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Complementarity of radio and magnetic observations by CASSINI in the making of a magnetic field model for Saturn

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Two distinct and variable rotation periods in Saturn's radio emissions were revealed by observations performed by the radio and plasma wave science (RPWS) experiment on board the Cassini spacecraft. These two periods, first measured at 10.6 hours and 10.8 hours, were quickly attributed to SKR produced in the northern and southern hemispheres respectively. Later observations showed that these two periods varied and became equal after the time of Saturn's equinox. Most of magnetospheric phenomena in Saturn's environment are affected by the planet spin despite the apparent steep axisymmetry of the internal magnetic field. The existence of a double period makes the study of the planetary magnetic field much more complicated and the building of a field model, based on the direct measurements of the MAG experiment from the magnetometers embarked on board Cassini, turns out to be uncertain. The first reason is the difficulty for defining a longitude system linked to the variable period, because the internal magnetic field measurements from MAG are not continuous. The second reason is the existence itself of two distinct periods which could imply the existence of a double rotation magnetic structure generated by Saturn's dynamo. However, the radio observations from the RPWS experiment allow a continuous and accurate follow-up of the rotation phase of the variable two periods, since the SKR emission is permanently observable and produced very close to the planetary surface. A wavelet transform analysis of the intensity of the SKR signal received at 290 kHz was performed in order to calculate the rotation phase of each Saturnian hemisphere. A dipole model was proposed for Saturn's inner magnetic field: this dipole presents the particularity to rotate around Saturn's axis at two different angular velocities; it is tilted and not centered. Then it is possible to fit the MAG data for each Cassini's revolution around the planet the periapsis of which is less than 5 Saturnian radii. This study suggests that Saturn's inner magnetic field is neither stationary nor fully axisymmetric.