Field compressing magneto-thermal instability in laser heated plasma

ROBERT KINGHAM, JOHN BISSELL, CHRISTOPHER RIDGERS, Imperial College London — We present a new instability in magnetized long scale-length plasmas heated by laser beams. It is active under conditions of recent nanosecond laser gas-jet experiments [1] - with collinear laser beam and applied B-field - designed to explore transport issues in magnetized laser-plasmas and in ICF, particularly hohlraum plasmas. The instability is driven by cross-field heat-flow out of the laser-heated column and leads to growth of large B-field and temperature perturbations (perpendicular to the field direction and bulk $\nabla T$). Unstable behaviour results purely from transport processes - feedback between the Nernst effect and the Righi-Leduc heat-flow phenomena in particular - neither hydrodynamic motion nor density gradients are essential. The phenomena is distinct from other well known instabilities such as the Tidman-Shanny, Weibel and the MHD interchange instabilities. Calculations based on [1] predict a peak growth rate of order 10 ns$^{-1}$ at wavelengths of order 50 $\mu$m, for a 6T field and $n_e=1.5\times10^{19}$ cm$^{-3}$. The strong modulation in the B-field strength affects the spread of thermal energy from the heated region.


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