Heat Capacity of Superfluid ^{4}He in the Presence of a Heat Current near T$_\lambda$

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The thermodynamic theory of superfluid helium in the presence of a heat current is presented. We show that there is a thermodynamic relation between the heat capacity and the expression $\rho_s(\ddot{W})$, which describes the depression of the superfluid density with the counterflow velocity $\ddot{W}$. Using this relation we show that the heat capacity of superfluid ^{4}He in the presence of a heat current diverges at a depressed lambda transition temperature, suggesting the possibility of a new second order phase transition where the superfluid wave function is not the order parameter.

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