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In-House Project - 2023

Gate-tunable heavy fermions in a moiré Kondo lattice

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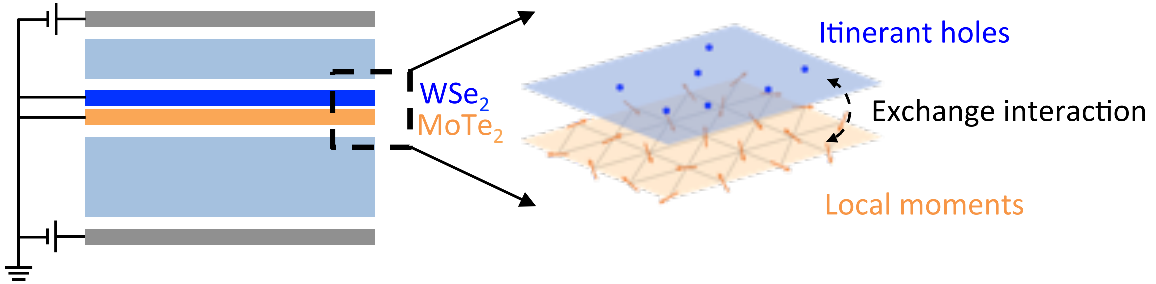
Common approaches to realizing strongly correlated quantum materials rely on intermetallic compounds that involve heavy elements like lanthanides. The use of naturally occurring elements limits the found material's tuneability. Further, each atom consists of several dozens of electrons creating a very complex electronic structure, which make them hard to describe and predict by theory.

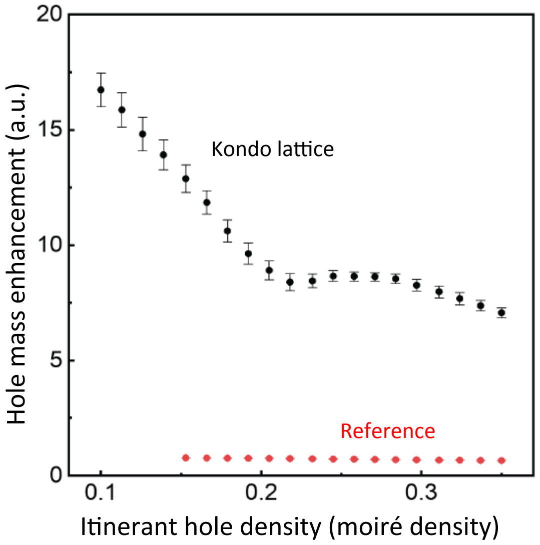
Here, **members of PARADIM's In-House Research Team** demonstrate a model system created by stacking a pair of monolayer semiconductors, providing a simpler way to study confounding quantum behavior, from heavy fermions to exotic quantum phase transitions.

The team uses $MoTe_2/WSe_2$ moiré bilayers, in which the $MoTe_2$ layer is tuned to a Mott insulating state, supporting a triangular moiré lattice of local moments, and the WSe_2 layer is doped with itinerant conduction carriers. They observe heavy fermions with a large Fermi surface below the Kondo temperature and that the heavy fermions be destructed by an external magnetic field. The Kondo temperature can be tuned widely and continuously via an applied electric voltage. The study opens the possibility of *in situ* access to the phase diagram of the Kondo lattice with exotic quantum criticalities in a single device based on semiconductor moiré materials.

W. Zhao *et al.* [Nature **616**, 61–65 (2023)].



Mass enhancement 10-20 times



Kondo destruction by magnetic field