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Torque and friction on rotating impurities

Over the last decades, impurity problems have been an invaluable framework to gain significant insight on the physics of many-body quantum systems. The usual setup involves a small quantum system (oftentimes just a single degree of freedom) coupled to a many-body environment. In bosonic quantum fluids, the onset of a drag force experienced by point-like objects is due to collective environment excitations, driven by the exchange of linear momentum between the impurity and the many-body bath.

The picture definitely becomes much more involved when we move from point-like objects, to impurities with a richer structure, where the geometric arrangement of their constituents endow them with the ability to perform rotations in real space, forcing us to deal with the non-trivial algebra of quantized angular momentum. Therefore, a reliable understanding has to be constructed within a framework where a coupling between rotational degrees of freedom and a many-body bath is established. By focusing on the bosonic case, where the environment is made of the low-energy excitations over the broken-symmetry state, we will show how familiar concepts such such as friction and torque are significantly modified for a rotating impurities.

Theme

Theme 3. Theoretical and experimental methods for quantum effects in energy processes

Primary author: CAPPELLARO, Alberto (Institute of Science and Technology Austria)

Presenter: CAPPELLARO, Alberto (Institute of Science and Technology Austria)

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