Long-range interactions leave a quantum reminder

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Credit: Joint Quantum Institute

Given enough time, a forgotten cup of coffee will lose its appeal and cool to room temperature. One way of telling this tepid tale involves a stupendous number of coffee molecules colliding like billiard balls with

themselves and colder molecules in the air above. Those constant collisions siphon energy away from the coffee, bit by bit, in a process that physicists call thermalization.

But this story doesn't mention quantum physics, and scientists think that thermalization must ultimately have a precursor at the quantum level. Recently, scientists have sketched out some of the ways that small quantum systems thermalize, sometimes even when they are almost completely isolated.

Last week, in *Science Advances*, a team of researchers from JQI and Indiana University reported finding a new kind of effect on the road to thermalization—one in which a chain of up to 22 trapped ions, all initially with their quantum spins aligned, can retain a memory of a flipped spin long after it begins to roam through the chain.

Unlike previous results in which imperfections trapped such flips near their starting spot, the memory in this experiment comes from the long-range communication of the ions and confirms a theoretical prediction by two of the paper's authors.

More information: Brian Neyenhuis et al. Observation of prethermalization in long-range interacting spin chains, *Science Advances* (2017). DOI: 10.1126/sciadv.1700672

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