SHELL OVERCOMES REPULSIVE NUCLEAR FORCE INSTABILITY: A NEW PHENOMENON

L. Satpathy and S. K. Patra

Institute of Physics, Sachivalaya Marg, Bhubaneswar-751 005, India

In the mid 1960s, the prediction of superheavy elements with $Z \simeq 120$, 164 and the double humped fission barriers with the manifestation of fission isomers, heralded a new era in nuclear physics. These phenomena are the results of the stabilization of Coulomb instability of the nucleus by the shell effects. Here we present the evidences of new nuclear phenomenon where the instability of the nucleus due to the repulsive component of the nuclear force is stabilized by the shell effects.

It is well known that nuclear force is state dependent and it has repulsive component. The odd-state interaction (triplet-triplet, singlet-singlet) of the n-n force is repulsive. As one moves across the valley of stability towards the neutron drip-line, the number of neutron-neutron pairs increases over that of the neutron-proton pairs, and consequently, because of the Pauli principle this component progressively contributes larger amount of repulsive energy resulting in the instability of the nucleus. One should expect, as in the case of Coulomb force, the shell effect can come to the rescue of the nucleus by overcoming this instability, giving rise to new magic numbers and associated islands of stability around them in the drip-line regions. This will have very desirable feature of shifting the drip-line away broadening the stability peninsula, complementary to the case of Coulomb force where it gets elongated. We provide strong evidence of this new exotic phenomenon from our study in infinite nuclear matter mass model [1] and microscopic relativistic mean field theory [2], where we obtain new neutron magic numbers N=100, 150, 164 and proton magic number Z=78, and new islands of stability around N=100, Z$\simeq$ 62; N=150, Z=78; and N=164, Z$\simeq$ 90 in the drip line regions. It is shown that shell effect stabilizes here the the instability due to repulsive component of the nuclear force giving rise to a new phenomenon [3]; complementary to the phenomena of fission isomer and superheavy elements where repulsive Coulomb instability is overcome by the same [3]. This will result in the broadening of the stability peninsula.

[1] L. Satpathy *et al.*, Phys. Rep. **319** (1999) 85.
[2] S. K. Patra and C. R. Praharaj, Phys. Rev. **C44** (1991) 2552.
[3] L. Satpathy and S. K. Patra, J. Phys. **G** (in press).