**Lecture Series in shear Alfven waves and energetic particle physics**

**in toroidal geometry**

Guoyong Fu

(June 30 – Sept. 14)

(1) shear Alfven waves in toroidal geometry; (June 30, July 7)

(a) shear Alfven wave equations

(b) Alfven continuum spectrum

(c) Alfven eigenmodes (AE): GAE, RSAE, TAE, BAE

(d) Effects of finite beta on TAEs and RSAE, existence of core-localized TAEs

(e) Kinetic AEs: kTAE, kRSAE

(2) Effects of energetic particles on MHD modes (July 16)

(3) Stability of energetic particle-driven TAEs (July 21)

(a) energetic particle drive of TAEs;

(b) damping mechanisms of TAEs

(4) Stability of energetic particle mode (EPM) (July 28)

(a) the classical fishbone instability and EPM

(b) EGAM

(5) Nonlinear saturation of AEs (Aug. 4, Aug. 9, Aug. 11)

(a) Nonlinear theory of Alfven waves ( Prof. Liu Chen, Aug. 4)

(b) Nonlinear theory of AE saturation: wave-wave nonlinearity, zonal field excitation (Prof. Zhiyong Qiu, Aug. 9)

(c) Bump-on-tail model (Berk-Breizman model) ( Prof. Guoyong Fu, Aug. 11)

(6) Simulation models for nonlinear dynamics of energetic particle-driven AEs and energetic particle transport (Sept. 1)

(a) Critical Gradient model;

(b) Quasilinear model;

(c) Fixed-mode-structure model;

(d) Hybrid model

(e) Gyrokinetic model

(7) Hybrid simulations of energetic particle-driven fishbone and AEs (Sept. 8, Sept. 14)

(a) numerical methods: finite elements, PIC, delta\_f method

(b) hybrid simulations of n=1 mode (internal kink and fishbone)

(c) hybrid simulations of TAEs