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Occurrence characteristics of Saturn's short-term radio burst

MARUNO, Daichi[1] ; KASABA, Yasumasa[1*] ; KIMURA, Tomoki[2] ; MORIOKA, Akira[1] ; CECCONI, Baptiste[3]

[1]Tohoku Univ., [2]ISAS/JAXA, [3]Obs. Paris

Saturn kilometric radiation (SKR) is emitted from auroral electrons and suggested to be correlated with Saturn's auroral processes. We extracted northern SKR (N-SKR) and southern SKR (S-SKR) burst events, by newly defined selection criteria, with radio data observed by the Cassini Radio and Plasma Wave Science (RPWS) instrument in the period from day 250 of 2005 to day 200 of 2006. The data was separated into northern and southern components according to its circular polarization degree. As a result, 16 N-SKR burst events and 36 S-SKR burst events were identified in this period. Based on statistical studies of these events, we obtained the following results: (1) We derived typical frequency profiles of N- and S-SKR during SKR bursts to compare the intensity of N- and S-SKR bursts. The profiles show that the S-SKR burst was more intense than the N-SKR by 7 dB in the main frequency range. From the recent studies, the north-south asymmetry could be explained by the difference in solar illumination due to the tilted the magnetic and rotational axis. (2) By comparing onset timings of N- and S-SKR bursts, we found that 67 % of S-SKR burst events were accompanied by N-SKR bursts or burst-like enhancements. (3) To elucidate what determines the timing of SKR burst onsets, we compared the onset timing of N- and S-SKR bursts with each SKR phase of the periodic modulations. The result showed that the timing of SKR burst onsets generally depends on both the N- and S-SKR modulation phases. This suggests the existence of the internal control of SKR burst onsets. It is, however, noted that some SKR bursts occurred out of phases with SKR modulation phases. That indicates the timing of SKR bursts can also be determined by the external process, i.e., solar wind compressions. (4) We investigated the time evolutions of SKR intensities in the main frequency range and the low frequency range before and after SKR bursts. By comparing them with AKR intensity evolutions at AKR breakup, we found that they had two similarities: the enhancement of lower-altitude source regions prior to onsets and the formation of the distinct higher source regions. On the other hand, their timescales are quite different. In addition, this study pointed out that the two-step evolution scenario could not be directly applied to Saturn's case.

In conclusion, our study demonstrated the north-south asymmetry, the conjugacy and the dependence on the SKR periodic modulations of SKR bursts. These results would be helpful for understanding the auroral process at Saturn's magnetotail reconnections by elucidating the relationship between SKR bursts and reconnections. We consider the third result is particularly important because this suggests that both northern and southern periodicities would affect magnetotail reconnections.

Keywords: Saturn, SKR, aurora, Cassini