Title: Inner Magnetospheric Plasma Waves

1. A description of the topic

This focus group studies the various plasma waves that occur in the magnetosphere, and their interactions with the plasma environment. Plasma waves occur ubiquitously within the Earth's inner magnetosphere, and serve to accelerate and deplete the radiation belts, transfer energy between different regions of space, as well as between different energy ranges of particles. Such waves can occur either naturally or be man-made, can originate either in space or on the ground (for example, lightning or VLF transmitters), and can be used as either a passive, remote sensing tool, or as an active instrument, to affect change within a certain plasma environment.

2. A statement on timeliness of the FG idea

An understanding of the Earth's wave environment is critical to various efforts that are already underway at GEM (discussed below). Most notably, this focus group will anticipate and overlap the Radiation Belt Storm Probes mission which is due for launch in 2011, and whose primary objective is to study the relativistic electron and ion populations that form as a direct consequence of wave-particle interactions. Other missions that are due for launch within the next 2 years are the Air Force's DSX mission, Canadian ORBITALS mission, and Japanese ERG mission.

3. A description of how the FG would relate to existing FGs

Magnetospheric plasma waves affect nearly every aspect of the space environment, and impact broadly on the existing focus groups. Most notably, cold-plasma density and structures control and mediate the wave environment and consequently there is already an aspect of plasma wave research included in FG11 (Plamsasphere-Magnetosphere Interactions), which was scheduled to end this year - 2009 (i.e., only the wave section, FG11 continues through 2013). Waves directly drive the diffuse aurora (chorus and ECH waves), and a thorough understanding of their distribution and characteristics is essential for this working group (FG10: Diffuse Auroral Precipitation), which in turn, forms a component of MI-coupling by modifying the ionospheric conductivity. Since waves directly affect the radiation-belts, they are also especially relevant to FG9 (Space radiation climatology).

4. A specific goal that includes a deliverable (see below)

The goal of this focus group is a specification of the inner magnetospheric wave environment as a function of space (e.g., L, MLT, and latitude), and time (relative to storm or substorm phase). We seek an understanding of the wave excitation, propagation, and attenuation, specifically of those waves that impact the radiation-belt environment (e.g., chorus, EMIC, hiss, magnetosonic, lightning, and ECH waves).

5. The names of the proposed co-chairs

Jacob Bortnik (jbortnik@gmail.com)
Craig Kletzing (craig-kletzing@uiowa.edu)

6. The Research Area with which it will be associated

IMS: inner magnetosphere and storms

7. The term, not more than 5 years (so, ending on or before summer 2014)

5 years: 2010-2014

8. Expected activities, for example topics of sessions or challenges

The specific challenges and themes of our focus group include:

8.1 A physical understanding of wave excitation
- How are waves generated from an unstable distribution of particles?
- Is it possible to predict characteristics such as frequency bandwidth of excited waves, spatial location and distribution of the waves, saturation amplitudes, and other characteristics of the waves, e.g., frequency rise-time of chorus elements?

8.2 Nonlinear and nonresonant processes
- What role do nonlinear processes play in radiation-belt acceleration and loss? i.e., effect of waves on energetic particles
- What are the nonlinear processes that control wave amplitude saturation, and can these be quantitatively described? i.e., effect of particles on waves
- What nonresonant processes are associated with these waves, and what role do they play?

8.3 Wave distribution and characteristics
- How is wave power distributed in the inner magnetosphere as a function of space (L, MLT, latitude), and time (relative to storm/substorm phase)?
- How is wave power distributed in frequency and wave-normal angle? (i.e., k-space)
- Can we describe the phenomenology of wave characteristics? e.g., chorus subpackets, formation in minimum-B pockets, EMIC wave structure, etc.
- What are the dominant waves that control radiation-belt acceleration and loss?

8.4 Wave-particle interactions
- How do waves control the radiation-belt environment, what is the effect of each wave type?
- Is it possible to artificially control the radiation-belt environment through man-made wave injection (e.g., in-situ, VLF transmitters, modulation of the auroral electrojet)