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Title: Supersolidity and Disorder.

Abstract: Supersolidity is the possible coexistence of superfluidity and crystalline order, a rather paradoxical phenomenon. Although it was proposed nearly 40 years ago by Andreev and Lifshitz (1969), Chester (1969), and Leggett (1970) that ^4He crystals could be supersolid, it is not until the 2004 experiments by Kim and Chan (Penn State University) that experimental evidence for supersolidity was presented in solid helium. However, Rittner and Reppy (Cornell) showed in 2006 that disorder played a major role in the observed phenomenon and, at the ENS in Paris, we showed that grain boundaries in polycrystalline samples allow mass superflow through solid helium[1]. The wetting properties of grain boundaries are important in materials science and we have started their study in solid He[2] where these interesting 2D quantum systems have been predicted to have a superfluid transition [3]. We have also shown that they are not sufficient to explain supersolidity in all experiments. I will summarize the present understanding of this controversial issue.

[1] S. Sasaki, R. Ishiguro, F. Caupin, H.J. Maris, and S. Balibar, *Science* 313, 1098 (2006).

[2] S.Sasaki, F. Caupin, and S. Balibar, to appear in *Phys. Rev. Lett.* (2007).

[3] L. Pollet et al. , *Phys. Rev. Lett.* 98, 135301 (2007).