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Gamow-Teller Decay of 74Co and Decay Properties of 78Co→78Ni

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First experimental studies of the doubly magic nucleus 78Ni became possible [1,2] and are needed to provide critical data to test robustness of the nuclear shell structure and model the astrophysical r-process [3]. One way to study the structure of neutron-rich nickel isotopes (Z = 28) is to investigate decays of the respective cobalt precursors (Z = 27). This method has been successfully implemented in fragmentation-type experiments reaching the very exotic 77Co. While it is presently not possible to produce 78Co with sufficient rate to use it for studies of excited states in 78Ni, the decay measurements of 78Co will be possible with the new facilities under construction around the world and beam intensity upgrades. Nevertheless, information on the β decay of the most neutron rich cobalt isotopes enables us to predict decay properties of 78Co to 78Ni. We will present new data on the decay of 74Co, which we use to extend the systematics on the decay of even-A cobalt isotopes to predict decay properties of 78Co.
Low-energy level structure of 74Ni was investigated through the β-decay of 74Co at the National Superconducting Cyclotron Laboratory (NSCL). The ions of 74Co were produced by projectile fragmentation of 82Se ions at an energy of 140 MeV/nucleon on a 9Be target. The particle identification was performed on an event-by-event basis by measuring energy loss (ΔE) in a silicon detector placed in the beam line and time-of-flight (TOF) between focal planes. The separated fragments were implanted in a germanium double-sided strip detector [4]. The experimental data show existence of two β-branching states in 74Co based on observation of two γ-ray cascades populating low- and high-spin states in 74Ni. The origin of the decay is attributed to the strong Gamow-Teller transformation from νf5/2 to πf7/2. The systematics of the B(GT) strength distribution in neutron-rich cobalt isotopes and N=51 isotones indicate the robustness of the closed core in
78Ni. Predictions for decay properties of 78Co are made from the systematics and shell model calculations.
References:
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Primary author: Dr GO, Shintaro (University of Tennessee)

Co-authors: Prof. KORGUL, Agnieszka (University of Warsaw); Prof. JON, Batchelder (University of California); Prof. GROSS, Carl (Oak Ridge National Laboratory); Prof. MAZZOCHI, Chiara (University of Warsaw); Mr PROKOP, Christopher (Michigan State University); Ms ALEKSANDRA, Ciemny (University of Warsaw); Dr KOLOS, Karolina (Lawrence Livermore National Laboratory); Prof. RYKACZEWSKI, Krzysztof (Oak Ridge National Laboratory); Dr ALSHUDIFAT, Mohammad (University of Tennessee); Prof. RAJABALI, Mustafa (Tennessee Technological University); Dr STANLEY, Paulauskas (University of Tennessee); Prof. GRZYWACZ, Robert (University of Tennessee); Prof. LIDDICK, Sean (NSCL / MSU); Mr TAYLOR, Steven (University of Tennesee); Dr BAUMANN, Thomas (National Superconducting Cyclotron Laboratory); GINTER, Tom (Michigan State University); Mr XIAO, Yongchi (University of Tennessee)

Presenter: Dr GO, Shintaro (University of Tennessee)

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