Contribution ID: **289** Type: **Oral**

The Oslo Method at iThemba LABS

Wednesday, 29 November 2023 14:50 (15 minutes)

The Oslo Method is a powerful tool that allows for detailed studies of the Nuclear Level Density (NLD) and γ-ray strength function (γSF) at energies below the neutron separation energy. In the last decade, several Oslo Method experiments have been performed at iThemba LABS, most notably with inverse-kinematics. Coupling the Oslo Method with inverse kinematics allows for study of nuclei that otherwise would have been inaccessible due to chemical properties or short half-life.
The first ever inverse-Oslo method experiment was performed at iThemba LABS in 2015 where an ^{86}Kr beam impinged on a deuterated polyethylene target [1]. Following the success of this experiment two more inverse-kinematics experiments was performed with ^{84}Kr and ^{132}Xe beams, to study the NLD and γSF of ^{85}Kr and ^{133}Xe, respectively.

It has been suggested that for very hot plasmas the nucleus should interact with electrons (Nuclear Plasma Interaction/NPI), as the level spacing within the quasi-continuum would be on a similar scale as the electron energies [2]. The strength of the interaction would be strongly affected by the magnitude of the γSF at low energy and accurate measurement of the low energy region of the γSF is critical to give accurate theoretical estimates for the magnitude of this effect. The effect of NPI has been tested on ^{133}Xe at Lawrence Livermore National Laboratory [2], which is the main motivation for measuring the γSF and NLD of ^{133}Xe.

The reason for investigating the NLD and γSF of ^{85}Kr is due to the significant structural changes that nuclei near magic numbers typically undergo. By examining NLD and γSF data for $N = 49$ and $N = 51$ isotopes of Kr, valuable information about these structural changes can be revealed. Additionally, the mass region around A $\sim$ 80 is important for nucleosynthesis, as ^{85}Kr functions as a branching point nucleus for the s-process, and nuclei within this range can have an impact on the weak r-process. Therefore, the existence of a low energy enhancement in this region could have a significant impact on nucleosynthesis models [3].

In this talk I will present the results of inverse-Oslo experiments performed at iThemba LABS, as well as the NLD and γSF of ^{63}Ni, which has been measured with the Oslo Method with normal kinematics at iThemba LABS [4].

[1] V. W. Ingeberg et al., EpJ A **56**, 68 (2020)
[2] D. L. Bleuel et al., Plasma and Fusion Research **11**, 3401075 (2016)
[3] A. C. Larsen and S. Goriely, Phys. Rev. C **82**, 14318 (2010)
[4] V. W. Ingeberg et al., Phys. Rev. C **106**, 054315 (2022)

Attendance Type

In-person

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Session Classification: Session 3

Track Classification: Nuclear Astrophysics