# The Giant Plasticity of a Quantum Crystal

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We have shown that the shear modulus of $^4$He single crystals is highly reduced in one particular direction if their dislocations are free to move. This "Giant Plasticity" occurs at low enough temperature where thermal phonons disappear and probably down to absolute zero if $^3$He impurities are suppressed. By studying single crystals with various orientations, we have identified the gliding planes of the dislocations: it is the basal plane of the hcp structure. We found no dissipation in the plasticity region and a linear elastic behavior for single crystals down to 10 mK and nanobar stresses. This suggests that dislocations are strings moving freely with no measurable Peierls barriers to overcome, as assumed in the Granato-Lücke theory. We have also demonstrated that the dissipation occurring at higher temperature is due to collisions with thermal phonons. It allowed us to measure dislocation densities ($10^4$ to $10^6$ cm$^{-2}$ depending on crystal quality) and lengths (50 to 200 $\mu$m) precisely and to show that these dislocations are grouped in sub-boundaries, consequently poorly connected. These results rule out most existing scenarios for a possible supersolidity of solid helium 4. A comparison with classical crystals is interesting.

Section: QS - Quantum solids

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