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Electromagnetic transition rate measurement of 36Ar and 37Ar

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Different predictive nuclear models, based on the nuclear shell model, have been developed to describe fundamental properties of all nuclei, such as energies and transition rates between nuclear states; however, no nuclear model is found to be complete. The quality of predictive nuclear models are often assessed by comparing the theoretical electromagnetic transition rates with the experimental measurements. An accurate transition rate measurement for excited nuclear states allows the determination of their corresponding off-diagonal matrix elements, and thus the study of their nuclear wavefunctions using well-defined electromagnetic multipole operators.

To contribute to these measures, a low-energy Coulomb excitation experiment was performed at TRIUMF to measure transition rates in ^{36}Ar, by delivering an ^{36}Ar beam to a natural carbon target with ^{197}Au backing. The TRIUMF-ISAC Gamma-Ray Escape Suppressed Spectrometer (TIGRESS) and the TIGRESS Integrated Plunger (TIP) devices, developed by Simon Fraser University (SFU), were used for γ-ray and charged particle detection, respectively. The experimental data indicated a formation of excited ^{37}Ar due to a probable neutron transfer process from ^{13}C to ^{36}Ar. In total, four states, $3/2^-_2$, $3/2^-_1$, $7/2^-_1$ and $1/2^-_1$, were observed to be populated in ^{37}Ar. Although studies of ^{37}Ar have been conducted previously, the availability of the data opens an opportunity for high precision transition rate measurements in ^{37}Ar.

The transition rate measurements of the observed states in ^{36}Ar and ^{37}Ar have been completed with the Doppler-Shift Attenuation Method (DSAM) and the Delayed Coincidence Method (DCM). Results of transition rate measurements for both nuclei will be presented and discussed, with a focus on the analysis of ^{37}Ar with a newly developed GEANT4 reaction model based on Rutherford scattering and neutron transfer through quantum tunnelling. This analysis is part of an ongoing collaboration with theoretical physicists, and the findings will be presented and discussed.

Keyword-1

Transition Rate Measurement

Keyword-2

DSAM

Keyword-3

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