ULF Waves in the Proton Radiation Belt

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We present results from a numerical study of structure and dynamics of dispersive Alfvén waves in the near-earth magnetosphere containing proton radiation belt (PRB). The interest in this problem is motivated by numerous observations of magnetic oscillations with frequencies in the range of 0.1-4.0 Hz detected on the ground at low and middle latitudes. In a number of studies these oscillations interpreted as ULF waves standing inside the so-called ionopspheric Alfvén resonator (IAR). Our study shows that these pulsations can be produced by the fundamental mode of the global field line resonator, spanning the entire magnetic field line in the low or middle magnetosphere. In particular, our simulations reveal that:

- The fundamental eigenfrequency of the global field line resonance at L = 1.5 magnetic shell is in the range of frequencies normally associated with the ionospheric Alfvén resonator at high latitudes. Therefore, it is reasonable to assume that many previously published observations of resonant structures at low and middle latitude refer not to the waves in IAR but to the waves in FLR.
- Even the waves with the highest considered frequencies were not trapped inside the ionospheric resonator. Therefore, if these waves will be generated by some ionospheric source (natural ionospheric feedback mechanism or artificial ionospheric heating by the ground HF transmitters) they can reach the equatorial magnetosphere and interact with energetic protons in the proton radiation belt.
- At the latitudes corresponding to PRB the wave dispersive effects due to the finite electron inertia or the finite plasma temperature are quite small, and ULF waves form a standing pattern along these magnetic field line and accumulate significant energy from the driver.
- The same driver can excites several high-harmonic FLRs in close vicinity of each other.