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Laboratory Studies of Supersonic Magnetized Plasma Flows: Jets and Collisionless Shocks

In recent years there has been an increasing interest in the modeling of astrophysical phenomena in laboratory experiments using high energy laser and z-pinch facilities, an approach know as High Energy Density Laboratory Astrophysics (HEDLA). The astrophysical connection in these experiments is provided by appropriate scaling considerations, based on dimensionless parameters such as the plasma beta, Reynolds and magnetic Reynolds numbers. The introduction of a dynamically significant magnetic field in HEDLA experiments is of particular interest, as magnetic forces play critical role in many astrophysical objects and could dominate their observed behavior.

In this talk I will discuss the results of recent laboratory studies of magnetically driven supersonic plasma flows and jets at the MAGPIE facility at Imperial College. The talk will focus on the interactions of magnetically driven plasma jets with ambient plasma, on the properties of collisionless shocks formed due to pile-up of magnetic fields advected by high Mach number flows, and on the formation of differentially rotating plasma discs. Measurements of the plasma parameters obtained with optical Thomson scattering, two-color laser interferometry, monochromatic X-ray radiography and miniature magnetic probes will be compared with the results of numerical simulations.

About the Speaker: Sergey Lebedev is a professor of Plasma Physics at Imperial College London which he joined in 1996. Prof. Lebedev received his Ph.D. in Physics (1987) from Budker Institute of Nuclear Physics, Novosibirsk, where he worked on the physics of relativistic electron beams and their interaction with plasma. For this work he was awarded the Gold Medal Early Career Award of the Russian Academy of Science (1985). His research at Imperial College, where he leads a group working at the MAGPIE pulsed power facility, covers physics of wire array z-pinches, laboratory astrophysics and plasma diagnostics. He is a Fellow of the American Physical Society (2004) and of the Institute of Physics (2005).