Abstract Submitted
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Plasma waves thermometer.[1] ANDREY KABANTSEV, C. FRED DRISCOLL, University of California, San Diego — We have developed non-destructive temperature measurements in cold electron plasmas, by tracking the ratio of the frequencies for two radial TG-eigenmodes. These TG modes are magnetized plasma waves with finite k_z and $k_\perp$ quantized by the finite cylindrical plasma column length L_p and radius r_p with a frequency $f_{TG}(k_\perp, k_z)$ proportional to (a fraction) the plasma frequencyf_p. The modes frequencies are shifted upward by finite temperature, since plasma pressure increases the wave restoring force. These thermal shifts in frequency are well understood, and the ratio of the frequencies of two radial eigenmodes can be expressed as $(f_{TG1}/f_{TG2})^2 = (k_2/k_1)^2(1+\alpha k_1 T)/(1+\alpha k_2 T)$. Here, $\alpha^{-1} = 4\pi e^2 n_e/3$ stands for an "electrostatic" plasma pressure. If the wave vectors k's are known well enough for a given plasma column, then solving this frequency ratio equation for T gives the absolute values of $T(t)$. However, the Bessel function solutions for finite length plasma columns are a rather crude approximation, and it is beneficial to use a known temperature evolution such as initial cyclotron cooling to calibrate the Bessel function coefficients. Applying this technique and using up to the fourth radial eigenmode we have measured the absolute temperature evolution down to the 20 meV range, with an estimated accuracy of 10%.

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Andrey Kabantsev
University of California, San Diego

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