An Overview of Saturn Radio Emissions

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As with other magnetized planets in the solar system, Saturn is a source of a rich variety of radio emissions. So far four man-made spacecraft have visited Saturn: Pioneer 11, Voyager 1 and 2, and Cassini, with the Voyagers and Cassini equipped with radio wave instruments. The Saturn Kilometric Radiation (SKR) discovered during the Voyager 1 flyby is an R-X mode emission generated by unstable electron distributions along the auroral field lines via the cyclotron maser instability. Narrowband emissions (NB), also discovered by the Voyagers, are typically observed around 5 and 20 kHz and their polarizations are consistent with the L-O mode. Recent observations by Cassini showed that the 5 kHz emission is mode converted from Z-mode emissions and the 20 kHz emission is mode converted from intense upper hybrid emission at a density gradient on the boundary of Saturn's plasma torus. Saturn Electrostatic Discharges (SED) are very intense radio emissions typically observed in the frequency range of a few MHz. These emissions, first detected by Voyager, have been associated with lightning storms in the atmosphere of Saturn. The SEDs are detectable from ground-based antenna arrays due to their high frequency. SKR, narrowband emissions, and SEDs are all periodically modulated as their emission sources rotate with Saturn. Cassini discovered a new type of radio emission, Saturn Drifting Bursts (SDB), which occur sporadically below 50 kHz with a drift in frequency of 1 to 10 kHz within their duration of 1 to 15 minutes. The generation mechanism and source location of this new emission are still not known. Radio emissions, due to their unobstructed free space propagation, provide an important remote sensing tool for the properties of plasma in the source region. The intensity modulation of these emissions can also be analyzed to study the dynamics of Saturn's rotating magnetosphere.