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Spatial and spectral properties of plasma waves observed upstream of Saturn's bow shock by the Cassini spacecraft

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Plasma waves are commonly observed in the upstream regions of planetary and interplanetary shocks. Plasma waves are identified as intense narrowband emissions at a frequency very close to the local plasma frequency or weaker broadband waves below and above the plasma frequency deeper in the foreshock region. We present a statistical study of plasma waves detected upstream of Saturn's bowshock by the Cassini spacecraft. Using data from the Radio and Plasma Wave Science (RPWS) and Magnetometer (MAG) instruments we have analyzed all available waveforms obtained by the Wideband Receiver between June 2004 and December 2015. A typical wave spectrum exhibits a single intense peak. However, spectra with a superposition of two or more intense peaks are also observed. Using magnetic field observations and a model of the bow shock, plasma wave activity in the Saturn's foreshock has been analyzed. The plasma wave occurrence increases steeply behind the tangential magnetic field line and still rises with the increasing distance from the tangential line. The single peak spectra are observed across the entire foreshock while more complicated spectra are measured deeper inside the foreshock and closer to the bow shock. The most intense waves occur close to the tangent point and fade out deeper in the foreshock and along the tangential line.