

## RADIAL DIFFUSION OF RADIATION BELT ELECTRONS

Chan, A.A.<sup>1</sup>, Fei, Y.<sup>1</sup>, Elkington, S.R.<sup>2</sup>,  
Brizard, A.J.<sup>3</sup>, Albert, J.M.<sup>4</sup>

<sup>1</sup>Dept of Physics and Astronomy, Rice University, 6100 Main Street, Houston, TX 77005

<sup>2</sup>LASP, University of Colorado, 1234 Innovation Drive, Boulder, CO 80303

<sup>3</sup>Department of Chemistry and Physics, Saint Michael's College, Colchester, VT 05439

<sup>4</sup>Air Force Research Lab/VSBX, 29 Randolph Rd, Hanscom AFB, MA 01731-3010

Radiation belt particles adversely affect the performance and lifetime of space systems, and they can be a serious health hazard for astronauts. Although much is known about the basic properties of the radiation belts, the physical processes that determine the dynamics of the belts are not well understood.

Radial diffusion is one of the processes which contributes to the overall transport, acceleration and loss of radiation belt electrons. Recent work on radial diffusion has focused on enhanced radial transport during magnetic storms, including drift-resonant interactions with magnetospheric MHD waves in the ULF frequency band.

In this talk analytic calculations of quasilinear radial diffusion coefficients for relativistic electrons in general electromagnetic perturbations will be presented. Beginning with the Vlasov equation and Hamiltonian guiding center theory, we have derived a relativistic Fokker-Planck equation with a  $3 \times 3$  diffusion tensor (A. J. Brizard and A. A. Chan, *Physics of Plasmas*, **11**, 4220, 2004). The diffusion tensor describes quasilinear transport due to electromagnetic perturbations which can break all three adiabatic invariants, but only the 3-3 element is needed to describe radial diffusion. The resulting radial diffusion coefficient reproduces earlier results in the appropriate limits, but it can be applied to more general perturbations and to off-equatorial particle motion.

Radial diffusion coefficients have also been calculated numerically, using simulations of test particles in model wave fields, and preliminary comparisons (using a dipole magnetic field and purely-electric field perturbations) show good agreement with the quasilinear results. Further work is being carried out to include asymmetric fields and magnetic perturbations and to better understand details of the quasilinear diffusion, including the relative contributions of intrinsic stochasticity (caused by chaotic particle orbits in non-random electromagnetic fields) versus extrinsic stochasticity (caused by random electromagnetic fields).

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1. (a) Anthony Chan  
Dept of Physics and Astronomy,  
Rice University  
6100 Main St  
Houston, TX  
77005-1892 USA  
aac@rice.edu
- (b) 713-348-2531
- (c) 713-348-5143
2. H - Waves in Plasma
3. (a) Radiation Belt
4. I - Invited Paper
5. No special instructions