Contribution ID: **173** Type: **Invited Presentation**

Neutrons Correlations in the Continuum of Two (core + 4n) Systems

Thursday, 1 June 2017 16:50 (15 minutes)

Nuclear correlations involved in neutron-rich nuclei, up to the drip line, play essential roles in the understanding and modeling of neutron captures in the r-process nucleosynthesis as well as in the understanding of phenomena linked to the neutron star superfluidity. They are also interesting in view of generalizing the Ikeda conjecture, commonly applied to alpha clusters, to dineutron clusters above the corresponding emission threshold. We have discovered a novel method that allows to reveal neutron correlations in the nucleus and to search for dineutron contribution. This was achieved by studying the decay of high energy states above S2n populated after the sudden knockout of a deeply bound nucleon. This sudden approximation, together with a quasi-free knockout process can reliably be assumed, owing to the high energy of the projectile used (440MeV/u) during the experiment. This experiment, performed at GSI, required the complex and innovative R3B-LAND setup to determine the full kinematics of the reaction. My presentation will be focused on the n-n correlations observed in the decay of unbound states in the 18C and 20O (viewed as 14C+4n and 16O+4n, respectively) populated via the sudden knockout of a proton in 19N and a neutron in 21O, respectively. We have studied the evolution of the n-n correlations as a function of the increasing energy Ed of the neutrons and compared the decay patterns of the two systems; i.e. the former, in which neutron pairs are in principle kept intact, and the second in which the 16O core is broken, leaving two unpaired neutrons. We used a simulation that takes into account the different decay mechanisms (direct, sequential and dineutron decay) and the final state interactions to interpret the experimental data. Using information on n-n and core-n momenta, we show that we can clearly distinguish direct from sequential decays. Remarkably, direct decays are strongly dominant in 18C up to Ed=8MeV, beyond which sequential decay amounts to only 20%. A very strong enhancement is found at small relative neutron momentum angles, that is discussed in term of a dineutron component. This is in contrast to the case of 20O, in which sequential decays dominate already at low Ed, and in which much weaker n-n correlations are observed. Due to the success of this method, we are planning in a near future to extend such a study to other systems closer to the drip line and to generalize the study of neutron correlations to the 4n decay channel.

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Session Classification: Breakout 2