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## (I) Berry phase in the rigid rotor: the emergent physics of odd antiferromagnets

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The rigid rotor is a classic problem in quantum mechanics, describing the dynamics of a rigid body with its centre of mass held fixed. It can be viewed as the quantum mechanics of a particle moving in  $SO(3)$ , the space of all rotations in three dimensions. The particle can move along two types of closed loops: trivial loops that can be adiabatically shrunk to a point and non-trivial loops that cannot. This topology can lead to new consequences. With time-reversal symmetry, a Berry phase of  $\pi$  can be attached to all non-trivial loops. We solve this problem by exploiting the connection between  $SO(3)$  and  $SU(2)$  spaces. Remarkably, this framework is realized in the low-energy physics of certain quantum magnets. We demonstrate this result in a family of Heisenberg antiferromagnets defined on polygons with an odd number of vertices. At each vertex, we have a spin- $S$  moment that is coupled to its nearest neighbours. Their quantum spectra, at low energies, correspond to spherical top' and symmetric top' rigid rotors. For integer values of  $S$ , we recover traditional rigid rotor spectra. With half-integer- $S$ , we obtain rotor spectra with a Berry phase.

### Keyword-1

Magnetism

### Keyword-2

Topology

### Keyword-3

**Author:** RAMACHANDRAN, Ganesh (Brock University)

**Co-author:** KHATUA, Subhankar (University of Windsor, University of Waterloo)

**Presenter:** RAMACHANDRAN, Ganesh (Brock University)

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