Abstract Submitted
for the DPP16 Meeting of
The American Physical Society

Kinetic solution for the generation of magnetic fields via the Biermann Battery KEVIN SCHOEFFLER, Instituto de Plasmas e Fusao Nuclear, Instituto Superior Tecnico, Universidade de Lisboa, 1049-001 Lisboa, Portugal, NUNO LOUREIRO, Plasma Science and Fusion Center, Massachusetts Institute of Technology, Cambridge MA 02139, USA, LUIS SILVA, Instituto de Plasmas e Fusao Nuclear, Instituto Superior Tecnico, Universidade de Lisboa, 1049-001 Lisboa, Portugal — Recent experiments with intense lasers are probing the dynamics of self-generated large scale magnetic fields with unprecedented detail. In these scenarios the Biermann battery effect is critical to understand the field dynamics. Similar dynamics play an essential role in astrophysical magnetic field generation. In our previous work, particle-in-cell simulations were used to investigate the formation of magnetic fields in plasmas with perpendicular electron density and temperature gradients, showing the development of both the Biermann battery, and the smaller scale Weibel instability (due to an electron temperature anisotropy). Now, a general kinetic theoretical model for the generation of the Biermann battery is presented, which shows agreement with both fluid models and our simulations, and predicts, for an arbitrary temperature and density distribution, the generation of the temperature anisotropies exhibited in the simulations. The anisotropy grows as $(tv_{the}/L_T)^2$, where v_{the} is the thermal velocity of the electrons, and L_T is the length scale of a linearly varying temperature gradient. Furthermore, we see signs of the Weibel instability in collisionless regimes where these anisotropies should occur in present experimental configurations.

Kevin Scho
Instituto de Plasmas e Fusao Nuclear, Instituto Superior Tecnico, Universidade de Lisboa, 1049-001 Lisboa, Po

Date submitted: 15 Jul 2016 Electronic form version 1.4