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Excitation mechanism of low-latitude Pi2 pulsations: Cavity mode resonance or BBF-driven process?

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There are two schools of thought regarding the excitation mechanism of low-latitude Pi2 pulsations. One is the cavity mode resonance, which is established by fast mode waves that are emitted at substorm onset and form the standing oscillation within the plasmasphere. The other is the bursty bulk flow (BBF)-driven process, in which periodical BBFs traveling from the magnetotail cause pressure pulses in the inner magnetosphere, generating Pi2 pulsations. This study intends to examine which of these two excitation mechanisms is more plausible. A working assumption is that in the case of the cavity mode resonance the wave period of Pi2 pulsations depends on the size and the plasma mass density of the plasmasphere, while in the case of the BBF -driven process the wave period is controlled by the BBF period and is independent of the plasmaspheric parameters. We investigated long-term variation in wave period of Pi2 pulsations observed at the Kakioka observatory for the period from March 1983 to October 2009. Multiple correlation analysis revealed that the Pi2 period is negatively correlated with the Sigma_Kp index and positively correlated with ion mass in the near-Earth plasma sheet or the F10.7 index. The Sigma_Kp index is considered as a proxy for the size of the plasmasphere, and the plasma sheet ion mass or the F10.7 index can be considered as a proxy for the mass density of the plasmasphere, indicating that the Pi2 period is proportional to both the size and mass density of the plasmasphere. This result strongly supports the plasmaspheric cavity mode resonance as an excitation mechanism of low-latitude Pi2 pulsations.