Do anharmonic lattice vibrations govern charge carrier motion in halide perovskites?

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Halide perovskites have recently emerged as a class of promising semiconductors for efficient device applications, especially solar cells and light-emitting diodes. Their unique combination of optoelectronic properties and their impressive defect tolerance, despite low temperature, wet-chemistry synthesis, are unprecedented among functional materials. It has been suggested, but not yet clear, that the interaction of electrons with the soft ionic lattice lies at the heart of their peculiar properties. Qualitatively different models for the description of the electron-lattice interactions in these materials are currently debated. To resolve this controversy, the plan is to track the lattice motions and their interaction with electronic excitations in halide perovskites using advanced ultrafast spectroscopy and microscopy techniques. The scientists will investigate highly pure three-dimensional single crystals in an attempt to unravel intrinsic material properties before moving on to technologically relevant thin films. The results shall unveil how lattice motions and their dynamical fluctuations can affect the transport of charges in halide perovskites and test current hypotheses that such interactions are essential for their unique optoelectronic properties. OThe investigations will not only provide fundamentally new insight into the physics of this fascinating class of materials but may also significantly contribute to their rational design.

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