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Observation of superflow in solid ^4He ¹

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At temperatures below 2.176 K, liquid ^4He enters into a superfluid state and flows without any friction. There is strong evidence that Bose-Einstein condensates in dilute gases also exhibit superfluidity. Perhaps it is counter to intuition, but superfluid like behavior is thought possible even in solid helium. We employed a torsional oscillator technique and found evidence of superflow in bulk solid ^4He (1) and solid ^4He confined in porous Vycor glass (2). The effect appears as a drop in the resonant oscillation period as the sample cell is cooled below about 0.2 K. A series of control experiments reveals that the effect is due to irrotational superflow as in superfluid helium. The supersolid fraction in the low temperature limit is about 1%. It has a “universal” temperature dependence that is different from that of the superfluid transition in liquid and different from that of a weakly interacting Bose gas. The supersolid fraction is strongly attenuated with increasing oscillation speed, indicating that the critical velocity is extremely low. (1) E. Kim and M. H. W. Chan, *Science* **305**, 1941 (2004) (2) E. Kim and M. H. W. Chan, *Nature* **425**, 227 (2004)

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