Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

Heating and acceleration processes in galaxy cluster plasmas[1]
FRANCISCO LEY, Department of Astronomy, University of Wisconsin - Madison, ELLEN ZWEIBEL, Department of Astronomy, University Of Wisconsin-Madison, MARIO RIQUELME, Departamento de Fisica, Facultad de Ciencias Fisicas Y Matematicas, Universidad de Chile, LORENZO SIRONI, Department of Astronomy, Columbia University — Galaxy clusters are the most massive gravitationally bound structures in the Universe. Space among galaxies is filled with hot ($\beta \gg 1$), weakly collisional plasma, the Intracluster Medium (ICM). The nature of kinetic processes in these plasmas, such as particle energization and heating mechanisms and transport, and the interplay between them and the large-scale dynamics of galaxy clusters are not well understood. We perform Particle in Cell (PIC) simulations of a plasma with an oscillating magnetic field B that is periodically amplified and decreased in magnitude to study the heating and acceleration of particles. Both the amplification and dwindle of B can generate a pressure anisotropy $\Delta = p_\perp - p_\parallel$ that heats the plasma by gyroviscosity and is self-regulated by triggering kinetic microinstabilities. When $\beta = 10$ initially, both mirror ($\Delta > 1$) and firehose ($\Delta < 1$) instabilities arise, limiting Δ and creating a nonthermal tail. This acceleration mechanism is mediated by the instabilities, but ultimately it acts by extracting energy from the thermal pool and giving it to the nonthermal population of particles. These results are compared with a similar study of a steadily growing magnetic field at lower β (Ley at al. 2019)

[1]FL acknowledges partial support from the National Science Foundation. MR acknowledges partial support from grant Fondecyt Regular 1191673.

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Date submitted: 28 Jun 2020 Electronic form version 1.4