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A thermally stable heating mechanism for the intracluster medium: turbulence, magnetic fields and plasma instabilities MATTHEW KUNZ, ALEXANDER SCHEKOCHIHIN, University of Oxford — We consider the problem of self-regulated heating and cooling in galaxy clusters and the implications for cluster magnetic fields and turbulence. Viscous heating of a weakly collisional magnetized plasma is regulated by the pressure anisotropy with respect to the local direction of the magnetic field. The intracluster medium is a high-beta plasma, where pressure anisotropies caused by the turbulent stresses and the consequent local changes in the magnetic field will trigger very fast microscale instabilities. We argue that the net effect of these instabilities will be to pin the pressure anisotropies at a marginal level, controlled by the plasma beta parameter. This gives rise to local heating rates that turn out to be comparable to the radiative cooling rates. Furthermore, we show that a balance between this heating and Bremsstrahlung cooling is thermally stable. Given a sufficient (and probably self- regulating) supply of turbulent power, this provides a physical mechanism for mitigating cooling flows and preventing cluster core collapse. A balance between parallel viscous heating and radiative cooling gives predictions for magnetic field strengths, turbulent velocities and turbulent scales. If confirmed, these predictions would constitute strong evidence that microphysical processes play an important role in the large-scale structure and evolution of galaxy clusters.

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