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A Non-Abelian Geometric Phase for Spin Systems BHARATH H M, MATTHEW BOGUSLAWSKI, MARYROSE BARRIOS, MICHAEL CHAPMAN, Georgia Inst of Tech — Berrys geometric phase has been used to characterize topological phase transitions. Recent works have addressed the question of whether generalizations of Berrys phase to mixed states can be used to characterize topological phase transitions. Berrys phase is essentially the geometric information stored in the overall phase of a quantum system. Here, we show that geometric information is also stored in the higher order spin moments of a quantum spin system. In particular, we show that when the spin vector of a quantum spin system with a spin 1 or higher is transported along a closed path inside the Bloch ball, the tensor of second moments picks up a geometric phase in the form of an SO(3) operator. Geometrically interpreting this phase is tantamount to defining a steradian angle for closed paths inside the Bloch ball. Typically the steradian angle is defined by projecting the path onto the surface of the Bloch ball. However, paths that pass through the center cannot be projected onto the surface. We show that the steradian angles of all paths, including those that pass through the center can be defined by projecting them onto a real projective plane, instead of a sphere. This steradian angle is equal to the geometric phase picked up by a spin system.

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