Abstract Submitted
for the DPP14 Meeting of
The American Physical Society

Ion-acoustic Shocks with Reflected Ions: Implications for laser-based proton accelerators[1] ROALD SAGDEEV, UMD, MIKHAIL MALKOV, UCSD, UMD, GALINA DUDNIKOVA, UMD, TATYANA LISEYKINA, Potsdam University, Germany, PATRICK DIAMOND, UCSD, C.-S. LIU, J.-J. SU, UMD —
Analytic solution for an ion-acoustic collisionless shock with reflected ions is obtained. Its relation to classical non-reflecting solitons propagating at Mach numbers strictly limited by $M < M_* \approx 1.6$ (Boltzmann electrons) and $M_* \approx 3.1$ (trapped electrons), is quantified. Above $M = M_*$ the soliton begins to reflect upstream ions and turns into a shock. The shock has a double-structure consisting of two receding transitions. The first transition is the ion-acoustic shock itself formed in place of the soliton. The shock reflected ions progressively fill up an extended foot region ending with the second transition that propagates faster than the rear shock but slower than the most of reflected ions. A small fraction of these ions still remains trapped in the transition to maintain charge neutrality. Most of them pass through this front transition, and accelerate whereas their distribution becomes noteworthily monoenergetic. The obtained solution may thus have interesting implications for the laser-based ion accelerators. Applications to particle acceleration in geophysical and astrophysical shocks are discussed.

[1]Partially supported by NASA , ATP NNX14AH36G, and the US DoE

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Date submitted: 11 Jul 2014 Electronic form version 1.4