Michigan Institute for Plasma Science and Engineering Seminar

Three-Dimensional Magnetic Field Line Reconnection Involving Flux Ropes and Alfvén Waves

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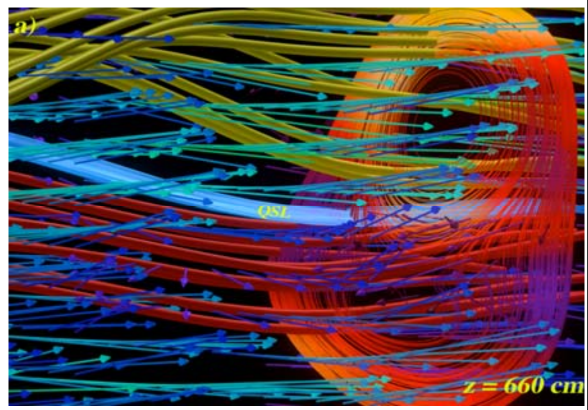
Room 1005 EECS Building

Abstract

We report on experiments investigating 3D magnetic field line reconnection, a phenomenon in which the magnetic field energy is converted to particle energy and heating accompanied by changes in magnetic topology. In the first experiment two magnetic flux ropes are generated from adjacent pulsed current channels in a background magnetoplasma in the Large Plasma Device (LAPD). The currents exert mutual $J \cdot B$ forces causing them to twist about each other and merge. The currents move towards or away from each other and filament after merging. Volumetric space-time data show multiple, time dependent reconnection sites. We also observed the quasi-separatrix layer (QSL), a narrow region between the flux ropes. Field lines on either side of the QSL have closely spaced foot-points at on end of the flux ropes, but a different separations at the other end. Outside the QSL, neighboring field lines do not diverge. In the second experiment 3D currents associated with colliding laser produced plasmas in the background magnetoplasma are observed. The currents are those of shear Alfvén waves. The wave fields are small fractions of the background field; nevertheless, reconnection regions, multiple magnetic "X" points and a QSL are all observed. These results imply that magnetic field line reconnection is not an independent topic, but part of the phenomena associated with the broader subject of 3D waves and current systems in plasmas.



Field lines associated with flux ropes. Magnetic field lines (red, green tubes), plasma current (arrows) and the QSL. [Phys. Rev. Lett., **103**, 105002 (2009)]

About the Speaker: Dr. Walter Gekelman is a Fellow of the American Physical Society and professor in the Dept. of Physics and Astronomy at UCLA. His BS was from Brooklyn College and Ph.D. from Stevens Institute of Technology. At UCLA Gekelman has developed three plasma devices, each progressively larger and more sophisticated to solve problems at the frontier of basic plasma physics. These have culminated in the Large Plasma Device (LAPD), the premier machine for basic plasma studies, yielding important insight into basic processes observed in space by rockets and spacecraft. Gekelman pioneered the use of computer visualization techniques in plasma physics to elucidate the complex 3D structures that are hidden in very large data sets.