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Temperature Control in Radiatively Cooled Plasmas through Autoresonant Drive of TG-waves[1] A.A. KABANTSEV, C.F. DRISCOLL, UCSD — We demonstrate accurate temperature control of pure electron plasmas, using driven wave heating "autoresonantly" in balance with cyclotron cooling. The $m_\theta = 0$ Trivelpiece-Gould wave frequencies are temperature-dependent, as$f_{TG}(T) = f_{TG}(0) * [1 + \varepsilon T]$; and they exhibit a narrow Lorentzian absorption response $R(f)$ with width $\gamma \sim 10^{-3} f_{TG}$. A continuous drive amplitude A_{dr} then produces plasma heating power $P_h \propto A_{dr}^2 R(f_{dr})$, which can exactly balance the cyclotron cooling power$P_c \propto T/\tau_c$. This balance point is autoresonantly *stable* when $f_{dr} \approx f_{TG}(T) - \gamma$: if T increases, then $f_{TG}(T)$ also increases and f_{dr} gets further from resonance, so the heating power decreases and T decreases back to the balance point. (The second power-balance point at $f_{dr} \approx f_{TG}(T) + \gamma$ is *unstable*.) In practice, we use a $m_z = 3$ TG wave having frequency range $5.2 < f_{TG} < 6.2\,\text{MHz}$ at temperatures $0.03 < T < 3.\,\text{eV}$. The plasma temperature can be either "pegged" at a desired value; or varied cyclically, with rates limited by $\tau_c \sim 2\,\text{sec}$ and by chosen drive amplitude. Simultaneously monitoring the $m_z = 1$ TG frequency can serve as a verification of the autoresonant "lock". This "at will" control of T may be experimentally useful, especially for temperature sensitive processes like recombination, charge exchange and electron impact detachment in $e + H^-$plasmas.

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