

## Tailoring the emergence of many-body phenomena with trapped-ion crystals

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In this talk, I will discuss some of the prospects for quantum simulations of many-body physics with crystals of trapped ions. The electronic and vibrational degrees of freedom of this system can be exploited to explore quantum spin models and bosonic lattice theories. I will discuss our recent work to target emergent phenomena related to the quantum Hall effect and quantum spin liquids. This can be accomplished by implementing synthetic gauge fields for the vibrational excitations, and a tunable range of frustration for different spin-ladder models. Finally, I will describe how to combine both degrees of freedom to perform a particular spin-boson model that would allow for the quantum simulation of the spin-Peierls instability.