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Analytical model of Weibel-mediated electron-ion collisionless shock formation C. RUYER, LULI, Ecole Polytechnique, 91128 Palaiseau, France, L. GREMILLET, CEA, DAM, DIF, F-91297 Arpajon, France, G. BONNAUD, CEA, Saclay, INSTN, F-91191 Gif-sur-Yvette, France, C. RICONDA, LULI, Sorbonne Universites-UPMC-Ecole Polytechnique-CNRS-CEA, 75005 Paris, France — We address the formation of ion-electron collisionless shocks in the non-relativistic regime. The shocks formed by the non-linear evolution of the Weibel-type instabilities, arise during plasma collisions in numerous high-energy astrophysical scenario such as pulsar wind nebulae or supernova remnants [N. Kato et al, Astrophys. J. Lett. 2008, T. Piran, Rev. Mod. Phys. 2004]. For the first time, a predictive fully analytical model of the ion Weibel saturation based on the coalescence of filaments is presented and allows to describe the evolution of the plasma and its characteristics until shock-formation [C. Ruyer et al, Phys. Plasmas 2015]. It is compared successfully to Weibel-mediated shock simulations until quasi-isotropisation of the ions, and close to shock formation. Our model compares well with two different recent experiments [W. Fox et al, Phys. Rev. Lett. 2013, C. M. Huntington et al, Nat. Phys. 2015] and allows us to pinpoint the role of the electron screening on the ion-Weibel dynamics. Our theoretical results, supported by both experiments and simulations, proves for the first time the effect of an artificially low ion to electron mass ratio on the formation of collisionless shocks commonly used in many numerical works.

C. Ruyer
LULI, Ecole Polytechnique, 91128 Palaiseau, France

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