

SUBPULSE STRUCTURE OF JOVIAN DECAMETRIC S-BURSTS

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Abstract

Jovian decametric S bursts occur only during Io-related storms, although they are considerably less common than the L bursts even in these storms. L bursts are of much longer duration and do not possess the impulsive, frequency-drifting, and repetitive properties that are characteristic of S bursts. Isolated S bursts observed with a receiver of 500 kHz bandwidth typically have durations between about 5 and 30 milliseconds. The best of the available published S burst dynamic spectra were obtained with spectrographs having time and frequency resolutions of about 0.3 millisecond and 3 kHz, respectively. The outstanding feature of S bursts displayed in such spectra is their drift from higher to lower frequency. The question arises whether another level of characteristic substructure would become apparent if S bursts could be examined using a spectrograph possessing much higher time and frequency resolutions than the current instruments can provide. We have found that this is indeed the case, and a program of investigation of this newly-discovered S burst substructure has been initiated by our group.

Our S burst observations were made using the 640-dipole antenna array at the University of Florida Radio Observatory. The frequency band accepted by the receiver (center frequency 26.3 MHz) was heterodyned down to baseband (center frequency 300 kHz). The analog tape recorded baseband output from the receiver was played back at greatly reduced speed and was digitized, providing a real-time equivalent sampling rate of 3.2 megasamples/sec. We have developed a method by which the digitized S burst baseband signal is cross correlated (in the computer) with each of a series of quasi-sinusoidal comparison signals of different frequencies and frequency drift rates, yielding surprisingly accurate frequency and drift rate measurements over intervals that are very small fractions of the duration of the S burst. Our preliminary measurements distinctly reveal that a 10 millisecond S burst is composed of a large number of often-overlapping subpulses having durations of tens of microseconds each. Each subpulse is internally phase coherent, but is incoherent with respect to the neighboring subpulses. A dozen consecutive subpulses may have mid-frequencies that jump around randomly within a range about 5 to 10 kHz wide, and may have quite different drift rates. It thus appears that an S burst seen with presently available dynamic spectrographs is the incoherent but narrow band frequency-drifting composite resulting from the superposition of many discrete internally coherent subpulses. We are continuing our investigation of this interesting and potentially important phenomenon.

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