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Mirror Symmetry in the f7/2 Shell below 56Ni: Excited States and Electromagnetic Transition Rates in 55Ni and 55Co

Monday 9 June 2025 14:45 (15 minutes)

Nuclear theories often operate under the assumption that the strong nuclear force is independent of electric charge. As a result, it is expected that exchanging the number of protons with the number of neutrons in a nucleus will produce a mirror nucleus with identical structure after electromagnetic considerations. However, due to the charge dependence of the strong nuclear force, isospin non-conserving interactions give rise to quantities like Mirror Energy Differences between analogous excited states in mirror nuclei which cannot be accounted for by Coulombic forces.

This charge dependence is being explored at TRIUMF, Canada's particle accelerator centre. Stable ^{20,21}Ne and radioactive ^{21}Na beam experiments were conducted with ^{40}Ca targetry for production of ^{55}Co and ^{55}Ni through fusion evaporation. These experiments leverage: TRIUMF's Isotope Separator and ACcelerator (ISAC) beamline for delivery of high-intensity radioactive beams; the TRIUMF-ISAC Gamma-Ray Escape Suppressed Spectrometer (TIGRESS) for gamma-ray detection; SFU's TIGRESS Integrated Plunger (TIP) for charged particle detection; TRIUMF's Electromagnetic Mass Analyzer (EMMA) for measurement of the A, Z, and energy loss of residual nuclei; as well as specialized ^{40}Ca targetry carefully protected from oxidation.

This presentation will focus on highlighting the selectivity offered by combining TIGRESS, TIP, and EMMA for lifetime and electromagnetic transition rate measurements, as well as the present state of the ongoing analysis. In the longer term, this work aims to explore the $f_{7/2}$ hole configurations in ^{56}Ni and electromagnetic transition rates for excited states of ^{55}Ni and ^{55}Co. Ultimately, these measurements enable an investigation into the charge dependence of the strong interaction.

Keyword-1

Mirror symmetry

Keyword-2

Fusion evaporation

Keyword-3

TRIUMF

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