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Microscopic generation process of Jovian quasi-periodic radio bursts

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Jovian quasi-periodic (QP) bursts were discovered by Voyager (Kurth et al., 1989) and named " Jovian Type III bursts" due to their dispersive spectral nature. Observations of X-ray, UV, IR, and radio emissions imply the relativistic particle acceleration processes in the Jovian polar region, accompanied with quasi-periodic radio and auroral emissions. This study addresses the propagation and generation process of quasi-periodic radio bursts based on theoretical approaches. We discuss the magnetospheric dynamics responsible for the particle acceleration process based on the radio emission studies(in the presentation).
Statistics and ray tracing analysis in Kimura et al. (2008b, 2010) implied that QP bursts have two kinds of sources: one has higher altitudes (f_{RX}surface at around 10 Rj altitudes) source emitting R-X mode waves which form the wave shadow zone in the equatorial region near Jupiter, and the other has lower altitudes ($f_p$source at around 2 Rj altitudes) emitting L-O mode waves.
Two possible scenarios were proposed for the microscopic generation mechanism of QP bursts: the "direct generation scenario" and "indirect generation scenario". In this study, they were examined based on theoretical approaches. The growth rate calculations were performed to examine the direct generation scenario at low (around 2 Rj) and high (around 10 Rj) source altitudes by considering resonance with MeV electrons relating to QP bursts. The results suggested that free-space O mode (i.e., L-O mode) waves are directly excited by relativistic electron beams via the Cyclotron Maser Instability (CMI). On the other hand, it was indicated that free-space X mode waves (i.e., R-X mode) waves are not excited effectively. This means that the observed wave shadow zone is not formed by the R-X mode waves. The ray tracing and theoretical study suggested that the O mode waves could propagate in the magnetosphere forming the observed shadow zone. The indirect generation scenario was examined by referring to the previous theoretical study propsed by Oya et al.(1974). It was concluded that the following mode conversion scenario is also possible at low and high source altitudes: (1) Z mode waves propagating toward Jupiter are excited at low and high altitudes via the cyclotron resonance, and (2) they are converted to free-space O mode waves at the density boundary where emission frequencies are approximately equal to local plasma frequencies.
Finally, this study presents a picture of quasi-periodic phenomena derived from the statistics, ray tracing, and theoretical studies.

Keywords: Jupiter, magnetosphere, particle acceleration, radio emissions