Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **3149** Type: **Oral (Non-Student) / Orale (non-étudiant(e))**

Study of cross-shell excitations near the 'island of inversion' using fusion-evaporation and Doppler shift methods

Thursday 9 June 2022 09:30 (15 minutes)

The 'island of inversion' centred on ^{32}Mg is characterized by ground state configurations with an inverted ordering of sd and pf (intruder) neutron orbitals due to nuclear deformation and nucleon-nucleon interactions. For neutron rich sd shell nuclei outside of the 'island of inversion', similar configurations incorporating the neutron pf shell occur in levels with high excitation energy and spin. Several recent studies have used fusion-evaporation reactions to preferentially populate and study these intruder states, including a recent experiment at the ISAC-II facility at TRIUMF in which the nuclides ^{25}Na and ^{28}Mg were produced following ^{12}C + ^{18}O fusion [1, 2].

In this experiment, fusion-evaporation exit channels were separated via time coincident identification of charged particles and gamma rays. Gamma-ray spectroscopy utilized the TIGRESS array at ISAC-II. Charged particles were detected and identified using a recently completed CsI(Tl) 'ball' scintillator array, developed at Simon Fraser University and commissioned at TRIUMF [3]. Lifetime measurements of excited states populated in the channels of interest were performed using Doppler shift methods.

Six new excited states in ^{25}Na and ^{28}Mg were identified, including candidates for the $I^\pi = 5^+_1, 6^+_1$ levels in ^{28}Mg. Evidence for negative parity states was also observed, including a candidate for the $I_\pi = 13/2^-_1$ level in ^{25}Na and an unusually long-lived state in ^{28}Mg thought to decay by an M2 transition ($I^\pi = (0, 4)^-$). The energies of these levels are consistent with predicted intruder states arising from single neutron excitation to the pf shell, using the SDPF-MU and FSU shell model interactions. This data and its interpretation with respect to the 'island of inversion' will be discussed, along with future plans to extend this work towards $N = 20$ by studying ^{32}Si and other nearby nuclides populated following ^{12}C + ^{22}Ne fusion.

[1] J. Williams et al., PRC 100 014322 (2019).
[2] J. Williams et al., PRC 102 064302 (2020).
[3] J. Williams et al., NIM A 939 1-9 (2019).

Presenter: STAROSTA, Krzysztof (SFU)

Session Classification: R1-4 Precision Nuclear Processes and Beyond (DNP) | Processus nucléaires de précision et au delà (DPN)

Track Classification: Technical Sessions / Sessions techniques: Nuclear Physics / Physique nucléaire (DNP-DPN)