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The miracle of molecules: far-from-equilibrium quantum magnetism in ultracold matter

"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.

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