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電波スペクトルから得られる土星のオーロラ加速領域の過渡的時間発展の特徴
Characteristics of the transient evolution of the auroral acceleration region of Saturn derived from radio spectra

丸野 大地 [1*], 笠羽 康正 [1], 木村 智樹 [2], 森岡 昭 [1], CECCONI, Baptiste[3]
MARUNO, Daichi[1*], KASABA, Yasumasa[1], KIMURA, Tomoki[2], MORIOKA, Akira[1], CECCONI, Baptiste[3]

[1] 東北大学, [2] 宇宙科学研究所, [3] パリ天文台
[1]Tohoku University, [2]ISAS, JAXA, [3]LESIA, Observatoire de Paris

We show the preliminary result for the characteristics of the altitude profile variation seen in the lower- frequency extensions of Saturn kilometric radiation (SKR) associated with substorm-like events.

SKR is an intense radio emission with a peak frequency between 100 and 400 kHz. It is thought to be emitted from energized electrons accelerated along auroral field lines via the Cyclotron Maser Instability (CMI) [Wu and Lee, 1979]. Compared with Earth and Jupiter, SKR shows several unique characteristics such as the modulation at or close to the planetary rotation period [Desch and Kaiser, 1981], long-term variation of modulation period [Galopeau and Lecacheux, 2000], North - South asymmetry of modulation period [Gurnett et al., 2009].

During the high activity of SKR, It is commonly seen that SKR expands toward lower frequency. It can be interpreted as an expansion of the auroral acceleration region to higher altitude with weaker magnetic field strength because SKR is emitted at approximately local electron cyclotron frequency. Similar characteristics have been known in the terrestrial auroral kilometric radiation (AKR) for a long time. For example, using this characteristic in AKR frequency variations, Morioka et al. [2010] derived the two-step evolution model of the auroral acceleration region during substorms. Our motivations are to adopt similar analysis to Saturn and to compare auroral field line accelerations between two planets.

In a previous study, Jackman et al. [2009] reported the general relationship between the lower-frequency extensions of SKR and substorm-like events seen as plasmoids in the magnetotail. We focus on short variations of such phenomena, from several minutes to hours. We use SKR spectra data observed from Cassini/RPWS high frequency receiver (HFR). Its high time resolution, approx. 15 sec, is enough to show that the time scale of lower-frequency extension of SKR, several hours, longer than that of AKR. In this case, we should consider not only the visibility effect (i.e., beaming at the source and propagation along the light-path from the source) but also the unique enhancement due to the rotation of SKR sources. In order to reduce the former effect, we use the data when Cassini locates specific position (in this preliminary study, radial range from 10 to 100 Rs, latitudinal range from -5 to +5 degrees, SKR phase range from -45 to +45 degrees). Based on this analysis, we now try to grasp (1) the relationship of maximum/minimum/central frequency of SKR versus its total flux (as a proxy effect from the amount of field-aligned current), and (2) the relation of maximum/minimum/central frequency of SKR versus specific SKR phase (as a proxy effect from the rotational enhancement). These characteristics will be used for event studies of short-term evolution of auroral acceleration region during substorm-like events.

キーワード: 土星, SKR, Cassini/RPWS
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