9. Combining models and observations in the inner magnetosphere (Hudson & Elkington)

- **Solicited Presentations:**
  - Daniel Boscher: Contribution of data assimilation to the radiation belt dynamics
  - Chia-Lin Huang: Quantifying ULF wave properties in the inner magnetosphere
  - Sasha Ukhorskiy: Mechanisms and properties of radial transport in the outer radiation belt

- **Brief presentations:**
  - Scot Elkington: Energetic particle dynamics during January 1995 geomagnetic storm
  - Shri Kanekal: Testing models of energization and loss of relativistic electrons: in situ observations and particle transport
  - Mike Liemohn: Cool results from RAM→HEIDI
Uncertainty on radial diffusion coefficients

And it is just statistical measurements and a model: in fact, radial diffusion is different from one storm to another

from Brautigam and Albert, JGR, 2000
ULF Wave Prediction of GOES, LFM & TS05

- Feb-Apr 1996: typical solar wind condition
- LFM wave prediction is much better than expected
- TS05 underestimates the wave power
- **Next step:** use LFM’s wave fields during non-storm time to study ULF wave effects on radiation belt electrons

C-L. Huang
S. Ukhorskiy

\[ b_{z}^{\text{rms}} = 2.5 \text{ nT}, \quad E_{\phi}^{\text{rms}} = 0.5 \text{ mV/m} \]

\[
\langle \langle (\Delta \mathcal{L}(t))^2 \rangle \rangle = \int (\Delta \mathcal{L})^2 F(\mathcal{L}, t) d\mathcal{L} = \frac{1}{N_p} \sum_{k=1}^{N_p} (\mathcal{L}_k(t) - \mathcal{L}_0)^2 = 2D_{\mathcal{L}ct}
\]
SAMPEX and HEO observations

Lplasmapause - 0.5 < L < Lplasmapause + 0.5

Related to the position of flux maximum

S. Kanekal
U. Alberta covariant ULF model

Rankin, Kabin, and co-workers at University of Alberta have devised a means of self-consistently calculating wave polarizations and frequencies in a model magnetic field.

Generalized field model:

Eigenmode equations:

\[
\alpha = \frac{B_0}{r} \sin^2 \theta - \frac{1}{2} r^2 b_1 (1 + b_2 \cos \phi) \sin^2 \theta
\]

\[
\beta = \phi
\]

\[
\frac{1}{\sqrt{g}} \frac{\partial \delta B_1}{\partial \mu} = \frac{1}{v_A^2} \left( g^{21} \omega \delta E_1 + g^{22} \omega \delta E_2 \right)
\]

\[
\frac{1}{\sqrt{g}} \frac{\partial \delta B_2}{\partial \mu} = \frac{1}{v_A^2} \left( g^{11} \omega \delta E_1 + g^{12} \omega \delta E_2 \right)
\]

Density:

\[
\rho = \rho_{eq} \left( \frac{r}{5} \right)^{-4}
\]

Rankin et al., JGR 27, 2000; Rankin et al., JGR 110, 2005; Kabin et al., PSS 33, 2007a; Kabin et al., Ann. Geophys 25, 2007b
ULF wave properties in the covariant model

Important differences from the simplified field model:
• Drift paths not along constant frequency contours.
• Wave polarization changes with radial distance and azimuthal location.

S. Elkington