To understand atomic nucleus from a new nuclear structure model

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To explain some very basic facts of atomic nucleus, such as the stability of isotopes, the even-odd variation in many properties and so on, a nuclear structure model of ring plus extra nucleon is proposed. For nuclei larger than \(^4\)He inclusive, protons (P's) and neutrons (N's) are basically bound alternatively to form \(^{2Z}E\) ring. The ring folds with a bond angle of 90˚ for every 3 continuous nucleons to make the nucleons packed densely. The ring must be identical when all the P and N interchange (negative symmetry). Extra N(s) can bind to ring-P with the same manner. When 2 or more ring-P's are geometrically available, the nuclide with extra N tends to be stable. Extra P can bind with ring-N in a similar way when the ratio of N/P < 1 although the binding is much weaker.

Even-Z rings always have superimposed gravity centers of P and N; while for odd-Z rings, both centers of P and N must be eccentric. The eccentricity results in a depression of \(E_b\) and therefore specific zigzag features of \(E_b/A\). This can be well explained by the shift of eccentricity by extra nucleons. Symmetrical center may present in even-Z rings and normal even-even nuclei. While for odd-Z ring, only antisymmetric center is possible. Based on this model, a pair of mirror nuclei, \(P_XN_{X+1}\) and \(PN_{X-1}\), should be equivalent in packing structure just like black-white photo and the negative film. Therefore, an identical spin and parity was confirmed for hundreds of pairs. In addition, the \(E_b/A\) difference of all the mirror nuclei pair is very nearly a constant of 0.184 MeV. Many other facts can also be easily understood from this model, such as the nuclear stabilities of isotopes in elements from He to Ne; the stability sequence of \(^9\)Be, \(^{10}\)Be and \(^{11}\)Be; the neutron halo in neutron-rich nuclides, the general rule for most stable isotopes: Odd-Z elements are odd A, even-Z elements are even A; and the highest cohesive energy of Li, Be, B atoms in their own elementary group and so on.

Biography

Xiaodong Li is a PhD holder from Universite de Montreal and MS from Nankai University. He is teaching in NUDT as a Professor with the research fields of Polymer Chemistry, Material Chemistry and Physics. He has published more than 100 papers in reputed journals.

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