

# Saturn Approach: Cassini Radio and Plasma Wave Science

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16 April 2004

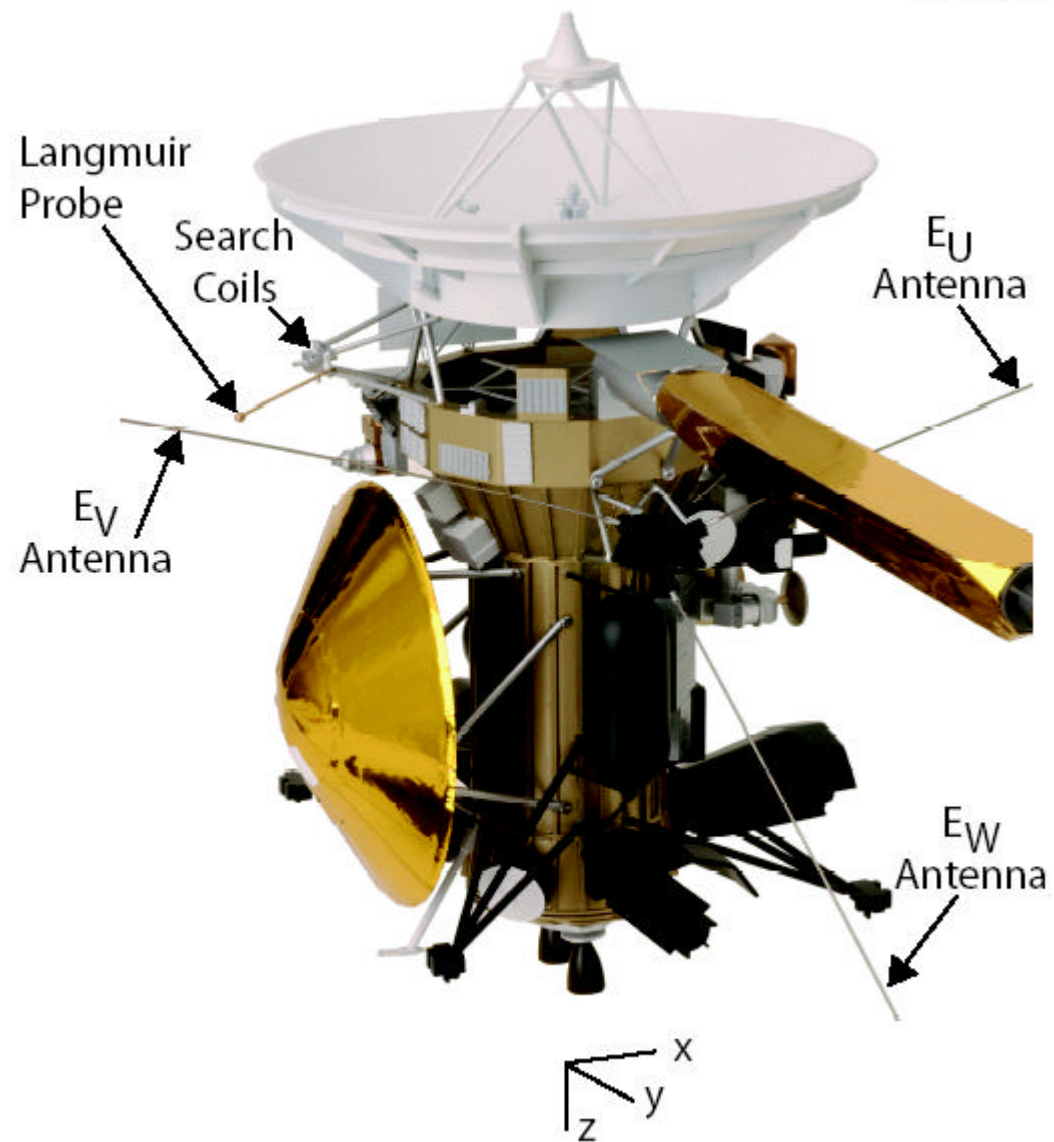
Titan: From Discovery to Encounter

ESTEC, 13 – 17 April 2004

# Outline

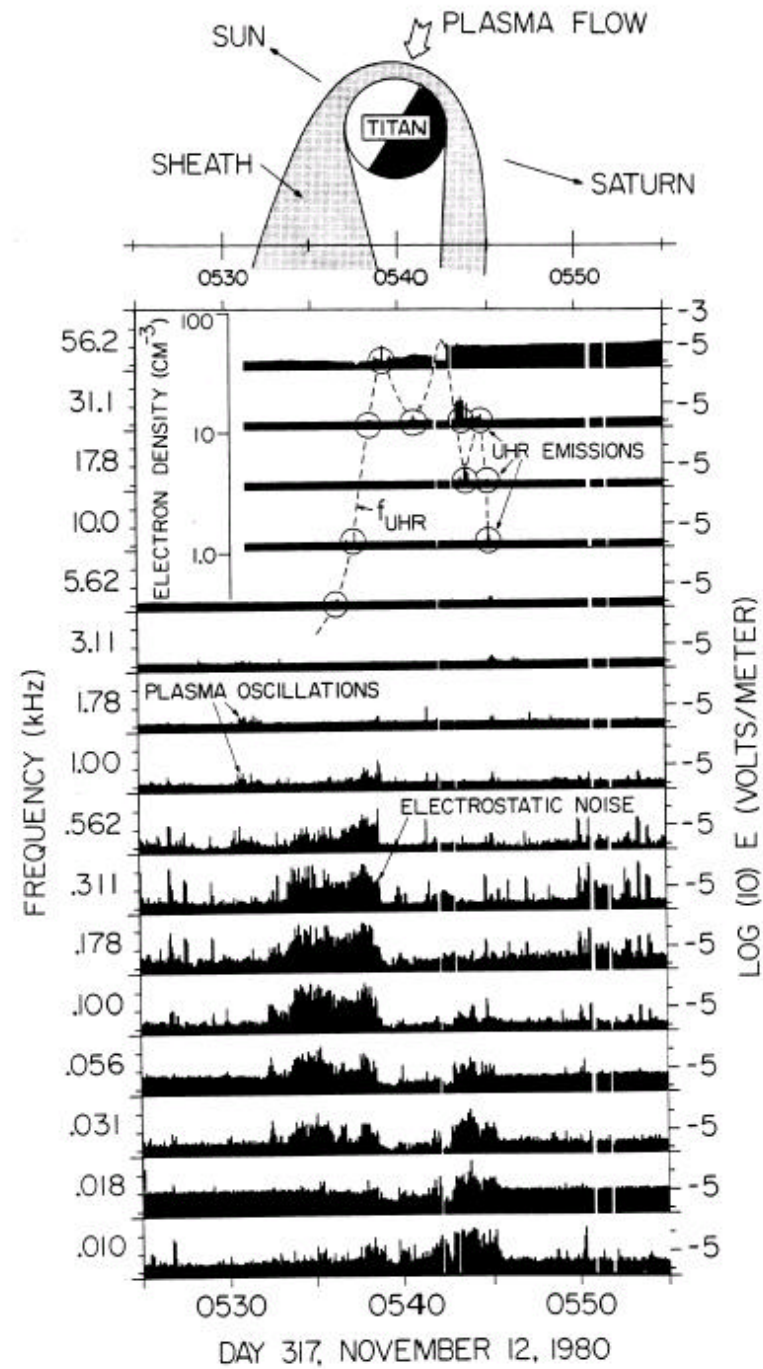
- Titan Objectives
- Approach Science
  - Trajectory
  - Saturn kilometric radiation fine structure
  - Saturn kilometric radiation periodicity
  - Solar wind – SKR correlations
  - Saturn electrostatic discharges
  - Upstream waves
  - Escaping continuum radiation
- Conclusions

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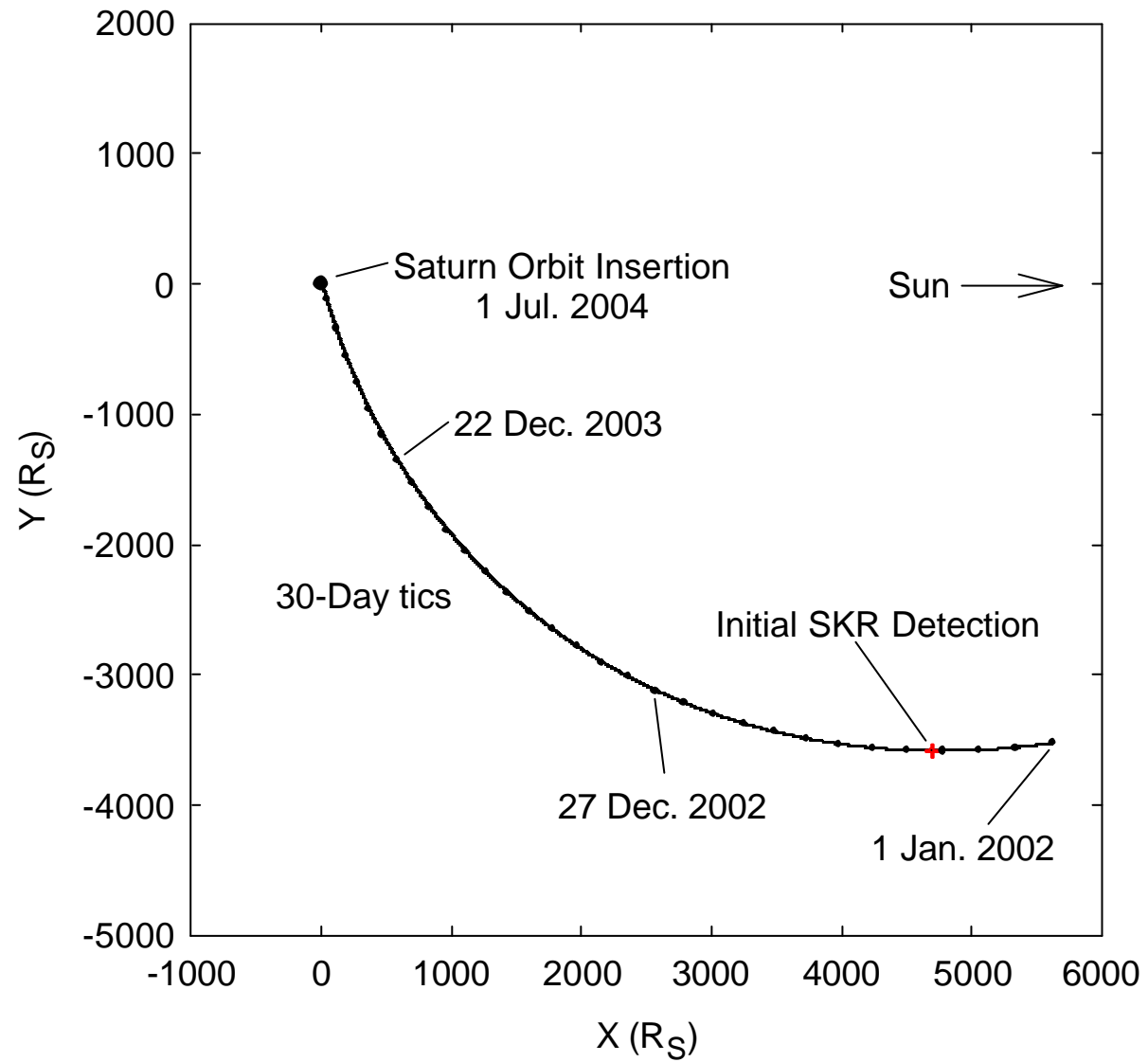
# Cassini RPWS Titan Objectives

- Establish the spectrum and types of plasma waves associated with gaseous emissions from Titan.
- Determine the role of plasma waves in the interaction of Saturn's magnetospheric plasma (and the solar wind) with the ionosphere of Titan.
- Determine the spatial and temporal distribution of the electron density and temperature in Titan's ionosphere.
- Characterize the escape of thermal plasma from Titan's ionosphere in the downstream wake region.
- Carry out a definitive search for lightning in Titan's atmosphere during the numerous close flybys of Titan.



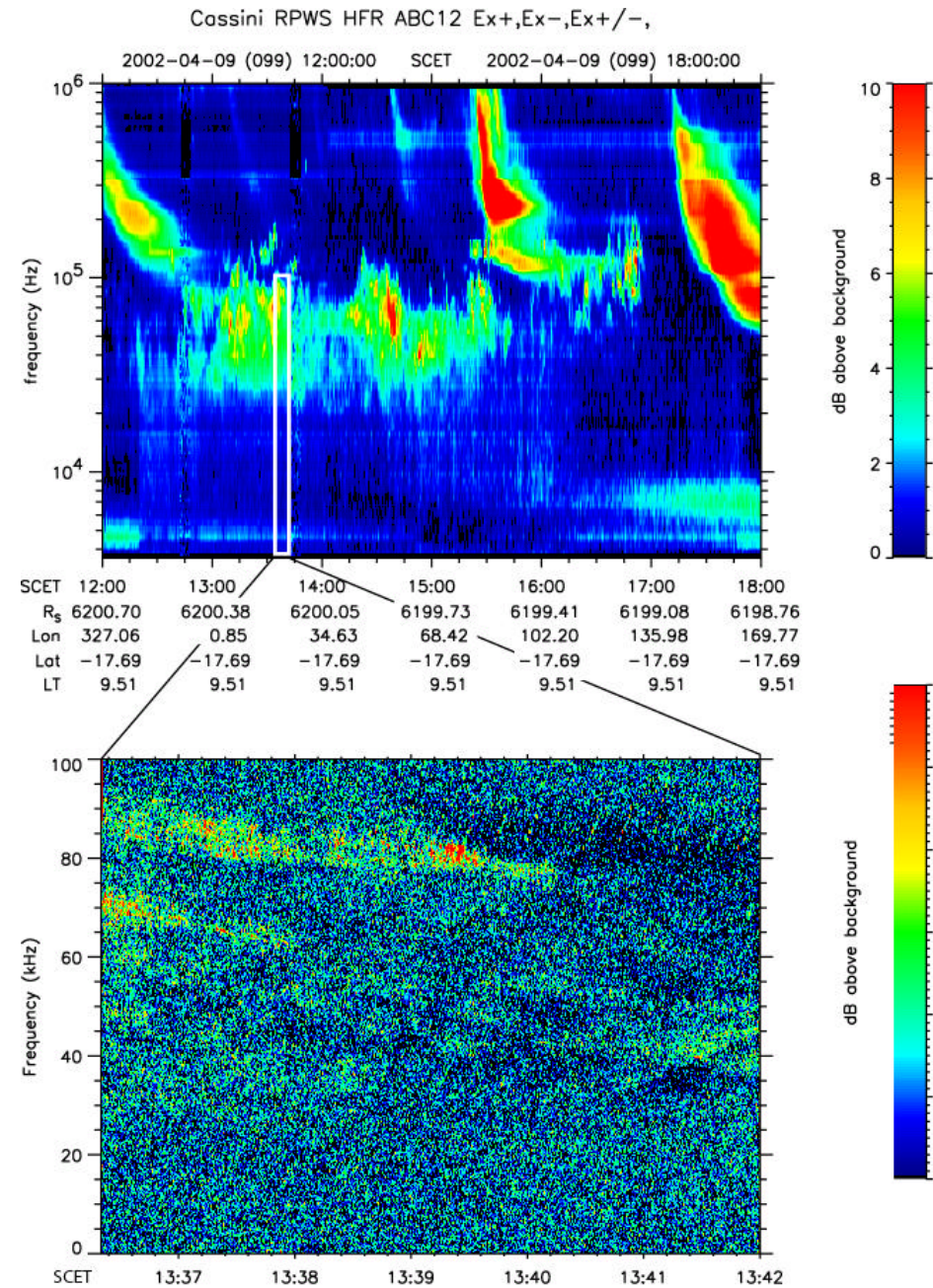
Trajectory

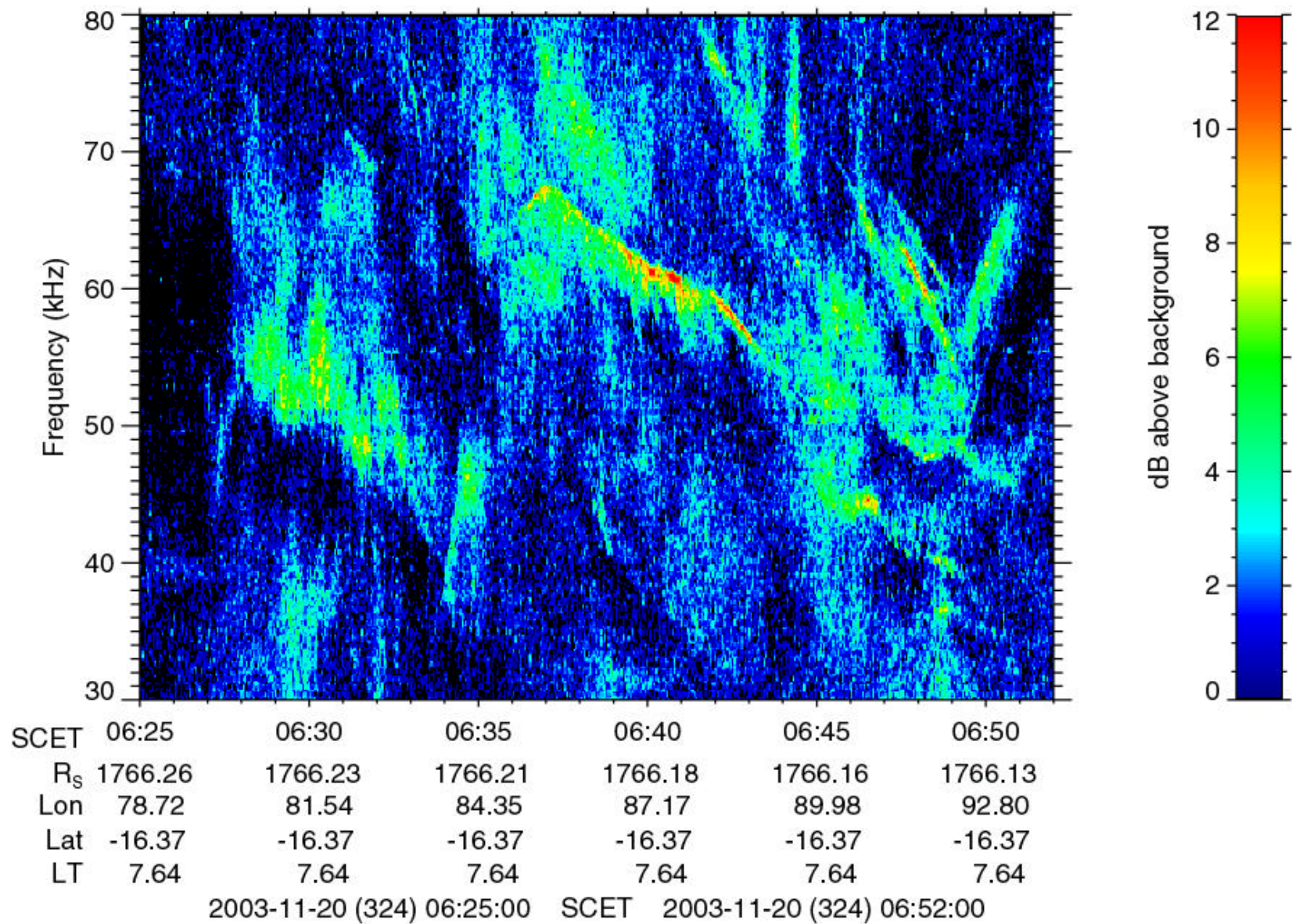
# Cassini Saturn Approach Trajectory



# Saturn Kilometric Radiation Fine Structure

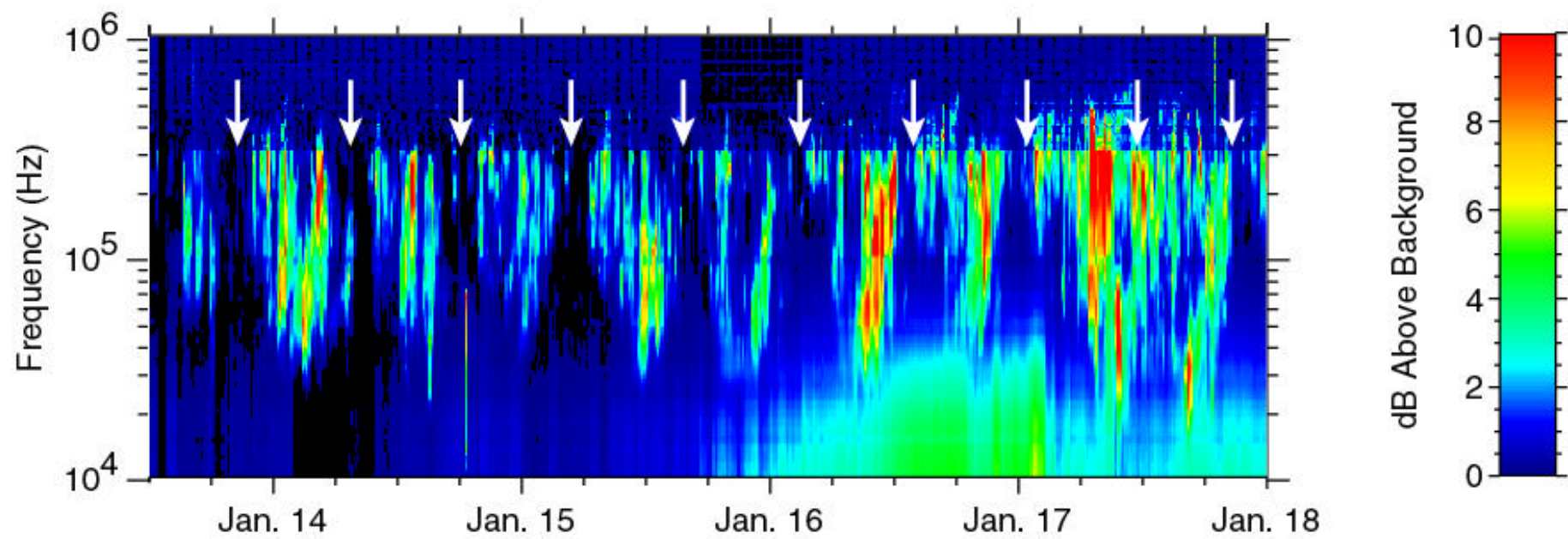




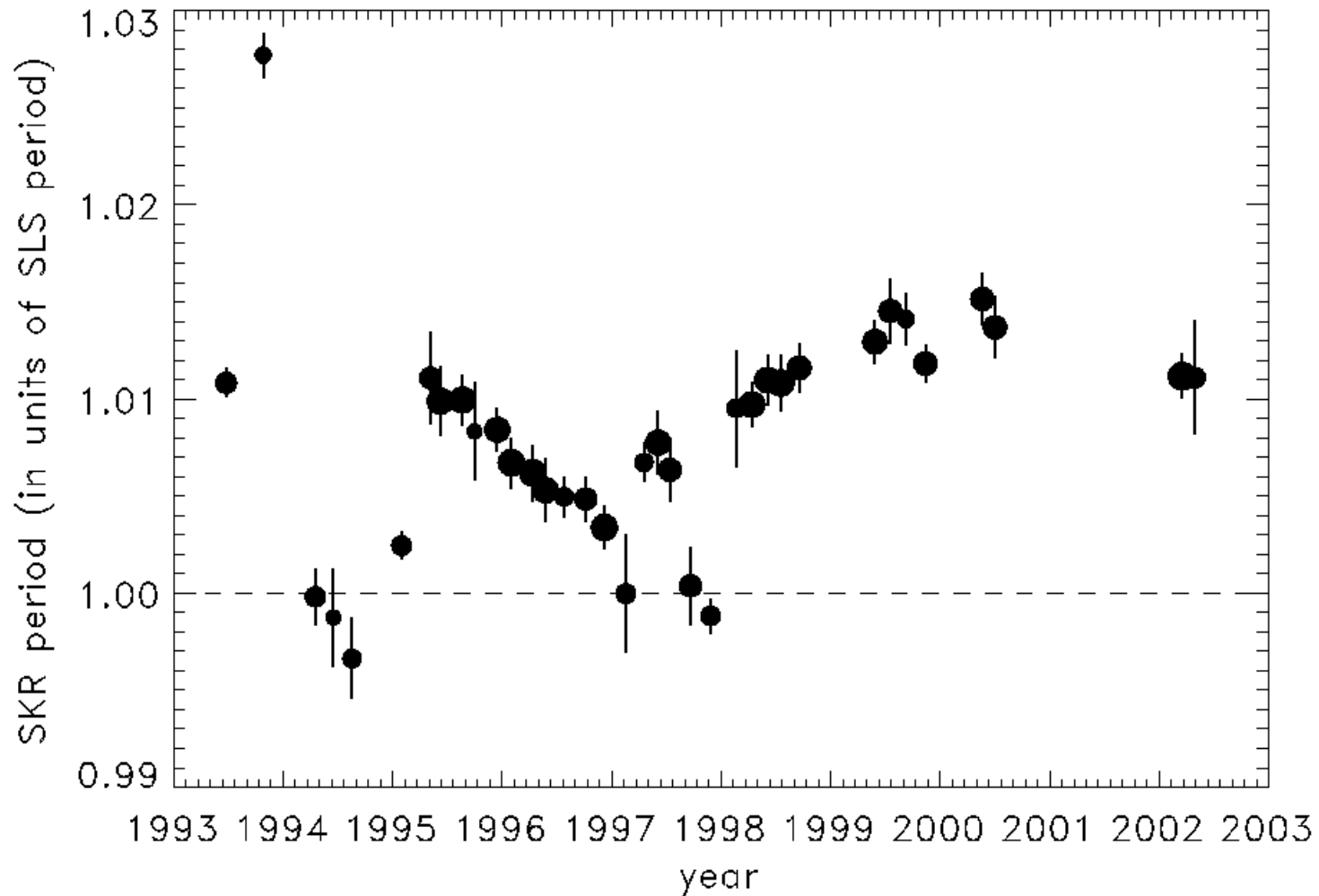


# Saturn Kilometric Radiation Periodicity

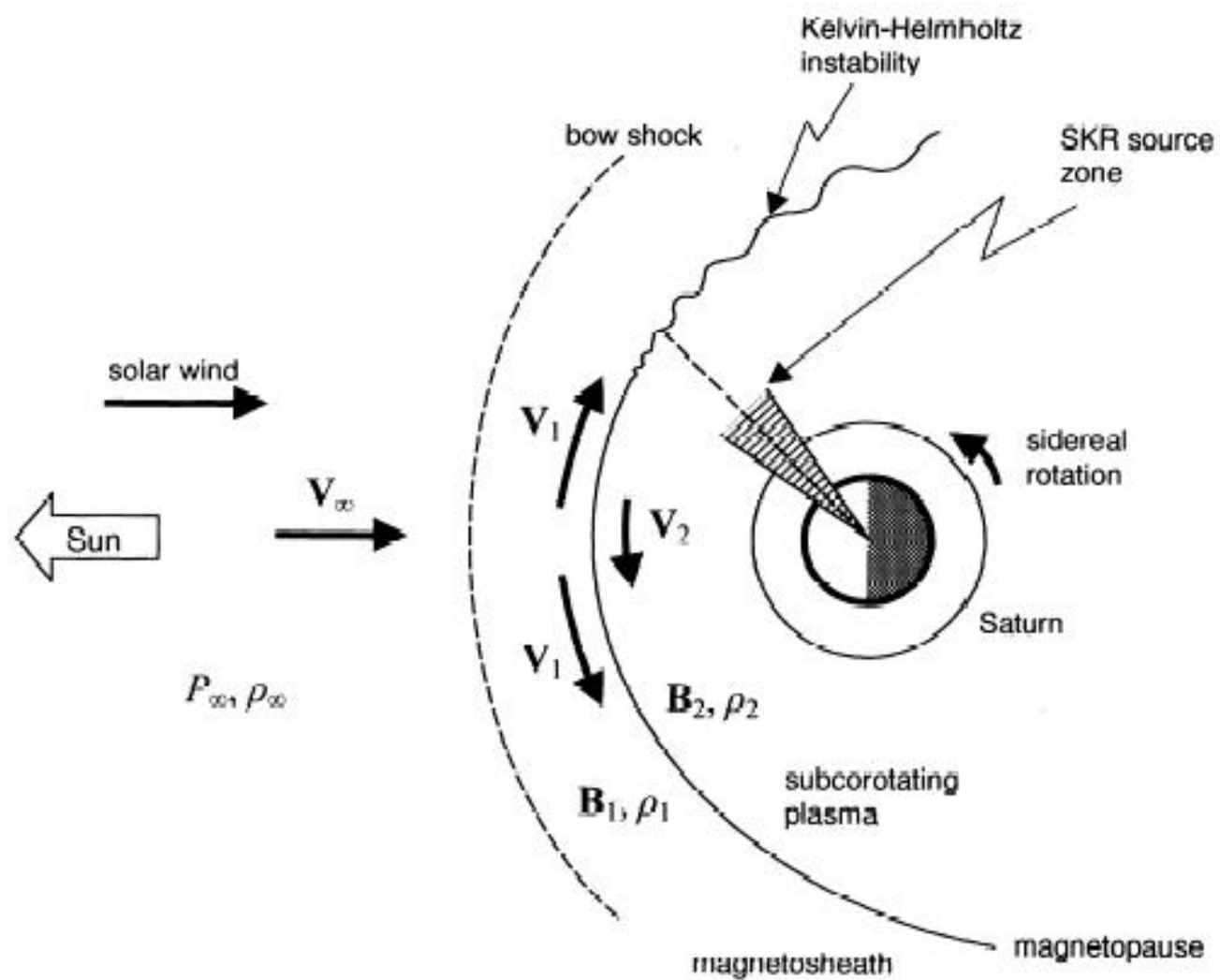


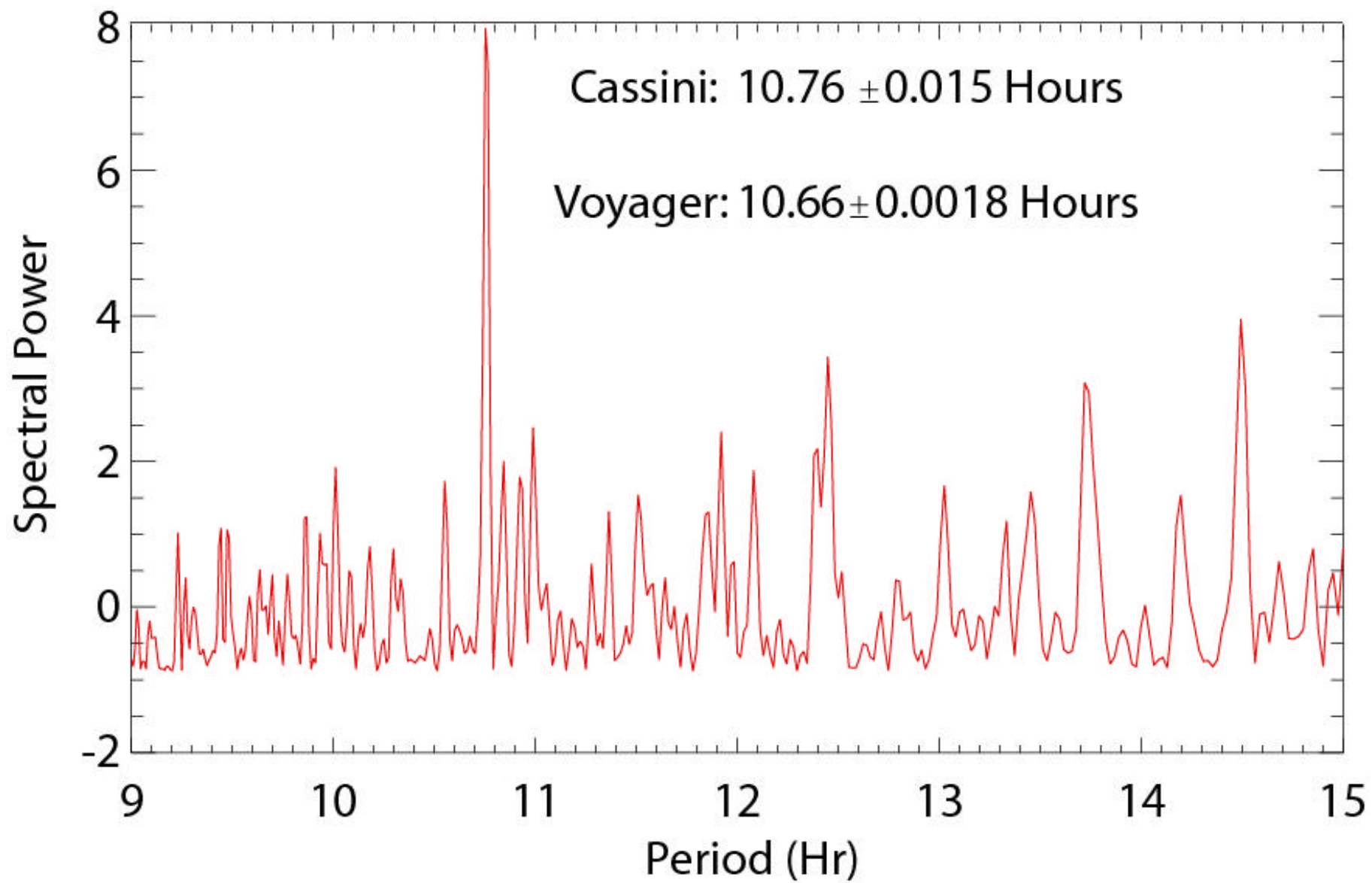


# Ulysses analysis update + Cassini



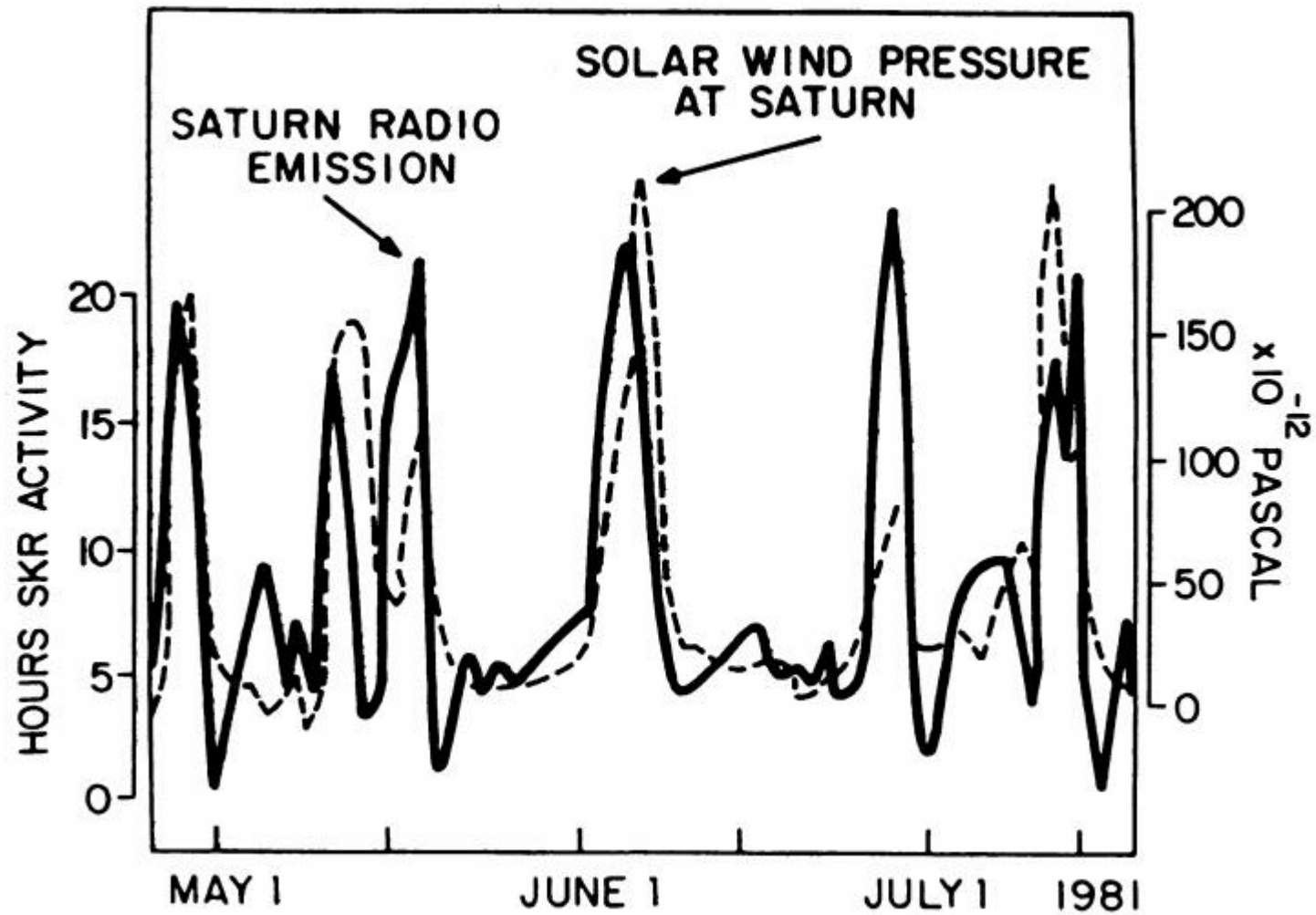
# GALOPEAU AND LECACHEUX: SATURN'S RADIO ROTATION PERIOD





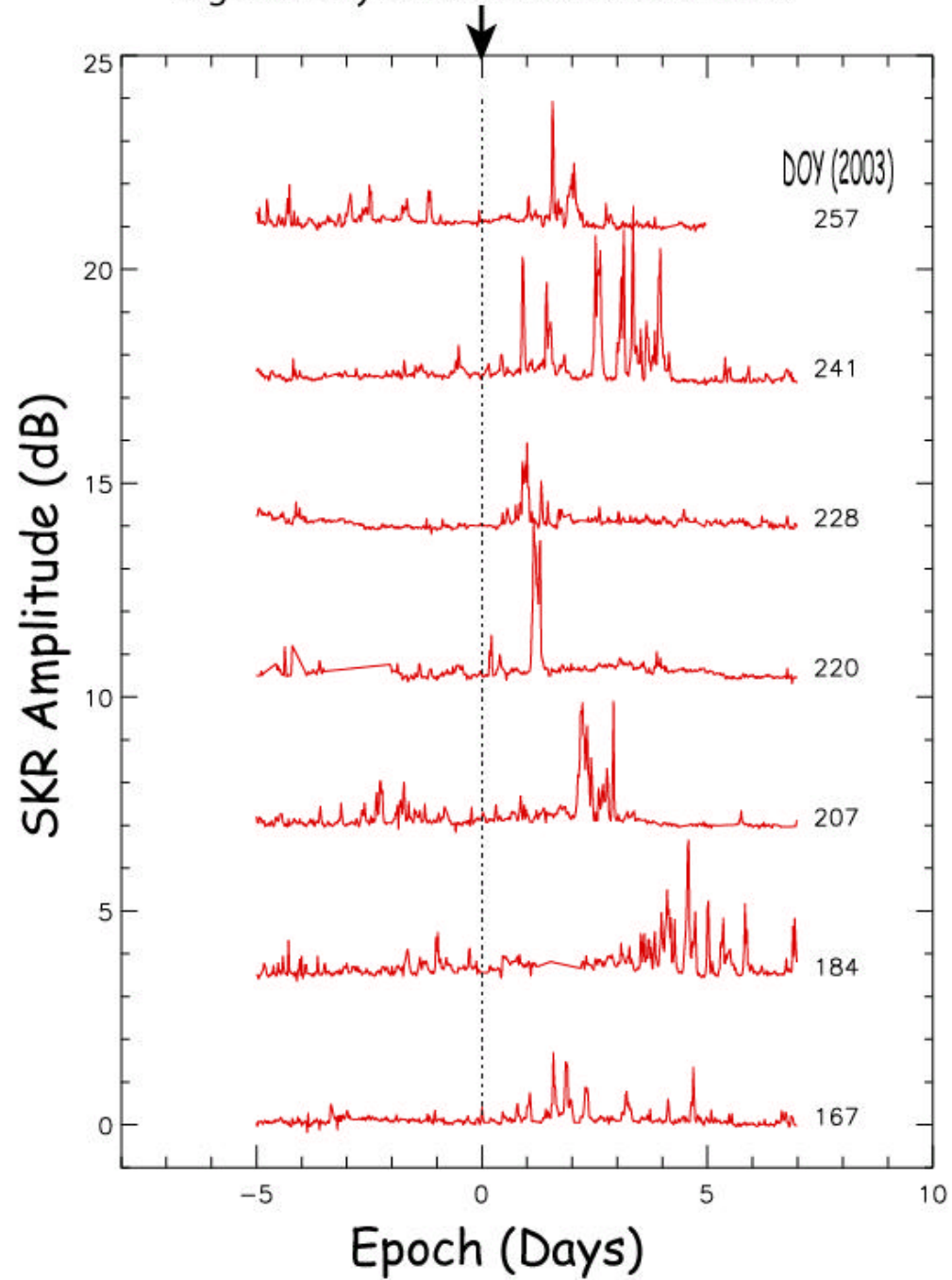
# Solar Wind – SKR Correlations

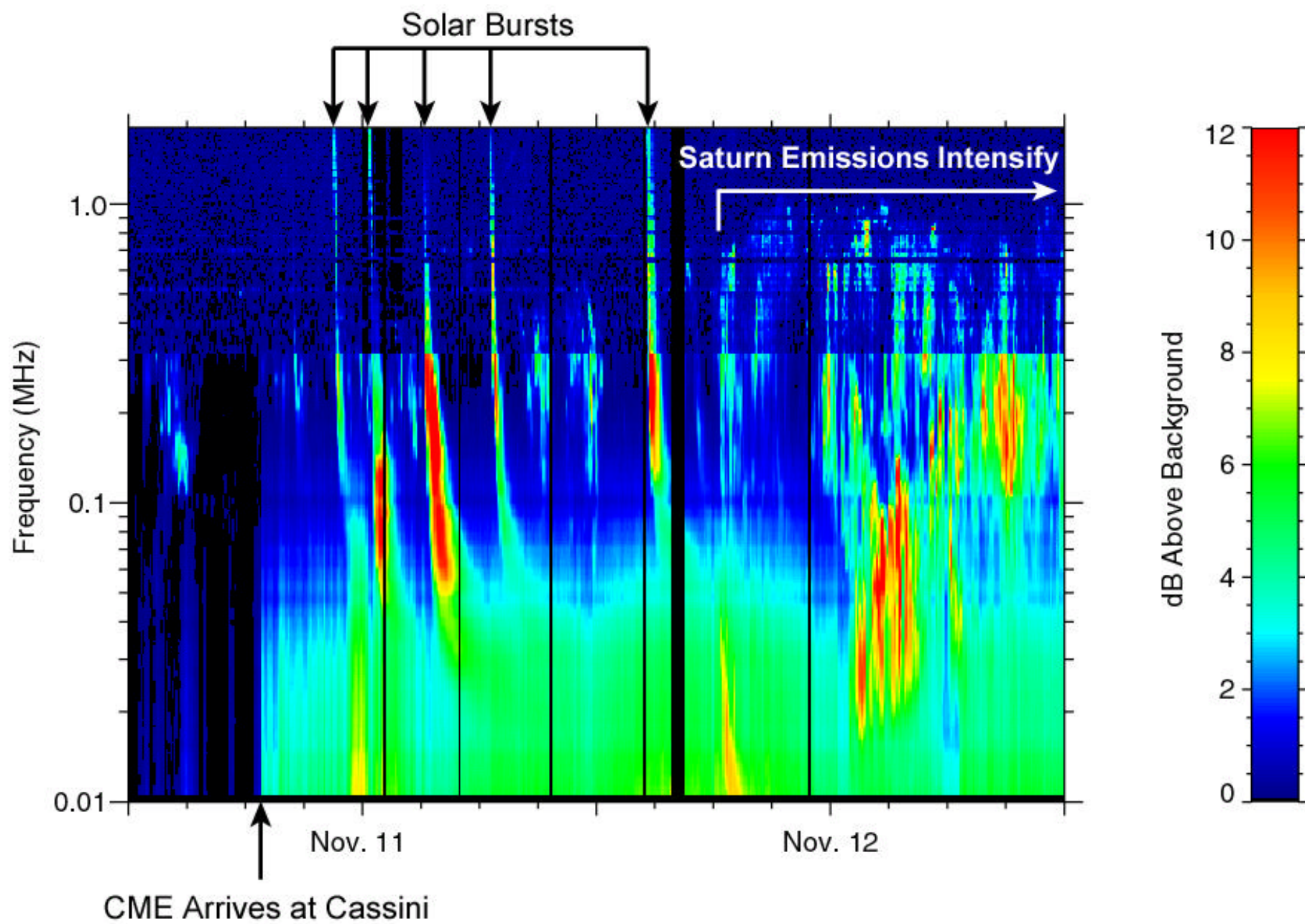




Kaiser et al., 1984

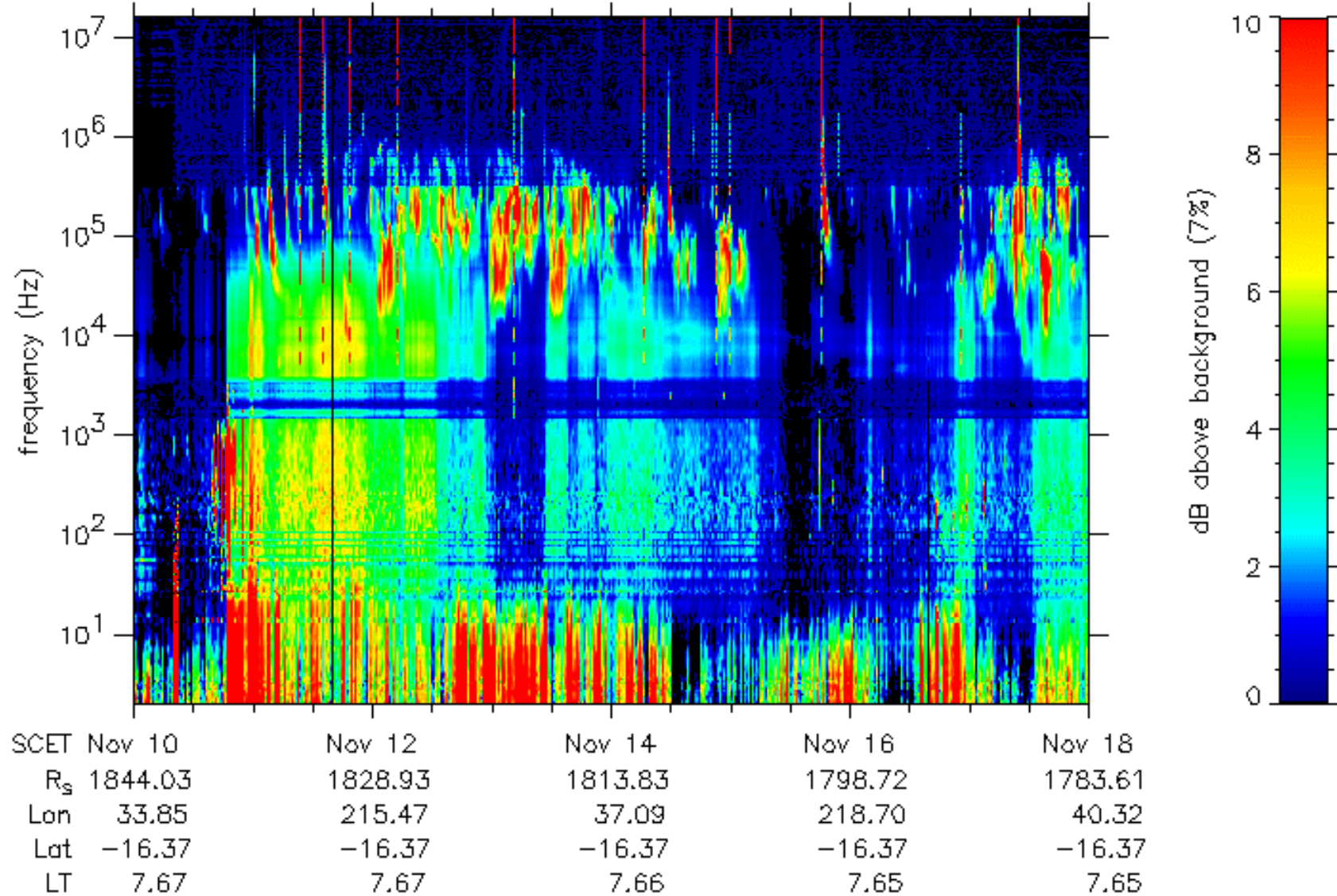
High Density Plasma Detected at Cassini



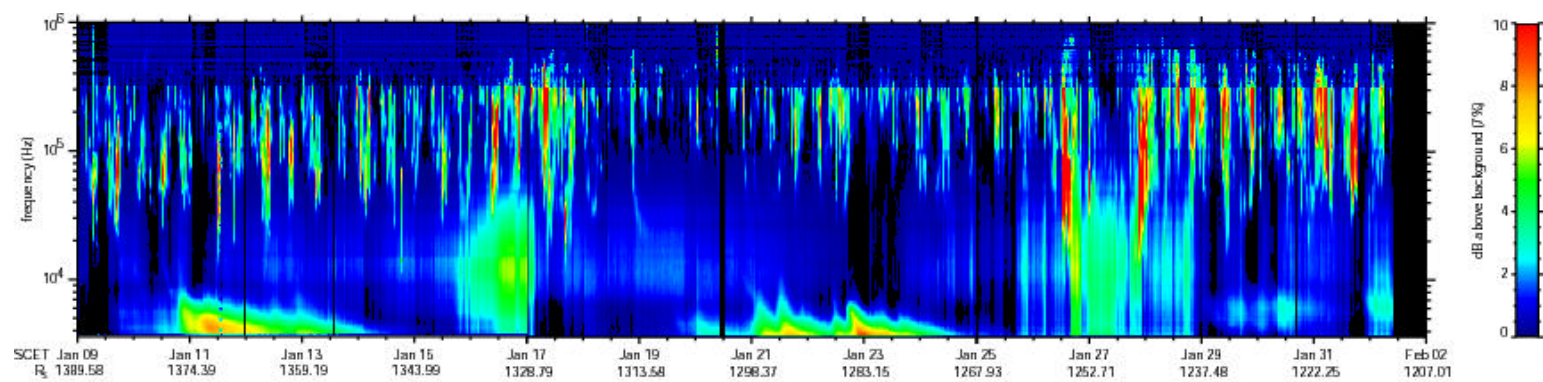


lrfc Lfdr ExEw, Mfdr ExEw, Mfr 13ExEw, Hfr ABC12EuEvEx

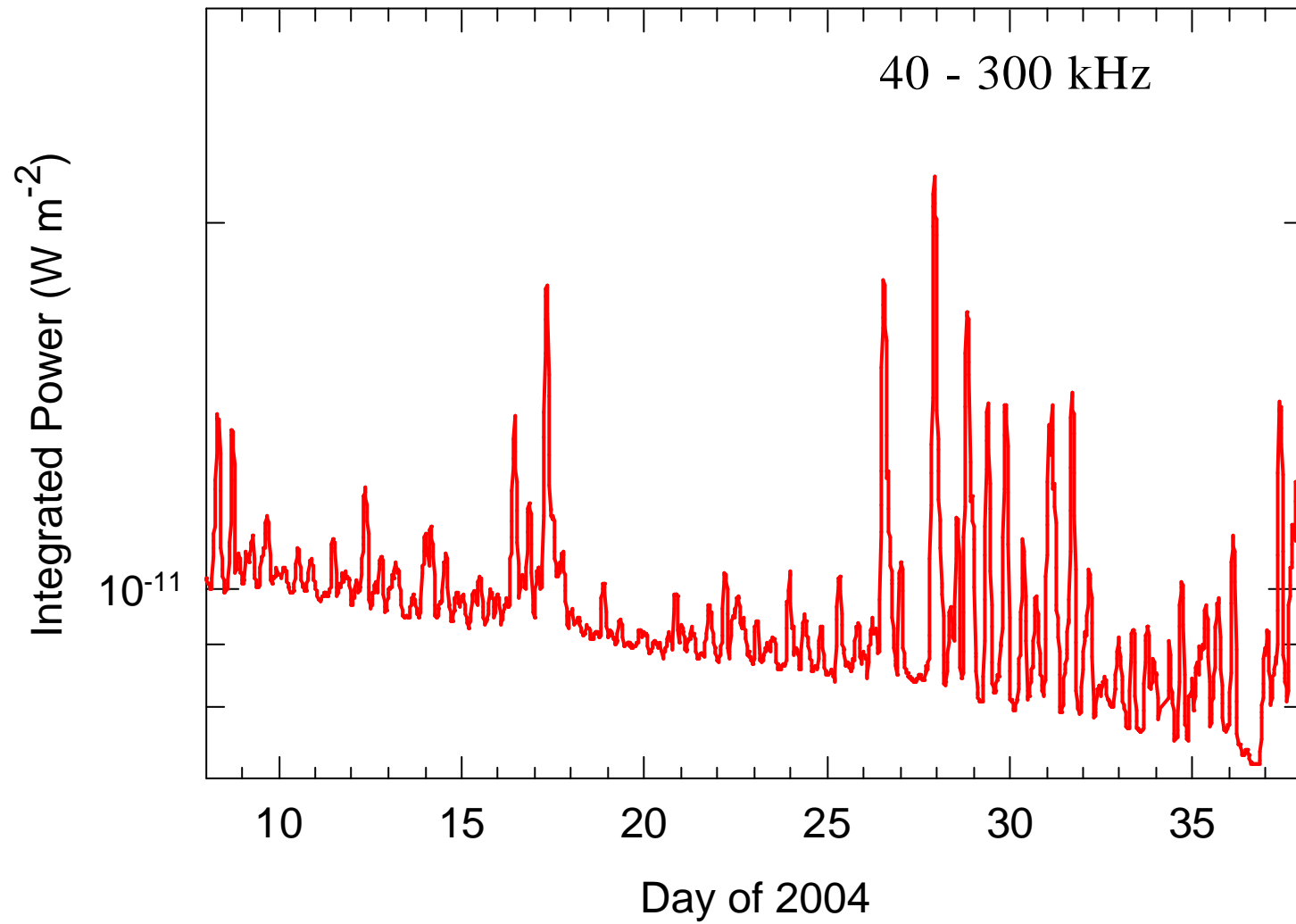
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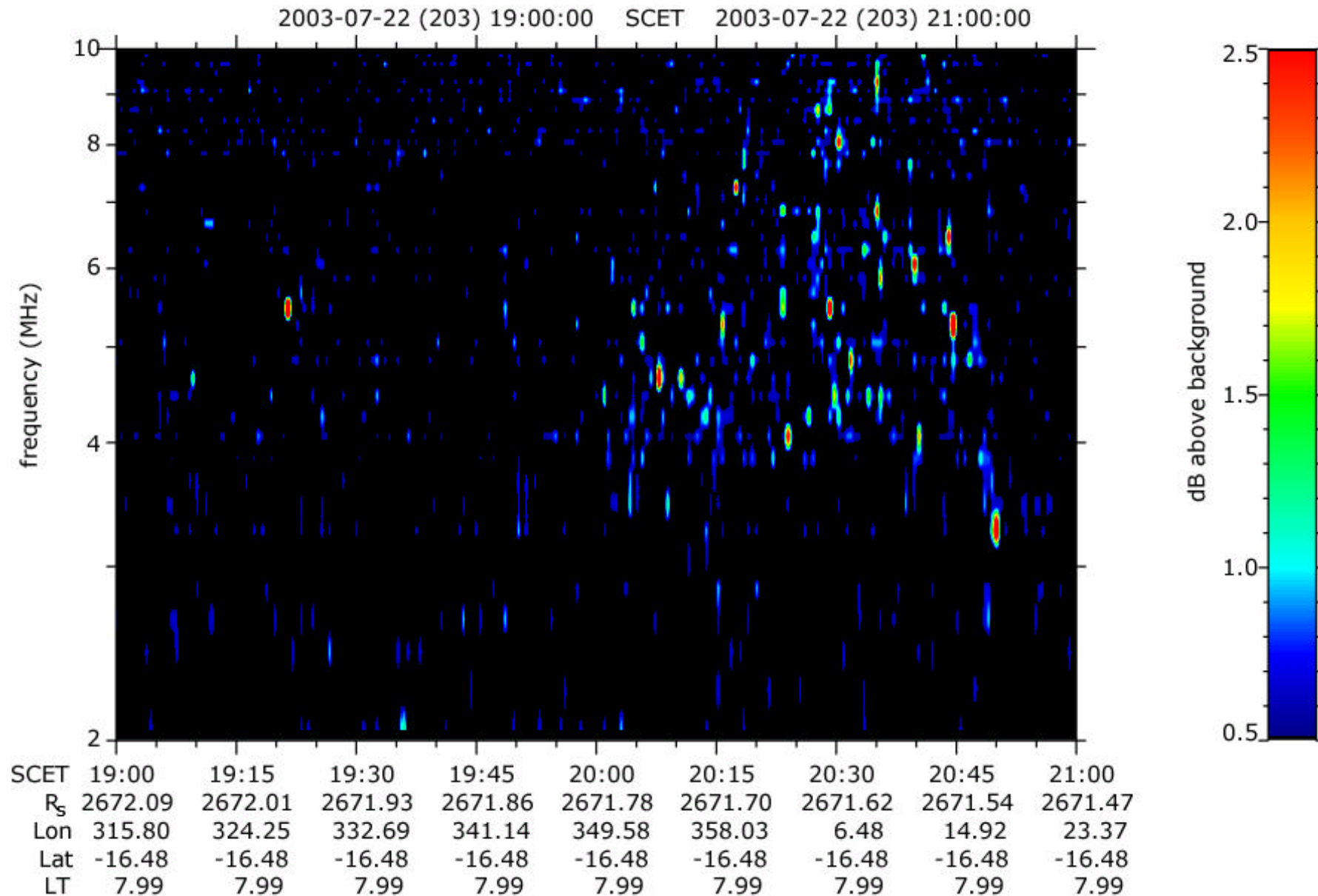


Saturn Kilometric Radiation  
Integrated Power  
(Scaled to 100 R<sub>S</sub>)

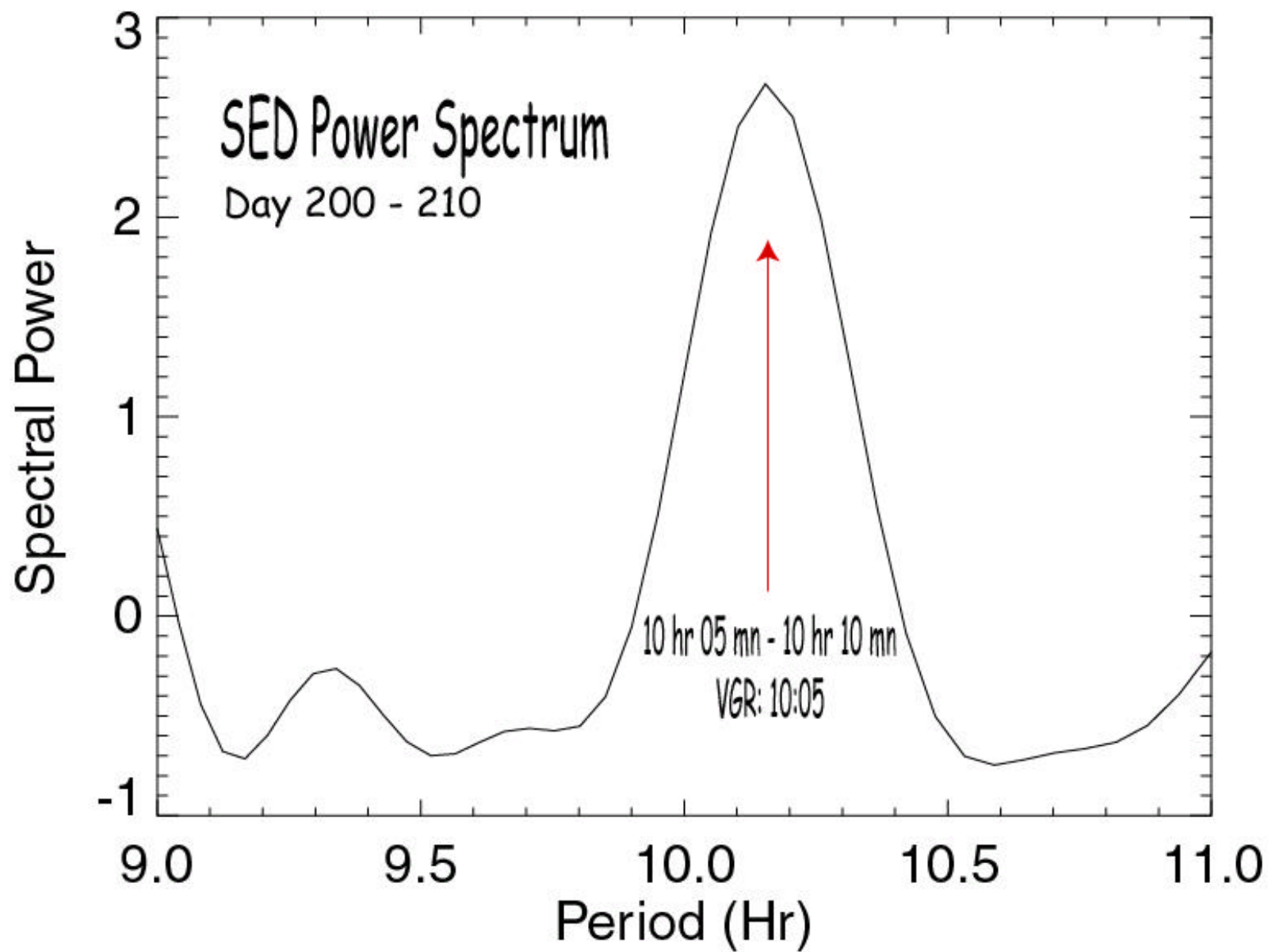


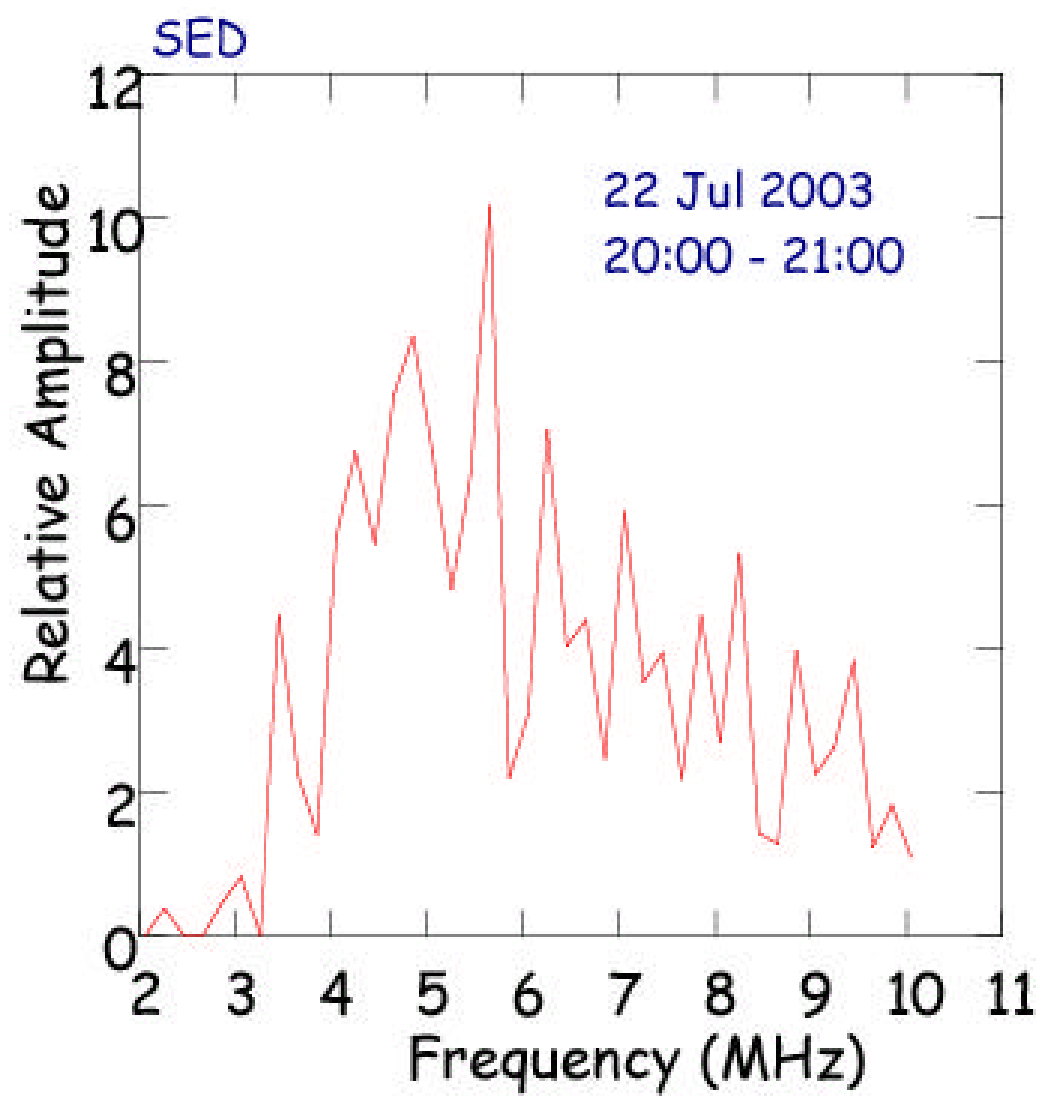
# Saturn Electrostatic Discharges

# First SED Detection?

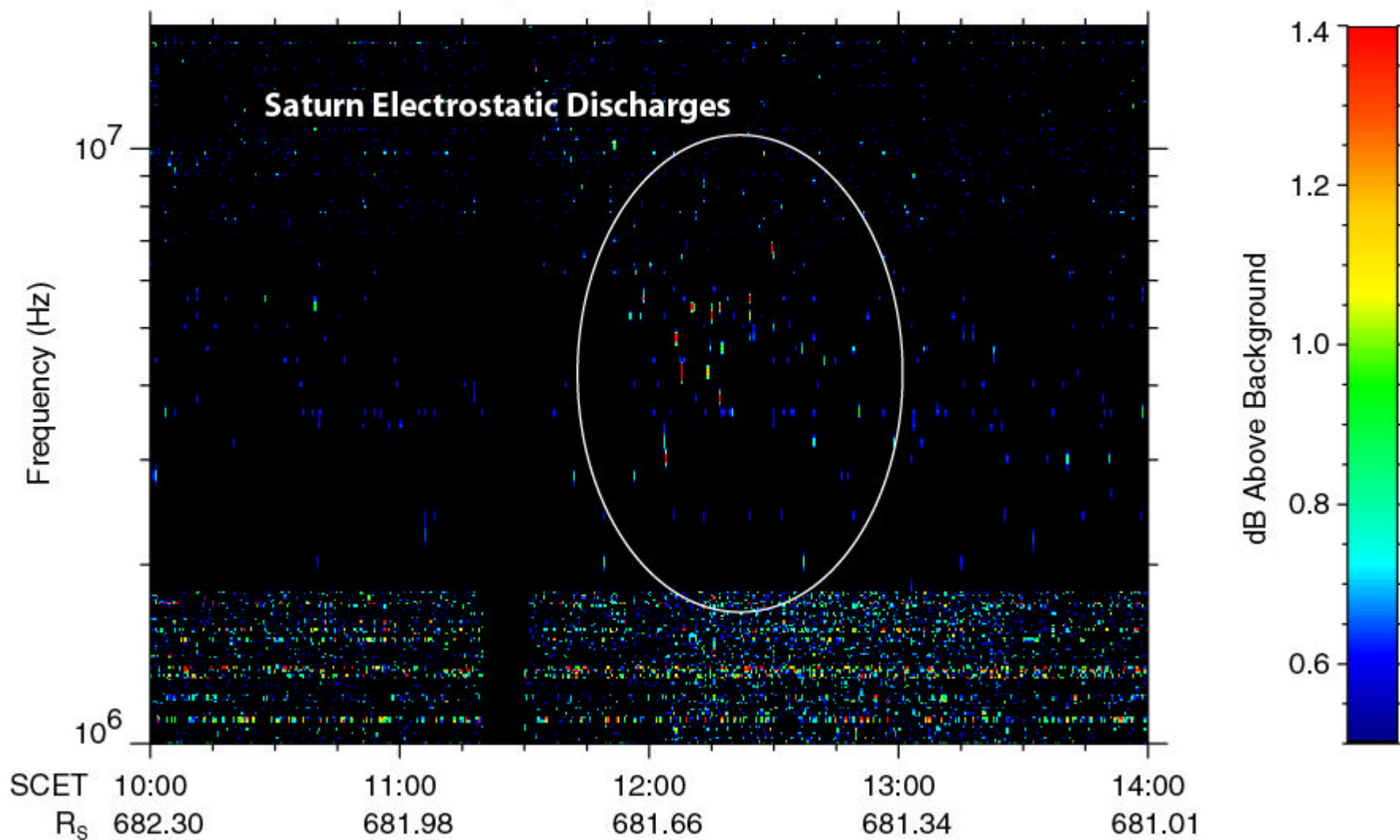






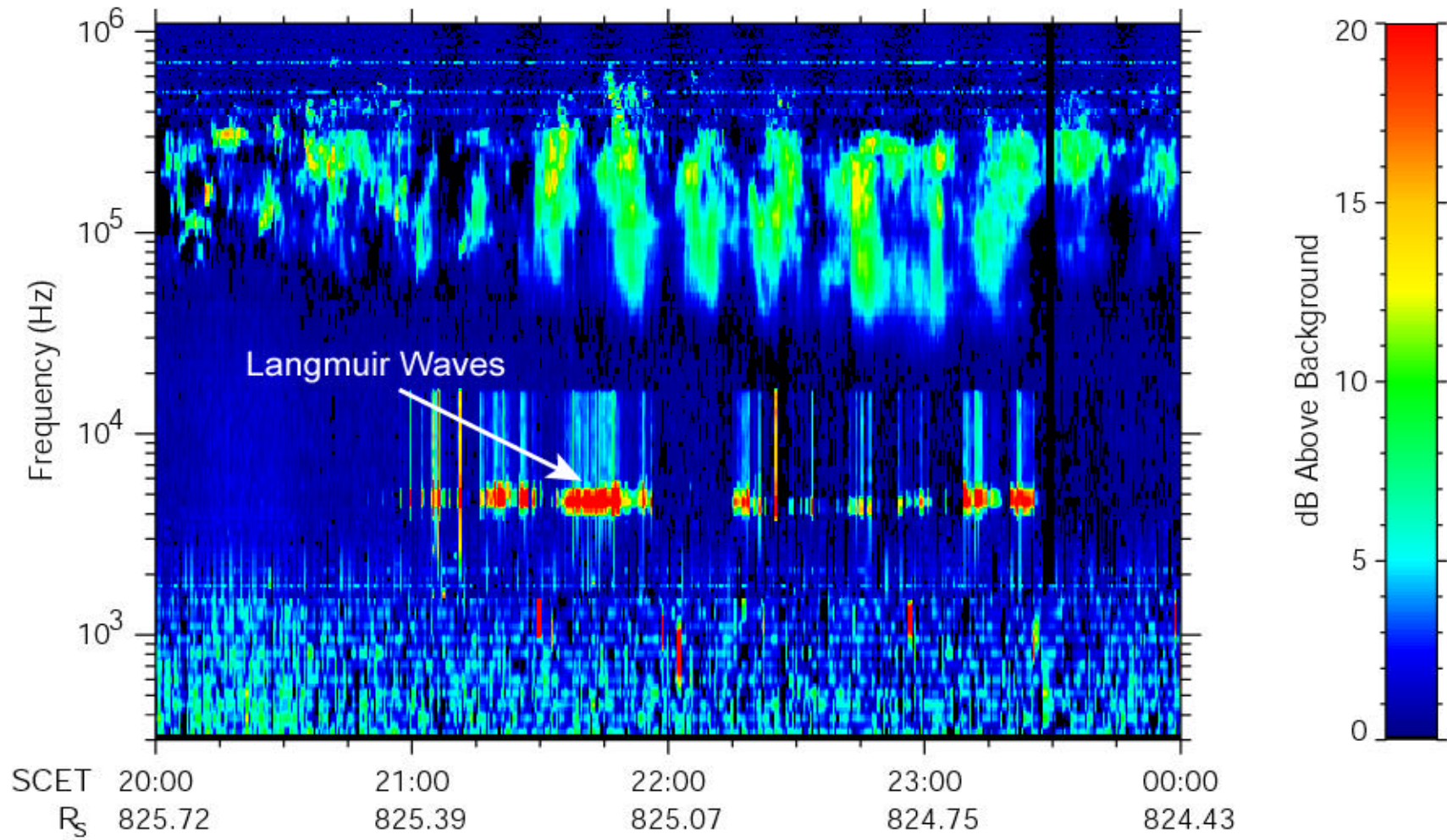


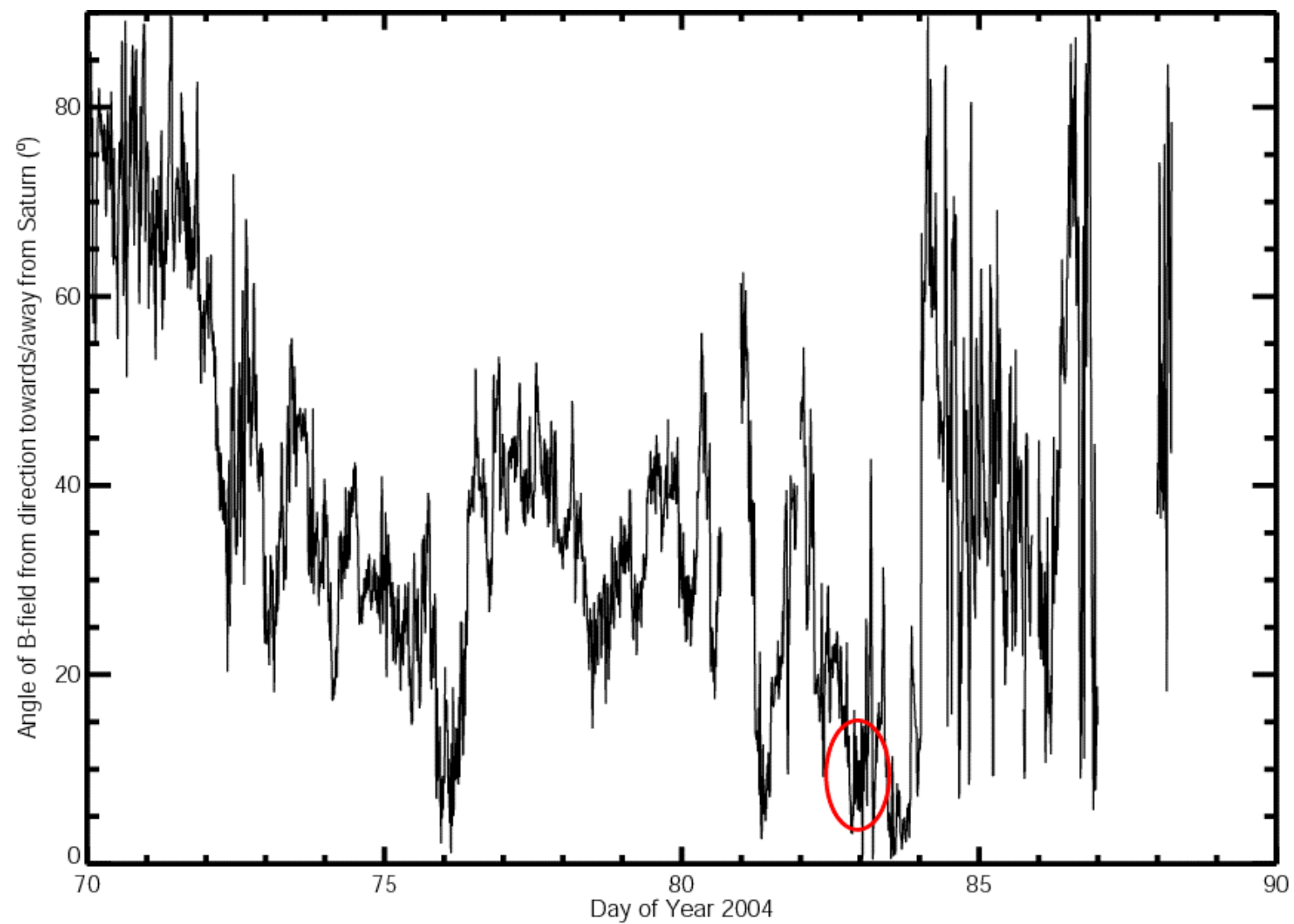
Cassini RPWS  
April 10, Day 101, 2004



# Upstream Waves

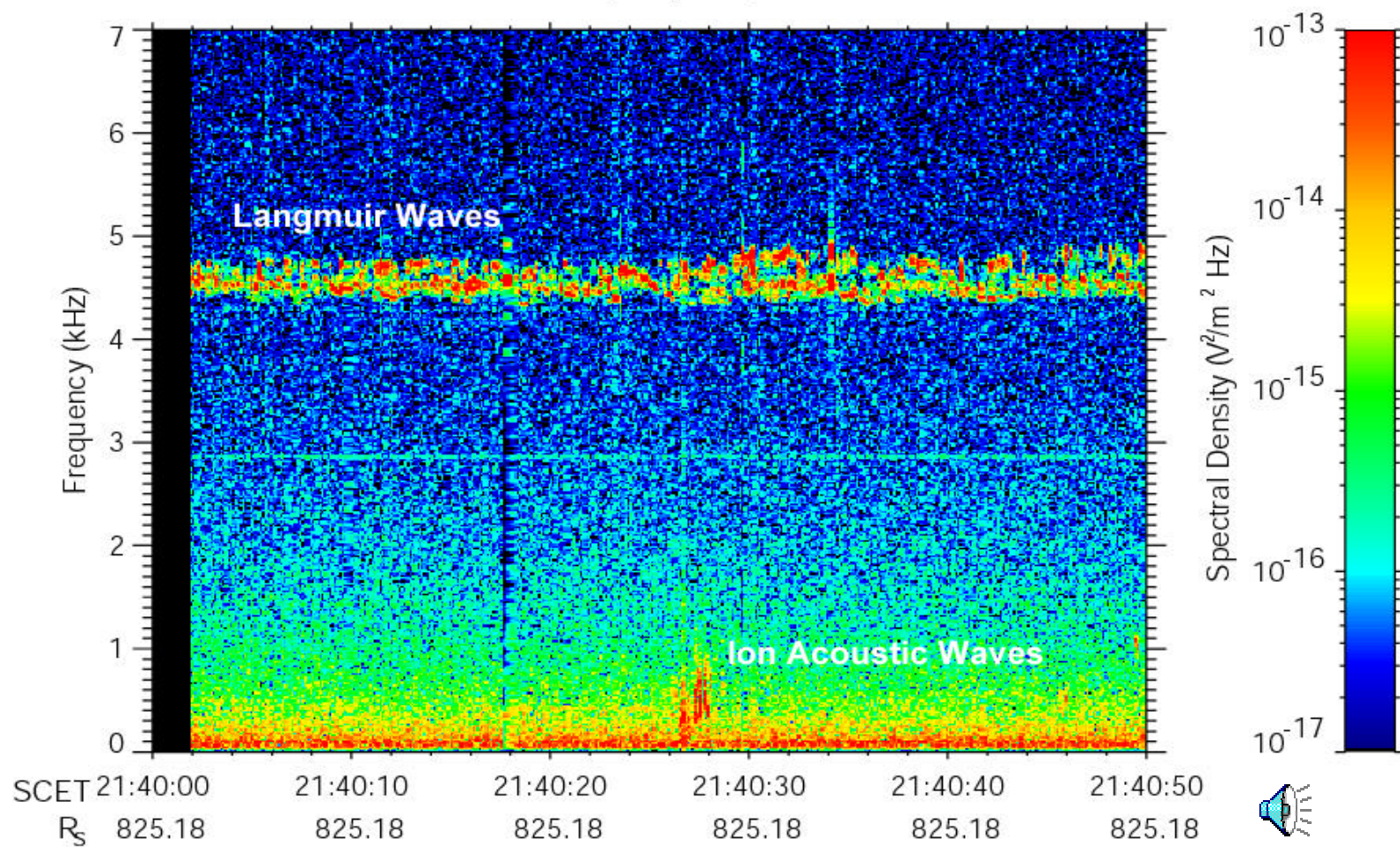
Cassini RPWS  
March 22, Day 082, 2004







Cassini RPWS  
March 22, Day 082, 2004



# Conclusions

- RPWS has a number of exciting Titan objectives involving the ionospheric electron density and temperature, the role of plasma waves in the Titan-magnetosphere interaction, the loss of Titan's atmosphere to Saturn's magnetosphere, and a much improved search for atmospheric lightning.
- The Approach Science phase has been ongoing for RPWS
  - Beginning with the first observations Cassini has provided unprecedented detail of the fine structure of Saturn kilometric radiation
  - Saturn kilometric radiation displays a periodicity which varies by order 1%. This may mask the true rotation period of Saturn and presents an interesting problem.
  - Voyager demonstrated correlations between the solar wind and SKR intensity; we hope to refine these to use as a proxy for solar wind input during the tour.
  - Despite a very early detection of Saturn electrostatic discharges (lightning), none have been observed until just recently. This suggests temporally variable storm intensity.
  - Upstream waves in the form of Langmuir waves and ion acoustic waves have been seen at distances of more than  $800 R_S$ , indicating that Cassini will spend a long, fruitful time in Saturn's foreshock region.
  - The lowest frequency radio emission from Saturn, escaping continuum radiation, has just recently been observed.