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Spectroscopy of 50Ti through internal-pair formation

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The excited states of atomic nuclei predominantly de-excite via 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 greater than 1022 keV). In comparison to gamma-ray transitions that are predominantly studied across the nuclear chart, 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 of 0^+ states, E0 transitions also offer a reliable tool to explore shape coexistence in nuclei, as the E0 transition strength (ρ^2(E0)) is related 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 to 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, including those of higher (> 3 MeV) energies. 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) radioactive sources), calibration, transmission optimisation, etc, in readiness for the upcoming in-beam experiment (^{50}Ti$(\alpha, \alpha^{'})$ and ^{48}Ca$(\alpha, 2n)$ 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].

[1] M. Taylor, et al., Nature, 405, 430-433 (2000).
[2] JL. Wood, et al., Phys. Rep. 215(3-4), 101-201 (1992).
[3] T. Kibedi and R. Spear, Atomic Data & Nuc. Data Tables 89(1), 77-100 (2005).
[4] JL. Wood, et al., Nuc. Phys. A 651(4), 323-368 (1999).
[5] DS. Oakley, et al., Phys. Rev. C 35(4), 1392 (1987).
[6] JG. Pronko, et al., Phys. Rev. C 10(4), 1345 (1974).
[7] HP. Morsch, Phys. Lett. B 47(1), 21-23 (1973).

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