Physical Sciences Seminar

Beyond the Fröhlich Hamiltonian: Large polarons in anharmonic solids

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In solid state physics, the large polaron is a system consisting of an impurity electron interacting with a phonon field. It is is one of the most fundamental and well-known problems of many-body physics. Large polarons are often described using the Fröhlich Hamiltonian, which assumes a linear electron-phonon interaction. However, in recent years significant interest has been raised in additional interaction terms such as the 1-electron-2-phonon interaction. In our work, Fröhlich theory is extended to include 1-electron-2-phonon interaction for the solid state polaron. Additionally, the basic properties of the resulting polaron are studied.We derive an analytical expression for the interaction strength of an electron coupling to LO phonons. For cubic materials, the interaction strength only depends on a single scalar parameter, making it well-suited for analytical calculations. Since the resulting Hamiltonian is quadratic, we may investigate several properties using the path integral formalism: these include the energy and effective mass of the new polaron, and formation of bipolarons. It is shown that the additional term leads to significant additional trapping of the electron, broadens the bipolaron stability regime, and causes a secondary absorption peak in the optical conductivity.

Tuesday, January 16, 2024 01:30pm - 03:00pm
Heinzel Seminar Room (I21.EG.101), Office Building West, ISTA

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