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A 'Superglass' State in Solid ^{4}He[1] BENJAMIN HUNT, ETHAN PRATT, VIKRAM GADAGKAR, Cornell University, MINORU YAMASHITA, Kyoto University, ALEXANDER V. BALATSKY, T-Division, Center for Integrated Nanotechnologies, Los Alamos National Lab, J. C. DAVIS, Cornell University, Brookhaven National Laboratory, University of St Andrews — We study the relaxation dynamics of both the resonance frequency $f(T)$ and the dissipation rate $D(T) = Q^{-1}(T)$ of a torsional oscillator (TO) containing solid ^{4}He. Abruptly at the temperature $T*$ characteristic of the proposed supersolid phase, the relaxation times within $f(T)$ and $D(T)$ begin to increase precipitously together. Moreover, for all $T < T*$, relaxation processes in both $D(T)$ and a component of $f(T)$ exhibit a synchronized ultra-slow evolution towards equilibrium and strong thermal hysteresis. We demonstrate that, while reminiscent of glassy dynamics, these phenomena are quantitatively inconsistent with a simple freeze-out transition because the variation in f is far too large. We conclude that, if solid ^{4}He exhibits a superfluid component, this system represents a new form of quantum matter – a complex supersolid in which a crystalline excitation exhibiting glassy dynamics controls the superfluid phase stiffness.

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