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Beyond Shell Model: Radii, halo orbits and shell structure.

The Shell Model is about solving a Schrödinger equation with suitable interactions. So far, nuclear radii, binding energies and basic shell structure cannot be explained by the Shell Model. To “go beyond” means addressing the problem phenomenologically in ways to make it possible to discover basic mechanisms at play. Our starting point is the observation that nuclear radii and masses exhibit strong shell effects associated with “magic numbers” numbers 6,14,28,50,82 and 126. Their origin is an open problem, difficult to pinpoint in the case of masses but subsumed by a single phenomenological term that brings down root mean square deviations with observed radii to 0.01 fermi. The origin of this term is unambiguously traced to the existence of huge “halo” orbits...

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