Statistical Property of Long Lasting Poloidal Pc 4-5 Waves and Relation with Particle Dynamics in the Inner Magnetosphere: Van Allen Probes Observations

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Poloidal ULF waves in the inner magnetosphere have been attracting many attentions because they can interact with plasma particles. A lot of event analysis of the drift-bounce resonance, the bounce resonance, and the drift resonance have been conducted (e.g., *Hughes et al.*, 1978; *Takahashi et al.*, 1990, 2018; *Liu et al.*, 2013; *Dai et al.*, 2013; *Min et al.*, 2017; *Oimatsu et al.*, 2018; *Rubtsov* et al., 2018). However, the statistical relation between the poloidal mode waves and particles is rarely reported, and the phase relation between poloidal oscillations and resonance particles is only studied by *Ren et al.* (2018).

To reveal the importance of a poloidal ULF wave in the dynamics of the inner magnetosphere, we statistically analyzed 91 events of the poloidal waves detected by Van Allen Probes with duration time larger than 2 hr, because significant wave particle interaction is expected for such long lasting waves. We calculated eigen-frequencies of the selected waves using the Tsyganenko 89 model (*Tsyganenko*, 1989), and found that most of them are second harmonic mode waves. The cross phase between the radial magnetic field and the azimuthal electric field also supports this result. Using the ion sounding technique (*Su et al.*, 1977; *Min et al.*, 2017; *Yamamoto et al.*, 2018), we estimated the azimuthal wave number (m number) for 47 events from RBSPICE observation. Most of the 47 events have m = -120 to -200 (i.e., westward propagation). These high-m waves can be excited by wave-particle interaction.

Relation between the high-m poloidal waves and the plasmasphere was investigated. When the poloidal waves were observed, cold electron density increased by a factor of ~2. When the electron density decreased to the original state, the poloidal waves disappeared. This implies that the poloidal waves are excited in the structured high electron density region like plasma plume. The scenario of wave excitation through bounce resonance proposed by *Liu et al.* (2013) can explain the density variations during wave appearance.

We will also discuss the variations of proton flux around resonance energy and evaluate the importance of poloidal ULF waves in the dynamics of the inner magnetosphere. During quiet period (|Dst| < 10 nT), the proton flux at energy of (0.3-1)W_{res} (W_{res}: resonance energy) was slightly smaller than that on the orbit just before the wave onset. The decrease of resonance particle flux may be caused by wave-particle interaction.

Keywords: poloidal ULF waves, ring current, plasmasphere, wave particle interaction, Van Allen Probes (RBSP)

