CONFERENCE ON NEUTRINO AND NUCLEAR PHYSICS

2020

CONFERENCE GUIDE

AFRICAN PRIDE ARABELLA HOTEL & SPA

24 - 28 FEBRUARY 2020

science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

NRF
National Research Foundation
20
1999-2019

iThemba LABS
Laboratory for Accelerator Based Sciences

Welcome

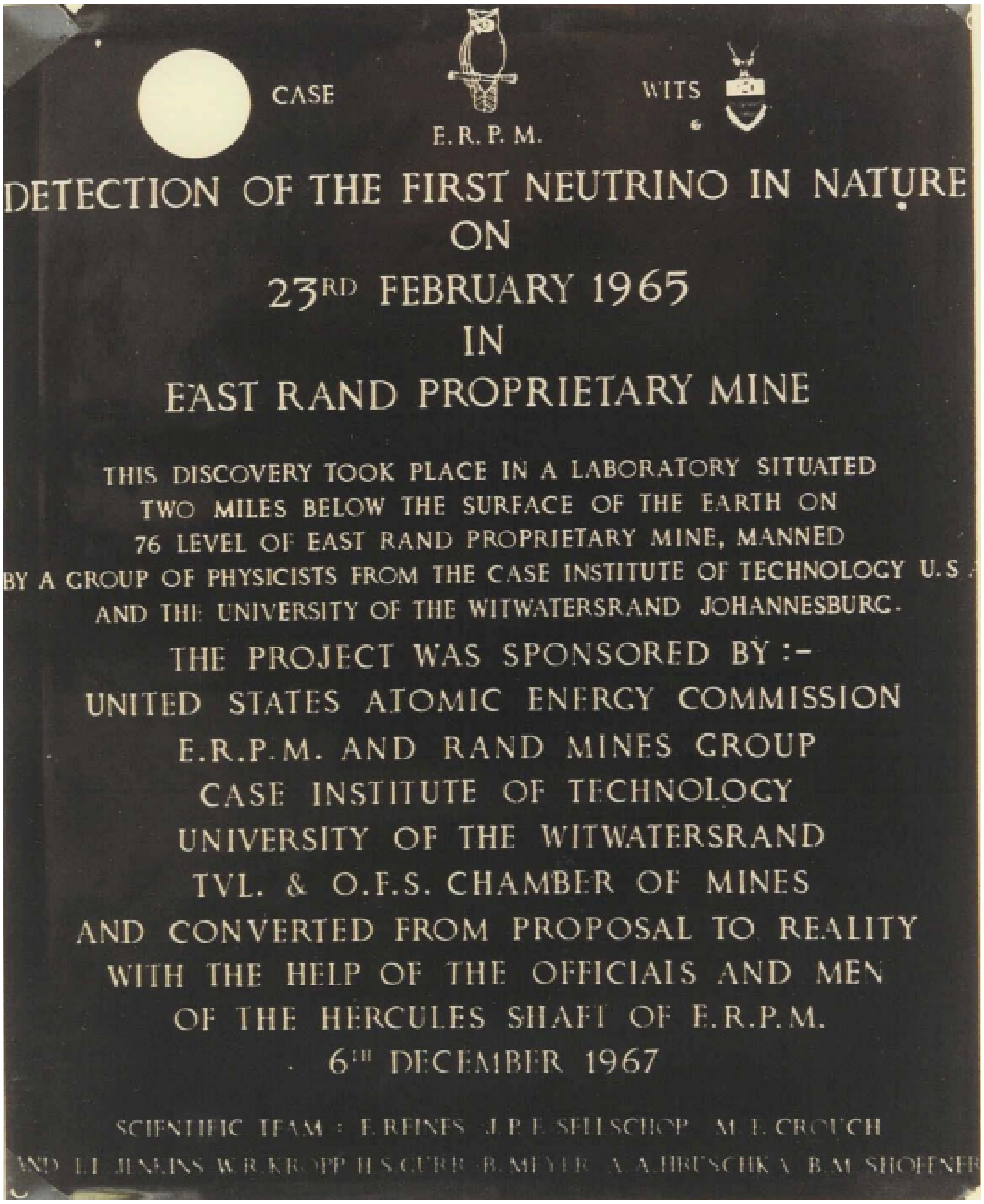
It is with great pleasure that I extend a warm welcome to all the participants to this, the second in the series of the Conference on Neutrino and Nuclear Physics (CNNP), hosted by the iThemba Laboratory for Accelerator Based Sciences (iThemba LABS). iThemba LABS is a multidisciplinary laboratory contributing to research and training in the physical, medical and biological sciences.

When the International Advisory Panel of the CNNP elected iThemba LABS as the host of the 2^{nd} CNNP conference they were cognizant of the fact that experiments in neutrino detection in South Africa go back to the 1960s. Reines and Sellschop operated a liquid scintillator in the East Rand gold mine, 3288 m below ground-level, which allowed them to be the first to observe cosmic-ray induced neutrinos. Present day experimental facilities available at iThemba LABS can be utilised to improve our understanding of the nuclear matrix elements used in the description of neutrinoless double-beta decay. In fact, scientists at iThemba LABS now form part of the NUMEN collaboration, with discussions underway to adapt detector hardware from LNS-Catania to be used with the K600 magnetic spectrometer at iThemba LABS.

A strong program for the week has been organised by the International Advisory and Local Organising Committees, from which it is our hope that all will benefit hugely. We have chosen to use a conference venue in the countryside in the Kogelberg Biosphere to allow for a relaxed environment and provide you with the opportunity to enjoy the natural beauty of the Western Cape Region.

May you have many discussions that will lead to fruitful new collaborations and enjoy your visit.

Dr Faïçal Azaiez
Director, iThemba LABS


CASE
WITS
E.R.P.M.
DETECTION OF THE FIRST NEUTRINO IN NATURE
ON
23RD FEBRUARY 1965
IN
EAST RAND PROPRIETARY MINE
THIS DISCOVERY TOOK PLACE IN A LABORATORY SITUATED
TWO MILES BELOW THE SURFACE OF THE EARTH ON
76 LEVEL OF EAST RAND PROPRIETARY MINE, MANNED
BY A GROUP OF PHYSICISTS FROM THE CASE INSTITUTE OF TECHNOLOGY U.S.
AND THE UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG.
THE PROJECT WAS SPONSORED BY :-
UNITED STATES ATOMIC ENERGY COMMISSION
E.R.P.M. AND RAND MINES GROUP
CASE INSTITUTE OF TECHNOLOGY
UNIVERSITY OF THE WITWATERSRAND
TVL. & O.F.S. CHAMBER OF MINES
AND CONVERTED FROM PROPOSAL TO REALITY
WITH THE HELP OF THE OFFICIALS AND MEN
OF THE HERCULES SHAFT OF E.R.P.M.
6TH DECEMBER 1967
SCIENTIFIC TEAM : F. REINES J.P.F. SELLSCHOP M.F. CROUCH
AND T.L. JENKINS W.R. KROPP H.S. GURR B. MEYER A.A. HRUSCHKA

About CNNP2020

iThemba LABS is hosting the 2^{nd} Conference on Neutrino and Nuclear Physics (CNNP) from 24-28 February 2020 at the African Pride Arabella Hotel and Spa near Kleinmond, South Africa.

The main objective of this conference is to promote collaboration between scientists from the fields of nuclear, neutrino, astro and dark-matter physics, and to create an environment where experiments and theories, in which nuclear-physics aspects are particularly relevant, can be discussed.

The very successful inaugural CNNP2017 conference was held in Catania in October 2017. CNNP2020 is the second conference in the series and aims to build upon the foundation of CNNP2017 to bring together people working at the intersections of different fields to exchange ideas and results.

The scientific topics to be discussed during the conference include:

- Nuclear double-beta decays
- Nuclear structure in connection with neutrino physics
- Nuclear reactions as probes for weak decays
- Neutrino-nucleus interaction at low and high energies
- Supernova models and detection of supernovae neutrinos
- Solar models and detection of solar neutrinos
- Direct and indirect dark-matter searches
- Rare beta decays of nuclei for neutrino-mass measurements
- Neutrino oscillations and matter effects
- Anomalies in reactor neutrinos
- New detection technologies related to the field

Organising Committees

International Advisory Committee

Clementina Agodi (INFN-LNS)
Naftali Auerbach (Tel Aviv University)
Faïçal Azaiez (iThemba LABS)
Akif Baha Balantekin (University of Wisconsin-Madison)
John F. Beacom (Ohio State University)
Chiara Brofferio (University and INFN Milano-Bicocca)
Ricardo A. Broglia (Niels Bohr Institute)
Alex B. Brown (Michigan State University)
Francesco Cappuzzello (University of Catania/INFN-LNS)
Gianluigi De Geronimo (Stony Brook University)
Hiro Ejiri (RCNP)
Amand Faessler (University of Tuebingen)
Dieter Frekers (University of Muenster)
Alfredo Galindo-Uribarri (Oak Ridge National Laboratory)
Muhsin N. Harakeh (KVI-CART)
Charles J. Horowitz (Indiana University)
Francesco Iachello (Yale University)
Toshitaka Kajino (University of Tokyo)
Karlheinz Langanke (FAIR, GSI)
Horst Lenske (University of Giessen)
Manfred Lindner (MPI for Nuclear Physics)
Jesus R. Lubian (University Federal Fluminense)
Antonio Masiero (University of Padova)
Wolfgang Mittig (MSU)
Witold Nazarewicz (FRIB, MSU)
Takaharu Otsuka (University of Tokyo)
Marco Pallavicini (University and INFN Genova)
Akira Sato (Osaka University)
Kate Scholberg (Duke University)
Jouni Suhonen (University of Jyväskylä)
Francesco Terranova (University and INFN Milano Bicocca)
Vladimir Tretyak (Kiev Institute of Nuclear Research)
Francesco Vissani (GSSI/INFN-LNGS)
Kai Zuber (TU Dresden)

Local Organising Committee

Faïçal Azaiez (Chair – iThemba LABS)
Clementina Agodi (INFN-LNS)
Andy Buffler (University of Cape Town)
Francesco Cappuzzello (University of Catania/LNS-INFN)
Lindsay Donaldson (iThemba LABS)
Naomi Haasbroek (iThemba LABS)
Retief Neveling (Deputy Chair - iThemba LABS)

Luna Pellegri (iThemba LABS/University of the Witwatersrand)
Elias Sideras-Haddad (University of the Witwatersrand)
Ricky Smit (iThemba LABS)
Michelle van der Ventel-Bark (iThemba LABS)
Mathis Wiedeking (iThemba LABS)

Logistics Team at iThemba LABS

Naomi Haasbroek
Michelle van der Ventel-Bark
Audrey Sauls
Wilma Abrahams
Chantall Cyster
Thobelani Jacu
Mpho Mashego
Thembela Ntloko
Luchricia Sidukwana

Our Sponsors

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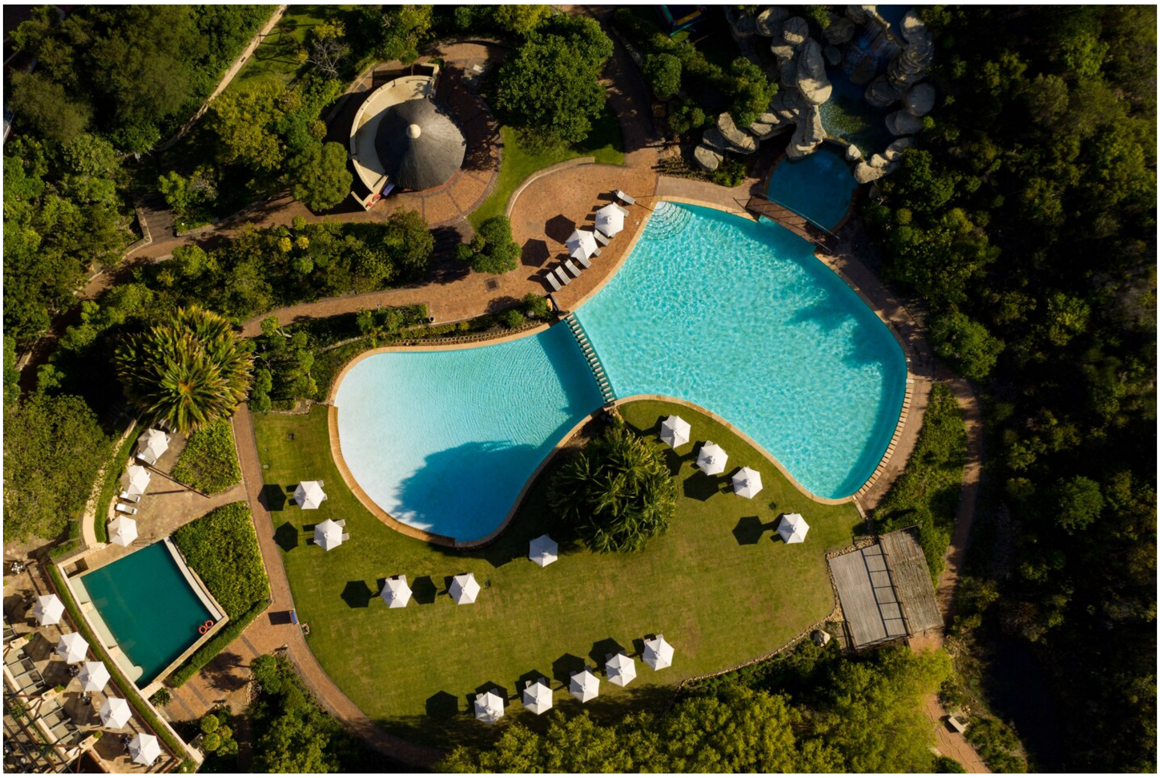
SAINT-GOBAIN

The Venue

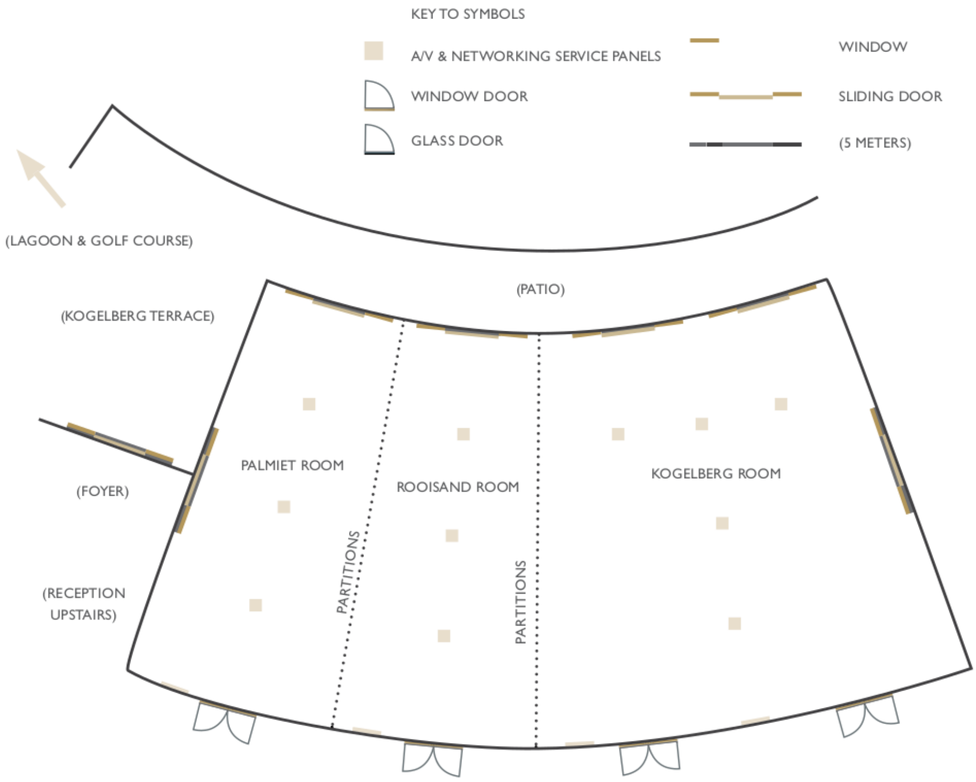
The conference is being held at the African Pride Arabella Hotel & Spa, situated in the countryside in the Kogelberg Biosphere near the seaside resort towns of Kleinmond and Hermanus, 70 km from iThemba LABS and within an hour's drive from Cape Town.

The African Pride Arabella Hotel & Spa, Autograph Collection, provides a unique opportunity for guests to experience a perfect blend of luxury and rare natural beauty, the perfect environment for undisturbed academic discourse. After a busy day, delegates can indulge in an array of dining options, relax at the luxurious spa, or lounge beside the sparkling swimming pools. The hotel provides easy access to world-famous whale-watching destinations (although whale season is typically between July and December) and exciting outdoor activities. There is also a signature golf course, which is ranked in the Top 10 in South Africa.

Arrangements will be made by the conference organisers for transport between the airport and the conference venue.



KOGELBERG CENTRE



ORCA CENTRE

Conference Registration Desk

Registration will be available on Sunday 23 February from 16:00 - 18:00 and on Monday 24 February from 08:00 onward. The Conference Registration Desk will be available during conference hours at the conference venue.

WiFi Information

South Africa has a well-developed communications infrastructure. A number of cell-phone providers offer national coverage and there are well-established landline phone networks. Internet and WiFi are easily accessible in most urban areas.

The African Pride Arabella Hotel & Spa offers complimentary WiFi for conference delegates. The WiFi password will be provided at the start of the conference.

Oral Presentation Prizes

iThemba LABS will be sponsoring two prizes during the conference for student presentations. A committee consisting of members of the International Advisory Committee will vote for the best presentations. The prizes will be presented on Friday 28 February during the iThemba LABS spitbraai.

SAINTS Poster Session

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SAINTS@tlabs

[**S**]outhern **[A]**frican **[I]**nstitute for **[N]**uclear **[T]**echnology and **[S]**ciences

Empowerment through education, training and experience

A special poster session sponsored by the Southern African Institute for Nuclear Technology and Sciences (SAINTS) has been organised from 18:00 - 19:00 on Monday evening to allow masters and doctoral students doing research in basic/applied nuclear physics at South African universities to participate in CNNP2020 by presenting a poster on their research. This session is intended to exhibit the range of topics in nuclear physics studied at South African universities as well as to showcase the talent of our students. The opportunity for the students to share their research with and receive feedback from the CNNP scientific community is an experience that will play an invaluable role in their professional development.

Social Functions

Welcome Function

Conference delegates and accompanying persons are invited to attend a Welcome Function at the outdoor pool area of the African Pride Arabella Hotel & Spa on Sunday 23 February from 18:30 - 20:30.

Excursion

Upon registration for CNNP2020, delegates were asked to select between an activity-based excursion and a relaxed excursion at a cost of R750.00 pp, both of which will take place on Wednesday 26 February. Please be sure to bring your excursion voucher along with you.

The activity-based excursion will provide delegates with the opportunity to do **one** of the following:

- go quad biking through the vineyards and the Fernkloof Nature Reserve to reach a breath-taking look-out point of the bay and surrounding areas,
- have a tree-top zip-line experience, gliding from platform to platform over a small waterfall between Poplar trees, or
- go sea kayaking, exploring the scenic coastline of Walker Bay (weather permitting).

The alternative excursion will be in the form of a leisurely wine tour, visiting two wineries and enjoying a fantastic food and wine pairing experience.

Transport for the excursions will depart after lunch between 14:15 and 14:30 from the hotel.

Conference Dinner

The Conference Dinner will be held at the African Pride Arabella Hotel & Spa in the Plenary Venue on Thursday 27 February at 19:00. If you indicated that you would be attending the Conference Dinner, please be sure to bring your voucher with you to the event.

iThemba LABS Tour and Spitbraai

A tour of iThemba LABS facilities will take place on Friday 28 February from 15:30 onward. Delegates are invited to a spitbraai after the tour, which will begin at 18:30. Buses will depart to the African Pride Arabella Hotel & Spa at 20:00.

General Information

Local Weather

Cape Town is never out of season, with a particularly good, long summer from November to March. These are the most popular months for visitors, who come to enjoy the 11 or more hours of sunshine every day. The average summer temperature in Cape Town is 24.3°C, with January and February temperatures averaging 26°C. February is the driest month of the year, with 15 mm (0.6 inches) of rain.

Currency

The local currency is the South African Rand (ZAR). The Rand comes in a range of coins (R1 = 100 cents) and note denominations of R10, R20, R50, R100 and R200. Foreign exchange facilities are widely available and can be found at the VA Waterfront, Cape Town International Airport and at bureau de change in various major shopping centres. Automated Teller Machines (ATMs) accept most international bank and credit cards. The ATMs are available 24/7. South Africa has a modern and sophisticated banking and commercial system, and most shops and hotels accept all major credit cards. You are advised to be alert when conducting banking transactions and do not disclose your PIN to anyone.

VAT: South Africa has a Value Added Tax system of 15% on purchases and services. Foreign visitors can reclaim VAT on collective purchases of more than R250. VAT Refund Offices can be found at: Ground level, International Departures, Cape Town International Airport, Tel: +27 21 934 8675.

Tipping

A 10% tip is standard in restaurants. Tables of over eight people often have an automatic service charge added to the bill. A tip of R5 to R10 per piece of luggage is acceptable for porters in hotels and at airports. In some shopping areas, uniformed attendants will either take a fee or offer to mind your car for a tip.

Banking and Shopping Hours

Most shops and businesses are open between 09:00 and 17:00 on weekdays and on Saturdays until 13:00. Major malls tend to stay open later: up to 21:00 during the week, on weekends and on most public holidays. Government agencies keep to limited weekday-only hours, often closing around 15:00.

Most banks close at 15:30 on weekdays, but are open on Saturday mornings (from around 09:00 until 11:00). Muslim-owned businesses close between 12:00 and 13:00 on Fridays.

Local couriers can help you ship your purchases home and deal with formalities. Check with Cape Town Tourism Visitor Information Centres for contacts. Postage stamps are available at Post Offices, as well as at some Cape Town Tourism Visitor Information Centres.

Credit Cards

Credit cards are widely accepted in South Africa, especially MasterCard and Visa. Nedbank is an official Visa agent, and Standard Bank is a MasterCard agent – both have branches across the country.

Electricity

The South African electricity supply is 220/230 volts AC 50 Hz. With a few exceptions (in deep rural areas), electricity is available almost everywhere. International adaptors are available in most hotel rooms. In South Africa the power sockets used are of type D / M, using three-prong (round pin) plugs.

Mobile Phones

Roaming mobile network services are available in South Africa. If you wish to join a South African mobile network, you can buy or hire a cell phone at the airport or at most of the major shopping centres. Local SIM cards may be purchased at the airport and at local shopping centres.

Local Transport

Uber and Bolt

Uber and Bolt are available and a safe option for transport in Cape Town. You can use a debit or credit card to pay, or there is a cash option. See uber.com or bolt.eu for more information.

Metered Taxis

Metered taxis can be found at the Cape Town International Airport, on Adderley Street in the Central Business District (CBD) and at several points in the V&A Waterfront. Rates are charged per km and a minimum fare usually applies. Avoid unmarked cars or casual offers of transport services. All hotels would also be able to assist with booking of taxis and tours - contact the concierge to assist. All major car-hire companies operate from the airport and city.

MyCiti

MyCiti is a bus rapid transit service with feeders, which forms part of a greater Integrated Public Transport driven economic development strategy of the City of Cape Town Municipality in South Africa. The MyCiTi Airport station is right on the doorstep of the main Airport terminal with level access directly into the arrivals and departures hall for both domestic and international flights. Transfers between the Airport and the city offer great value for money, and getting one of MyCiTi's multi-day travel packages also offers the opportunity to visit many of Cape Town's top tourism sites and leisure destinations. (). The GoMetro app provides information and timetables for Metrorail, Golden Arrow and MyCiti transport services.

Security Tips

Avoid carrying large sums of cash, carrying cameras or video cameras in plain sight and leaving belongings unattended. Heed the advice of your hosts, Cape Town Tourism Visitor Centre staff or locals on where to go after dark. Try not to walk alone. Do not allow strangers to assist you in any way at ATMs. Street children and beggars may approach you for a handout. Many social workers counsel against giving money to the children as it usually gets handed over to an older person or is used to purchase drugs. At night, park in a secure, well-lit area.

To report any safety incident, phone the following numbers:

- All emergencies from your cellphone: 112
- All emergencies from a landline: 107
- South African Police Services: 10111

Cape Town Tourism in partnership with Protection and Emergency Services run a successful Visitor Support Programme to assist you further, should you be involved in an incident. Contact Tourism Safety officers: Neo - +27 82 554 2010 or Cynthia - +27 72 447 1504.

Timetable

	Sunday 23 February 2020	
	Main Venue	**Parallel Venue (Orca)**
13:00		
14:00		
15:00		
16:00	**Registration**	
17:00		
18:00		
18:30	**Welcome Function**	
19:30		
20:30		

Speaker names in blue indicate that the talk is given by a student.

Monday 24 February 2020

Time	Main Venue				Parallel Venue (Orca)			
08:00	**Registration**							
08:30	**Opening and Welcome by Dr Faïçal Azaiez - Director of iThemba LABS**							
09:00	**Session 1**	**Chair: Francesco Cappuzzello**	Opening session	Kai Zuber	**Session 1**	-	-	-
09:30				Jouni Suhonen				-
10:00				Toshitaka Kajino				-
10:30	**Coffee/Tea break**							
11:00	**Session 2**	**Chair: Elena Aprile**	Nuclear double beta decays	Giovanni Benato (CUORE)	**Session 2**	-	-	-
11:30				Alessandro Minotti (SuperNEMO)				-
12:00				Giorgio Gratta (nEXO)				-
12:30				David Hervas (GERDA/LEGEND)				-
13:00	**Lunch**							
14:00	**Session 3**	**Chair: Clementina Agodi**	Direct and indirect dark-matter searches	Marcello Campajola (Belle II)	**Session 3**	**Chair: Javier Menendez**	Nuclear double beta decays	Claudia Nones (CUPID-Mo)
14:20				Andrea Giuliani (EDELWEISS)				Lorenzo Pagnanini (CUPID-0)
14:40				Christian Enss (DELight)				Anil Kumar
15:00				Christian Wittweg (XENON1T)			New related detection technologies	Xiaonan Li
15:20				Luciano Pandola (ReD)				-
15:40	**Conference Photograph**							
15:50	**Coffee/Tea break**							
16:10	**Session 4**	**Chair: Federico Nova**	Supernova models and detection of supernova neutrinos	Karlheinz Langanke	**Session 4**	-	-	-
16:40				Francesca Gulminelli				-
17:10				Clarence Virtue (HALO-1kT)				-
17:40								
18:00	**SAINTS Poster Session**							
18:30								
19:00								

Speaker names in blue indicate that the talk is given by a student.

Tuesday 25 February 2020

Time	Main Venue				Parallel Venue (Orca)			
08:00								
08:30	Session 5	Chair: Kai Zuber	Rare beta decays of nuclei for neutrino-mass measurements	Elias Sideras-Haddad	Session 5	-	-	-
09:00				Christian Weinheimer				-
09:30				Klaus Blaum				-
10:00				Christian Enss (ECHo)				-
10:30	**Coffee/Tea break**							
11:00	Session 6	Chair: Karlheinz Langanke	Direct and indirect dark-matter searches	Roy Maartens (SKA)	Session 6	-	-	-
11:30				Elena Aprile (XENONnT)				-
12:00				Pierluigi Belli (DAMA/LIBRA)				-
12:30				Yeongduk Kim (COSINE)				-
13:00	**Lunch**							
14:00	Session 7	Chair: Klaus Blaum	Nuclear double beta decays	Patricia Sanchez-Lucas (DARWIN)	Session 7	Chair: Giorgio Gratta	Solar models and detection of solar neutrinos	Alina Vishneva
14:20				Hawraa Khalife (CROSS)				Carlo Gustavino
14:40				Philip Adsley (iThemba LABS)				Almaz Fazliakhmetov
15:00			Neutrino-nucleus interaction at low and high energy	Ricky Smit (EARTH)			Rare beta decays of nuclei for neutrino-mass measurements	Tommi Eronen
15:20				Hyun Su Lee (NEON)				Luciano Pandola (GERDA)
15:40				Samuel Hedges				Marco Faverzani (HOLMES)
16:00	**Coffee/Tea break**							
16:30	Session 8	Chair: Clarence Virtue	New related detection technologies	Andrea Longhin	Session 8	-	-	-
17:00				Jeff Hartnell				-
17:30				-				-

Speaker names in blue indicate that the talk is given by a student.

	Wednesday 26 February 2020							
	Main Venue				Parallel Venue (Orca)			
08:00								
08:30								
09:00	Session 9	Chair: Christian Enss	Reactor neutrino experiments	Leendert Hayen	Session 9	-	-	-
09:30				Manfred Lindner (CONUS)				-
10:00			Nuclear structure in connection with	Yuri Efremenko (COHERENT)				-
10:30	**Coffee/Tea break**							
11:00	Session 10	Chair: Horst Lenske	Nuclear structure in connection with neutrino physics	Fedor Simkovic	Session 10	-	-	-
11:30				Takaharu Otsuka				-
12:00				Jason Holt				-
12:30				Jonathan Engel				-
13:00	**Lunch**							
14:00	**Excursion**							
14:20								
14:40								
15:00								
15:20								
15:40								
16:00								
16:30								
17:00								
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18:00								
18:30								
19:00								

	Thursday 27 February 2020							
	Main Venue				Parallel Venue (Orca)			
08:00								
08:30	Session 11	Chair: Manfred Lindner	Neutrino-nucleus interaction at low and high energy	Ernesto Kemp (DUNE)	Session 11	-	-	-
09:00				Yuichi Oyama (T2K)				-
09:30				Eligio Lisi				-
10:00	**Coffee/Tea break**							
10:30	Session 12	Chair: Jouni Suhonen	Nuclear double beta decays	Smarajit Triambak	Session 12	-	-	-
11:00				Manuela Cavallaro (NUMEN)				-
11:30				Horst Lenske				-
12:00				Hong Joo Kim (AMoRE)				-
12:30	**Lunch**							
13:30	Session 13	Chair: Yuichi Oyama	Neutrino oscillations and matter effects	Karol Lang	Session 13	Chair: Toshitaka Kajino	Supernova models and detection of supernova neutrinos	Ernesto Kemp
13:50				Vincenzo Bellini				Mohamed Ismaiel
14:10				Ushak Rahaman				Andrey Sheshukov
14:30				-				Salvador Miranda Palacios
14:50	**Coffee/Tea break**							
15:10	Session 14	Chair: Francesca Gulminelli	Nuclear double beta decays	Aldo Serenelli	Session 14	-	-	-
15:40			Solar models and detection of solar neutrinos	Federico Nova (HyperKamiokande)				-
16:10				Alessio Caminata (Borexino)				-
16:40								
17:00								
17:30								
18:00								
18:30								
19:00	**Conference Dinner with Welcome Address by Dr Clifford Nxomani - NRF Deputy CEO: National Research Infrastructure Platforms**							

Speaker names in blue indicate that the talk is given by a student.

	Friday 28 February 2020							
	Main Venue				Parallel Venue (Orca)			
08:00								
08:30								
09:00	Session 15	Chair: Manuela Cavallaro	Nuclear structure in connection with neutrino physics	Jörn Kleemann	Session 15	Chair: Hyun Su Lee	Reactor neutrinos	Helena Almazan
09:20				Grigory Koroteev				Joel Kostensalo
09:40				Andrei Vyborov			Neutrino-nucleus interaction at low and high energy	Toshio Suzuki
10:00				-				Rajan Gupta
10:20	**Coffee/Tea break**							
10:50	Session 16	Chair: Takaharu Otsuka	Nuclear reactions as a probe for weak decays	Peter von Neumann-Cosel	Session 16	-	-	-
11:20				Javier Menendez				-
11:50				Lotta Jokiniemi				-
12:20			Nuclear double beta decays	Sabin Stoica				-
12:50								
13:00	**Lunch**							
14:00	**Move to buses**							
14:15	**Bus drive to iThemba LABS**							
15:00								
15:30	**General announcements and iThemba LABS safety talk**							
15:50	**iThemba LABS tour**							
16:50								
17:50								
18:00	**iThemba LABS braai**							
18:30								
19:00								
19:30								
20:00	**Bus to African Pride Arabella Hotel & Spa**							

Speaker names in blue indicate that the talk is given by a student.

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Invited Talks

Dark Matter Direct Detection with Noble Liquids

Tuesday
25 February
11:30
Main Venue

Elena Aprile
Columbia University

What is the Dark Matter which makes 85% of the matter in the Universe? We have been asking this question for many decades and used a variety of experimental approaches to address it, with detectors on Earth and in space. Yet, the nature of Dark Matter remains a mystery. An answer to this fundamental question will likely come from ongoing and future searches with accelerators, indirect and direct detection. Detection of a Dark Matter signal in an ultra-low background terrestrial detector will provide the most direct evidence of its existence and will represent a ground-breaking discovery in physics and cosmology. I will review direct detection experiments using noble liquids which have shown the highest sensitivity to-date.

Beta-delayed proton emission in neutron-rich nuclei: The quest for dark decay of the neutron

Tuesday
25 February
16:30
Main Venue

Yassid Ayyad
MSU/FRIB

Nuclei with more neutrons than protons tend to get rid of excess neutrons to reach the valley of stable nuclei through beta-minus (β^-) decays. On the other side of the valley of stability, proton-rich nuclei follow the analogous process through beta-plus (β^+) decays. Beta-delayed proton emission, observed more than 40 years ago, typically occurs in very proton-rich nuclei and not on the neutron-rich side of the stable nuclei. However, the emission of protons following β^- decay is energetically allowed for neutron-rich nuclei with neutrons bound by less than 782 keV. This condition may be fulfilled in so-called halo nuclei where one or several neutrons are loosely bound and orbit far from the core. ^{11}Be is one of the most promising candidates, resulting in ^{10}Be following the beta decay to ^{11}B and the subsequent proton emission. A team of NSCL (National Superconducting Cyclotron Laboratory, Michigan State University, USA) and TRIUMF (Canada) researchers carried out the first direct observation of the beta-delayed proton decay of a neutron-rich nucleus by directly measuring the very low-energy protons emitted following the beta decay of ^{11}Be. This experiment was performed with the Active Target Time Projection Chamber (AT-TPC), a gas-filled detector capable of providing high efficiency and resolution for low-energy charged particles such as the emitted protons. In this talk, I will discuss the technique and the results of such experiment, as well as different aspects of this decay, including a speculative dark matter decay.

Tuesday
25 February
12:00
Main Venue

Annual modulation with DAMA/LIBRA-phase2

Pierluigi Belli
INFN Roma Tor Vergata

The new results obtained by the first six independent annual cycles of DAMA / LIBRA–phase2 experiment deep underground at Gran Sasso are presented; they correspond to a total exposure of 1.13 ton $\times$ yr. The improved experimental configuration with respect to the phase1 allowed a lower energy threshold. The DAMA/LIBRA–phase2 data confirm the evidence of a signal that meets all the requirements of the model independent Dark Matter annual modulation signature, at high C.L. The model independent DM annual modulation result is compatible with a wide set of DM candidates. In this talk we summarize some of them and perspectives for the future will be outlined.

Monday
24 February
11:00
Main Venue

New results from the CUORE experiment

Giovanni Benato for the CUORE collaboration
LNGS-INFN

The Cryogenic Underground Observatory for Rare Events (CUORE) is the first bolometric experiment searching for neutrinoless double-beta decay ($0\nu\beta\beta$) that has been able to reach the one-ton scale. The detector, located at the Laboratori Nazionali del Gran Sasso in Italy, consists of an array of 988 TeO_2 crystals arranged in a compact cylindrical structure of 19 towers. The construction of the experiment was completed in August 2016 with the installation of all towers in the cryostat. CUORE achieved its first physics data run in 2017 corresponding to a TeO_2 exposure of 86.3 kg·yr and a median statistical sensitivity to a ^{130}Te $0\nu\beta\beta$ half-life of 7.0×10^{24} yr. Following multiple optimization campaigns in 2018, CUORE is currently in stable operating mode and has accumulated data corresponding to a TeO_2 exposure approaching 500 kg·yr. In this talk, we present the updated $0\nu\beta\beta$ results of CUORE, as well as review the detector performance. We finally give an update of the CUORE background model and the measurement of the ^{130}Te two neutrino double-beta decay ($2\nu\beta\beta$) half-life.

Precision mass measurements for nuclear and neutrino physics studies

Tuesday
25 February
09:30
Main Venue

Klaus Blaum

Max-Plank-Institut für Kernphysik

Rapidly developing neutrino physics has found in Penning-trap mass spectrometry a staunch ally in investigating and contributing to a variety of fundamental problems. The most familiar are the absolute neutrino mass and the possible existence of resonant neutrinoless double-electron capture/double-beta decay and of keV-sterile neutrinos. This review provides an overview on the latest achievements and future perspectives of Penning-trap mass spectrometry on short-lived as well as stable nuclides with applications in nuclear structure, neutrino physics and most recently even in dark matter searches where relative mass uncertainties at the level of 10^{-11} and below are required.

Results and future perspectives of Borexino

Thursday
27 February
16:10
Main Venue

Alessio Caminata

INFN Genoa

The Borexino liquid scintillator neutrino observatory is devoted to perform high-precision neutrino observations: the study of solar neutrinos is the primary goal of the experiment. The exceptional radiopurity together with the good energy resolution (5% at 1 MeV) put Borexino in the unique situation of being able to validate the MSW-LMA oscillation paradigm across the full solar energy range. A comprehensive study of the pp-chain neutrinos was recently released: this new study reports the direct measurements of *pp*, ^{7}Be and *pep* neutrino fluxes with the highest precision ever achieved (down to 2.8% in the ^{7}Be component), the ^{8}B with the lowest energy threshold, the best limit on CNO neutrinos and the first Borexino limit on hep neutrinos. The present talk shows the new results based on the full 10 years data sample and, in particular, on the more radiopure Phase-2 data, taken after the detector purification campaigns in 2010-11 and the perspectives for the final stage of the solar program. The talk will be concluded reporting the latest news on the detection of geoneutrinos with Borexino and the analysis techniques applied.

Recent results on nuclear reactions of interest for neutrinoless double beta decay at INFN-LNS within the NUMEN project

Thursday
27 February
11:00
Main Venue

Manuela Cavallaro

INFN-LNS

Research on neutrinoless double beta decay have crucial implications on particle physics, cosmology and fundamental physics. It is likely the most promising process to access the absolute neutrino mass scale. To determine quantitative information from the possible measurement of the $0\nu\beta\beta$ decay half-lives, knowledge of the Nuclear Matrix Elements (NME) involved in such transitions is mandatory. The use of heavy-ion induced double charge exchange (DCE) reactions as tools towards the determination of information on the NME is one of the goals of the NUMEN and the NURE projects. The basic point is that there are a number of similarities between the two processes, mainly that the initial and final state wave functions are the same and the transition operators are similar, including in both cases a superposition of Fermi, Gamow-Teller and rank-two tensor components.

The availability of the MAGNEX magnetic spectrometer for measurements of the very suppressed DCE reaction channels is essential to obtain high resolution energy spectra and accurate cross sections at forward angles including zero degrees. Measurement of the competing multi-nucleon transfer processes allows to study their contribution and to constrain the theoretical calculations. An experimental campaign is ongoing at INFN-Laboratori Nazionali del Sud (Italy) to explore medium-heavy ion induced reactions on target of interest for $0\nu\beta\beta$ decay.

Recent results obtained by the (^{20}Ne,^{20}O) and (^{18}O,^{18}Ne) DCE reactions and competing channels, measured for the first time using ^{20}Ne(10+) and ^{18}O(8+) cyclotron beams at 15 AMeV will be presented. A preliminary analysis of the double charge exchange channel in comparison with the competitive multi-nucleon transfer channels will also be shown and discussed.

Wednesday
26 February
10:00
Main Venue

What can we learn from CEνNS? (CEνNS - Coherent Elastic Neutrino Nucleus Scattering)

Yuri Efremenko
University of Tennessee

The CEνNS process has been predicted in 1974 right after discovery of the neutral current of the weak interactions. It took more than 40 years to confirm this prediction experimentally. In 2017 COHERENT collaboration reported the first observation of CEνNS using a 14 kg CsI detector and SNS neutrino source at the ORNL. In my talk I will review the first observation of CEνNS and present experimental status to study CEνNS. The focus of my talk will be how we can use accurate CEνNS measurements to test the S-M of particle physics, and make contributions to nuclei physics and astrophysics.

Wednesday
26 February
12:30
Main Venue

Theory of Double-Beta Decay from First Principles

Jonathan Engel
University of North Carolina

I discuss recent work to calculate the nuclear matrix elements that govern neutrinoless double beta decay in an ab-initio way, that is, without the adjustment of parameters except those in chiral effective field theory. A method based on the use of techniques from energy-density functional theory in combination with ab-initio Hamiltonians has proved particularly powerful. I describe its application to the double-beta matrix elements of ^{48}Ca and ^{76}Ge.

The Electron Capture in ^{163}Ho experiment, ECHo

Tuesday
25 February
10:00
Main Venue

Christian Enss for the ECHo collaboration
Kirchhoff Institute for Physics

The goal of the Electron Capture in ^{163}Ho (ECHo) experiment is the determination of the electron neutrino mass by the analysis of the electron capture spectrum of ^{163}Ho. The detector technology is based on metallic magnetic calorimeters operated at a temperature of about 10 mK in a reduced background environment. For the first phase of the experiment, ECHo-1k, the detector production has been optimized and the implantation process of high purity ^{163}Ho source in large detector arrays has been refined. The implanted detectors have been successfully operated and characterized at low temperatures, reaching an energy resolution below 5 eV. High statistics and high resolution ^{163}Ho spectra have been acquired and analyzed in the light of the recent advanced theoretical description of the spectral shape, considering the independently determined and more precise value of the energy available to the electron capture process, Q_{EC}. We present preliminary results obtained in ECHo-1k so far and discuss the necessary upgrades towards the second phase of the experiment, ECHo-100k.

The nEXO double-beta decay experiment

Monday
24 February
12:00
Main Venue

Giorgio Gratta for the nEXO collaboration
Stanford University

The search for neutrinoless double-beta decay represents one of the most exciting opportunities to explore physics beyond the Standard Model. The knowledge that neutrinos are massive particles, yet, with masses that are many orders of magnitude smaller than those of charged fermions, provides encouragement to further push the sensitivity of these experiments.

nEXO is a 5-tonne detector based on the isotope ^{136}Xe in a single phase, liquid time projection chamber. Its design is based on EXO-200, the first 100kg-class experiment to take data, demonstrating the power of a monolithic detector with good energy resolution and superior topological event reconstruction. nEXO is expected to reach a half-life sensitivity of about 10^{28} years, covering substantial discovery space. The detector includes several state-of-the-art components but, at the same time, offers a conservative approach in which the background estimate is solidly grounded on existing materials and reliable simulation tools. In this talk the nEXO design and sensitivity reach will be discussed.

Monday
24 February
16:40
Main Venue

Neutrinos from CCSN and the contribution of nuclear experiments

Francesca Gulminelli[1], Micaela Oertel[2], Anthea Fantina[3], Aurelien Pascal[2], Jerome Novak[2] and Adriana Raduta[4]

[1]LPC Caen and University of Caen
[2]LUTH Meudon
[3]GANIL
[4]IFIN Bucarest

The impact of different microphysics inputs on the dynamics of core collapse during infall and early post-bounce is studied performing spherically symmetric simulations in general relativity using a multigroup scheme for neutrino transport and full nuclear distributions in extended nuclear statistical equilibrium models. We show that the individual EC rates are the most important source of uncertainty in the simulations, and establish a list of the most important nuclei to be studied in order to constrain the global rates. The effect on the collapse dynamics and neutrino luminosity is studied.

Tuesday
25 February
17:30
Main Venue

LiquidO detector development

Jeff Hartnell

University of Sussex

In this talk I will present a potentially game-changing new particle detector technology called LiquidO. This idea turns the concept behind the widespread scintillator detectors on its head: for 50 years research has focussed on making more and more transparent scintillator materials, whereas LiquidO actually requires an opaque scintillator. In LiquidO, scintillation light is confined near its creation point due to a short scattering length and collected by a dense grid of wavelength shifting fibres. The resulting topological information, normally lost in transparent LS detectors, allows for powerful event-by-event particle identification including MeV-scale positrons, electrons and gammas, enabling strong background suppression. Another advantage over classical liquid scintillator detectors is the possibility of loading to unprecedented levels, since high transparency is no longer required. I will give an overview of the LiquidO idea in this talk as well as show the first results from the 'micro-LiquidO' prototype detector, which provided the proof of principle of light confinement.

Wednesday
26 February
09:00
Main Venue

First-forbidden transitions in the reactor antineutrino ux and spectral anomalies

Leendert Hayen

North Carolina State University and Triangle Universities Nuclear Laboratory

It has been almost a decade since the reactor antineutrino anomaly entered the stage, where the number of experimentally detected antineutrinos emerging from a nuclear power reactor interior was significantly less than theoretically predicted from nuclear decay. This has, in turn, motivated the search for an eV-scale sterile neutrino in several very short baseline experiments, none of which have so far confirmed its existence. From the theory point of view, initial analyses introduced a significant number of approximations, in particular for the treatment of so-called forbidden transitions. We report on the first large-scale calculation of the influence of first-forbidden transitions using state-of-the-art nuclear shell model calculations for a select number of highly-contributing branches. We use these results to propose a probability distribution for first-forbidden spectral shapes and employ Monte Carlo techniques to translate this into a detailed construction of theoretical uncertainties for the remaining forbidden transitions. We observed significant changes in both the integrated ux and spectral shape of the cumulative antineutrino spectra for all fission actinides [1, 2], and discuss both a mitigation of the so-called reactor shoulder and changes in the reactor antineutrino anomaly. Finally, we will comment how an improved treatment of allowed transitions [2, 3] can further significantly change both ux and spectral shape.

[1] L. Hayen, J. Kostensalo, N. Severijns, and J. Suhonen, Phys Rev C 99 (2019) 031301(R).
[2] L. Hayen, J. Kostensalo, N. Severijns, and J. Suhonen, Phys Rev C 100 (2019) 054323, arXiv:1805.12259.
[3] L. Hayen, N. Severijns, K. Bodek, D. Rozpedzik, and X. Mougeot, Reviews of Modern Physics 90 (2018) 015008, arXiv:1709.07530.

MAJORANA, LEGEND, and the future of the search for Neutrinoless Double-Beta Decay in ^{76}Ge

Monday
24 February
12:30
Main Venue

David Hervas
University of North Carolina at Chapel Hill

The MAJORANA collaboration is searching for neutrinoless double-beta ($0\nu\beta\beta$) decay in ^{76}Ge using modular arrays of enriched, high-purity Ge detectors. The MAJORANA DEMONSTRATOR consists of an array of 44 kg of high-purity Ge detectors with a p-type point contact geometry currently operating in the Sanford Underground Research Facility in Lead, South Dakota. The ultra-low back-ground and world-leading energy resolution achieved by the MAJORANA DEMONSTRATOR enable a sensitive $0\nu\beta\beta$ decay search, as well as additional searches for physics beyond the Standard Model. The Large Enriched Germanium Experiment for Neutrinoless Double-Beta Decay (LEGEND) will combine the best techniques from the DEMONSTRATOR and the Germanium Detector Array (GERDA) to reach even higher sensitivities to $0\nu\beta\beta$ decay. The LEGEND collaboration is pursuing a phased approach to a tonne-scale ^{76}Ge experiment, with ultimate discovery potential at a half-life beyond 10^{28} years. The first phase, LEGEND-200, is the deployment of 200 kg of enriched ^{76}Ge detectors in the existing GERDA cryostat at the LNGS underground lab in Italy. LEGEND-200, scheduled to start operation in 2021, will use GERDA and MAJORANA enriched detectors and newly developed inverted coax point contact detectors. The MAJORANA DEMONSTRATOR's latest results will be presented as well as the construction status of LEGEND-200, ongoing LEGEND tonne-scale RD, and the physics outlook of the LEGEND experimental program.

Wednesday
26 February
12:00
Main Venue

Ab initio nuclear theory for beyond standard model physics

Jason Holt
TRIUMF

Long considered a phenomenological field, breakthroughs in many-body methods together with our treatment of nuclear and electroweak forces are rapidly transforming modern nuclear theory into a true first-principles, or ab initio, discipline. In this talk I will discuss recent advances, which expand the scope of ab initio theory to global calculations of nuclei, potentially as heavy as ^{208}Pb, including first predictions of the limits of nuclear existence into the medium-mass region. I will then focus on recent extensions to fundamental problems in nuclear-weak physics, including a proposed solution of the long-standing gA quenching puzzle, calculations of neutrinoless double-beta decay for determining neutrino masses, and WIMP-nucleus scattering cross sections relevant for dark matter direct detection searches.

Friday
28 February
11:50
Main Venue

Nuclear responses for double beta decay and muon capture

Lotta Jokiniemi[1], Jouni Suhonen[1] and Hiro Ejiri[2]
[1]University of Jyväskylä
[2]RCNP, Osaka and CTU, Prague

To describe the double beta decay processes reliably one needs the possibility to test the involved virtual transitions against experimental data. In this work we manifest how to utilise the nuclear and lepton (μ) charge-exchange reaction data in the study of $0\nu\beta\beta$ decay and astro-neutrinos. In my contribution I will cover the theoretical aspects of ordinary muon capture (OMC) as well as the recent studies of (^{3}He,t) and charge-exchange studies at RCNP, Osaka [1].

The OMC strength function in ^{100}Nb was computed in the pnQRPA framework [2], and compared with the experimental strength function measured at RCNP in Osaka [3]. The calculated first OMC giant resonance in ^{100}Nb is in agreement with the experimental value. However, the computed total OMC strength is higher than the measured strength, which refers to quenched g_A value. Furthermore, the OMC rates to the daughter nuclei of the $0\nu\beta\beta$ decay triplets of immediate experimental interest are computed [4] and compared with available data of [5]. The capture rates to the low-lying states of ^{76}As are in accordance with the data. The OMC rates to the daughter nuclei of $0\nu\beta\beta$ decay triplets are also compared with the corresponding $0\nu\beta\beta$ matrix elements in order to find possible connections between them [6].

Eventually, the OMC process can be used to probe the structure of the intermediate states appearing in the double-beta-decay process. Future experiments can help fine-tune the nuclear-structure parameters for the double-beta-decay calculations.

[1] H. Ejiri *et al.*, Phys. Rep. **797** (2019) 1.
[2] L. Jokiniemi *et al.*, Phys. Lett. B **794** (2019) 143.
[3] I.H. Hashim *et al.*, Phys. Rev. C **97** (2018) 014617.
[4] L. Jokiniemi and J. Suhonen, Phys. Rev. C **100** (2019) 014619.
[5] D. Zinatulina *et al.*, Phys. Rev. C **99** (2019) 024327.
[6] L. Jokiniemi, and J. Suhonen, Phys. Rev. C (2020), *submitted.*

Roles of Neutrinos in Explosive Nucleosynthesis of Supernovae and Neutron-Star Mergers and Cosmic Evolution

Monday
24 February
10:00
Main Venue

Toshitaka Kajino

Beihang University, NAOJ and University of Tokyo

The big-bang universe, supernovae (SNe), collapsars and binary neutron-star mergers (NSMs) are the viable celestial sources of multi-messengers. These messengers are neutrinos for weak force, gravitational waves for gravity, photons for electromagnetism, and atomic nuclei for strong nuclear force. Their detection takes the keys to solve still unanswered questions such as overproduction of big-bang lithium [1], mass hierarchy of neutrinos [2], the origin of p-nuclei [3], and the origin of r-process elements [4].

We will first discuss cosmological background neutrinos and CMB fluctuations of magnetic fields in order to solve the big-bang lithium problem [1]. The relic SN neutrinos also are the energetic component of cosmic background neutrinos. We will propose how to constrain the mass hierarchy and EOS of neutron stars with detecting relic SN neutrinos [5]. We will secondly discuss how to determine the mass hierarchy with SN neutrinos [2,3]. A huge flux of neutrinos is emitted from proto-neutron stars or accretion disks formed in CCSNe. They provide unique conditions for studying the collective neutrino-flavor oscillation. Collective oscillation is presumed to occur in the deepest region, while the MSW high-density resonance occurs near the He/C-layer. Therefore, several light ν-process nuclei are affected by both collective and MSW effects, while the r-process and νp-process nuclei are almost free from the MSW effect [2-4]. We will discuss how to separate these two effects, i.e. collective oscillation and MSW effect, in nucleosynthetic method.

Finally, we will discuss the origin of r-process to understand the cosmic evolution by taking account of three contributions to r-process elements from SNe, collapsars and binary NSMs [6]. We here discuss the roles of GW detection and astronomical observation of atomic nuclei as well as nuclear experiments of radioactive nuclei.

[1] Y. Luo *et al.*, ApJ. 872 (2019) 172; G. Mathews *et al.*, Mod. P. L. E26 (2017) 1741001.
[2] H. Ko *et al.* (2020), to be published; T. Kajino *et al.*, J. Phys. G41 (2014) 044007.
[3] H. Sasaki *et al.*, Phys. Rev. D96 (2017) 043013.
[4] T. Kajino *et al.*, PPNP 107 (2019) 109; T. Kajino, G. Mathews, RPP 80 (2017) 084901.

[5] J. Hidaka *et al.*, ApJ. 869 (2018) 31.
[6] Y. Yamazaki *et al.*, (2020) to be published.

Thursday
27 February
08:30
Main Venue

Neutrinos in DUNE: long-baseline oscillations and non-beam physics

Ernesto Kemp for the DUNE collaboration
University of Campinas

The Deep Underground Neutrino Experiment (DUNE) is one of the most ambitious particle physics experiments of the next generation. DUNE consists of two detectors: the Near Detector (ND) - just downstream of the neutrino beam at FERMILAB (IL - USA), and the Far Detector (FD) - 1300km away and 1500 m deep in the underground SURF laboratory (SD - USA). The ND is a multi-technology apparatus aiming to constrain the uncertainties related to the unoscillated neutrino flux and also to explore neutrino interactions physics. The FD is a modular 40 kton fiducial mass Liquid Argon Time Projection Chamber, dedicated to studying long-baseline neutrino oscillations, which includes precise measurements of neutrino mixing parameters, the CP violation phase as well as the determination of neutrino mass hierarchy. The physics list of DUNE extends to non-beam physics like supernova neutrinos and search for nucleon decay. In this contribution, we describe the main features of DUNE and its sensitivity for measurements on the primary physics goals.

Thursday
27 February
12:00
Main Venue

Status of the ^{100}Mo based AMoRE neutrinoless double-beta decay experiment

Hong Joo Kim for the AMoRE collaboration
Kyungpook National University

The AMoRE (Advanced Mo-based Rare process Experiment) intends to find an evidence for neutrinoless double beta decay of ^{100}Mo by using a cryogenic technique with molybdate based crystal scintillators. The crystals, which are cooled down to 10 20 mK temperatures, are equipped with MMC-type phonon and photon sensors to detect both thermal and scintillation signals produced by a particle interaction in the crystal to achieve high energy resolution and efficient particle discrimination. The AMoRE-pilot experiment with an array of six $^{48depl}Ca^{100}MoO_4$ crystals with a total mass of about 1.9 kg was performed at the 700-m-deep YangYang underground laboratory and AMoRE-I preparation is in progress with ab 6.1 kg of crystals, mostly $^{48depl}Ca^{100}MoO_4$ and several RD crystals such as $Li_2{}^{100}MoO_4$ crystals. Significant improvement of effective Majorana neutrino mass sensitivity at the level of inverted hierarchy of neutrino mass, 20-50 meV, could be achieved by the AMoRE-II with 200 kg of molybdate crystals at the new 1000m deep underground laboratory excavated by the end of 2021 in the Yemi. Results of the AMoRE-pilot and status of the AMoRE-I and AMoRE-II preparation will be presented.

COSINE experiment - A WIMP dark matter search experiment with NaI(Tl) detectors

Tuesday
25 February
12:30
Main Venue

Yeongduk Kim
Institute for Basic Science

The COSINE experiment searches for interactions of Weakly Interacting Massive Particles (WIMPs) using an array of NaI(Tl) crystal detectors in the 700-m-deep Yangyang underground laboratory, Korea. The main goal is to check the annual modulation signal observed by DAMA/LIBRA with the same target material. The first phase of the experiment, COSINE-100 with 106 kg of NaI(Tl) crystals, has been running stably for more than 3 years. Several analyses in addition to the annual modulation have been actively ongoing, based on the 1 keV energy threshold and about 3 counts/day/kg/keV background rate in an energy region between 1 and 6 keV. In this talk, the detector performance, recent analysis results, and future prospects of the COSINE experiment will be presented.

The role of neutrino-nucleus reactions in supernova nucleosynthesis

Monday
24 February
16:10
Main Venue

Karlheinz Langanke
GSI Darmstadt

Neutrinos play an important role for the supernova dynamics and the associated nucleosynthesis. During collapse, electron neutrinos, produced by electron capture on nuclei, dominate, while all neutrino families are being produced during the cooling phase of the protoneutron star. Neutrinos are crucial for the explosive nucleosynthesis. At first, by interaction with free nucleons they determine the proton-to-neutron ratio of the ejected matter which is crucial for the subsequent nucleosynthesis. Modern supernova simulations indicate that the ejected matter is not sufficiently neutron rich to support an r-process which also produces the solar abundances in the third r-process peak. Neutrino-induced spallation reactions on abundant nuclei in the outer stellar shells are responsible for the production of selected nuclides (neutrino nucleosynthesis). Recently the first study of neutrino nucleosynthesis has been presented which considers the time-dependence of the neutrino emission including the neutrino burst, the accretion phase and the cooling phase as well as changes in the spectral forms of the neutrinos.

Heavy ion charge exchange reactions as probes for nuclear β-decay

Thursday
27 February
11:30
Main Venue

Horst Lenske
University of Giessen

The status and prospects of heavy ion charge exchange reactions are discussed. Their important role for nuclear reaction, nuclear structure, and beta-decay investigations is emphasized. Dealing with peripheral reactions, direct reaction theory gives

at hand the proper methods for single (SCE) and double charge exchange (DCE) ion–ion scattering. The microscopic descriptions of charge exchange ion–ion residual interactions and the reaction mechanism are obtained by distorted wave theory. Ion–Ion optical potentials and reaction form factors are determined in a folding approach by using NN T-matrices and microscopic ground state and transition densities, respectively. The theory of onestep direct and two-step transfer reaction mechanisms for SCE reactions is discussed and illustrated in applications to data. Specific SCE reactions are discussed in detail, emphasizing the versatility of projectile–target combinations and incident energies. SCE reactions induced by ^{12}C and ^{7}Li beams are presented as representative examples. Heavy ion DCE reactions are shown to proceed in principle either by sequential pair transfer or two kinds of collisional NN processes. Double single charge exchange (DSCE) is given by two consecutive SCE processes, resembling in structure $2\nu2\beta$ decay. A competing process is a two-nucleon mechanism, relying on short range NN correlations and leading to the correlated exchange of two charged mesons between projectile and target. These Majorana DCE (MDCE) events are of a similar diagrammatic structure as $0\nu2\beta$ decay. The similarities of the DSCE and MDCE processes to pionic DCE reactions are elucidated. An overview on recent applications to heavy ion DCE data is given.

Wednesday
26 February
09:30
Main Venue

The CONUS Experiment and future potential of coherent neutrino scattering

Manfred Lindner

Max-Planck-Institute für Kernphysik

Coherent elastic neutrino nucleus scattering (CEνNS) was first observed 2018 with neutrinos from pion decay at rest. CONUS aims at detecting CEνNS with low energy anti-neutrinos. It uses novel Germanium detector technology and a virtual depth shield for operation at shallow depth only 17 meters away from the core of a multi GW power reactor. The talk will cover the status of CONUS, latest results and an outlook of the potential of future CEνNS experiments.

Thursday
27 February
09:30
Main Venue

Neutrino masses, mixings and electroweak nuclear physics

Eligio Lisi

INFN Bari

The current status of the mass-mixing parameters in the three-neutrino framework will be reviewed. The increasing connections between neutrino and nuclear physics will be highlighted. A case will be made for establishing an interdisciplinary field, that might be named as “electroweak nuclear physics”.

A high precision narrow-band neutrino beam: the ENUBET project

Tuesday
25 February
17:00
Main Venue

Andrea Longhin
Padova University and INFN

The knowledge of initial flux, energy and flavor of current neutrino beams is currently the main limitation for a precise measurement of neutrino cross sections. The ENUBET ERC project (2016-2021) is studying a facility based on a narrow band neutrino beam capable of constraining the neutrino fluxes normalization through the monitoring of the associated charged leptons in an instrumented decay tunnel. Since March 2019, ENUBET is also a CERN Neutrino Platform project (NP06/ENUBET) developed in collaboration with CERN AT and CERN-EN. In ENUBET, the identification of large-angle positrons from K_{e3} decays at single particle level can potentially reduce the ν_e flux uncertainty at the level of 1%. This setup would allow for an unprecedented measurement of the ν_e cross section at the GeV scale. Such an experimental input would be highly beneficial to reduce the budget of systematic uncertainties in the next long baseline oscillation projects (i.e HyperK-DUNE). Furthermore, in narrow-band beams, the transverse position of the neutrino interaction at the detector can be exploited to determine a priori with significant precision the neutrino energy spectrum without relying on the final state reconstruction.

This contribution will present the final design of the ENUBET demonstrator, which has been selected on April 2019 on the basis of the results of the 2016-2018 test beams. It will also discuss advances in the design and simulation of the hadronic beam line. Special emphasis will be given to a static focusing system of secondary mesons that, unlike the other studied horn-based solution, can be coupled to a slow extraction proton scheme. The consequent reduction of particle rates and pile-up effects makes the determination of the ν_μ flux through a direct monitoring of muons after the hadron dump viable, and paves the way to a time-tagged neutrino beam. Time-coincidences among the lepton at the source and the neutrino at the detector would enable an unprecedented purity and the possibility to reconstruct the neutrino kinematics at source on an event by event basis. We will also present the performance of positron tagger prototypes tested at CERN beamlines, a full simulation of the positron reconstruction chain and the expected physics reach of ENUBET.

Probing Dark Energy with the SKA in Africa

Tuesday
25 February
11:00
Main Venue

Roy Maartens
University of the Western Cape

I will survey the progress towards the SKA radio telescope array, including the successful building and operation of South Africa's MeerKAT array. Then I will focus on how these instruments can deliver new measurements and insights about the Dark Energy that is driving the accelerated expansion of the Universe.

Friday
28 February
11:20
Main Venue

Nuclear structure observables to shed light on neutrinoless double-beta decay

Javier Menendez
University of Barcelona

Neutrinoless double-beta decay ($0\nu\beta\beta$) is notoriously difficult to observe. Moreover, expected decay rates depend on the value of the nuclear matrix elements (NMEs) which are poorly known. In order to obtain insights on the NMEs, and therefore on expected decay rates, one can study other processes connected to $0\nu\beta\beta$ decay. In this talk I confront predictions and measurements of the half-life and beta spectrum of the two-neutrino double-beta decays to test nuclear models used to calculate $0\nu\beta\beta$ NMEs. In addition, I discuss the relation between $0\nu\beta\beta$ NMEs (mediated by the weak interaction) and other nuclear observables such as double Gamow-Teller (strong) and double-gamma (electromagnetic) transitions.

Monday
24 February
11:30
Main Venue

Status of the SuperNEMO Experiment

Alessandro Minotti for the SuperNEMO collaboration
LAPP - IN2P3

The SuperNEMO Experiment is designed to search for neutrinoless double beta decays of the ^{82}Se isotope. The detector employs the multi-observable tracking-and-calorimetry technique pioneered by the NEMO-3 Experiment. Electrons originating from double beta decays of an isotope in thin isotopic foils are tracked in wire tracking chambers and their energy is measured by large scintillator blocks. The topology, timing, and energy provide a powerful means of identifying and measuring the final state of decays. The technique is also very effective in rejecting backgrounds due mostly to traces of natural radioactivity in foils and detector materials. The SuperNEMO Demonstrator module is currently being commissioned at the Modane Underground Laboratory in the Frejus Tunnel. We will discuss details of the detector elements, the latest status of the experiment, and the physics reach.

Friday
28 February
10:50
Main Venue

Quenching of the spin-isospin response in nuclei

Peter von Neumann-Cosel
Institut für Kernphysik, Technische Universität Darmstadt

Quenching of the Gamow-Teller strength in weak processes is a well-established phenomenon. I will briefly review our knowledge of quenching of the isospin-analog spin-M1 resonance. The interest is driven by recent developments of ab initio calculations based on interactions derived from EFT, which allow a unified description of electromagnetic and weak processes populating isospin-analog states. This provides a unique testing ground for the role of two-body currents for the quenching phenomenon. I will also discuss the (very limited) data on quenching of higher multipoles and their implications for astrophysical scenarios and $0\nu\beta\beta$ decay and present some ideas for future experimental work using transverse electron scattering.

Status and perspectives of the Hyper-Kamiokande project

Thursday
27 February
15:40
Main Venue

Federico Nova

Rutherford Appleton Laboratory

A future neutrino experiment based in Japan, Hyper-Kamiokande (HK) consists of a high-intensity neutrino beam from the J-PARC accelerator targeting a Near Detector suite, an Intermediate Water Cerenkov detector and an underground world-largest Water Cerenkov Far Detector, providing 0.19 Mt (fiducial mass) of ultra-pure water sensed by newly developed photo-sensors with 40%-equivalent photo-coverage, to perform Cerenkov ring reconstruction with a few MeV energy threshold. A second identical far detector may later be added in Korea. Building on the legacy of Super-Kamiokande and T2K, the HK project will address a broad scientific program and substantially enhance our knowledge of both particle physics and astrophysics. Its objectives include precise measurements of neutrino oscillations and CP-asymmetry (with CPV discovery at 3 sigma for 76% of the phase space), solar neutrino astronomy, determination of supernova burst dynamics, detection of supernova relic neutrinos allowing to study supernova populations, searching for nucleon decay with improved sensitivity (10^{35} years for p→epi0 mode at 90% CL) and finding possible exotic phenomena. Here we will present the project status and milestones, from the beginning of construction in 2020 towards the commissioning in 2027.

Nuclear Matrix Elements of neutrinoless double-beta decay calculated by Monte Carlo Shell Model for ^{76}Ge and ^{136}Xe

Wednesday
26 February
11:30
Main Venue

Takaharu Otsuka

Department of Physics, University of Tokyo

The neutrinoless double beta decay is of special importance in determining the fundamental properties of neutrinos. The nuclear matrix element of this decay must be evaluated in a sufficient accuracy, and the shell-model calculation can make contributions to this end. This is because the shell-model calculations incorporate basically all correlations into the wave functions of the initial and final states of the decay, and the accuracy of the calculation can be investigated by referring to other observables. I will report results obtained by recent large-scale shell-model calculations on ^{76}Ge and ^{136}Xe as well as their daughter nuclei ^{76}Se and ^{136}Ba. Here the large-scale shell-model calculations mean those by Monte Carlo Shell Model at its most advanced edition. The results are not away from the ranges of earlier studies, but are rather on the edges of smaller values. I will also discuss why such smaller values arise as natural consequences of basic features of the wave functions.

Thursday
27 February
09:00
Main Venue

Status of the T2K experiment

Yuichi Oyama
KEK/J-PARC

Current status of the T2K long-baseline neutrino-oscillation experiment is presented. Future upgrades and prospects in coming ten years are also reported.

Thursday
27 February
15:10
Main Venue

Solar Models and Neutrino: where do we stand?

Aldo Serenelli
Institute of Space Sciences (ICE-CSIC)

In this talk, I will present the status of solar models, review the main limitations imposed by uncertain input physics in the models and by external constraints (aka solar abundances), and discuss the current constraints imposed from helioseismic and solar neutrino measurements. Also, I will discuss the implications that our current limitations in modeling the Sun have for stellar physics. Finally, some discussion will be devoted to the importance of a prospective measurement of solar neutrinos from the CN-cycle would have for solar models and other fields.

Tuesday
25 February
08:30
Main Venue

Hunting Down Solar Neutrinos; an Extraordinary South African Particle Physics Safari

Elias Sideras-Haddad
University of the Witwatersrand

The detection of the neutrino and subsequently the solar neutrino had stood for over 25 years as a major challenge for nuclear physicists. The presentation is a narrative of the ground-breaking experiment of the joint South African and American teams of JPF Sellschop and F. Reines for the search of cosmic ray neutrino in the early sixties. The Case Western-Wits team operated a gigantic for its time liquid scintillator detector at an unbelievable depth of almost 3.5km underground in the East Rand Proprietary Gold Mine (EPRM) in Johannesburg. After six years of preparations and operation the first evidence of high-energy cosmic ray neutrino interactions was published in 1965 in Physical Review Letters. This achievement was the determining factor for the career of JPF Sellschop and in certain respects for the development of Nuclear Physics in South Africa.

Majorana neutrino mass generation, $0\nu\beta\beta$-decay and nuclear matrix elements

Wednesday
26 February
11:00
Main Venue

Fedor Simkovic
Comenius University

A Quark Condensate See-Saw (QCSS) mechanism of generation of Majorana neutrino mass due to spontaneous breaking of chiral symmetry accompanied with the formation of a quark condensate is presented. Consequences of this scenario of neutrino mass generation for the neutrinoless double-beta decay ($0\nu\beta\beta$-decay), tritium beta decay and cosmological measurements are drawn. The attention is paid also to the problem of reliable calculation of the $0\nu\beta\beta$-decay nuclear matrix elements and the evaluation of quenching of the axial-vector coupling constant g_A. For solving of these nuclear physics problems an importance of experimental study of the two-neutrino double-beta decay, muon capture in nuclei and nuclear charge-exchange reactions is stressed.

Study of kinematic factors in double-beta decay

Friday
28 February
12:20
Main Venue

Sabin Stoica
International Centre for Advanced Training and Research in Physics and Horia Hulubei National Institute of Physics and Nuclear Engineering

Until the recent past not to much importance was given to the kinematic factors related to the double-beta decay (DBD), i.e. the phase space factors, electronic spectra and angular correlations between the emitted electrons. The reason was largely because on the one side they were considered to be calculated/predicted with enough precision (in comparison for example with the nuclear matrix elements) and, on the other side, the experimental measurements had not reached a sufficient degree of accuracy to be able to distinguish fine details of them. This situation is changing now. A detailed analysis of the DBD electron spectra and angular correlations can provide us with useful information on transitions to excited states, on decay modes and mechanisms contributing to neutrinoless DBD and, very recently on possible effects of Lorentz symmetry violation in the neutrino sector.

In my presentation I will give first a short review about the challenges in computation of the space phase factors, electron spectra and electron angular correlations. Then, I refer to the analysis of observable effects of Lorentz violation (LV) in two-neutrino DBD in the framework of the Standard Model Extension (SME) and I present a comparison between the methods of calculation the summed electron spectra including the deviations due to LV associated to the like-time component of the so-called countershaded operator. Finally, I show that our predictions regarding electronic spectra correlated with their precise measurements that are currently being done in DBD experiments (like EXO-2000, SuperNEMO, etc.) for searching LV effects, can improve with up to 30% the actual upper limits of the (ä)3of coefficient that governs the LV contribution.

Monday
24 February
09:30
Main Venue

Nuclear processes and effective weak couplings

Jouni Suhonen
University of Jyväskylä

The axial-type of weak couplings seem to be renormalized in medium-heavy and heavy nuclei as suggested by analyses of nuclear beta and double beta decays, nuclear muon capture, charge-exchange reactions and low-energy neutrino-nucleus scattering [1]. Also some calculations suggest that also the vector-type of couplings could attain effective values in nuclei [2,3]. The possible variation of the values of weak couplings as functions of the nuclear mass number affects the information deduced from the possible future measurements of the half-lives of neutrinoless double beta ($0\nu\beta\beta$) decays [4], nuclear muon captures, electron and antineutrino spectra of medium-mass fission fragments in nuclear reactors, etc. In particular, there could be direct effects on the reactor antineutrino anomaly and the Gallium anomaly [1].

Studies of the $0\nu\beta\beta$ decays of nuclei are of paramount importance in order to learn about the basic properties of the neutrino. An appealing way to probe this decay rather directly is the nuclear muon capture, since it operates in the same momentum-exchange region as the $0\nu\beta\beta$ decays. Recent results on the muon capture rate on ^{100}Mo [5] indicate that the muon-capture calculations are able to reproduce the measured capture strength function in a quite satisfactory way.

In my contribution I present an overview of the problem of effective weak couplings and discuss the relation of the nuclear muon capture to $0\nu\beta\beta$ processes.

[1] H. Ejiri, J. Suhonen and K. Zuber, Phys. Rep. 797 (2019) 1-102.
[2] J. Suhonen, Front. Phys. 5 (2017) 55.
[3] J. Suhonen and J. Kostensalo, Front. Phys. 7 (2019) 29.
[4] J. Suhonen, Phys. Rev. C 96 (2017) 055501.
[5] L. Jokiniemi, J. Suhonen, H. Ejiri and I. H. Hashim, Phys. Lett. B 794 (2019) 143.

Thursday
27 February
10:30
Main Venue

Benchmarking aspects of weak interaction physics via precision beta decay spectroscopy and two-nucleon transfer reactions

Smarajit Triambak
University of the Western Cape

In this talk I shall present results from recent high-precision half-life and branching ratio measurements for ^{19}Ne beta decay and the detailed spectroscopic analyses of states in ^{136}Ba and ^{136}Cs via two-nucleon transfer reactions. I will briefly discuss the connection between these experiments in the context of Standard Model tests, highlighting the importance of reconciling the experimental results with state-of-the-art theory calculations. Particular emphasis will be placed on implications pertaining to neutrinoless double beta decays.

HALO-1kT - Status and Design

Monday
24 February
17:10
Main Venue

Clarence Virtue
Laurentian University and SNOLAB

HALO-1kT is a lead-based supernova neutrino detector proposed for the Laboratori Nazionali del Gran Sasso (LNGS). By utilizing lead from the decommissioning of the OPERA detector at LNGS, HALO-1kT will improve of the sensitivity of the Helium and Lead Observatory (HALO), that has been running in SNOLAB in Canada for the past 7 years, by a factor of 25. The lead-based neutrino detection technology takes advantage of the large neutrino-nuclear cross sections for lead, and Pauli-blocking of the anti-electron-neutrino charged current channel, to offer a robust, low cost and low maintenance electron-neutrino-sensitive detector that complements water Cherenkov and liquid scintillator neutrino detectors. Neutrino detection is through charged and neutral current interactions with the lead nuclei that expel neutrinos that a subsequently detected with high efficiency in ^{3}He proportional counters. The talk will focus on the physics capabilities of the detector, aspects of its design, and its current status.

First results from the neutrino mass experiment KATRIN

Tuesday
25 February
09:00
Main Venue

Christian Weinheimer for the KATRIN collaboration
Institut für Kernphysik, University of Münster

Since the discovery of neutrino oscillation we know that neutrinos have non-zero masses, but we still do not know the absolute neutrino mass scale, which is as important for cosmology as for particle physics. The direct search for a non-zero neutrino mass from endpoint spectra of weak decays is complementary to the search for neutrinoless double beta-decay and analyses of cosmological data. Today the most stringent direct limits on the neutrino mass originate from investigations of the electron energy spectra of tritium beta-decay.

The next generation experiment KATRIN, the Karlsruhe Tritium Neutrino experiment, is improving the sensitivity from the tritium beta decay experiments at Mainz and Troitsk of 2 eV by one order of magnitude probing the region relevant for structure formation in the universe. KATRIN uses astrong windowless gaseous molecular tritium source combined with a huge MAC-E-Filter as electron spectrometer. To achieve the sensitivity, KATRIN has been putting many technologies at their limits. The full 70m long setup has been successfully commissioned. From early 2019 on KATRIN is taking high statistics tritium data hunting for the neutrino mass.

In this talk a detailed presentation of the KATRIN experiment and its results from the first KATRIN science run will be given. The new results are already bringing KATRIN into the lead position of the field. In the outlook the perspectives of KATRIN for the coming years and new technologies to potentially improve further the sensitivity on the neutrino mass will be presented.

Monday
24 February
09:00
Main Venue

Recent results and perspectives on beta decay, double-beta decay and lepton flavour violation

Kai Zuber

Technical University Dresden

The lepton sector of the Standard Model is a very important and interesting field to search for new physics beyond the Standard Model. As we know that quarks and neutrinos are mixing it is an open question why the charged leptons are now. This stimulates the search for charge lepton violation (CLFV). In addition, neutrino-less double beta decay would violate total lepton number by 2 and prove that neutrinos are their own antiparticle. The obtained half-life can be linked to a potential Majorana neutrino mass. This is providing a complementary measurement to normal beta decay where new interesting results are obtained. This talk will shortly review the current situation in this area of research, required support from theory and an outlook into the future.

Contributed Talks

Prospects for pair-transfer reactions at iThemba LABS

Tuesday
25 February
14:40
Main Venue

Philip Adsley[1,2], Retief Neveling[2] and Paul Papka[3]
[1]University of the Witwatersrand
[2]iThemba LABS
[3]Stellenbosch University

Pair-transfer reactions such as (p,t) and (^{3}He,n) have been used to probe the pairing in nuclei. The nature of pairing in neutrinoless double-beta decay candidates can strongly impact the predicted nuclear matrix elements linking the ground states of the parent and daughter nuclei in neutrino-less double-beta decay candidates, with various different theoretical approaches such as the QRPA sometimes using the BCS pairing approximation. Evidence from pair-transfer reactions provides evidence for the breaking down of the BCS approximation in some nuclei.

This contribution will discuss experimental developments at iThemba LABS using the K600 magnetic spectrometer to measure (p,t) cross sections, and arrays of HPGe and neutron detectors to measure the (^{3}He,n) reaction, providing an excellent opportunity to probe the nature of pairing in nuclei,including neutrinoless double-beta decay candidates.

The search for eV sterile neutrinos with the STEREO experiment

Friday
28 February
09:00
Parallel Venue

Helena Almazan
Max-Plank-Institut für Kernphysik

In the last decade, two unsolved anomalies have appeared from the study of reactor neutrinos: one related to the neutrino spectral shape, and another to the absolute neutrino flux. The second one, known as the Reactor Antineutrino Anomaly, presents a deficit in the observed flux compared to the expected one that could point to the existence of a light sterile neutrino in the eV range participating in the oscillation phenomena.

The STEREO experiment is a short baseline reactor antineutrino experiment trying to test the existence of those sterile neutrinos. This experiment, taking data since the end of 2016, measures the antineutrino energy spectrum from the compact core of the research reactor of the Institut Laue-Langevin (Grenoble, France) operated with highly enriched ^{235}U fuel. Covering baselines between 9 and 11m with a segmented neutrino target, STEREO can study the rate of neutrino interactions and compare it among cells to test oscillation hypotheses at different distances from the source. STEREO can also measure the absolute neutrino flux and spectral shape emitted from a pure ^{235}U core. Neutrino data from 179 (235) days of reactor turned on (off) have been analyzed, showing compatibility with the null oscillation hypothesis and rejecting the best fit point of the Reactor Antineutrino Anomaly at 99.8% CL. In this talk, these results together with the latest improvements in the description of the detector models and the background treatment are reported, providing a crucial input in the search for sterile neutrinos.

Thursday
27 February
13:50
Main Venue

Sterile neutrino searches with the ICARUS detector

Vincenzo Bellini
INFN-Sezione di Catania

The ICARUS collaboration employed the 760-ton T600 detector in a successful three-year physics run at the underground LNGS laboratories studying neutrino oscillations with the CNGS neutrino beam from CERN, and searching for atmospheric neutrino interactions. ICARUS performed a sensitive search for LSND-like anomalous ν_e appearance in the CNGS beam, which contributed to the constraints on the allowed parameters to a narrow region around 1 eV^2, where all the experimental results can be coherently accommodated at 90% CL. After a significant overhauling at CERN, the T600 detector has now been placed in its experimental hall at Fermilab where installation activities are in progress. It will be soon exposed to the Booster Neutrino Beam to search for a sterile neutrino within the Short Baseline Neutrino (SBN) program, devoted to definitively clarify the open questions of the presently observed neutrino anomalies. The proposed contribution will address ICARUS achievements, its status and plans for the new run at Fermilab and the ongoing developments of the analysis tools needed to fulfill its physics program.

Monday
24 February
14:00
Main Venue

Dark Matter searches at Belle II

Marcello Campajola
INFN-Napoli

The Belle II experiment at the SuperKEKB energy-asymmetric e^+e^- collider is a substantial upgrade of the B factory facility at the Japanese KEK laboratory. The design luminosity of the machine is 8×10^{35} cm^{-2}s^{-1} and the Belle II experiment aims to record 50 ab^{-1} of data, a factor of 50 more than its predecessor. Main operation of SuperKEKB has started in March 2019, with the full detector installed; this first running period ended in July. The machine reached a peak luminosity of 1.2×10^{34} cm^{-2}s^{-1}, and Belle II recorded a data sample of about 6.5 fb^{-1}. Data taking will resume in October 2019. Already this early data set, with specifically designed triggers, offers the possibility to search for a large variety of dark sector particles in the GeV mass range, complementary to LHC and to dedicated low energy experiments;

these searches will benefit from more data which will be accumulated in the upcoming Fall/Winter run. This talk will review the state of the dark sector searches at Belle II with a focus on the discovery potential of the early data, and show the first results.

Characterization of first prototypes of thin targets for the NUMEN experiment

Monday
24 February
15:00
Parallel Venue

Vittoria Capirossi[1], Daniela Calvo[2], Frank Delaunay[3], Maria Fisichella[2], Felice Iazzi[4], Federico Pinna[4] and Valentino Rigato[5]

[1]Polytechnic of Turin - INFN Turin
[2]INFN-Sezione di Torino
[3]LPC Caen, Normandie Université, ENSICAEN, UNICAEN, CNRS/IN2P3
[4]DISAT - Politecnico di Torino
[5]INFN-Laboratori Nazionali di Legnaro

The NUMEN Experiment, at INFN-LNS (Catania), aims to get information on the Nuclear Matrix Elements of the Neutrinoless Double Beta Decay, by measuring Double Charge Exchange (DCE) reactions cross-sections [1]. The energy of the reaction products must be measured with high resolution. To fulfil this requirement, the target must be thin to minimize dispersion and straggling effects on the ejectile energy; the energy resolution is also influenced by the target thickness uniformity. Due to the small thickness, a mechanical support is necessary for the target. On the other hand, to have a large statistics very intense ion beams are required, which release a large amount of heat inside the target. Therefore the isotope will be deposited on a Highly Oriented Pyrolytic Graphite (HOPG) substrate that quickly transfers the heat outside the target system, thanks to its high surface thermal conductivity [2]. The target thickness will be of a few hundreds of nanometer, while the HOPG will be around 2 micrometers thick [3]. Prototypes of Germanium and Tellurium targets have been deposited with Electron Beam Evaporation process, which parameters have been optimized. In the NUMEN Experiment the reaction final nuclei can be produced in different final states; a good energy resolution is needed to distinguish between the ground state and the first excited states to deduce the related DCE cross-sections. Unfortunately, the deposition technique does not guarantee a perfectly uniform target thickness. Such surface non-uniformity can be qualitatively inspected by Field Emission Scanning Microscopy (FESEM): images of the best Tellurium and Germanium target prototypes will be presented in the talk.In order to evaluate both thickness and uniformity of the targets, alpha transmission spectroscopy measurements have been performed. The energy distribution shows a peak, which corresponds to the most frequent thickness; the width is related to the thickness spread. An experimental setup has been designed, using an ^{241}Am alpha-source and a silicon detector to measure the energy of the transmitted alpha particles. Some tests have been made with Rutherford Backscattering (RBS) technique on the same target samples, to evaluate the systematic error of the alpha-measurements. In order to evaluate the dispersion and straggling effects due to the thickness and non-uniformity on the resolution of the measurements of the DCE products energy, a Monte Carlo code has been implemented. The measured parameters of the thickness distribution have been inserted as input data of the simulation, for different values of the relative branching fractions of ground, first and second excited states. The obtained spectra give information about the resolution between two levels. The results are promising and will be shown in the talk.

[1] F. Cappuzzello *et al.*, Eur. Phys. J. A, 54 (2018) 72, https://doi.org/10.1140/epja/i2018-12509-3
[2] V. Capirossi *et al.*, Nucl. Instr, and Meth. in Phys. Res. A (2018), https://doi.org/10.1016/j.nima.2018.08.081
[3] F. Pinna *et al.*, Design and test of an innovative static thin target for intense ion beams, Il NuovoCimento (2019), in press.

Monday
24 February
14:40
Main Venue

DELight – Searching for light dark matter using superfluid helium

Christian Enss[1], Loredana Gastaldo[1], Sebastian Kempf[1] and Jörg Jäckel[2]
[1]Kirchhoff Institute for Physics, Heidelberg University
[2]Institute for Theoretical Physics, Heidelberg University

The Direct search Experiment for Light Dark Matter (DELight) aims to develop a novel detector technology for the search for light dark matter based on the properties of the superfluid phase of the inert gas ^{4}He. This detector uses the purest material imaginable, provides multiple independent signals for background suppression, has the potential to exploit directionality for event identification,and offers the ability to extend the sensitivity of direct dark matter search to the MeV range. In the first phase, we will build a 10-liter prototype detector with metallic magnetic calorimeters (MMCs) as photon and phonon sensors to investigate the signal threshold that can be reliably detected and to study the directional dependence of the quantum evaporation of He atoms on the energy and mass of the scattering particle. Here we will discuss the physics and the potential of such a detector for light dark matter as well as the goals and long-term perspective of DELight.

Tuesday
25 February
15:00
Parallel Venue

Q-value measurements of rare weak beta decays with JYFLTRAP

Tommi Eronen, Antoinen de Roubin, Joel Kostensalo, Jouni Suhonen, Dmitrii Nesterenko, Marjut Hukkanen, Ari Jokinen, Anu Kankainen, Iain Moore, Ville Virtanen, Ruben de Groote and Sami Rinta-Antila
University of Jyväskylä

Rare weak beta decays can be potentially used in searches for the neutrino mass. These are, e.g., decays between nuclear ground states and excited states in daughter nuclei that have very small (<1 keV) decay energy (Q-value). The beta decay of ^{115}In $9/2^{+}$ ground state to $3/2^{+}$ state in ^{115}Sn currently has the smallest measured Q-value (0.155(24) keV [1,2]) of any beta decay.

There are several more nuclei that potentially possess similarly low Q-values [3]. Those are optimal for experimental neutrino mass determination through distortions in the beta endpoint spectrum. First, before any attempt to measure the endpoint spectrum, it is necessary to confirm whether the Q-value of the decay is positive. The ground-state-to-ground-state Q-value can be measured with mass spectrometry while the excitation energy of the excited state in the daughter can be deduced from gamma-ray spectroscopy.

Using the JYFLTRAP Penning trap setup [4,5] at the Accelerator Laboratory of the University of Jyväskylä, we have measured Q-values of several such cases. One of those is the ^{135}Cs decay to ^{135}Ba, which was measured with a precision at the 100-eV level. Along with this Q-value measurement I'll give an overview of the used Phase-Imaging Ion-Cyclotron mass measurement technique [6].

[1] B.J. Mount, M. Redshaw, E.G. Myers, Phys. Rev. Lett. 103 (2009) 122502.
[2] J. S. E. Wieslander, J. Suhonen, T. Eronen *et al.*, Phys. Rev. Lett.103 (2009) 122501.
[3] H. Ejiri, J. Suhonen, K. Zuber, Phys. Rep. 797 (2019) 1-102.
[4] T. Eronen *et al.*, Eur. Phys. J. A48 (2012) 46.
[5] D. Nesterenko *et al.*, Eur. Phys. J. A54 (2018) 154.
[6] S. Eliseev *et al.*, Appl. Phys. B114 (2014) 107.

Update on the HOLMES experiment to directly measure the neutrino mass

Tuesday
25 February
15:40
Parallel Venue

Marco Faverzani
INFN Milano-Bicocca

The absolute neutrino mass is still a missing parameter in the modern landscape of particle physics. The HOLMES experiment aims at exploiting the calorimetric approach to directly measure the neutrino mass through the kinematic measurement of the decay products of the weakly-mediated decay of ^{163}Ho. This low energy decaying isotope, in fact, undergoes electron capture emitting a neutrino and leaving its daughter nucleus, ^{163}Dy*, in an atomic excited state. This, in turn, relaxes by emitting electrons and, to a considerably lesser extent, photons. The high energy portion of the calorimetric spectrum of this decay is affected by the non-vanishing neutrino mass value. Given the small fraction of events falling in the region of interest, to achieve a high experimental sensitivity on the neutrino mass it is important to have a high activity combined with a very small undetected pile-up contribution. To achieve these targets, the final configuration of HOLMES foresees the deployment of a large number of ^{163}Ho ion-implanted TESs characterized by an ambitiously high activity of 300Hz each. This contribution will provide an overview on the status of the major tasks that will bring HOLMES to achieve a statistical sensitivity on the neutrino mass as low as 2 eV: from the isotope production and embedding to the detector production and readout.

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^{127}I(ν,e)^{127}Xe reaction for solar neutrino spectrum clarification

Tuesday
25 February
14:40
Parallel Venue

Almaz Fazliakhmetov
Moscow Institute of Physics and Technology

Solar neutrino spectrum measurement plays a crucial role for solar metallicity determination. ^{127}I(ν,e)^{127}Xe reaction is sensitive to CNO and boron components of the solar neutrino spectrum due to the relatively high threshold (662 KeV). For neutrinos with energies upper $S_n = 7.246$ MeV ^{127}I(ν,e) capture produces ^{126}Xe + n. The concentration ratio of ^{127}Xe and ^{126}Xe could clarify parameters of high energy solar neutrino spectrum and neutrino oscillations. We present production rate estimation for of ^{127}Xe and ^{126}Xe based on experimental strength function from ^{127}I(p,n)Xe reaction.

EDELWEISS: searching for low-mass dark matter particles with germanium low-temperature detectors

Monday
24 February
14:20
Main Venue

Andrea Giuliani for the EDELWEISS collaboration
CNRS/CSNSM

EDELWEISS is a direct dark matter search experiment aiming at the detection of WIMPS and other candidates as the composition of the galactic dark matter halo. The EDELWEISS detection method is based on arrays of germanium mono-crystals operated at temperatures around or below 20 mK. Energy deposited in the crystals by particle interactions are read out simultaneously by thermal sensors, which collect the phonon component of the signal, and by surface electrodes, which collect the ionization component. This hybrid detection method is extremely powerful for background reduction. The EDELWEISS devices are operated in a low-radioactivity heavily-shielded dilution refrigerator installed in the deepest European underground laboratory in Modane (France). Recently, results have been achieved also with an extremely low-noise set up installed above ground. The versatile and highly performing technology adopted by EDELWEISS opens new possibilities to detect signals induced by either electrons or nuclear recoils. EDELWEISS has developed a rich program to look for DM candidates with masses below 1 GeV and down to the MeV range (EDELWEISS SubGeV program), in a region of the parameter space where low-temperature detectors are extremely competitive. There is an increasing interest in this mass range motivated by the lack of evidence of new physics at LHC (e.g. SUSY), which pushes to look beyond the standard WIMP dark matter scenario.

Detectors are operated in two modes, according to the voltage magnitude applied to the ionization electrodes. In the low-voltage mode, discrimination between nuclear and electron recoils is maintained, with threshold down to 50 eV (electron equivalent) in prospects. In the high-voltage mode, detection of single electron-hole pair in massive detectors is possible.

We will report both on the promising technological advancements in these detection regimes ando n recent results about low-mass candidates. In particular, we will present results on Axion-Like Particles in the keV range and will report the attainment of the first sub-GeV spin-independent dark matter limit based on a germanium target. The search has been extended to Strongly Interacting Particles (SIMP) down to masses of 45 MeV by exploiting the Migdal effect. Results on SIMPs with spin-dependent interactions will also be presented.

Axial Vector Form Factors of the Nucleon using lattice QCD

Friday
28 February
10:00
Parallel Venue

Rajan Gupta
Los Alamos National Laboratory

The success of experiments such as DUNE require the determination of neutrino flux and cross-section with nuclear targets with unprecedented accuracy. A crucial input in the calculations of these is the axial form factor. Starting from the standard model that defines the interaction of the axial current with quarks, one needs to include both QCD corrections that bind quarks into nucleons and nuclear effects that arise in heavy nuclear targets such as argon. Experimental access to the first, QCD corrections for nucleons, is prevented by safety concerns posed by liquid hydrogen targets. Axial and electromagnetic form factors of the nucleon can be calculated from first principals using lattice QCD. This talk will show that we now have control over all sources of systematic errors that arise in lattice QCD calculations and the axial form factors satisfy the PCAC relation, an essential and non-trivial check [see arXiv:1905.06470]. Finally, I will present state-of-the-art results at the physical pion mass and in the continuum limit and compare them with phenomenology. Prospects for reaching 1–2% accuracy will be discussed.

BBN, Underground Nuclear Astrophysics and Neutrinos

Tuesday
25 February
14:20
Parallel Venue

Carlo Gustavino
INFN-Roma

Nuclear astrophysics plays an important role in understanding open issues of neutrino physics. As an example, the two key reactions of the solar p-p chain ^{3}He(^{3}He,2p)^{4}He and ^{3}He(^{4}He,γ)^{7}Be were studied at low energy with LUNA (Laboratory for Underground Nuclear Astrophysics), providing an accurate experimental footing for the Standard Solar Model and consequently to study the neutrino mixing parameters.The LUNA collaboration has now completed the measurement of the D(p,γ)^{3}He cross section with unprecedented precision at Big Bang Nucleosynthesis (BBN) energies. The accurate study of this deuterium-burning process provides a precise determination of the universal baryon density Ω_b, in agreement with the value derived from CMB data and with comparable accuracy. Finally, our analysis severely constrains the possible existence of "dark radiation", i.e. the existence of relativistic particles not foreseen in the standard model, such as sterile neutrinos or hot axions [1]. The LUNA result and consequences in cosmology and particle physics are discussed in this contribution.

[1] E. Di Valentino, C. Gustavino *et al.*, Phys. Rev. D 90 (2014) 023543.

Tuesday
25 February
15:40
Main Venue

COHERENT's Neutrino-Induced Neutron Detectors

Samuel Hedges
Duke University

Neutrino-nucleus interactions can produce excited nuclear states that can de-excite by emitting particles, including neutrons. Neutrino-induced neutrons (NINs) produced in common gamma shielding material, such as lead or iron, can pose a background for neutrino and dark matter experiments. Additionally, NIN production in lead is the primary mechanism for the Helium and Lead Observatory (HALO) to detect supernova neutrinos, and iron-based supernova NIN detectors have been proposed. As part of the COHERENT experiment, two detectors seeking to study NIN production in lead and iron have been deployed to the Spallation Neutron Source (SNS). An overview of the detector design and current status will be presented.

Thursday
27 February
13:50
Parallel Venue

Deflection of cosmic neutrino by a stellar magnetic field

Mohamed Ismaiel
Helwan University

Neutrinos in the Standard Model (SM) are considered neutral particles. However, recent experiments showed that the neutrino has infinitesimal electric charge leads to non-zero magnetic moment (μ) with precise constraints on the value, this electromagnetic interaction contribution enhances neutrino properties i.e. Oscillation, Scattering, and Spin. This work discusses the possible neutrino deflection under the influence of Interstellar Magnetic Field (IMF) or at extreme magnetic field condition exists in celestial objects, and for what limit could affect the neutrino flux measured at Earth. The primary results were validated by SN1987A supernovae arrival time data.

Friday
28 February
09:40
Main Venue

Study of ^{150}Nd 2β decay to the 0^+_1 excited level of ^{150}Sm

Dmytro Kasperovych[1], Alexander S. Barabash[2], Pierluigi Belli[3], Rita Bernabei[3], Roman S. Boiko[1], Fabio Cappella[3], Vincenzo Caracciolo[4], Riccardo Cerulli[3], Fedor A. Danevich[1], Alessandro Di Marco[3], Antonella Incicchitti[3], Vladislav V. Kobychev[1], S.I. Konovalov[2], Mathias Laubenstein[5], Denys V. Poda[6], Oksana G. Polishchuk[1], Vladimir I. Tretyak[1] and V.I. Umatov[2]

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[6]CSNSM, Université Paris-Sud, CNRS/IN2P3, Université Paris-Saclay

The ^{150}Nd nuclide is one of the most promising ones to search for double beta decay among the 35 naturally occurring double beta isotopes because of the high energy release: 3371.38(20) keV, and of the comparatively high isotopic abundance:

5.638(28)%. The 2β transition to the 740.5 keV 0_1^+ excited level of ^{150}Sm was observed in few experiments with half-lives in a wide range (7–14) $\times 10^{19}$ y. The investigation of this decay is performed at the Gran Sasso underground laboratory (Italy) with a highly purified 2.381-kg Nd_2O_3 sample in the low-background setup with 4 HP Ge detectors ($\approx$ 225 cm^3 each), mounted in one cryostat. Two gamma-quanta with energies 334.0 keV and 406.5 keV emitted after the deexcitation of the 0_1^+ excited level of ^{150}Sm have been observed in the coincidence spectra accumulated over 25947 h giving the preliminary half-life value of the ^{150}Nd relatively to the decay searched for: $T1/2 = [6.9^{+4.0}_{-1.9}(\text{stat}) \pm 1.1(\text{syst})] \times 10^{19}$ y. The experiment is in progress in order to improve the half-life value accuracy.

Limits on the spectral parameters of core-collapse neutrinos extracted from the Diffuse Supernovae Neutrino Flux (DSNνF)

Thursday
27 February
13:30
Parallel Venue

Ernesto Kemp and Rafael Raiser
University of Campinas

In February 1987 neutrinos from the SN1987 traveled a distance of about 50 kpc from the Large Magellanic Cloud and were detected on Earth by two of the largest neutrino telescopes of that time, Kamiokande-II and IMB, thus confirming the vast amount of energy (10^{53} ergs) predicted to be emitted in neutrinos and setting allowed intervals for the emission parameters like the neutrinosphere temperature. The confirmation of the main features of neutrino emission for a single supernova also supports the prediction that all the past supernovae in the universe should originate a ubiquitous and isotropic neutrino flux, the so-called Diffuse Supernova Neutrino Flux (DSNνF). Up to now, no evidence of events from DSNνF was found by different neutrino telescopes. In this work, we use the upper limit on the DSNνF obtained from the null results of the Super-Kamiokande collaboration to estimate limits on average energy, spectral pinching, and neutrinosphere temperature for electron antineutrinos from a core-collapse neutrino burst. Finally, we check our results with those obtained from the solely SN1987a data concluding that the DSNνF may lead to comparable - or even better - upper limits on the neutrino emission parameters.

The CROSS experiment: rejecting surface events with PSD

Tuesday
25 February
14:20
Main Venue

Hawraa Khalife
CSNSM-CNRS

Neutrinoless double-beta decay is a hypothetical rare nuclear transition ($T_{\frac{1}{2}} > 10^{26}$ y). Its observation would provide an important insight about the nature of neutrinos (Dirac or Majorana particle) demonstrating that the lepton number is not conserved. This decay can be investigated with bolometers embedding the double beta decay isotope, the possibility to investigate this rare process is strongly influenced by the background level in the region of interest. A new RD has recently begun within the CROSS project (Cryogenic Rare-event Observatory with Surface Sensitivity) aiming at the development of bolometric detectors, embedding the promising isotopes ^{100}Mo and ^{130}Te, capable of discriminating surface alpha and beta interactions by exploiting the properties of super-conducting material (Al film) or normal metal (Pd film) deposited on the crystal faces (Li_2MoO_4 and TeO_2). These films work as pulse-shape modifiers. The results of the tests on prototypes performed at CSNSM (Orsay, France) showed the capability of a few-m (nm)-thick Al (Pd) film deposited on the crystal surface to discriminate surface from bulk events, with the required rejection level of the surface background. While Al film can only identify surface alpha particles, there are preliminary indications that normal-metal films can separate also the beta surface component. This is a breakthrough in bolometric technology for double beta decay that could lead to reach a background index in the range 10^{-5} counts/(keV kg y). The CROSS cryostat has been recently installed underground (Canfranc, Spain). We plan to run the first CROSS demonstrator in 2021 with 32 enriched $Li_2{}^{100}MoO_4$ crystals containing 5 kg of ^{100}Mo. A 5-year sensitivity to the effective Majorana neutrino mass $m\beta\beta$ with a background of the order of 10^{-3} counts /(keV kg y) would be in the range 68-122 meV (2.8×10^{25} y), at the level of the best currently running experiments.

Friday
28 February
09:00
Main Venue

Decay Characteristics of the Scissors Mode of $0\nu\beta\beta$-Decay Partner Isotopes*

Jörn Kleeman[1], T. Beck[1], U. Friman-Gayer[1], N. Pietralla[1], V. Werner[1], S. Finch[2], J. Kotil[3], K. Fnu[2], B. Löher[1,4], H. Pai[1,5], O. Papst[1], W. Tornow[2] and M. Weinert[6]

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[2]TUNL
[3]University of Jyväskylä
[4]GSI
[5]SINP
[6]IKP, Universität zu Köln

The search for neutrinoless double beta ($0\nu\beta\beta$) decay, a process only allowed if the neutrino were a Majorana particle, recently gained much attention with numerous experiments being dedicated to its observation. It would demonstrate lepto-genesis in the universe and allow the determination of the neutrino mass from its decay rate. However, to quantitatively extract the neutrino mass or estimate decay rates a nuclear matrix element (NME) is required, which has to be calculated using nuclear structure models. One of them is the Interacting Boson Model 2 (IBM-2), which will be discussed below. Those calculations can be difficult because many of the $0\nu\beta\beta$-decay candidate nuclei lie in regions of the nuclear chart that feature shape coexistence, with the hypothesized $0\nu\beta\beta$-decay mother nucleus ^{150}Nd and its daughter ^{150}Sm even being located in the region of a shape phase transition along their respective isotopic chains. In particular, the occurrence of shape coexistence may lead to a significant population of an excited 0^+ state in $0\nu\beta\beta$ decay. To improve $0\nu\beta\beta$-NME calculations for ^{150}Nd and ^{150}Sm within the IBM-2 information on its so-called Majorana interaction is needed. Therefore, new data on the decay characteristics of the scissors mode of these nuclei was recently taken in nuclear resonance fluorescence experiments performed at the High Intensity γ-ray Source. The decay characteristics of the scissors mode are sensitive to the nuclear deformation and allow inducing constraints on model parameters, especially the Majorana parameters of the IBM-2, in turn resulting in a more reliable prediction of the $0\nu\beta\beta$-NME. Similar information has also been obtained for the 0-partner nuclides ^{82}Se and ^{82}Kr. The experimental results and updated IBM-2 calculations will be presented and discussed.

*Supported by the DFG through the research grant SFB 1245 and by the State of Hesse under the grant "Nuclear Photonics" within the LOEWE program.

GT nuclear resonances for ^{71}Ga$(\nu, e)^{71}$Ge reaction investigation

Friday
28 February
09:20
Main Venue

Grigory Koroteev
Moscow Institute of Physics and Technology

Neutrino-matter interaction has great importance for neutrino physics and astrophysics. Neutrino capture cross-section depends on the structure of the target nucleus strength function. ^{71}Ga$(\nu, e)^{71}$Ge process could be analysed using the charge-exchange strength functions of ^{71}Ga(p,n)^{71}Ge and ^{71}Ga(^{3}He,t)^{71}Ge reactions. Nuclear phenomenology of charge-exchange reactions describes not only discrete excited levels, but also collective resonant states such as GT and pygmy resonances. It is shown that accounting of GT-resonances increase neutrino capture rate and that capture rate is very sensitive to the exact behavior of the Fermi function at low energies. We will discuss the quenching effect estimation and the accuracy of B(GT) extraction from experimental data as a function of resonance width. The talk proposes a comparison of the experimental data processing and calculations obtained in the framework of the self-consistent theory of finite Fermi systems.

Implications of new theoretical calculations on reactor antineutrino and gallium anomalies

Friday
28 February
09:20
Parallel Venue

Joel Kostensalo[1], Jouni Suhonen[1] and Leendert Hayen[2]
[1]University of Jyväskylä
[2]KU Leuven

The reactor antineutrino and gallium anomalies have been long unexplained. Possible explanations for both of these anomalies include new physics, such as the existence of one or more eV-scale sterile neutrino [1]. However, the previous theoretical calculations, which do not replicate the experimental results, rely on many simplifying approximations [2,3].

In the reactor-antineutrino analysis the beta decays contributing to the cumulative electron spectrum are usually assumed to have allowed spectral shapes. However, many of these decays are actually first-forbidden. Moreover, these decays dominate the experimentally observable region. In some cases, like in the case of the ground-state-to-ground-state decay of ^{140}Cs, this is found to be a rather poor approximation. Based on the recent results, the use of this allowed approximation can at least partially explain the so called reactor antineutrino anomaly.

Our new large-scale shell model calculations regarding the neutrino-nucleus scattering cross section of ^{71}Ga shows no statistical difference to the experimental results of GALLEX and SAGE experiments. Conflict between charge-exchange BGTs and the neutrino-nucleus cross sections can to some extent be explained by destructive interference between Gamow-Teller and tensor contributions. A Bayesian approach to estimating the significance of the gallium anomaly is discussed.

[1] S. Gariazzo, C. Giunti, M. Laveder, Y. F. Li, and E. M. Zavanin, J. Phys. G: Nucl. Part. Phys. 43 (2015) 033001.
[2] J. N. Bahcall, Phys. Rev. C 56 (1997) 3391.
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Monday
24 February
14:40
Parallel Venue

Theoretical description of half-lives and electron spectra for higher order forbidden non-unique β decays

Anil Kumar and Praveen Srivastava
Department of Physics, Indian Institute of Technology

In this work we have calculated logft and half-lives values of the higher order forbidden β-decays for selected nuclei [for e.g. ^{87}Rb($3/2^- \rightarrow$^{87}Sr($9/2^+$)] in the framework of the nuclear shell model [1-3]. In the present study, we have included next-to-leading-order terms [4-6] in the shape functions to see their effect in the calculated half-lives and (or electron) spectra. The role of effective value of axial-vector coupling constant (g_A) in half-lives and β spectra for higher-forbidden beta decay are very important. The β^--spectrum of the fourth-forbidden non-unique decays of ^{113}Cd and ^{115}In strongly depends on the effective value of g_A [4,7]. In our study we will report the spectrum-shape method (SSM) for electron spectra with the effective value of g_A. With the SSM, it is possible to extract information of effective value of the weak coupling constant by comparing the theoretical and experimental β electron spectra of forbidden non-unique β-decays.

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Tests of three-neutrino paradigm by MINOS and MINOS+ experiments

Thursday
27 February
13:30
Main Venue

Karol Lang
University of Texas

MINOS and MINOS+ experiments collected unprecedented amount of data using two long baseline detectors that operated on axis of the NuMI neutrino beam at Fermilab. This has allowed to conduct some of the best measurements of neutrino oscillations that provide stringent constraints on neutrino mixing and transitions involving sterile neutrinos. We will present the latest results from these studies.

NEON - Neutrino Elastic-scattering Observation with NaI(Tl)

Tuesday
25 February
15:20
Main Venue

Hyun Su Lee
Institute for Basic Science

NEON is a proposed experiment to detect coherent elastic neutrino-nucleus scattering (CENNS) with high light yield NaI(Tl) detectors and a reactor as antinuetrino source. Due to extremely low energy signal predicted from the CENNS process, one needs to develop extremely low threshold detectors. We have optimized size of the crystals and developed new optical coupling design for high light collection efficiency. With current best crystal of approximately 23 photoelectrons per keV, a sub-keV scintillation signal is accessible with the NaI(Tl) crystals. We consider to install approximately 10 kg target mass at Hanbit reactor power plant, which is same place of the NEOS short baseline neutrino experiment, in early 2020. The site is 24 m far from reactor core with measured antineutrino flux of $7 \times 10^{-12}/\mathrm{cm}^2/\mathrm{s}$. We will present current status of detector developments as well as our strategy for an observation of CENNS process with the reactor antineutrino.

JUNO (Jiangmen Underground Neutrino Observatory), its design and status

Monday
24 February
15:00
Parallel Venue

Xiaonan Li
Institute of High Energy Physics, Chinese Academy of Sciences

Jiangmen Underground Neutrino Observatory (JUNO), a next generation underground reactor antineutrino experiment, is proposed to determine the neutrino mass hierarchy and precisely measure neutrino oscillation parameters using a massive liquid scintillator detector underground. The experimental hall, spanning more than 50 meters, is under a granite mountain of over 700 m overburden. The central antineutrino detector, built with 35.4-meter diameter acrylic sphere, contains 20 kilotons of liquid scintillator and 18,000 20 inch PMTs (and 25,000 3 inch PMTs). The antineutrino detector is placed in a water pool shielding system which also functions as an active water Cherenkov veto detector. On the top of water pool is a Top Tracker system which further improves the muon track reconstruction. The talk will present the project design and status.

Monday
24 February
14:00
Parallel Venue

Searching for neutrinoless double-beta decay of ^{100}Mo: the CUPID-Mo experiment

Claudia Nones for the CUPID-Mo collaboration
CEA/IRFU/DPhP

^{100}Mo deployed in the form of enriched Li_2MoO_4 crystals can be used as a promising scintillating bolometer to search for $0\nu\beta\beta$ in a tonne-scale experiment. In this talk we will review the properties of this target crystal and achieved bolometric detector performances that make it the baseline choice for CUPID (CUORE Upgrade with Particle ID). CUPID-Mo, installed in the underground laboratory of Modane, consists of an array of 20 enriched 0.2 kg Li_2MoO_4 crystals equipped with 20 cryogenic Ge bolometers to discriminate alpha from beta/gamma events by the detection of both heat and scintillation light signals. The commissioning has started in December 2018 and we have switched to routine data taking in spring 2019. In this talk, we will present results confirming an excellent bolometric performance of 5-6 keV energy resolution (FWHM) at 2615 keV, full alpha to beta gamma separation and improved estimates on the radiopurity of the crystals. We will also report on the background level observed in the region of interest and give a competitive limit on the neutrinoless double-beta decay half-life of ^{100}Mo as well the most precise measurement of the 2-neutrino decay mode. We will conclude with an expectation of the sensitivity of CUPID-Mo and prospects for CUPID.

Monday
24 February
14:20
Parallel Venue

CUPID-0: a double-readout cryogenic detector for DBD

Lorenzo Pagnanini for the CUPID-0 collaboration
INFN Milano Bicocca

A convincing observation of neutrino-less double beta decay ($0\nu\beta\beta$) relies on the possibility of operating high-energy resolution detectors in background-free conditions. Scintillating cryogenic calorimeters are one of the most promising tools to fulfill the requirements for a next-generation experiment. Several steps have been taken to demonstrate the maturity of this technique, starting form the successful experience of CUPID-0. The CUPID-0 experiment demonstrated the complete rejection of the dominant alpha background measuring the lowest counting rate in the region of interest for this technique. Furthermore, the most stringent limit on the ^{82}Se $0\nu\beta\beta$ was established running 26 ZnSe crystals during two years of continuous detector operation. In this contribution we present the final results of CUPID-0 Phase I including a detailed model of the background, the measurement of the $2\nu\beta\beta$ decay half-life and the evidence that this nuclear transition is single state dominated. The first results obtained after the upgrade of the detector in 2019 are presented as well.

Status and prospects of the KM3NeT/ORCA

Thursday
27 February
14:30
Parallel Venue

Salvador Miranda Palacios

University of Johannesburg

KM3NeT is the next-generation neutrino Cherenkov telescope currently under construction in the Mediterranean Sea. Its low energy configuration ORCA (Oscillations Research with Cosmics in the Abyss) is optimised for the detection of atmospheric neutrinos with energies above 1 GeV. The main research target of the ORCA detector is the measurement of the neutrino mass ordering (NMO) and atmospheric neutrino oscillation parameters. This contribution will present the first results on atmospheric neutrinos detected with the already deployed ORCA detection units. The projected sensitivity of the detector to the NMO will be shown, alongside prospects for early analyses of data collected with a small sub-array of the detector during construction phase. The ORCA potential for other physics topics, including dark matter, non-standard interactions, sterile neutrinos, and supernovae neutrino detection will also be presented.

GERDA Highlights: Probing the Majorana Neutrino Mass at 100 meV

Tuesday
25 February
15:20
Parallel Venue

Luciano Pandola

INFN Laboratori Nazionali del Sud

Since 2010, the GERDA project has been operated at Laboratori Nazionali del Gran Sasso (LNGS), searching for the neutrinoless double beta decay ($0\nu\beta\beta$) of Ge-76 to Se-76. GERDA is nowadays completing its mission, having attained 100 kgy exposure and, as first experiment, surpassed the goal sensitivity of 10^{26} yr on the half-life of the searched process. Since its beginning in 2010 GERDA has increased its sensitivity for the measurement of the decay by almost a factor of 5, thanks to excellent passive shield setup, operating procedures, energy resolution, and implementation of active background suppression strategies. The GERDA results allow to directly probe the Majorana neutrino mass down to about 100 meV scale.

In this talk, the GERDA setup, technological features and operation will be summarized, and the above outlined results, based on an exposure of about 85 kgy, will be reviewed in the framework of results from other $0\nu\beta\beta$ players. The Ge-76 two neutrino double beta decay half-life measured by GERDA, the main detected background sources, the performances and background indexes for the different detector types, the data analysis flow and algorithms will be discussed as well.The perspectives of the final GERDA data release and the transition to the LEGEND project will be addressed.

Monday
24 February
15:20
Main Venue

ReD: a SiPM based LAr TPC for directionality studies

Luciano Pandola
INFN Laboratori Nazionali del Sud

The Recoil Directionality project (ReD) within the DarkSide Collaboration aims to characterize the light and charge response of a liquid argon (LAr) dual-phase Time Projection Chamber (TPC) to neutron-induced nuclear recoils. The main goal of the project is to probe for the possible directional dependence suggested by the SCENE experiment. Furthermore, ReD will have the possibility to study the response of a LAr TPC to very low-energy nuclear recoils. Sensitivity to directionality and to low-energy recoils are both key assets for future argon-based experiments looking for Dark Matter in the form of WIMPs.

ReD consists in the irradiation of a miniaturized LAr TPC with a neutron beam at the INFN, Laboratori Nazionali del Sud (LNS), Catania. Neutrons are produced via the reaction p(^{7}Li,^{7}Be)n from a primary ^{7}Li beam delivered by the TANDEM accelerator of LNS. A $/E$ telescope, made by two Si detectors, identifies the charged particles (^{7}Be) which accompany the neutrons emitted towards the TPC. The core detector of ReD is a small custom-made double phase LAr TPC, having sensitive volume of $5 \times 5 \times 5$ cm^3. The ReD TPC uses all the innovative features of the DarkSide-20k design: in particular the optoelectronic readout based on SiPM and the cryogenic electronics. It is thus a valuable test bench of the technology which is being developed for DarkSide-20k and for the future project Argo. Neutrons scattered from the TPC are eventually detected by using an array of nine 3-inch liquid scintillator (LSci) detectors. All LSci are placed such to tag recoils having the same energy, i.e. the same scattering angle with respect to the incident neutron, but different angle with respect to the drift field of the LAr TPC, thus allowing to search for a possible directional response. The integration of the three detector systems was performed within several test beams performed in 2018-2019, using the TANDEM accelerator of LNS. Neutrons were produced by sending a ^{7}Li 28 MeV beam onto a set of CH2 targets having thickness between 250 and 400 μg/cm^2. The physics measurement is expected to take place during the early months of 2020. This contribution will report about the current status of the project, including the physics results possibly obtained in the meanwhile, and on the short- and medium-term plans. The feasibility is also discussed of a wider-purpose facility at INFN-LNS, targeted to the calibration of detectors of interest for Dark Matter or rare events searches with tagged neutrons.

Friday
28 February
09:20
Main Venue

New limits on double beta processes in ^{106}Cd

Oksana G. Polishchuk[1], Pierluigi Belli[2], Rita Bernabei[3], V.B. Brudanin[4], Fabio Cappella[2], Vincenzo Caracciolo[2], Riccardo Cerulli[2], Fedor A. Danevich[1], Antonella Incicchitti[2], Dmytro Kasperovych[1], V.R. Klavdiienko[1], Vladislav V. Kobychev[1], Vladimir I. Tretyak[1] and M.M. Zarytskyy[1]
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By comparing rates of neutrinoless double positron emission and electron capture with positron emission one could distinguish mechanism (due to light neutrino exchange or right-handed currents admixture in the weak interaction) of the neutrinoless double beta "minus" decay when observed. However, even the allowed two-neutrino mode of electron capture with positron emission is not observed yet. The nuclide ^{106}Cd is a promising candidate for the experimental investigations of the double beta "plus" decays (double electron capture, electron capture with positron emission and double positron emission) due to its high energy release 2775.39(10) keV and relatively high isotopic abundance 1.245(22)%. An experiment to search for double beta processes in ^{106}Cd is in progress with the help of $^{106}CdWO_4$ crystal scintillator (enriched in ^{106}Cd to 66%) in coincidence with two large volume $CdWO_4$ scintillation detectors in close geometry at the Gran Sasso Underground Laboratory. The sensitivity of the experiment is approaching the theoretical predictions for the double beta processes in ^{106}Cd at a level of 10^{20}–10^{22} yr that corresponds to the most sensitive double beta-plus experiments. The new limits on different modes and channels of ^{106}Cd were set.

Hints of non-unitarity in the present T2K and NOνA data

Thursday
27 February
14:10
Main Venue

Ushak Rahaman[1], Salvador Miranda Palacios[1], Pedro Pasquini[2,3] and Soebur Razzaque[1]

[1]University of Johannesburg
[2]Instituto de Física Teórica, Universidade Estadual Paulista (UNESP)
[3]Instituto de Física Gleb Wataghin - UNICAMP

The mixing of three neutrino flavours is parameterised by the unitary PMNS matrix. If there are more than three neutrino flavours, effective 3×3 neutrino mixing matrix will be non-unitary. In this paper, we have analysed the latest T2K and NOνA data with the hypothesis of non-unitary mixing matrix. Present results from NOνA and T2K collaboration have tension between them as NOνA disfavours T2K best-fit point at 1σ confidence level and vice versa. In this paper we have shown that latest data from both the experiments disfavour unitary 3×3 mixing at 60% C.L. The combined analysis disfavours unitary mixing at 1σ C.L. Moreover, the tension between two experiments can also be reduced with the non-unitary approach.

Sensitivity to the neutrinoless double beta decay of the DARWIN observatory

Tuesday
25 February
14:00
Main Venue

Patricia Sanchez-Lucas
University of Zurich

The DARWIN observatory is a proposed next-generation experiment whose primary goal is to search for particle dark matter. It will operate 50 tonnes of natural xenon in a dual-phase time projection chamber under ultra-low background conditions. These two characteristics make DARWIN sensitive to other rare interactions, like the neutrinoless double beta decay of the isotope ^{136}Xe. Without isotopic enrichment DARWIN will contain in total more than 4.5t of ^{136}Xe. We present here the expected half-life sensitivity for this rare decay. This sensitivity is based on a detailed study of attainable backgrounds, Monte Carlo predictions and event topologies in the homogeneous target. We show that DARWIN will be comparable in its science reach to dedicated double beta decay experiments using enriched ^{136}Xe.

Thursday
27 February
14:10
Parallel Venue

Detection of supernova neutrino signal with NOνA detectors

Andrey Sheshukov
Joint Institute for Nuclear Research

The NOνA experiment has two segmented liquid scintillation detectors, which are sensitive to the neutrino signal from a core-collapse supernova in our galaxy. Each of these detectors performs an online reconstruction and analysis of the neutrino interaction candidates, comparing their time distribution to that of the signals expected from a core-collapse supernova. The statistical significance calculated in this comparison is used to decide if a detector is currently observing a supernova signal. The combination of these significance values from both detectors provides a more efficient metric for detecting the supernova signal, increasing the maximum distance at which NOνA can detect a core-collapse supernova. NOνA's approach for its combination of two detectors for supernova detection can be generalized to a network of various detectors with different background levels and sensitivities.

Tuesday
25 February
15:00
Main Venue

EARTH, a meeting of neutrino- and nuclear-physics

Frederick Smit[1] and Rob de Meijer[2,3]
[1]iThemba LABS
[2]Stichting EARTH, the Netherlands
[3]Department of Physics, University of the Western Cape

Over the past 15 years, in the consortium EARTH (Earth AntineutRino TomograpHy), low energy experiments have been carried out with the detection of antineutrinos as a theme. The ultimate goal was to learn more about the role of nuclear decay in the interior of the Earth [1-3]. This required developing direction sensitive antineutrino detection to detect geoneutrinos. Here searching for remnants of possible nuclear reactions may also provide clues [4]. Other experiments were done into whether neutrinos from the Sun have a greater influence on radioactive decay than is commonly accepted by using antineutrinos from reactors as a surrogate to investigate these claims [5]. The work done on these unfinished projects will be reviewed and some ideas for future work will be given.

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Neutrino-induced reactions on ^{13}C and ^{16}O at supernova neutrino energies

Friday
28 February
09:40
Parallel Venue

Toshio Suzuki[1], A. Baha Balantekin[2], Toshitaka Kajino[3,4] and Satoshi Chiba[5]
[1]Nihon University
[2]Wisconsin University
[3]Beihang University
[4]University of Tokyo
[5]Tokyo Institute of Technology

Neutrino-nucleus reactions on ^{13}C and ^{16}O at supernova (SN) energies are investigated by shell-model calculations with the use of new Hamiltonian, which can describe spin responses of nuclei quite well. Carbon-based scintillators and water-Cerenkov scintillators relevent to SN observation and experiments at the spallation neutron sources are now available. Cross sections for various particle and emission channels are evaluated by the statistical Hauser-Feshbach method. For ^{13}C, total reaction cross sections at reactor and solar neutrino energies were studied [1]. Here, we extend our study to SN neutrino energies up to ≈50 MeV, and evaluations of partial cross sections for proton and neutron emission channels within the Standard Model [2]. Among them, a reaction channel ^{13}C($\bar{\nu}$,$\bar{\nu}'$n)^{12}C (2^+, 4.44 MeV) followed by prompt 4.44 MeV γ emission is discussed in relation to the shape distortion in the 5-7 MeV range in the measured neutrino spectrum in the short-baseline reactor neutrino experiments [3]. The cross section is too small to explain the extra enhancement in the spectrum. Coherent elastic scattering cross section is obtained for ^{13}C, and compared with that for ^{12}C. Nuclear structure effects in the cross sections are pointed out [2]. Possible merit of large recoil momenta in light nuclei for the study of neutron distributions in nuclei is discussed. For ^{16}O, spin-dipole strength, which are the dominant contributions to the cross sections, and neutrino-induced reaction cross sections on ^{16}O are investigated [4]. Charged-current cross sections induced by SN neutrinos and their dependence on Mikheyev-Smirnov-Wolfenstein neutrino oscillations are discussed for a future SN burst [5].

[1] T. Suzuki, A. B. Balantekin and T. Kajino, Phys. Rev. C 86 (2012) 015502.
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[3] J. M. Berryman, V. Brdar and P. Huber, Phys. Rev. D 99 (2019) 055045.
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Borexino solar neutrino data as a probe of non-standard neutrino properties

Tuesday
25 February
14:00
Parallel Venue

Alina Vishneva
Joint Institute for Nuclear Research

Neutrinos produced in the Sun can be used as a probe of neutrino physics beyond the Standard Model (BSM). In this study, two BSM processes are considered, namely, non-standard neutrino-electron interactions, and electromagnetic neutrino interaction

caused by an anomalous magnetic moment. These processes may occur during both neutrino propagation through the solar matter and detection,causing distortions in solar neutrino fluxes, survival probability, interaction cross sections and other properties. In the Borexino experiment, possible impacts of the non-standard interactions of solar neutrinos to the data have been estimated using both interaction rate and spectral information. For the anomalous neutrino magnetic moment study, both neutrino and anti-neutrino datasets have been considered.

Calculation of the neutrino-nuclear reaction cross-sections for ^{76}Ge nuclei and estimation of the solar neutrino background in the GERDA/LEGEND experiments

Friday
28 February
09:40
Main Venue

Andrei K. Vyborov[1,2], Almaz Fazliakhmetov[1,2], Grigory Koroteev[1] and S.Yu Lutostansky[3]

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[2]Institute for Nuclear Research of the Russian Academy of Sciences
[3]Kurchatov Institute

The work presents calculations of the neutrino-nuclear reaction cross-sections using the example of the nucleus ^{76}Ge (^{76}Ge(ν_e,e)^{76}As. In the structure of the nucleus, not only discrete, but also continuous states formed due to the collective interaction of nucleons were distinguished. In particular, the contribution of the Giant Gamow-Teller resonance and so-called pygmy resonances in the capture rate of solar neutrinos was estimated (an increase of 25% to 50%, depending on the quenching parameter used).

Based on the obtained capture rate, a Monte Carlo simulation of the subsequent beta decay of the nucleus ^{76}As (^{76}As $\rightarrow^{76}$Se $+e^{-}$ + ν_e + $n\gamma$) was carried out for germanium detectors in the GERDA experiment. Thus, the contribution of the background component due to solar neutrinos was estimated, which, due to the small cross-sections of neutrino-nuclear reactions, is practically unremovable, imposing confines on the sensitivity limit of the setup.

A similar assessment can be made for the upcoming LEGEND experiment taking into account its geometry. Preliminary results suggest that BI of solar neutrinos are 1-2 orders of magnitude lower than the predicted accuracy of the LEGEND experiment.

Enlightening the dark with XENON1T and looking forward to XENONnT

Monday
24 February
15:00
Main Venue

Christian Wittweg
WWU Muenster

The most recent results of the XENON1T direct dark matter detector will be presented. XENON1T was a two-phase xenon TPC using 248 low radioactivity PMTs to detect scintillation signals in a 2-ton active liquid xenon target. The detector was operational between 2016 and 2018 at the Laboratori Nazionale del Gran Sasso with continuously improving xenon purity and reduction of the internal ^{85}Kr background source. In addition to WIMP searches, XENON1T also produced important results on nuclear processes, such as the double electron capture of 124Xe, and is sensitive to flavour independent measurements of solar and supernova neutrinos. The status of the successor experiment, XENONnT will be discussed, as well as projections for WIMP and neutrinoless double-beta decay searches.

Posters

Search for shape coexistence in mass 72 nuclei through internal conversion electron measurement

Monday
24 February
18:00-19:00
Poster Venue

Abraham Avaa[1,2], Pete Jones[2], Iyabo T. Usman[1], Maluba Vernon Chisapi[2,3], Tibor Kibédi[4], Bonginkosi R. Zikhali[2,5] and Lumkile Msebi[2]

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[4]Department of Nuclear Physics, Australian National University
[5]Department of Physics, University of the Western Cape

The occurrence of different nuclear shapes coexisting within the typical energy range of nuclear excitations appear to be present throughout the nuclear landscape. To establish experimentally the shape of a nucleus and by extension the presence of shape coexistence requires the measurement of electric monopole (E0) transition strength through experimental techniques such as electron spectroscopy. The E0 transition strength is directly linked to the change in nuclear charge square radii and change in quadrupole deformation. Hence, a large value is a key indicator of shape coexistence [1]. Other experimental observables like mixing ratios and transition probabilities required in describing the nuclear shape are deduced experimentally through the measurements of internal conversion electrons [2]. Shape coexistence in the even-even ^{72}Se and odd-odd ^{72}As region has come under intense scrutiny in the past years [3,4]. Though a lot of studies has been conducted in this region, the topic remains important as much experimental information is needed to fully advance our knowledge of the collective behaviour of the nuclear matter. The low-lying excited states in ^{72}Se and ^{72}As has been measured with a magnetic lens spectrometer at iThemba LABS, South Africa, in electron-gamma coincident experiment utilising ^{70}Ge $+\alpha$ reaction. The extracted and internal conversion coefficients will be presented.

[1] J.L. Wood *et al.*, Nucl. Phys. A 651 (1999) 323
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[3] D. Sohler *et al.*, Phys. Rev. C 59 (1999) 1328
[4] E.A. McCutchan *et al.*, Phys. Rev. C 83 (2011) 024310

Monday
24 February
18:00-19:00
Poster Venue

Spectroscopy of ^{22}Mg Relevant to Explosive Nucleosynthesis in Classical Novae and X-ray Bursts

Johan Wiggert Brummer[1,2], Philip Adsley[2,3], Frederick Smit[2], Paul Papka[1], Lindsay Donaldson[2], Kevin C.W. Li[1,2], Retief Neveling[2], Luna Pellegri[2,3] and Gideon Steyn[2]

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[2]iThemba LABS
[3]University of the Witwatersrand

X-ray bursts (XRBs) occur in stellar binaries and are explosive cosmic events where there is a sudden and large increase in X-ray luminosity [1]. Within this type of binary system is a neutron star and red giant. Nuclear mass accretion from the companion red giant onto the surface of the neutron star can take place which can lead to thermonuclear hydrogen burning through the CNO and HCNO cycles on the surface of the neutron star [2]. This leads to thermonuclear runaway and, eventually, an XRB.

Two breakout reactions from the HCNO cycles, ^{15}O(α,γ)^{19}Ne and ^{18}Ne(α,p)^{21}Na, are crucial in order for an XRB to occur in the binary system. The ^{18}Ne(α,p)^{21}Na reaction is, therefore, important as it influences energy generation in an XRB and influences the resultant lightcurve which can be detected by satellite X-ray telescopes.

This study performed the ^{24}Mg(p,t)^{22}Mg reaction in a novel way using the K600 magnetic spectrometer in coincidence with the CAKE silicon detector array at iThemba LABS using a 100-MeV proton beam. By studying the decay of states from ^{22}Mg, the p0 branching ratio to ^{21}Na was determined. It was used to make corrections to the ^{18}Ne(α,p)^{21}Na reaction rate which had been determined previously using the ^{21}Na(p,α)^{18}Ne time-reversed reaction [4]. The effect that the change in the thermonuclear reaction has on the XRB lightcurve was studied by simulation using MESA.

[1] S. Woosley and R. Taam, γ-ray bursts from thermonuclear explosions on neutron stars, Nature 263 (1976) 101.
[2] C. Iliadis, Nuclear Physics of Stars (Wiley-VCH, Weinheim, Germany, 2007).
[3] W. Bradfield-Smith *et al.*, Phys. Rev. C 59 (1999) 3402.
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[5] MESA simulation package, https://billwolf.space/projects/leiden$_2$019/

Monday
24 February
18:00-19:00
Poster Venue

Spectroscopy of ^{50}Ti through internal pair production

Maluba Vernon Chisapi[1,2], Pete Jones[1], Richard Newman[2], Abraham Avaa[1,3], Tibor Kibèdi[4], Bonginkosi R. Zikhali[1,5] and Lumkile Msebi[1,5]

[1]iThemba LABS
[2]Department of Physics, Stellenbosch University
[3]University of the Witwatersrand
[4]Department of Nuclear Physics, Australian National University
[5]Department of Physics, University of the Western Cape

Atomic nuclei in excited state eventually de-excites mainly through electromagnetic transitions, e.g. gamma-ray transitions or electric monopole (E0) transition in an event that the former is forbidden. E0 transitions proceed via conversion electrons and electron-positron pairs (for transition energies $\geq$ 1022 keV). Compared to gamma-ray transitions that are predominantly studied across the chart of nuclides, a great deal of E0 transitions and their associated excited 0^+ states are still not firmly characterized.

Apart from being the only alternative means of unambiguously assigning spin and parity to states, E0 transitions also offer a reliable thumb-print for shape coexistence in nuclei, as the E0 transition strength ($\rho 2$(E0)) is linked to changes in the mean-square charge radius and can be used to calculate the mixing parameters for shapes suspected to be coexisting. Measurements of E0 transitions also helps elucidate phenomena relating to nuclear compressibility and isotope or isomer shift, as well as provide sensitive tests on various models of nuclear structure [1,2,3,4].

A new facility, namely the internal conversion (IC) and internal-pair formation (IPF) spectrometer, for measuring E0 transitions was recently commissioned at iThemba Laboratory for Accelerator Based Sciences (iThemba LABS). The current work is aimed at giving the equipment new capability by coupling a segmented germanium (LEPS) detector to the magnetic lens in order for it to be used to measure e^-/e^+ pairs of higher ($>$ 3 MeV) energies as well. The LEPS detector is opted for owing to the fact that it offers very good resolution and also because of the scarcity (or exorbitant prices if found) of thick segmented Si(Li) detectors around the globe. The refurbishment is being aided by Geant4 simulations with magnetic field mapped out of the solenoid magnetic lens using OPERA-3D software. The Transmission, efficiency, momentum resolution and other parameters of the spectrometer, obtained using Geant4 simulations, will be presented. On-going work to assemble the equipment, carry out off-line test measurements using radioactive sources (e.g. ^{90}Y or ^{13}C(α,n) sources), calibration, transmission optimisation, etc, in readiness for the upcoming in-beam experiment (^{50}Ti(α,α') and ^{48}Ca(α,2n) reactions) in April 2020, will also be discussed.

Once the facility is fully operational, the physics case will involve measuring E0 transitions in ^{50}Ti through internal-pair decay, which will provide information that will subsequently be used to investigate the previously suspected existence of admixtures of 0^+ excited states with 2^+, 3^+ and 4^+ states [5,6,7].

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[2] JL. Wood *et al.*, Phys. Rep. 215(3-4) (1992) 101-201.
[3] T. Kibedi and R. Spear, Atomic Data & Nuc. Data Tables 89(1) (2005) 77-100.
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Monday
24 February
18:00-19:00
Poster Venue

Measuring particle behaviour with PEPT

Michael van Heerden, Tom Leadbeater, Katie Cole and Andy Buffler
University of Cape Town

PEPT Cape Town is a dedicated research centre focused on measuring the fundamental physics of opaque multiphase flow systems [1]. The basis of this nuclear measurement technique hinges on how accurate and representative the tracer particle is of the media of interest in these dynamic applications.

This presentation reports the development of tracer particle techniques used to investigate novel research from the launch of PEPT Cape Town in 2009 to the current state of tracer production [2]. The development of tracer techniques increases the demand for more bespoke tracer applications and as such the areas of active radiochemical tracer development for future applications in PEPT will be reported to conclude the presentation [3].

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[3] Buffler, A., Cole, K., Leadbeater, T.W., van Heerden, M.R. (2018). Positron emission particle tracking: a powerful technique for flow studies. International Journal of Modern Physics: Conference series, 48, 1860113, 10 pages. DOI: 10.1142/S2010194518601138.

Monday
24 February
18:00-19:00
Poster Venue

Sub-Millimetre Particle Tracking Using a CdZnTe Semiconductor Detector Array

Nicholas Hyslop, Steve Peterson and Tom Leadbeater
University of Cape Town

The Positron Emission Particle Tracking (PEPT) technique has been in development in Cape Town since 2009, and allows one to track a 1mm positron-emitting point source travelling at 1m/s to within 1mm, 1000 times a second. Typically, this utilises a large, high efficiency scintillation detector like BGO. However, recent experiments have shown that high resolution, relatively high efficiency semiconductor (CdZnTe) detectors, developed for use in prompt gamma-ray detection during proton radiotherapy, are able to track particles down to sub-millimetre precision. We have been using the Polaris-J detectors to implement the PEPT technique, with initial measurements showing that we are able to locate a positron-emitting 22Na calibration source (size 1mm) with an activity of 28.748 ± 0.048 kBq in three-dimensional space with an uncertainty of between 10μm 75μm (68% coverage) and a signal-to-noise ratio of 89%. This is a promising first step towards tracking micrometre-sized particles with submillimetre accuracy, with potential applications in fluid dynamics in lab-on-a-chip devices, capillary action, blood flow in capillary blood vessels, small-scale fluidiser beds, etc.

Multi-photon decay mode spectroscopy of positronium

Monday
24 February
18:00-19:00
Poster Venue

Storm Johnson[1], Tom Leadbeater[1] and Pete Jones[2]
[1]University of Cape Town
[2]iThemba LABS

Positronium (Ps) is a system consisting of an electron and its anti-particle, a positron, bound together into an exotic atom, specifically an onium. The system is unstable: the two particles annihilate each other to predominantly produce two or three gamma-rays, depending on the relative spin states. The ground state of positronium, like that of hydrogen, has two possible configurations depending on the relative orientations of the spins of the electron and the positron. These decays can be detected with a suitable array of sensitive detectors. Such a new array of detectors is being commissioned at iThemba LABS to study such rare branching by using locally-produced radioactive sources* (such as ^{22}Na). Data taking for extended periods with intense sources will provide unique data for study.

The structure of ^{33}Si and the magicity of the $N = 20$ gap at $Z = 14$

Monday
24 February
18:00-19:00
Poster Venue

Sandile Jongile[1,2], A. Lemasson[3,4], O. Sorlin[3], M. Wiedeking[2], P. Papka[1,2], D. Bazin[4], C. Borcea[5], R. Borcea [5], A. Gade[4], H. Iwasaki[4], E. Khan[6], A. Lepailleur[3], A. Mutschler[3,6], F. Nowacki[7], F. Recchia[4], T. Roger[3], F. Rotaru[5], M. Stanoiu[5], S. R. Stroberg[4,8], J. A. Tostevin[9], M. Vandebrouck[3,6], D. Weisshaar[4] and K. Wimmer[4,10,11]
[1]Stellenbosch University
[2]iThemba LABS
[3] Grand Accélérateur National d'Ions Lourds (GANIL)
[4]Department of Physics and Astronomy and NSCL, Michigan State University
[5]IFIN-HH
[6]Institut de Physique Nucléaire
[7]Université de Strasbourg, CNRS
[8]TRIUMF
[9]Department of Physics, University of Surrey
[10]Department of Physics, University of Tokyo
[11]Department of Physics, Central Michigan University

The structure of ^{33}Si and ^{35}S was studied by one-neutron knockout reactions from ^{36}S and ^{34}Si beams at 88 MeV/u incident on a ^{9}Be target. The prompt γ-rays following the de-excitation of ^{33}Si and ^{35}S were detected using the GRETINA γ-ray tracking array while the reaction residues were identified on an event-by-event basis in the focal plane of the S800 spectrometer at NSCL (National Superconducting Cyclotron Laboratory). The -1n reaction makes it possible to probe the neutron Fermi surface and its evolution between ^{34}Si and ^{36}S to see which of the nuclei ^{34}Si or ^{36}S has the most (doubly) magic behaviour. A previous ^{34}Si(-1n) knockout experiment was performed which could account for only three states in ^{33}Si due to limited statistics. The current experiment addresses limitations of the previous ^{34}Si(-1n) knockout experiment by observing and accounting for seven transitions. A level scheme has been built up to 5.5 MeV using the analysis of $\gamma\gamma$ coincidences. In addition parallel momentum distributions have been constructed and compared with theoretical predictions enabling orbital angular momentum assignments to each state. Spectroscopic factors obtained in this work are in good agreement with those from the previous ^{34}Si(-1n) reaction. In this presentation, I will show the latest results from these $N = 20$ nuclei ^{33}Si , ^{35}S and compare to previous work and elaborate on future planned measurements at iThemba LABS.

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Monday
24 February
18:00-19:00
Poster Venue

Explanation for the violation of the IMME for the $A = 32$, $T = 2$ isospin multiplet

Mohamed Kamil
University of the Western Cape

The Isobaric Multiplet Mass Equation (IMME) relates the masses of the members of an isospin multiplet in a simple quadratic form [1]. In this context the first $A = 32$, $T = 2$ quintet presents an interesting case [2]. It is one of the most precisely measured isobaric multiplets, where a large and hitherto unexplained violation of the IMME has been observed, which demands the requirement of a small cubic term of the order ~ 1 keV [3].
In this work we present results from a recent $^{32}\mathrm{S}(^{3}\mathrm{He}, \mathrm{t})$ experiment to explain the apparent violation of the IMME in the $A = 32$ system.

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Monday
24 February
18:00-19:00
Poster Venue

Cross section measurement of light ions production using (p,xp) reactions

Doris Carole Kenfack Jiotsa[1], Paul Papka[1] and Pete Jones[2]
[1]Stellenbosch University
[2]iThemba LABS

Neutron-rich beams are being developed at iThemba LABS to study nuclear structure away from stability. This is also the opportunity of deepening our understanding of astrophysical origin of elements. The interest of using (p, xp) reactions in the production of exotic nuclei, lies in the fact that proton beams can be produced with high intensity. Some measurements have been performed at iThemba LABS using, ^{7}Li, ^{9}Be and $^{\mathrm{nat}}$B targets with proton projectiles of energy 50 MeV and 66 MeV. The detection setup included two electron spectrometers composed of a 5mm thick plastic scintillator, for energy loss measurement, and a thin window Germanium detector (LEPS) for residual energy measurement. The E-ΔE technique with this combination of detectors allows particle identification and high-resolution measurement simultaneously. Some results will be presented. Beryllium and Boron are chosen here because they can be used in oxide, carbide or nitride form that can sustain large temperature amplitudes and therefore can be used in place as Uranium carbide in the current design of the ISOL source of iThemba LABS. This is important as there is no significant cost or resources implications. In addition, light targets produce a lot less species which makes the on-line separation easier. The results of this investigation will be used to evaluate the feasibility of light neutron rich beams at iThemba LABS.

Upcoming detector developments for the K600

Monday
24 February
18:00-19:00
Poster Venue

Thuthukile Khumalo[1,2], Retief Neveling[2], Sifiso Ntshangase[1], Philip Adsley[2,3], Luna Pellegri[2,3] and Lindsay Donaldson[2]

[1]University of Zululand
[2]iThemba LABS
[3]University of the Witwatersrand

A new position sensitive detector system is to be developed for the focal plane of the K600 magnetic spectrometer. The existing focal plane detectors were designed to detect Z≤2 ions with kinetic energies 30 MeV/u or higher. A new detector system is required for the efficient detection of fully stripped heavier particles (Z>2) at energies up to 30 MeV/u, as well as light Z≤2 ions with kinetic energies below 30 MeV/u.

One project that will benefit from such a new detector system is the the NuMEN (Nuclear Matrix Elements for Neutrinoless double-beta decay) project. This project aims to obtain the nuclear matrix elements (NME) for neutrino less double-beta ($0\nu\beta\beta$) decay. These can then to be used as input in models to determine the the absolute mass of the neutrino, which is related to the lifetime of $0\nu\beta\beta$ [1]. The aim is to obtain these NMEs by conducting heavy-ion double charge-exchange (DCE) reactions and measuring the cross sections of these reactions for all isotopes that have been predicted to undergo $0\nu\beta\beta$ decay [1]. Using high-resolution magnetic spectrometers for DCE measurements has been suggested as a way of combating the experimental challenge related with these measurements [1]. A program of heavy-ion induced DCE reactions was started with the MAGNEX spectrometer at the INFN-Laboratori Nazionali del Sud, Catania, at a beam energy of 15 MeV/u [1]. As part of the experimental program DCE measurements should also be performed at higher beam energies (25-30 MeV/u) to access the cross-section over a range of energies. However, the K800 superconducting cyclotron at INFN-LNS is currently unable to provide this beam and is in the process of being upgraded. Since the SSC at iThemba LABS has the capability to provide this beam energy, the possibility to do an experiment at iThemba LABS with the K600 is being explored [2]. The reaction of interest is ^{116}Sn(^{16}O, ^{18}Ne)^{116}Cd at a beam energy of 450 MeV.

The possibility to adapt the MAGNEX focal plane detector for the medium dispersion focal plane of the K600 is currently being investigated. At the same time a prototype low pressure focal plane detector for the K600 is under development, so that a suitable new detection system will be available for the K600 once the MAGNEX detection system moves back to INFN-LNS when the facility upgrade is finished.

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Monday
24 February
18:00-19:00
Poster Venue

High-resolution two-proton stripping to 2p-1h $9/2^+$ states via the ^{115}In(^{3}He,nγ)^{117}Sb reaction

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[3]University of the Western Cape
[4]University of Johannesburg
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[8]University of Zululand
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[10]Georgia Tech

The detection of coincident γ-ray decays from excited states populated through the (^{3}He,n) reaction enables high resolution measurements with respect to previous time-of-flight methods for neutron ejectiles. This was achieved with an array of escape-suppressed HPGe detectors (AFRODITE) in conjunction with plastic scintillators at forward angles.

The ground state spin of ^{115}In is $9/2^+$ as it is one proton hole in the 1g9/2 intruder orbit at the top of the major shell below $Z = 50$. The orbitals above $Z = 50$ are the 1g7/2, 2d5/2, 1h11/2, 2d3/2 and 3s1/2. The two $L = 0$ coupled neutrons stripped on to ^{115}In can only go into orbitals above $Z = 50$, specifically to states with spin $9/2^+$ and a proton 2p-1h configuration. The lowest $9/2^+$ state at 1160 keV is the band head of a 2-proton, one $9/2^+$ proton-hole [1]. The 1160 keV level is strongly populated in a previous ^{115}In(^{3}He,n)^{117}Sb low resolution experiment [2], however peaks at 2.28 and 3.00 MeV do not correspond to any known $9/2^+$ levels.

Shell-model calculations for ^{115}In and ^{117}Sb were performed using the G9SNA interaction to produce two-nucleon amplitudes for the five lowest-lying $9/2^+$ states in ^{117}Sb. The relative population strengths of these states were determined with CHUCK3 and compared to GEANT4 simulations for the experiment [3].

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Siddon reconstruction of a point source for UCT PET detector

Monday
24 February
18:00-19:00
Poster Venue

Moment Vikani Mahlangu[1], Michael van Heerden[2] and Matthew Spangler-Bickel[3]
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[2]iThemba LABS
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At UCT, positron imaging techniques are used to investigate systems of flow for science and engineering applications. As an example, positron emission tomography (PET) measurements are performed of the distribution of liquid in 2D flowing foams to investigate bubble coalescence in mineral froth flotation. The impact of the results and the feasibility of more complex measurements, such as extending the results to 3D and multiphase media, are limited by the simplicity of the image reconstruction techniques and uncertainties around the longer range of the positron in the gas phase. The goal of this preliminary study is to develop an advanced image reconstruction technique, namely maximum-likelihood expectation-maximisation (MLEM), for the PET camera configuration at UCT. PET measurements were performed on multiple point surfaces on the surface of a cylinder. The images were reconstructed with both MLEM and a simple back projection algorithm to ascertain the ability of the technique to reconstruct three-dimensional images. This is a promising first step towards the investigation of bubble coalescence in 3D; the next stage of which will be achieved with Géant4 simulation of the PET camera and a spherical shell radiolabeled with a positron emitting radionuclide.

The feasibility of using neutron activation analysis to measure elemental contamination in water and sediment in the Richards Bay Area

Monday
24 February
18:00-19:00
Poster Venue

Sizwe Mhlongo[1,2], Peane Maleka[2] and Sifiso Ntshangase[1]
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The Neutron Activation Analysis (NAA) technique is one of the reliable and most sensitive analytical techniques for analyzing materials. The technique has unique capabilities that are not found in other analytical techniques. For instance, it is relatively faster as it does not require much sample preparation, if the instrumental approach is to be used, and can analyze bulk samples [1,2].

In this study, the feasibility of using NAA to measure industrial pollution in the environmental samples (soil and water) was investigated, with Richards Bay being the area of interest. Although chemical elements are naturally present in the environment as major and trace elements, their content can increase due to anthropogenic

activities [3,4]. This may lead to various issues that negatively affect the environment. Richards Bay is one of the industrialized towns in South Africa and has industries that typically produce aluminum (Al), chromium (Cr), zinc (Zn), manganese (Mn), iron (Fe), nickel (Ni), cadmium (Cd) and strontium (Sr) as byproducts [5,6]. Thus, the study aims to investigate the sensitivity of NAA to the aforementioned elements.

To carry out the investigation, simulations and experiments were done. the simulations were done using a Monte Carlo-based code, FLUKA, and the experiments were performed using the available neutron sources (americium-beryllium and sealed tube neutron generator) and gamma-ray spectrometer at the Department of Physics, University of Cape Town (UCT). The simulations were useful, as well as successful, in evaluating competing reactions in known samples; the experiments showed that the NAA technique was more suitable for solid environmental samples than for liquid ones. In a sample with Al, Fe, Mg and Zn, the NAA technique with 14 MeV neutrons was more sensitive to Al and Fe.

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Monday
24 February
18:00-19:00
Poster Venue

Beam Emittance Measurements in the SPC2 Injection Beamline at iThemba LABS

Ndumiso Philani Mnikathi[1,2], Fhumulani Nemulodi[2], R.W. Thomae[2], Joele Mira[2], Muneer Sakildien[2] and Sifiso Ntshangase[1]

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[2]iThemba LABS

The solid pole injector cyclotron (SPC2) at iThemba Laboratory for Accelerator Based Sciences (LABS) is used for pre-acceleration of both light and heavy-ion beams [1]. Currently the cyclotron has an overall transmission of approximately 10% for heavy ion beams [2]. This transmission is too low for delivering high-intensity high energy beams due to the limited source output for high charge state ions. In order to improve the transmission, several ideas are being investigated through simulation studies [3].

The simulation codes require the beam emittance as an input parameter. Due to the fact that there is no system that measures beam emittance in the low energy beamline, the simulations are performed with estimated emittance values. The estimated emittance values could lead to undesirable results for the simulations. With the accurate knowledge of emittance it is anticipated that the reliability of simulation results can be improved.

Hence, a fast robust emittance measuring system based on profile measurements was developed. In this paper, the mathematical approach as well as the results obtained so far are presented.

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Neutron pairing correlations in ^{136,134}Ba nuclei and their relevance for neutrinoless double beta decays

Monday
24 February
18:00-19:00
Poster Venue

Jespere Calderone Nzobadila Ondze
University of the Western Cape

Observation of neutrinoless double beta decay ($0\nu\beta\beta$) is currently the only means by which one could establish the Majorana nature of neutrinos. Additionally, such an observation would determine the absolute neutrino mass scale. However, this requires that the matrix element for a given $0\nu\beta\beta$ decay process is accurately calculated [1]. In this work we present results from recent investigations of properties of pair correlated 0^+ states in ^{136,134}Ba nuclei. The aim of this study is to stringently test the Bardeen-Cooper-Schiffer (BCS) approximation [2] for like nucleons in even barium nuclei (in the vicinity of $N = 82$), to benchmark matrix element calculations for ^{136}Xe neutrinoless double beta decay [3].

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Monday
24 February
18:00-19:00
Poster Venue

Statistical Properties of ^{133}Xe and ^{85}Kr from Inverse Kinematics Reactions

Teffo Seakamelo[1], B.V. Kheswa[2], M. Wiedeking[3], V.W. Ingeberg[4], S. Siem[4], H.C. Berg[4], A. Avaa[3,8], D.L. Bleuel[5], C.P. Brits[3,6], J.W. Brummer[3,6], S.H. Connell[1], T. S. Dinoko[10], M. Guttormsen[4], P. Jones[3] , A.C. Larsen[4], K.L. Malatji[3,6], J.E. Midtbø[4], L. Msebi[3,7], S.H. Mthembu[3,9], G. O'Neil[7] , J. Ndayishimye[3], L. Pellegri[3,8], O. Shirinda[3,6], F. Zeiser[4], B.R. Zikhali[3,7] and D. Negi[11]

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A significant number of experimental efforts (see Ref. [1] and references therein) over the years have revealed the presence of a Low-Energy Enhancement (LEE) in the Gamma Strength Function (GSF). The GSF and the Nuclear level density (NLD) are critical input parameters in calculations of nuclear reaction cross sections within Hauser-Feshbach formalism. It has been shown that the existence of this LEE can enhance astrophysical r process reaction rates, by up to two orders of magnitude [2,3]. However, experimental data on the LEE is non-existent for noble gas isotopes due to the difficulty to produce suitable targets.

To search for the LEE in the ^{85}Kr and ^{133}Xe nuclei, the ^{84}Kr(d,p) and ^{132}Xe(d,p) reactions were studied at iThemba LABS. The AFRODITE and ALBA arrays were used to measure the gamma-rays while a particle telescope was used to measure the charged particles from the reactions.

At the time of experiments the array consisted of eight high resolution Germanium, six large volume and six small volume LaBr3(Ce) detectors and two S2 Silicon strip detectors. Data analysis is ongoing using Ratio Method of [1].

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Addressing the second class current anomaly in the $A = 22$ system

Monday
24 February
18:00-19:00
Poster Venue

Bhivek Singh[1], S. Triambak[1], A. Garcia[2], G.C. Ball[3], C.E. Vyfers[1], M. Kamil[1], N. Mukwevo[1], E. Smith[2], B. Dodson[2], J. Pederson[2] and V. Pesudo[1,4]

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[4]iThemba LABS

Searches for second class currents (SCC's) constitute an important test of the Standard Model [1]. Studying the beta decay of 22Na is an area where progress in this regard can be made. This is because the leading Gamow-Teller matrix element for the decay is highly suppressed, which makes experimental probes sensitive to higher-order matrix elements (including second-class terms). A previous measurement of the beta-gamma directional correlation coefficient for the decay [2] showed an anomalously large signal for SCC's, which was inconsistent with Standard Model predictions. In this work I shall present recent attempts [3] to address this issue, via a determination of the weak-magnetism form factor for the decay, which is might be the reason for the anomalous SCC term extracted from the angular correlation measurement.

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Digital Data Acquisition for Neutron Metrology

Monday
24 February
18:00-19:00
Poster Venue

Chloé Sole[1], Andy Buffler[1], Tom Leadbeater[1], Tanya Hutton[1], Vincent Gressier[2] and Richard Babut[2]

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[2]IRSN

Fast neutron fields are found in a wide variety of contexts, for example at accelerator and medical radiation facilities, around nuclear power plants, in airplanes in flight and space stations. These fields often vary widely with respect to both energy and intensity which complicates measurements of energy dependent fluence [1].

Bonner sphere systems remain widely in use, although systems based on scintillator detectors offer distinct advantages including improved energy resolution on the fast neutron energy range (above 1 MeV). Since scintillators are typically sensitive to all types of radiation, including gamma rays, it is necessary to select neutron-only events, and pulse shape discrimination capabilities of selected scintillators is typically used for this purpose [2]. Digital pulse processing electronics offer several distinct advantages over analogue systems, including being more cost effective and compact, but most importantly the flexibility of analyzing raw pulses in list mode [3].

Within the neutron metrology and spectrometry community digital pulse processing systems are being developed for a variety of purposes [1],[4]. New digital data acquisition systems need to be benchmarked against the current metrology standards, typically based on analogue systems. We present a comparison between the IRSN fast neutron metrology analogue acquisition system to an off-the-shelf CAEN desktop digitizer. Measurements were made using a BC-501A scintillator detector at IRSN AMANDE accelerator based facility. Uncertainty budgets for measurements of neutron energy dependent fluence distributions are compared for the analogue and digital acquisition systems. The broader aim of this project is to further the development of a digital data acquisition system for fast neutron metrology using advanced scintillator technology for use in neutron fields where time-of-flight may or may not be available.

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Monday
24 February
18:00-19:00
Poster Venue

Analytic and FLUKA Monte Carlo shielding calculations for a 10 MeV rhodotron electron accelerator facility

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[2]iThemba LABS

The Botswana International University of Science and Technology is looking at the possibility of acquiring a Rhodotron electron beam accelerator facility for research and industrial applications [1, 2]. Botswana has a particular interest to sterilize meat for local consumption and export as the meat industry plays an important role in Botswana's economy. Additional applications of the electron beam of interest include; sterilization of single-use medical devices and pharmaceuticals, wastewater and sludge treatment, cargo screening and postal mail decontamination.

It is mandatory to ensure that radiation facilities adhere to the best international nuclear safety practises. To ensure this was met for envisaged Rhodotron TT-100 accelerator facility in Botswana, two methods of shielding calculations were employed, namely analytical estimates using empirical formulas from the literature as well as Monte Carlo (MC) predictions based on the FLUktuierende KAscade (FLUKA) simulation package [3, 4].

FLUKA is a versatile tool for calculations of particle transport and interactions with matter. It has the added advantage that the transport of particles (photons and electrons in this study) and their interactions with matter are included for complex geometrical shielding structures. The biological shield of the accelerator building was designed to reduce the biological dose rate to less than 5 μSv/h during operation.

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Spectroscopy of proton unbound states in ^{24}Al

Monday
24 February
18:00-19:00
Poster Venue

E.C. Vyfers
University of the Western Cape

Stellar reaction rates play an important role in the nucleosynthesis of elements and the energy production in stars. Critical features in modelling stellar interiors [1] are a network of competing thermonuclear reaction rates and beta decays. In this context, the ^{23}Mg(p,γ)^{24}Al reaction is of great importance as it determines the isotopic abundance of proton-rich nuclei in explosive stellar environments such as novae [2,3]. In this work we present preliminary results from a recent experiment at iThemba LABS that aimed to determine the ^{23}Mg(p,γ)^{24}Al reaction rate indirectly, via a measurement of proton branches from astrophysically relevant states in ^{24}Al.

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