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How atomic nucleus behaves around its limit of existence and its impact on explosive burning in the cosmos

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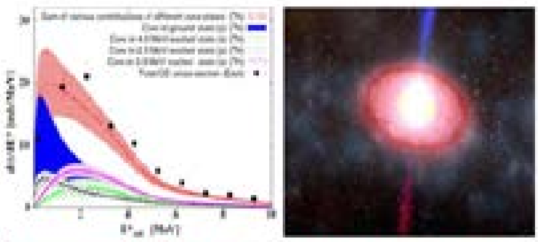
Even after 100 years of discovery of the atomic nucleus by Rutherford, the limits of the existence of the nuclei are still uncertain. This is due to lack of proper understanding of the nature of interactions that bind atomic nuclei. The atomic nucleus is a complex quantum many-body system but it's simple behavior can be explained by a mean nuclear field, containing many ingredients of the nucleon-nucleon interactions. The characteristics of that are the shell gaps at magic numbers, explained by Mayer and Jensen. The study of Nuclear Shell structure around the drip line and validation of theoretical prediction with the data may provide important information on nucleon-nucleon interaction. This may play key role in understanding the limits of its existence. The Coulomb breakup is an exclusive tool for probing the quantum states of valence nucleon. We have investigated the ground-state properties of neutron-rich nuclei around N~20 using this method via kinematical complete measurement at GSI, Darmstadt. Very clear evidences have been observed for the breakdown and merging of long cherished magic shell gaps at N=20, 28. The nuclei around the drip-line are short lived and naturally do not exist on the earth. But surprisingly, evanescent rare isotopes imprint their existence in supernovae and other stellar explosive scenarios (rp, r-process etc.). To understand those processes and evaluation of elements, one has to create those nuclei in the laboratory to explore specific-properties. Due to their fleeting existence, indirect measurements are often only possible access to the information which are valuable inputs to the model for star evaluation process. Neutron star, remnant of supernovae is the densest matter, observed in cosmos. To understand that state of matter, some valuable properties of neutron-rich nuclei are key issues. I shall discuss our achievements related to above mentioned facts using RIB in worldwide scenario.



Components of the w.f. of the gr. state of ^{34}Mg | Neutron star: Courtesy NASA

Biography

Ushasi Datta has expertise in experimental Nuclear Physics. She has completed her PhD from University of Kolkata and is working as a Professor at Saha Institute of Nuclear Physics, India. She leads many national and international projects. Her interest is to understand quantum many body systems via strong and weak interaction. Her research topics are disappearance of magic shell gap in the neutron-rich nuclei, modification of shell structure near drip-line, ground state configuration of neutron-rich nuclei, exotic shapes, exotic decay near proton-drip line, resonance states, cluster structure, quantum phase transition, fusion process near drip line, capture cross-section relevant to explosive burning scenario, neutron-skin, neutron star, active and sterile neutrino etc. She worked at GSI, Darmstadt for five years as a Visiting Scientist and Alexander Von Humboldt fellow. Shehas published more than hundred in peer review international journals with citations of 2000.

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