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Nuclei away from stability and the r-process

Nuclei away from the "valley of stability," typically near the "drip lines", have challenged our understanding of nuclear structure. Some have a "long tail" in their matter density distribution – popularly known as a "halo," as in 11Be, 19C, in the light mass region or 34Na, 37Mg, in the deformed medium mass region. Another exciting development is the existence of "bubble nuclei" as in 20N, 22O, and 24Si, which have a marked depression in their central densities and are shaped as a biconcave spheroid – more like a human red blood cell. Naturally, some of the tenets of nuclear structure physics, like the concept of magic numbers, are not sacrosanct anymore as one travels far from stability. Therefore, we ask what effect they have on crucial nuclear physics inputs, like reaction rates, in explosive nucleosynthesis, especially in forming heavy elements via the r-process.

To this effect, we consider two limited networks of C-N-O and Na-Mg-Al isotopes and study their final abundances, in an explosive scenario, for various nuclear physics inputs – some in which their exotic structures are accounted for and others with statistical inputs. Finally, we plan to show some of our recent results on what effect, even these limited data, can have on the full r-process network.

Primary author(s) : Prof. CHATTERJEE, Rajdeep (IIT-Roorkee)