Lifetime measurements toward the N = 20 Island of Inversion

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Far from the valley of stability, proton-neutron correlations may lead to a lowering of intruder states and, concurrently, to the onset of deformed configurations at low excitation energies, outlining the so-called Islands of Inversion. Among them, the Island of Inversion located at the N = 20 shell gap has recently become the subject of many theoretical [1-4] and experimental works [5]. The former, based on different approaches (including the latest *ab initio* calculations), show contradictory results on anticipating the exact location of the Island and on predicting shell and shape evolution towards it, especially for Ne and Mg isotopes. To validate these models and better understand the transition of these light isotopes into the Island of Inversion, an experimental campaign with the AGATA-PRISMA setup [6-8] was started at LNL using multi-nucleon transfer reactions induced by ^{22}Ne and ^{26}Mg beams on ^{238}U target [9]. While the first was devoted to spectroscopy, the second aimed at lifetime measurements with the DSAM technique.

Given the high quality of ^{22}Ne + ^{238}U data and considering that a larger number of excited states in Ne isotopes was observed, compared to the Mg-induced run, we propose the same ^{22}Ne-induced reaction and the AGATA-PRISMA setup, focused this time on lifetime measurements with the DSAM technique. The proposed experiment will rely on the expertise we gained during the previous runs to optimize the PRISMA spectrometer for light ions detection in conjunction with the newly developed analysis procedure to recover PRISMA inefficiencies.

We primarily aim at studying excited states of ^{23,24,25}Ne isotopes along with $^{19-22}$O and the proton-odd ^{23}F and ^{25}Na, which will also be populated with reasonable statistics by the same reaction. The setup configuration is proposed to be the same as the previous Ne experiment, requesting a ^{22}Ne beam at 160 MeV of total energy, impinging on a 1 mg/cm^2 ^{238}U target, tilted by 54° with respect to PRISMA entrance. An 8 mg/cm^2 Nb backing will act as a degrader to get access to tens-to-hundreds femtoseconds lifetimes of excited states.

To conclude the measurement and achieve our goals, we request 6 days of beamtime.

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