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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 independence, 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 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 ^{20}Ne beam experiment to produce ^{55}Co was conducted at TRIUMF, Canada's national particle accelerator centre, with an approved complimentary radioactive ^{21}Na beam experiment for production of ^{55}Ni, which is ^{55}Co's mirror nucleus. These experiments are conducted using TRIUMF's TIGRESS detector array for gamma-ray detection, SFU's TIGRESS Integrated Plunger for charged particle detection, and ^{40}Ca targetry. The ^{55}Co experiment used a thick target to employ the Doppler-Shift Attenuation Method, while the approved ^{55}Ni experiment will use a thin target to take advantage of TRIUMF's ElectroMagnetic Mass Analyzer for measurement of the A, Z, and energy of residual nuclei which enhances the selectivity of reaction channels.

This presentation will discuss how the ^{55}Co experiment was conducted, the preliminary analysis of the resulting data set, as well as the lessons that will be carried forward for the approved ^{55}Ni experiment. In addition to investigating the charge dependence of the strong interaction, this data will be utilized to explore the $f_{7/2}$ hole configurations in ^{56}Ni and electromagnetic transition rates for excited states of ^{55}Ni and ^{55}Co.

Keyword-1

Nuclear Structure

Keyword-2

Fusion Evaporation

Keyword-3

TRIUMF

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