

## **The miracle of molecules: exploring quantum magnetism in ultracold matter**

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"How do large collections of objects produce emergent phenomena that are drastically different from the individual constituents?" This challenging question pervades science. In physics, the components are often quantum -- electrons, quarks, atoms, or photons. NanoKelvin-scale ultracold matter provides unique insights into emergent quantum behavior, because ultracold experiments are extremely flexible and well-characterized. Recently-produced cold molecules add capabilities to the ultracold toolbox that are unavailable with atoms. I will discuss how joint experiment-theory work has harnessed these new capabilities to experimentally realize interacting spin models, and how measuring their far-from-equilibrium dynamics has led us to develop new theoretical methods.