Abstract Submitted
for the APR08 Meeting of
The American Physical Society

Non-relativistic collisionless shocks in unmagnetized electron-proton plasmas TSUNEHIKO KATO, YASUHIRO KURAMITSU, YOUICHI SAKAWA, HIDEAKI TAKABE, ILE, Osaka University, Japan — We show that collisionless shocks with non-relativistic propagation speed can be driven even in unmagnetized electron-proton plasmas by using two-dimensional particle-in-cell simulations. We performed a series of simulations for flow velocities of 0.9c, 0.45c, 0.2c and 0.1c with a reduced proton to electron mass ratio of 20 and observed formation of collisionless shocks in all cases. In these shocks, the Weibel-type instability generates strong magnetic fields within the shock transition layer. The generated magnetic fields provide an effective dissipation mechanism for the upstream plasma which enables the shocks to form without background magnetic fields. Since non-relativistic shocks are frequently driven in weakly magnetized electron-proton plasmas in the universe associated with various astrophysical phenomena (e.g., supernova explosions), this kind of shocks mediated by the Weibel instability can exist in the universe. In addition, thanks to the self-similarity in the basic equations of collisionless plasma, there is a possibility to generate such shocks in a laboratory with high-power laser facilities by scaling the quantities.

Tsunehiko Kato
ILE, Osaka University

Date submitted: 11 Jan 2008 Electronic form version 1.4