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Direct Measurement of the Critical Velocity Above Which a Tuning Fork Generates Turbulence in Superfluid Helium

V.B. Efimov · Deepak Garg · O. Kolosov · P.V.E. McClintock

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Abstract The dynamics of an electrically-driven 8 kHz quartz tuning fork has been studied experimentally in liquid helium-4 in the temperature range $1.3 < T < 4.2$ K under the saturated vapour pressure. The fork has relatively large dimensions compared to standard 32 kHz fork used in recent investigations. The velocity of the tip of the fork prong is measured by the indirect electromechanical equivalent method and is compared with the velocity of another 8 kHz fork (from the same batch) determined by direct optical measurement of the oscillation amplitude through Michelson interferometry. A comparison of these results has provided absolute values for the critical velocity of the transition to the turbulent state.

Keywords Quantum fluid · Quantum turbulence · Tuning forks · Superfluid helium · Critical velocity

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1 Introduction

Quantized vortices and their dynamics in superfluid helium-4 are often studied by analyzing the dynamics of vibrating objects, which can be used for both generation and detection of vortices. In recent years, quartz tuning forks have been widely used for this purpose. Although, used primarily as frequency standards (32,768 Hz) in watches, these inexpensive, robust and magnetically insensitive forks have shown [1]

V.B. Efimov (✉)
Institute of Solid State Physics RAS, Chernogolovka, Russia
e-mail: victor_efimov@yahoo.co.uk

V.B. Efimov · D. Garg · O. Kolosov · P.V.E. McClintock
Physics Department, Lancaster University, Lancaster, LA1 4YB, UK