The distribution of dislocation lengths in ^{4}He crystals

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The existence of mobile dislocations results in plasticity of crystals. The "giant plasticity" of ultra pure ^{4}He crystals at low temperature is a consequence of the free motion of their dislocations between the nodes in their network. By measuring the shear modulus as a function of the nano-strain applied to our crystals, we have demonstrated that there is not a single free length of dislocations between nodes in their network but a rather large distribution of these lengths, which we have measured. By including this distribution in an improved model of the dislocation motion, we obtain excellent agreement with all measurements of the shear modulus and the dissipation as a function of both temperature and the applied strain.