Dynamics of the Density of Quantized Vortex-Lines in Superfluid Turbulence

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The quantization of vortex lines in superfluids requires the introduction of their density in the description of quantum turbulence. The space homogeneous balance equation for the vortex line density proposed by Vinen on the basis of dimensional and physical considerations, allows a number of competing forms. Attempts to choose the correct one on the basis of time-dependent homogeneous experiments ended inconclusively. To overcome this difficulty I will describe an approach that employs an inhomogeneous channel flow which is excellently suitable to distinguish the implications of the various possible forms of the desired equation. We demonstrate that the originally selected form which was extensively used in the literature is in strong contradiction with our data. We therefore present a new inhomogeneous equation for the vortex line density that is in agreement with our data and propose that it should be considered for further studies of superfluid turbulence.