Laboratory Scale Experiments for Collisionless Shock Generated by Taper-cone-shaped Plasma Focus Device

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To understand the behavior of astrophysical phenomena, laboratory scale experiments with well-defined behaviors are required. Collisionless shock phenomena have unclear mechanism such as energy dissipation process and generation of highly energetic particles. To generate the collisionless shock in the laboratory scale experiments, Drake, et al. [1] has considered the required conditions, which depend on the magnetic flux density and the shock velocity. To obtain the collisionless shock, the hypersonic plasma flow generated by a taper-cone-shaped plasma focus device is proposed to evaluate in these shocks.

The plasma focus system consists of a pair of tapered electrodes and an acrylic guiding tube with a constant cross section, which is located on the top of the tapered electrodes. [2] The focused plasmas are stagnated at the center of cone electrode. The stagnated plasmas are guided by the acrylic tube. The quasi-one-dimensional shocks generates at the front of stagnated plasmas. The generated shock behaviors are observed the streak camera.

The evolution of the shock wave with applied magnetic field was measured. The decreasing shock velocity was observed at the applied region of magnetic field. The result indicates that the magnetic pressure affects the decreasing shock velocity. From comparison of the different plasma $\beta$, the shock velocity at lower plasma $\beta$ is not explained by the hydrodynamic theories.
