Contribution ID: **40** Type: **Poster**

Development of a spectrometry system for measurement of internal-pair studies

A new approach to studying excited 0^+ states is being introduced at iThemba LABS. It involves the study of low-lying electric monopole (E0) transitions which proceed via internal conversion (IC) and internal pair formation (IPF). Precise measurement of these processes require use of unique tools and techniques, such as an electron spectrometer. An electron spectrometer is currently under development at iThemba LABS, where investigation of its properties is being done both through measurements and simulations using Geant4 code coupled with a magnetic field grid mapped by the OPERA-3D package. Once fully operational, this device will be used to measure nuclear decay via emission of conversion elelctrons or electron-positron pairs.

Measurements of this kind will help in firmly identifying and characterizing the nature of excited 0^+ states in nuclei, for example in the ^{50}Ti nucleus where potential existence of admixtures of 0^+ excited states with 2^+, 3^+ and 4^+ states are still unresolved. Moreover, availability of such a facility will go a long way in availing the most needed experimental data on E0 transitions, which not only provides a thumbprint for shape coexistence in nuclei but also help elucidate phenomena relating to nuclear compressibility and isotope and isomer shift, as well as provide sensitive tests on various models of nuclear structure.

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Track Classification: Track B