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土星電波放射における短時間スケールのバースト現象：土星自転位相との関係および南北非対称性
Short-term intense burst of Saturn's radio emission: Its relationship to the rotation phase and north-south difference

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This paper presents characteristics of short-term intense bursts of Saturn kilometric radiation (SKR) from 2005 to 2006 with the separation between northern and southern SKR. Our result shows the dependence of SKR bursts on rotational modulations of Saturn. This suggests that the internal process of the Kronian magnetosphere mainly drives SKR bursts. We also discovered that most of northern and southern SKR bursts occur independently of one another.

SKR is generated by electron beams accelerated along the auroral field lines via cyclotron maser instability, like auroral kilometric radiation (AKR) at Earth. Since this radiation is emitted at near the local electron cyclotron frequency in their source, the altitude of the radio source can be derived from the spectra. At Earth, AKR spectra show the bursty variations characterized by a sudden increase of the main emission with the extension of their spectra down to lower frequencies, associated with substorms (magnetic reconnection) driven by external (solar wind) drivers. It means that the occurrence of such variations is independent of the terrestrial rotation phase. SKR shows the similar short-term bursts like AKR although they occur on a longer time scale (several hours). In the case of Saturn, its magnetotail activities are affected by both external and internal (planetary rotation) drivers [Cowley et al., 2004]. Jackman et al. [2009] suggested the link between the SKR rotational modulations and the magnetotail reconnections. On the other hand, SKR has the rotational modulations with north-south asymmetric periods [Kurth et al., 2008; Gurnett et al., 2009]. There should therefore be some difference between northern and southern SKR bursts if they reflect strength of the field-aligned current system with distinct two rotational periods in each hemisphere [Andrews et al., 2010].

In this study, we examined the relationship between the short-term intense bursts and the SKR rotational phases with northern and southern SKR spectra observed with the Radio and Plasma Wave Science [Gurnett et al., 2004] on board Cassini spacecraft from 2005 to 2006. During this period, Cassini was traveling in an equatorial orbit, which is suitable to receive radio emissions from both northern and southern polar region. Northern and southern SKR phases are defined based on rotational modulations of SKR from each hemisphere [Lamy, 2011]. We selected 17 short-term intense bursts in northern SKR and 36 in southern SKR with the criteria, which consist of the followings: (1) SKR flux densities at low frequencies and (2) SKR total power must be significantly higher than median values of those during about 60 hours before and after the time of an SKR burst. (3) There must be no spectral gap between SKR main and lower-frequency bands. The result shows that more than 60 percent of bursts took place around time when northern or southern SKR phase was from 300 to 60 degrees, respectively. It clearly suggests that the short-term SKR bursts occur in synchronization with SKR rotational modulations, and supports the result by Jackman et al. [2009]. We suggest that the internal process of the Kronian magnetosphere mainly drives SKR bursts. On the other hand, we got the result that only six pairs of northern and southern SKR bursts we identified took place almost simultaneously (within two hours), that is, there is an asymmetry between northern and southern SKR bursts.

We are also investigating the SKR bursts independent of the rotation, which should be driven by the external (solar wind) effects. In addition, we will compare the results obtained during the southern summer with those after the equinox in 2009 to examine the effect of the long-term variations of SKR. These analysis results will be also presented.

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