HAO Colloquium Series

(Refreshments served)

Speaker: **Allen H. Boozer, Columbia University**

Time: **1:30 pm**

Date: **Wednesday, April 27, 2011**

Location: **CG-1, Room 3131**

Title: **Constraints on magnetic reconnection and the solar corona from fundamental electrodynamics**

Abstract: Traditional magnetic reconnection theory is based on islands and X-points, but Faraday's law implies these concepts are ill defined in three dimensions except for carefully designed toroidal plasmas or in near perfect symmetry. When an X-point can be defined, neighboring magnetic field lines near the X-point separate exponentially. The exponential separation of neighboring magnetic lines is generic throughout the volume of natural plasmas and not limited to the vicinity of isolated lines--only carefully designed laboratory plasmas can avoid this. The number of e-folds in the ratio of the separation of neighboring lines from one end of a natural system to another is not conserved by an ideal evolution. When this ratio reaches about 20 e-folds, dissipative, reconnection-like, phenomena tend to occur, which provides a natural trigger for reconnection. A star must have a corona if the scale height of the electron number density *n* in its photosphere is sufficiently short compared to the spatial scale of a magnetic field. The corona of a star can be no higher above the photosphere than the height at which the steaming velocity for the parallel current, *j/en*, reaches the electron thermal velocity. The Dreicer runaway electron effect then accelerates electrons to whatever energy is required to carry the current. Without a corona on the sun, the ratio *j/en* would increase by roughly *exp(1000)* from the photosphere to the tops of magnetic loops. The current density along a magnetic field embedded in a highly conducting medium is naturally extremely large and spatially fractal across the magnetic field due to the exponential separation of neighboring lines.

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