## Abstract Submitted for the MAR05 Meeting of The American Physical Society

Temperature Gradient of Hydrodynamic Origin in Vertically Counterflowing Helium-II Near the Lambda Transition Under Gravity S.T.P. BOYD, R.V. DUNCAN, University of New Mexico — We describe a calculation of the temperature gradient occurring in helium-II near  $T_{\lambda}$  when it transports a uniform energy flux density vertically upward or downward under gravity. The calculation is performed within the dissipationless two- fluid model and assumes 1D and steady- state. An exact solution is obtained which indicates a temperature gradient of hydrodynamic origin in which both the gravitational hydrostatic pressure head and the suppression of the superfluid component density  $\rho_s$  by the counterflow velocity  $w^2 = (v_n - v_s)^2$  play essential roles. The temperature gradient is very small for temperatures well below  $T_{\lambda}$  and rises toward a limiting value of  $dT_{\lambda}/dz$  as temperature is increased. It is quadratic in the component fluid flow velocities and thus its sign, remarkably, is independent of the sign of the heat flow. The predicted gradient occurs in a narrow temperature range and it is not clear if it will be directly observable. However, its existence may provide some insight into the recently-discovered up-down heat flow asymmetry in the "thermal resistance" of helium-II near  $T_{\lambda}$ .

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