Study of magnetized collisionless shocks on Omega

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There are many natural observations of collisionless shocks, from the solar wind to galaxy cluster shock, and of the effects they cause, from particle acceleration to magnetic field amplification. Collisionless shocks are mediated by plasma instabilities when the Coulomb mean-free-path is much larger than the system size. This condition is easily met in the majority of astrophysical objects, both relativistic and non-relativistic. In unmagnetized, or weakly magnetized plasmas, it is believed that shocks are mediated by Weibel-type instabilities [1]. Whereas in magnetized plasmas it is mediated by plasma reflection from compressed magnetic fields [2]. Significant progress has been made in the last years in using laboratory experiments to study Weibel-mediated shocks in counterstreaming plasmas produced with high power lasers [3]. We will discuss a new experimental configuration to study magnetized collisionless shocks, where one target is illuminated with relatively low energy laser beams to produce a background plasma inside the magnetic field volume. Then, a second, nearly orthogonal target is illuminated with high intensity beams to generate a piston with flow velocity of ~1000 km/s and density of ~10^{18} – 10^{19} cm^{-3}. The piston pushes the magnetized plasma, leading to the formation of a diamagnetic cavity. The pushed magnetized plasma can be compressed, amplifying the magnetic field and generating a magnetized shock. We will present initial experimental results.

[1] E. Weibel, Phys. Rev. Lett, 2, 83 (1959)
[2] A. Spitkovsky, AIP Conf. Proc. Vol 801, 345 (2005).
[3] See H. Rinderknecht's invited talk at this conference