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Skyrmions and Collective Isospin Dynamics

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Skyrmions, the stable soliton solutions in an EFT introduced by Tony Skyrme, have been constructed for many baryon numbers (atomic mass numbers). They have interesting intrinsic shapes and also an intrinsic pion field structure. So a Skyrmion spontaneously breaks translational, rotational and isorotational symmetry. These symmetries are restored through quantization of the collective motion (zero-mode quantization). The resulting quantum states have momentum, spin and isospin and represent nuclei in their ground and excited states. Further states are obtained by including vibrational degrees of freedom. The idea that nuclei have intrinsic shapes and can vibrate, for example as alpha-particle clusters, is well known. The intrinsic pion field structure is less familiar. In this talk I shall explore some evidence for this, by reviewing what is known about correlations between the spin and isospin quantum numbers for quantized Skyrmions up to baryon number 12 (Carbon-12 and its isobars) and comparing with experimental data. It is proposed that the strong spin-orbit coupling in nuclei also arises from the pion field structure, and that beta-decay strengths depend on it too. This latter work is ongoing.

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