Conversion and Pair Electron Spectroscopy of Low-Lying Excited States in Nuclei

Project: Phd level
Supervisor: P Jones
Start date: Immediately

Project Aim / Scope:
Excited 0^+ states are the least understood of any low-energy degree of freedom in nuclei. E0 transition strengths are a measure of the off-diagonal matrix elements of the mean-square charge radius operator. Mixing of configurations with different mean-square charge radii produces E0 transition strength. The study of low-lying 0^+ states has been a focus of attention in the last two decades because of their implications regarding shape coexistence in nuclei. The aim of this work is to understand the nature of these states (particle, quasiparticle and pairing correlations) through the use of selective reactions, dedicated apparatus, and high-precision studies.

Abstract:
The Siegbahn-Kleinheinz lens spectrometer for the study of excited 0+ states has been commissioned [1] at iThemba LABS in late 2018 with successful measurements from in-beam experiments to characterise the device. In addition, spectroscopy including the extraction of E0 strengths of nuclei around ^{70}Ge, has been successfully undertaken. The next step in the advancement of this tool is the coupling to the K600 spectrometer for coincident measurements with inelastically scattered beam (alpha) particles to conclusively determine the angular momentum of these excited states decaying with a strong E0 component, to elucidate new states, and also to enhance spectroscopy between said states of two nuclei in different parts of the Segre chart.

The PhD project will use of the electron spectrometer coupled to the K600 in order to deduce conversion coefficients of the low-lying excited states in ^{74}Ge and ^{154}Sm with the aim of determining their electric monopole (E0) transition strengths at higher energies (E > 1 MeV). The E0 transition strength connecting the lowest 0^+ levels is an excellent signature for shape coexistence and phase transition. Thus, these measurements are used to shed more light on the structure of the low-lying levels

Relevant References:

[1] A.A. Avaa et al., Nucl. Instrum. Methods Phys. Res. A. 964 (2020) 163809