



## The Saturnian Magnetic Field: Internal and External Interaction

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The planetary magnetic field of Saturn has been an enigma since the earliest spacecraft flybys. Thus far there remains no documented determination of any internal field coefficients beyond the quadrupole. Moreover, the field is apparently precisely rotation axis aligned. Nonetheless, there is a magnetic signal close to the rotation rates detected in the atmosphere. Moreover, as at other planets that period is associated with a radio signal (SKR) Saturn kilometric radiation, which however is a clock like signal (pulsing in time rather than rotating). Furthermore both the radio and magnetic period slowly drift in time with a change of order 1% per annum. The polarisation of the magnetic signal first reported in a re-analysis of Pioneer and Voyager data indicates that it comes from an external source. Moreover, we show that unlike the radio signal the magnetic signal is rotating with a very low order harmonic variation with azimuth (predominantly  $m = 1$ ). Remarkably the result is that the field at large distances ( $R > 15 R_S$ ), for example in the magnetotail mimics a rocking of a tilted dipole. What links a low order external rotating source to the internal field? The atmosphere offers some possibilities however there are difficulties. We examine a variety of possibilities including the possibility of shielding of the asymmetric part of the internal field by either a process involving the rings or a process in the low to mid-latitudes of the planet.