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Mirror symmetry in the f7/2 shell below 56Ni, excited states and electromagnetic transition rates in 55Ni and 55Co

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Nuclear theories often operate under the assumption that the strong nuclear force is charge independent. As a result, it is expected that mirror nuclei, which are identical under the exchange of total number of protons and neutrons, will have similar nuclear structures when Coulombic contributions are considered. Under the assumption of charge dependence, protons and neutrons are grouped together as nucleons which differ only by their isospin quantum number. However, the charge dependence of the strong nuclear force creates isospin non-conserving interactions which give rise to quantities like Mirror Energy Differences (MED) in analogous excited states for mirror nuclei which cannot be accounted for by Coulombic forces. Building a deeper understanding of isospin non-conserving interactions and how they affect nuclear structure will allow for more robust predictive powers in nuclear theories.

In order to explore the charge dependence of the strong force, a stable 20Ne beam experiment to produce 55Co was conducted at TRIUMF, Canada's national particle accelerator centre, with a complimentary radioactive 21Na beam experiment proposed for production of 55Ni. These experiments are conducted using TRIUMF's TIGRESS for gamma-rays, SFU's TIGRESS Integrated Plunger (TIP) for charged particle detection, 40Ca targetry, and the Doppler-Shift Attenuation Method (DSAM). The 55Ni experiment will also utilize TRIUMF's ElectroMagnetic Mass Analyzer (EMMA) for measurement of the A, Z, and energy of residual nuclei to enhance selectivity of reaction channels.

This talk will discuss how the 55Co experiment was conducted, the preliminary analysis of the resulting data set, as well as the lessons that will be carried forward for the 55Ni experiment. In addition to investigating the charge dependence of the strong interaction, this data will be utilized to explore the f7/2 hole configurations in 56Ni and electromagnetic transition rates for excited states of 55Ni and 55Co.

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