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New evidence of supersolidity in rotating solid helium[1]

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The irrotationality of superfluid causes it to decouple form the container, leading to a reduction in the rotational inertia. This is more technically known as non-classical rotational inertia (NCRI). Although it is intuitively most natural to associate superflow only with the liquid phase, a decrease in the resonant period of a torsional oscillator (TO) was detected in solid helium below about 200 mK and interpreted as the appearance of NCRI. However, the resonant period may be also reduced for reasons other than supersolidity, such as the temperature dependence of the elastic modulus of solid helium. Unusual increase in the shear modulus with striking resemblance to those of NCRI supports the non-superfluid explanations. We superimposed dc rotation onto oscillatory measurements to distinguish between the supersolidity and classical elastic modulus change effects. We performed such simultaneous measurements of the TO and the shear modulus, and observed substantial change in the resonant period with rotational speed where the modulus remained unchanged. This contrasting behavior suggests that the decrease in the TO period is a result of supersolidity. This work is performed by collaboration with H. Choi, D. Takahashi, and K. Kono.

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