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GMP algebra and fractonic dynamics of CP(N-1) skyrmions

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Skyrmions were proposed in 1961 by Tony Skyrme as a mathematical description of hadrons. Observation of the O(3) version of the skyrmion in two dimensions in a variety of magnetic materials since 2010 sparked keen interests in its structure, dynamics, and potential device applications. I give a brief review of the history of the theoretical and experimental progress in magnetic skyrmions over the past 15 years. In recent years, magnetization dynamics for higher-spin systems with dipolar, quadrupolar, and general multipolar order came into focus. In keeping with the progress, I present the generalization of the existing CP(1) theory of skyrmion dynamics to arbitrary CP(N-1) skyrmions. It is shown that the Girvin-MacDonald-Platzmann (GMP) algebra of the CP(N-1) topological density is generally obeyed without reference to the specific Hamiltonian. The continuity equation for the topological density has a fractonic nature, which allows for the total charge and dipole conservation and explains the immobility of an isolated CP(N-1) skyrmion. The dipole conservation is loosened upon the introduction of Gilbert damping, which in turn allows the skyrmion-antiskyrmion creation/annihilation process.

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