Physics Colloquium

Thursday, April 10th at 3:40PM in SC 234

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The Superfluid Transition in ^{4}He Driven Far From Equilibrium

When a heat flux is applied to a column of liquid helium, the temperature at which the isothermal transport of heat by superfluid counterflow abruptly fails is depressed below the static critical temperature. When this heat flux is applied from above, the helium column forms a state where the thermal gradient across the helium is equal and opposite to the hydrostatically-induced pressure gradient in this critical temperature, and where the distance of the helium temperature from criticality as a function of pressure (and hence column height) across the column is constant. This is an example of self-organized criticality (SOC). This thermally-resistive SOC state is actually colder than the isothermal superfluid state, and it supports a new anisotropic temperature wave that travels only against the vector direction of the heat flux that self-organizes the column. We measured the heat capacity of the helium in this SOC state, and we found it to be equal to the static gravity-free heat capacity of helium as measured by John Lipa in space over a wide temperature range of reduced temperatures. The heat capacity on this dynamical SOC state diverged at the static critical point, while the effective thermal conductivity diverged below this critical temperature at the depressed temperature induced by the heat flux. This work has been supported by NASA's prior Microgravity Fundamental Physics Program, and has been conducted by many collaborators and co-authors over the years.

Refreshments at 3:00PM in SC 103