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Time series analysis of the spectral modulation of MeV electrons in the Jovian magnetosphere

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Abstract

The structure of the Jovian magnetosphere is essentially determined by the fast rotation of the planet in $\sim$10h and the huge plasma source Io, which in combination lead to the formation of the Jovian current sheet that extends up to the magnetopause and moves up and down due to Jupiter's dipole tilt of 9.6°. Already the first in-situ measurements of the Jovian magnetosphere by the Pioneer 10 and 11 spacecraft in the 1970's revealed a 10h modulation of MeV electrons within the Jovian magnetosphere and also in the so-called Jovian electrons beyond the magnetopause. This finding, however, is somewhat puzzling since it requires a pulsar-like behaviour of the magnetosphere rather than the expected current-sheet driven modulation, which would have required also a 5h modulation being present in the data. We therefore carefully reanalysed the energy spectrum of MeV electrons measured by the Kiel Electron Telescope (KET) and the High Energy Telescope (HET) aboard Ulysses during the Jupiter flyby in early 1992 and found, confirmed by a Lomb analysis, the 10 periodicity actually being superimposed by a less pronounced, but significant one of 5h. Relating the electron data to the spacecraft trajectory we could in addition show that these observations can actually be explained by current sheet crossings of the spacecraft.