Altimetry Using GPS-Reflection/Occultation Interferometry

A concept is proposed of the thermally driven Josephson effect in superfluid helium. Heretofore, the Josephson effect in a superfluid has been recognized as an oscillatory flow that arises in response to a steady pressure difference between two superfluid reservoirs separated by an array of submicron-sized orifices, which act in unison as a single Josephson junction. Analogously, the thermally driven Josephson effect is an oscillatory flow that arises in response to a steady temperature difference.

The thermally driven Josephson effect is partly a consequence of a quantum-mechanical effect known as the fountain effect, in which a temperature difference in a superfluid is accompanied by a pressure difference. The thermally driven Josephson effect may have significance for the development of a high-resolution gyroscope based on the Josephson effect in a superfluid: If the pressure-driven Josephson effect were used, then the fluid on the high-pressure side would become depleted, necessitating periodic interruption of operation to reverse the pressure difference. If the thermally driven Josephson effect were used, there would be no net flow and so the oscillatory flow could be maintained indefinitely by maintaining the required slightly different temperatures on both sides of the junction.

This work was done by Konstantin Penanen and Talso Chui of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-40231

Perturbation Effects on a Supercritical C_7H_16/N_2 Mixing Layer

The 2D simulations were undertaken to ascertain whether perturbations having the shortest unstable wavelength obtained from a linear stability analysis for inviscid flow are unstable in viscous nonlinear flows. The goal of the 3D simulations was to ascertain whether perturbing the mixing layer at different wavelengths affects the transition to turbulence.

It was found that transitions to turbulence can be obtained at different perturbation wavelengths, provided that they are longer than the shortest unstable wavelength as determined by 2D linear analysis for the inviscid case and that the initial Reynolds number is proportionally increased as the wavelength is decreased. The transitional states thus obtained display different dynamic and mixture characteristics, departing strongly from the behaviors of perfect gases and ideal mixtures.

This work was done by Estel Cardielach, Manuel De La Torre, George A. Hajj, and Chi Ao of Caltech for NASA’s Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-41551

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