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Abstract for an Invited Paper
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Time crystal and non-equilibrium dynamics with trapped ions

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After a brief review and discussion of the concept of the time crystal, I will show how to use trapped ions in a ring trap under a transverse magnetic field to realize a finite-size space-time crystal, which automatically rotates in its ground state [1]. I will also discuss how to use the trapped ion system to observe non-equilibrium spin dynamics and dynamical phase transitions [2]. In particular, we show that one can observe a transition from prethermalization to thermalization under realistic experimental configurations through tuning of the effective interaction range.

[1] Tongcang Li, Zhe-Xuan Gong, Zhang-Qi Yin, H. T. Quan, Xiaobo Yin, Peng Zhang, L.-M. Duan, Xiang Zhang, Space-time crystals of trapped ions, *Phys. Rev. Lett.* 109, 163001 (2012).

[2] Zhe-Xuan Gong, L.-M. Duan, Prethermalization and dynamical transition in an isolated trapped ion spin chain, *New J. Phys.* 15 113051 (2013).