Laser Produced Plasma Interaction With Strong Magnetic Fields In Applications To Astrophysical Studies

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Astrophysical phenomena are of great interest since they proceed in a very large scale and imply the greatest known energies. It is however difficult to understand all the corresponding physics due to extremely large time scales and distances and the impossibility of controlling parameters of interaction. Laboratory experiments and numerical modelling for the astrophysics-related parameters may provide informations complementary to the classical observational astronomy, however, sufficient energy deposition is required for reaching the corresponding parameter scale.

One of the important areas of laboratory astrophysics is plasma interaction with magnetic fields. We consider several configurations of laser-produced magnetized plasma experiments, analysing the magnetization which may be achieved. One of the key questions we consider is the formation of the electromagnetic collisionless shock via TNSA plasma interpenetration in intense ambient magnetic field. In the corresponding studies it was found that in a case when interacting plasmas are weakly magnetized, the initial stage of the interaction involves the increase of the ambient magnetic field in the region between plasmas. Depending on the plasma profile, velocity, and the magnetic field strength, the next step may be a development of instability [1] in the region of the high magnetic field, which puts a significant imprint on the succeeding interaction and shocks phenomenon. Subsequent behavior of interpentrating plasmas is compared in different conditions, relevant to astrophysics.

[1] Ph. Korneev, E. D'Humières and V. Tikhonchuk, *Physics of plasmas* **21**, 022117 (2014)