Session 25aA

Shear Flow and Kelvin-Helmholtz Instability in Superfluids **25aA1**

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A shear-flow instability between two fluid layers occurs in many different natural phenomena. The most common example is the creation of waves on water by wind. In the ideal case of inviscid and incompressible liquids this phenomenon is known as the Kelvin-Helmholtz (KH) instability. We present an experiment where we stabilize the boundary between ^{3}He-A and ^{3}He-B in a rotating cylindrical container. On starting a slow acceleration, A phase vortices, which have low critical velocity, form immediately, while at this point no vortices are detected in the B phase. We thus have two superfluids sliding over each other, and for the first time created the ideal conditions of the KH instability. The onset of the instability, detected through a burst-like injection of vorticity in the B phase, is in perfect agreement with theory.

Critical thickness of A-B phase transition in superfluid ^{3}He film **25aA2**

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The anisotropic A phase becomes stable in thin film because of the axial symmetry. From NMR measurements with 0.8 μm and 1.1 μm superfluid ^{3}He film, we observed A phase even at low pressures and we have obtained the critical thickness δ for A-B phase transition occurrence in wide pressure range. This thickness is the ratio of real film thickness to temperature dependent coherence length at which A-B transition occurs. This δ depended nearly linearly on pressure p [MPa] as δ =13.7+7.37p, which was estimated about 8 in the weak coupling approximation. It is estimated that in the superfluid ^{3}He film thinner than 0.3 μm only A phase appears in all pressures below the superfluid transition temperature T_c.

25aA3 The Shapiro Effect using a superfluid ^{3}He weak link

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In the original paper predicting the superconducting Josephson effect, Josephson proposed that if, in addition to a constant voltage bias, a high frequency ac voltage is applied across a superconducting Josephson junction, the super-currents will exhibit characteristic changes. Shapiro first observed these predicted phenomena appearing as “steps” in the current-voltage curves of superconducting Josephson junctions. These results yielded a strong confirmation of the superconducting Josephson relations. For over thirty years much effort has been focused on searches for equivalent phenomena using a single small orifice, both in liquid ^{4}He and in liquid ^{3}He. We describe the first successful observation of the “superfluid Shapiro effect” using a superfluid ^{3}He weak link array. Ironically, this result has only appeared *after* the direct verification of Josephson’s relations for a superfluid ^{3}He weak link.

25aA4 Kinetic growth properties of the interface of phase-separated ^{3}He$-^4$He liquid mixtures

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The kinetic growth properties of the interface of phase-separated ^{3}He$-^4$He mixtures play an important role in the nucleation process from the supersaturated state. We have determined the kinetic growth coefficient of the interface, ξ_ω, by measuring the transmission of sound(9, 14 and 32MHz) through the interface within the temperature range 10mK$-$200mK. It is found that ξ_ω starts increasing with the decrease of temperature, i.e., below $\sim$70mK for 9MHz, below $\sim$100mK for 14MHz, and below $\sim$160mK for 32MHz. The whole data of this increasing behavior can be fitted very well as $\xi_\omega \propto \omega^{5/2}/T^3$. We present the data including the pressure dependence and give theoretical discussions.

25aA5 Condensation of ^{3}He and Reentrant Superfluidity in ^{3}He-^{4}He Mixture Films on H_2

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The superfluid response of submonolayer ^{3}He-^{4}He mixture films adsorbed onto H_2 and Au substrates has been investigated by means of torsional oscillator technique. On the Au substrate the introduction of ^{3}He into the superfluid film suppresses the superfluid onset temperature monotonically. In contrast, on the H_2 substrate superfluidity is initially suppressed, then enhanced, and suppressed again with increasing ^{3}He coverage. This behavior leads to reentrant superfluidity in the limit of zero temperature. We attribute this novel behavior to the condensation of ^{3}He confined near the free surface of the superfluid ^{4}He film into a self-bound 2D liquid.