

Wigner crystals in transition-metal dichalcogenides: optical detection and quantum simulation

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Cold atoms in optical lattices and trapped ions have proved to be an exciting and fruitful playground to explore quantum many-body physics and serve as quantum registers.

We explore the possibility to realize an analogous regular and tunable array of charge carriers in semiconductor structures. Wigner crystals in transition-metal dichalcogenides prove to be a promising platform to realize such structures.

We characterize the requirements for the Wigner crystallization in this setting and for the appearance of quantum effects in the ground state of the system. We analyze which spin systems can be simulated in this setting and we propose optical methods for the read-out and manipulation of the quantum spin system.