A Method for Driving an Oscillator at a Quasi-Uniform Velocity

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Homogeneous and isotropic turbulence in superfluids in the low-temperature limit is extremely difficult to produce. One of the ways would be pulling a grid at a uniform velocity through the superfluid contained in a channel. The arising problem in this case is that the actuators pulling a grid at low temperature must be frictionless, so as to not cause excess heating. Hence, oscillations occur during the motion of an actuator, which undermine the uniformity of the velocity[1,2].
In this work we describe an electromagnetically driven "floppy grid" device similar to that described in Ref. 2 and a method for driving it at a quasi-uniform velocity, so that almost no oscillations occur during its motion and after reaching its destination. The method consists in profiling the driving force in such a way that the solution of the equation of motion of the actuator does not contain oscillatory motion. The parameters responsible for the form of the time dependence of the driving force are the effective resonant frequency and the effective damping parameter in the equation of motion of a simple harmonic oscillator with damping. Our method can result in motion of the grid in superfluid ^{4}He inside a channel over the distance of 4.3 cm at 10 cm/s with oscillations of less than 50 μm in amplitude (or less than 1 mm/s in terms of velocity).

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