Shocks, magnetic field, and energetic particles in laboratory and astrophysical plasmas

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Magnetic field plays an important role in particle acceleration and transport in astrophysics. It has been shown theoretically that the non-resonant instability driven by cosmic rays may provide the large fields needed to accelerate cosmic rays to high energy. Corresponding large fields are inferred from x-ray observations of supernova remnants and extragalactic jets. We explore the potential of laser-plasma experiments for a laboratory demonstration of the instability.

Magnetic field, generated by other processes, is already known to be a feature of high intensity short pulse laser-plasma experiments. The laser produces high energy electrons which stream into a solid target. A compensating return current is carried by collisional thermal electrons. A magnetic field is generated through the curl of the electric field required to draw the resistive return current. A similar process may generate a small seed magnetic field during the first billion years of the universe's existence [1].

[1] Miniati F & Bell AR, arXiv:1001.2011 (2010)

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