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Adatom's Berry phase as a classification toolkit and responsible for enhanced lifetimes of degenerated ground states

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In the early 80's, Berry discovered an intriguing, non-integrable phase depending only on the geometry of the parametric space. This phase, which had been overlooked for decades, provided a deep insight on the geometric structure of quantum mechanics, resulting in various observable effects. The concept of the Berry phase is a central unifying concept in quantum mechanics, shedding light onto a broad range of phenomena such as the Aharonov-Bohm effect, the quantum and the anomalous Hall effect, etc. Moreover, geometric or Berry phases nowadays represent the most robust resource for storing and processing quantum information. In this work, we derive the general form of the non-trivial geometric phase resulting from the unique combination of point group and time reversal symmetries. This phase arises e.g. when a magnetic adatom is adsorbed on a non- magnetic Cn symmetric crystal surface, where n denotes the fold of the principal axis. This phase dictates non-trivial spin dynamics, bearing enhanced lifetimes of prepared states. In addition, the energetic ordering and the relevant quantum numbers of the eigenstates are entirely determined by this quantity. Moreover, this phase allows to conveniently predict the protection mechanism of any prepared state, shedding light onto a large number of experiments and allowing a classification scheme. Owing to its robustness this geometric phase also has great relevance for a large number of applications in quantum computing, where topologically protected states bearing long relaxation times are highly desired.

Biography

Marta Prada is a Theoretical Physicist at the Institute for Theoretical Physics. She obtained her PhD degree in 2006 from the University of Leeds. She did her first Post-doctoral degree from the University of Purdue with Professor Klimeck, on the topic of large scale nano-electronic simulators, and then moved as a Lecturer and Research Assistant to the University of Madison-Wisconsin, in the Quantum Computing Group. Currently, she works at the University of Hamburg, Germany since 2013 and is involved in a number of projects: correlations in ultra-cold atom systems, effects of interactions in topological systems, bulk band-edge correspondence in graphene-like systems and nano-electromechanical systems.

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