John Aiello

9 Dec 2014

My TERPS Presentation

Icarus 229 (2014) 57–70

Contents lists available at ScienceDirect

Icarus

journal homepage: www.elsevier.com/locate/icarus

Spatial and temporal dependence of the convective electric field in Saturn's inner magnetosphere

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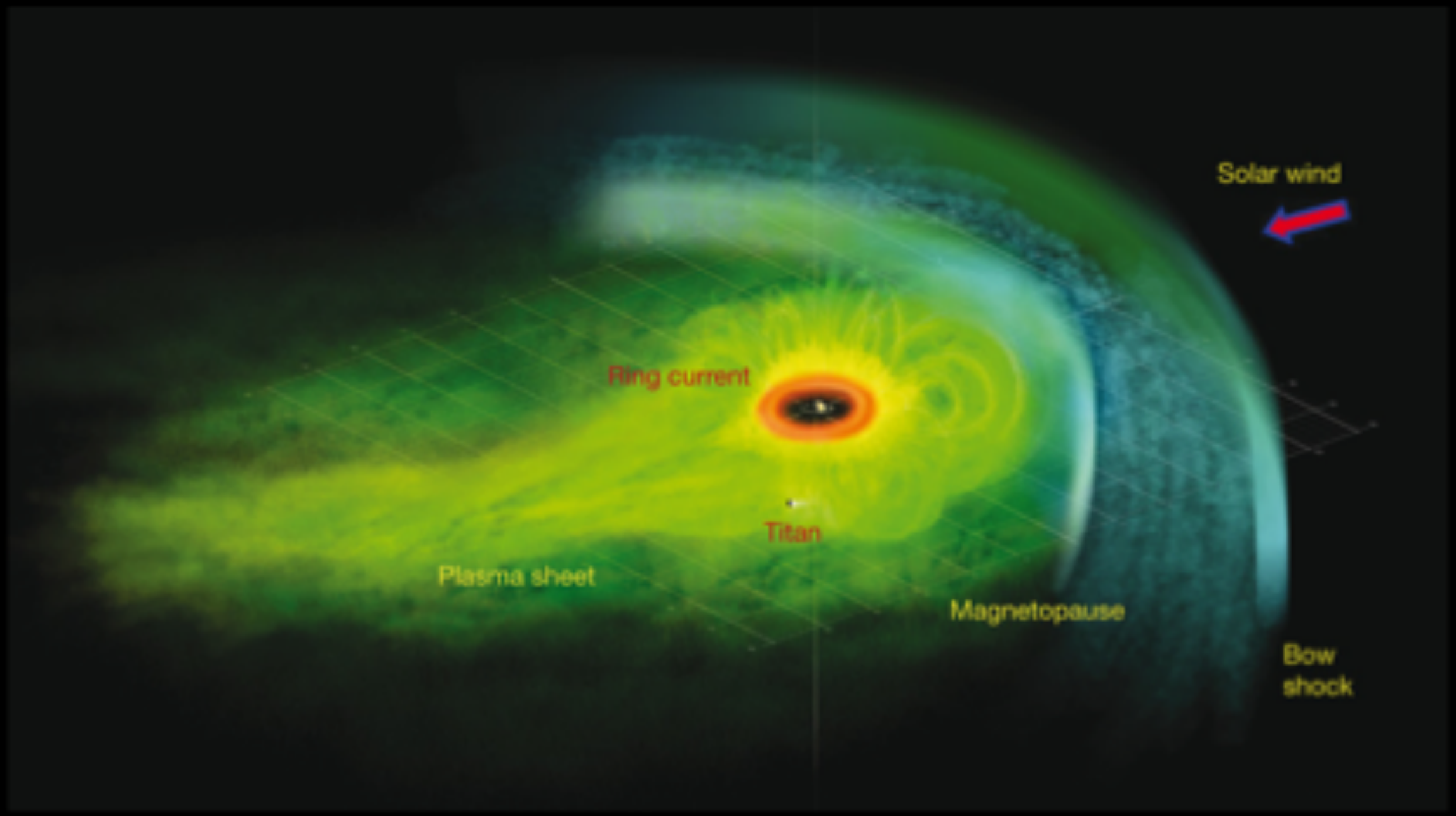
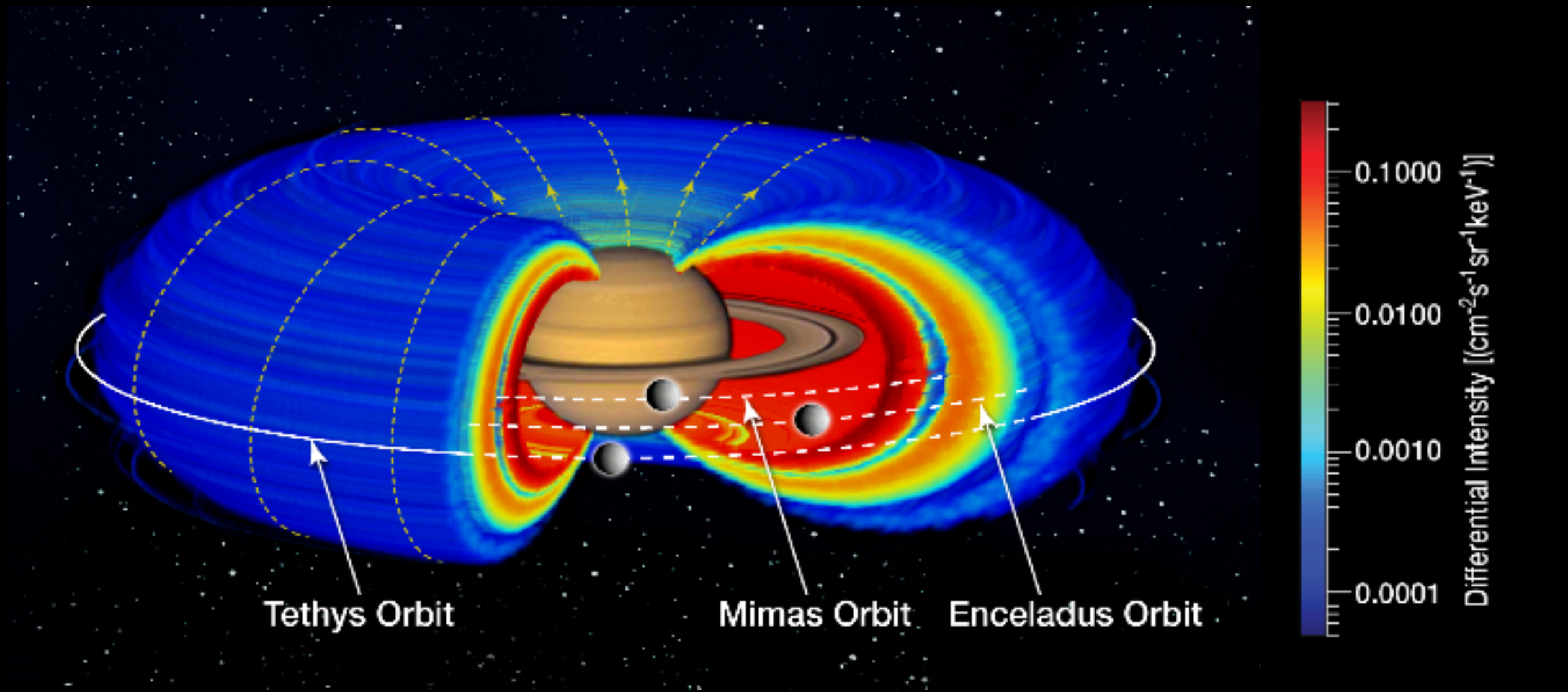
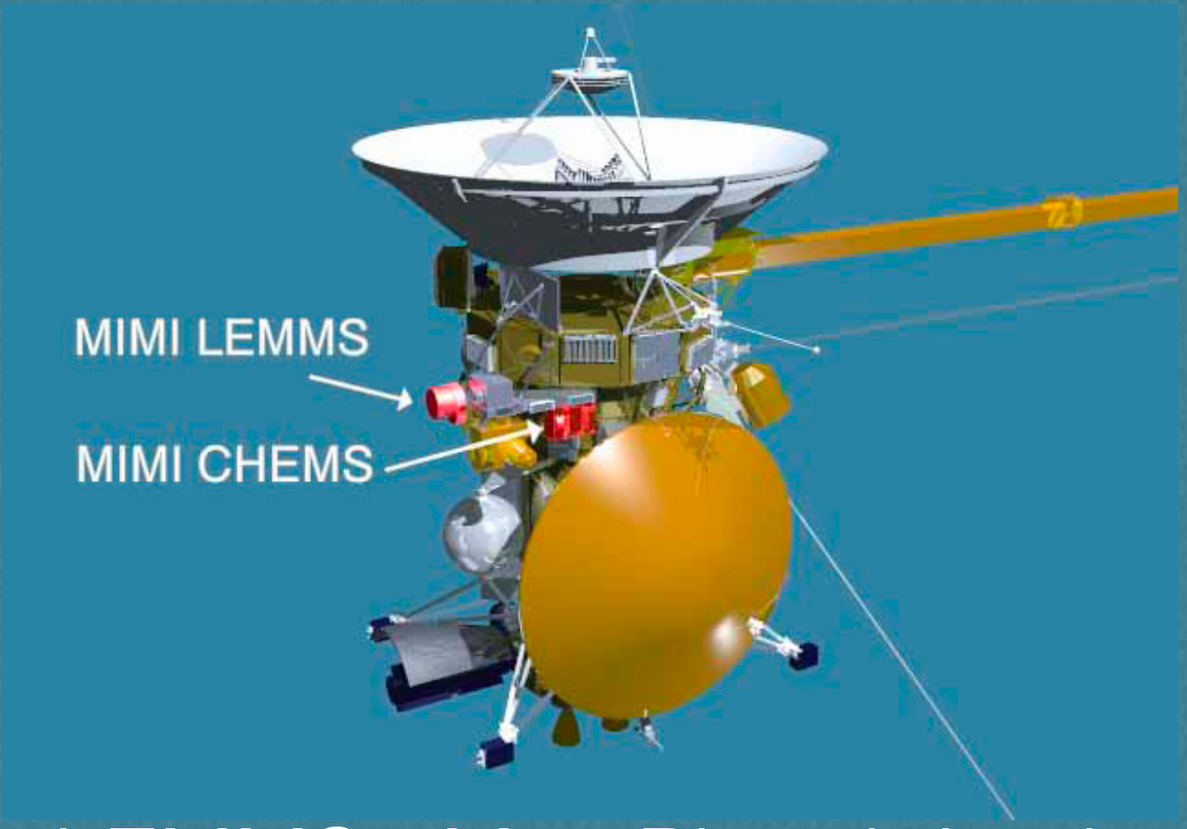
Saturn's Magnetosphere
one artist's impression



Krimigis et al., Nature, 2007

Saturn's Radiation Belts



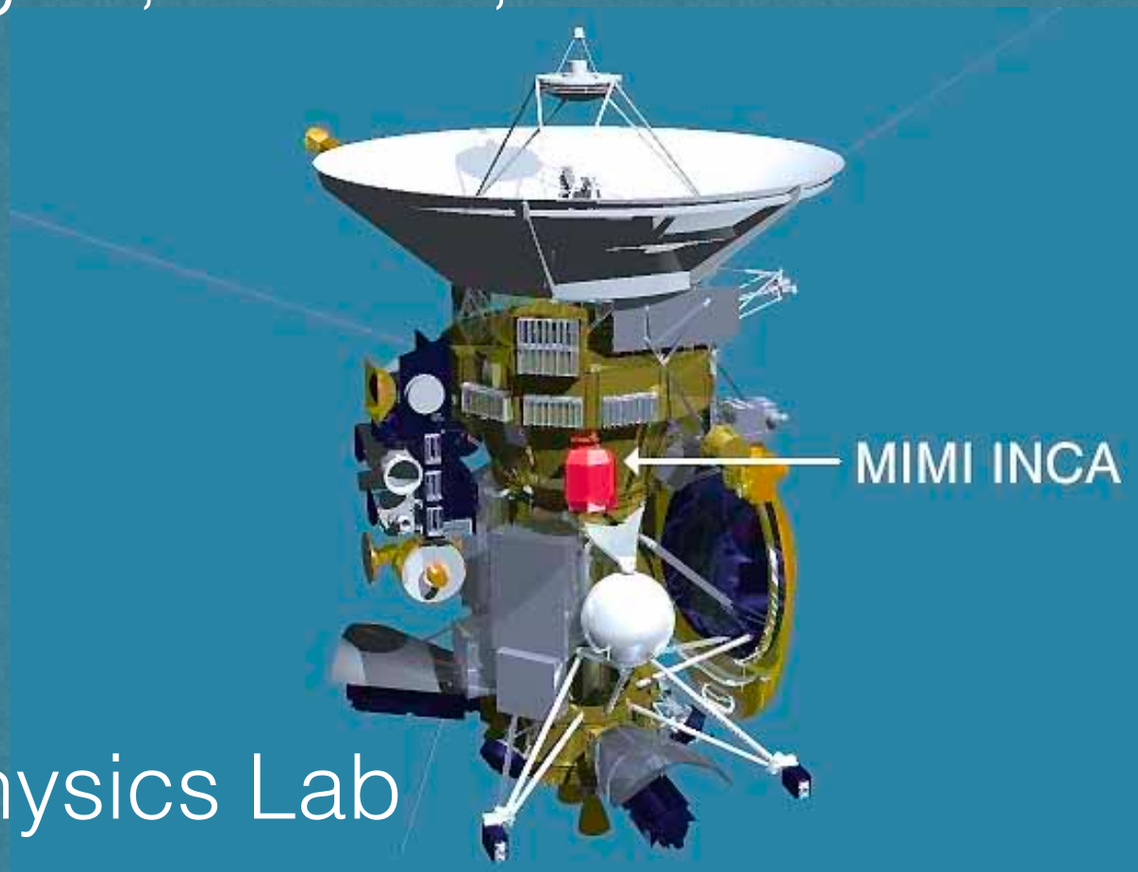


MIMI

Magnetospheric Imaging Instrument

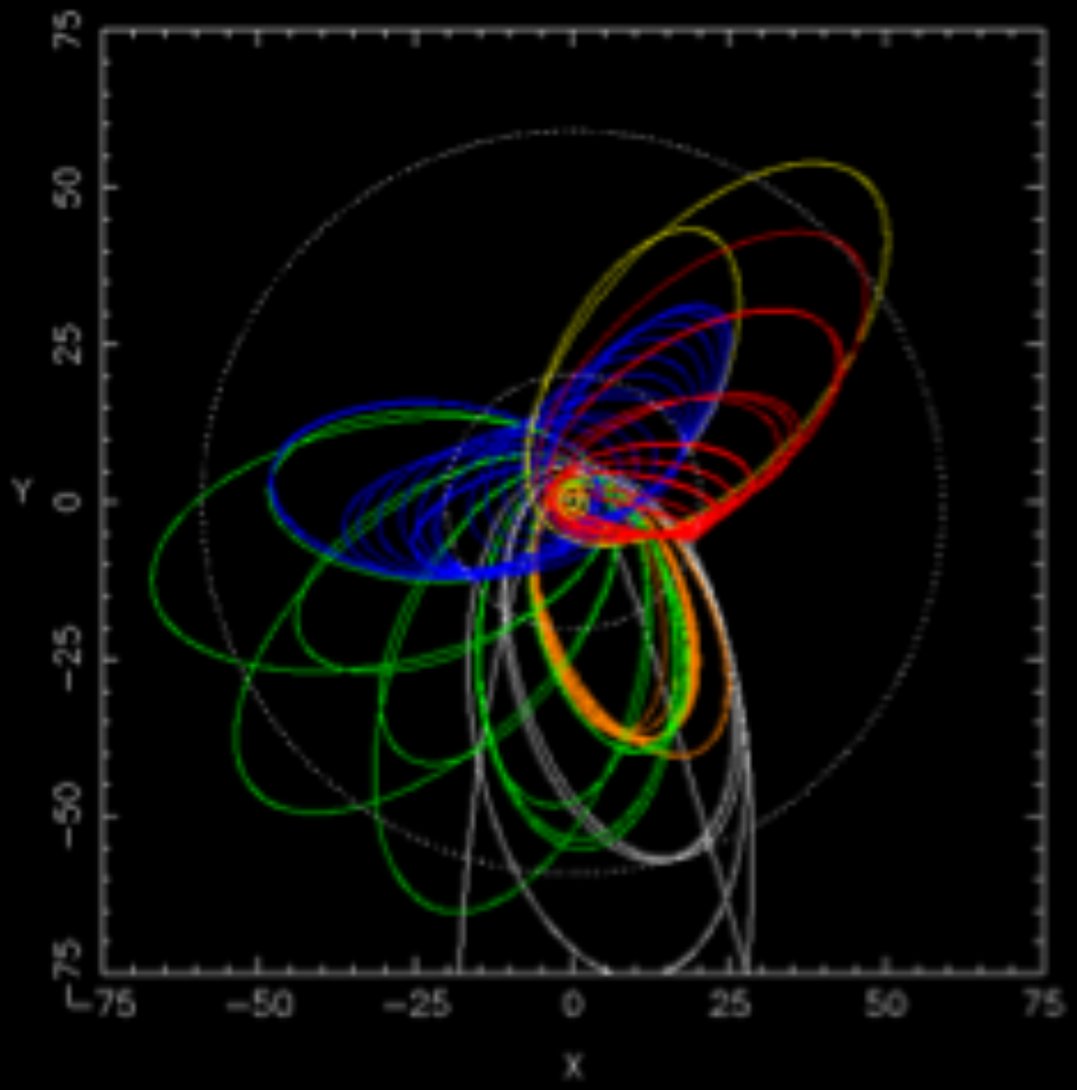
LEMMS: Max Planck Institut für Sonnensystemforschung

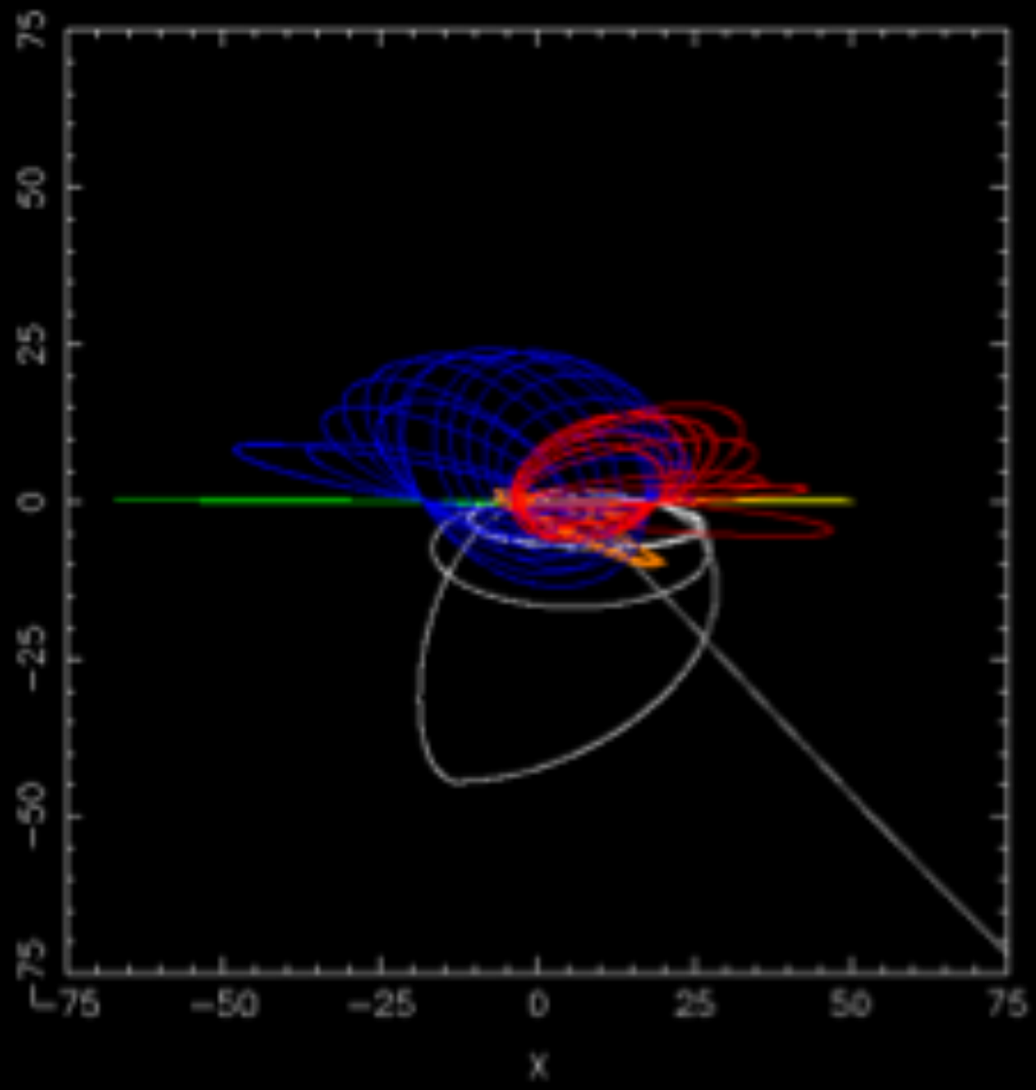
CHEMS: Fundamental Technologies, Kansas,
(but really UMd)



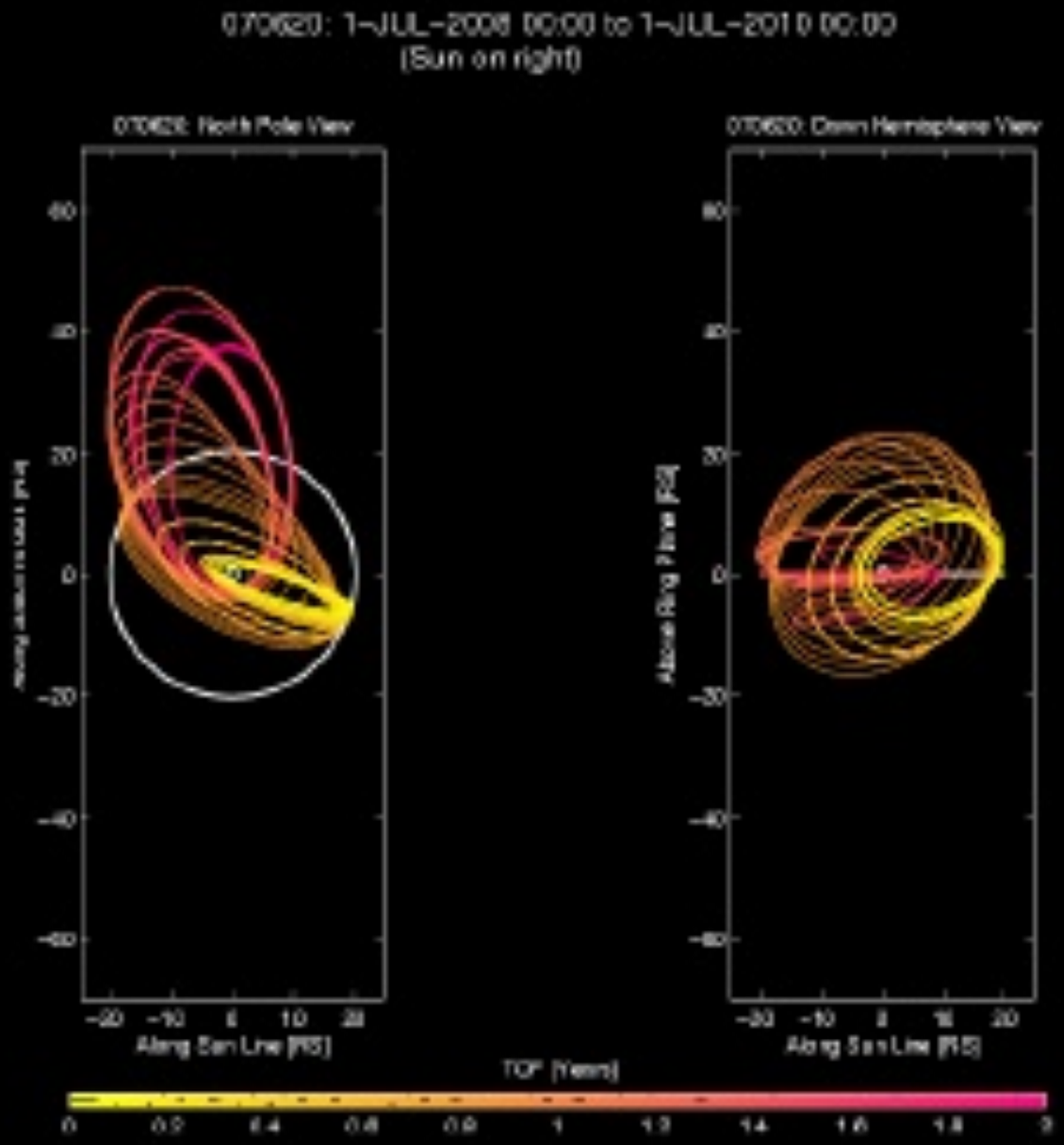
INCA: Johns Hopkins Applied Physics Lab

Cassini Prime Mission





Cassini Extended Mission

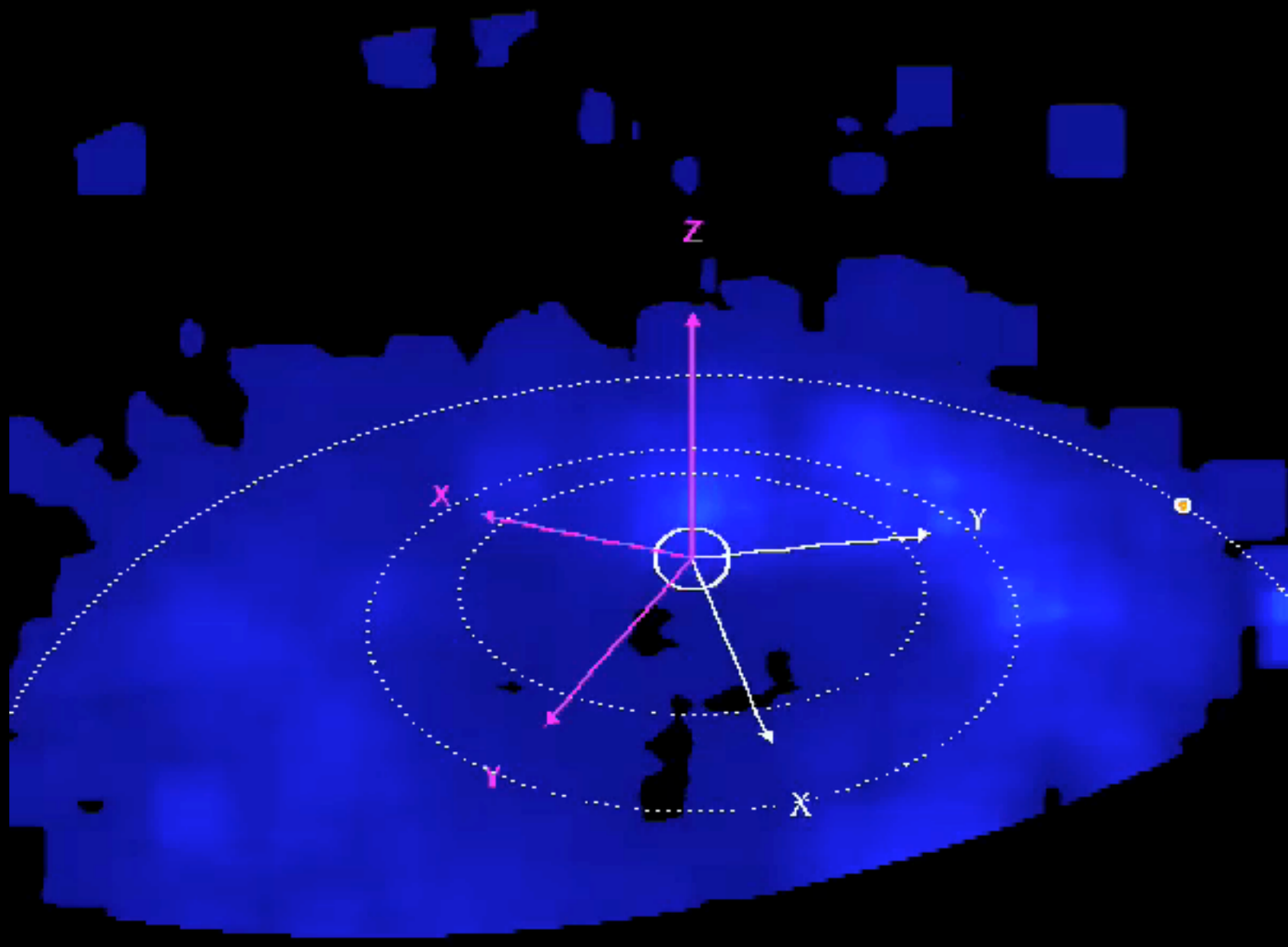


ENA Imaging with INCA

Cassini/MIMI Inca
Spatial H+ 50-80 keV

11 Jan 2009 (11)

10:33:39 - 11:37:39
(UTC)



Frame: SATURN

2.000

1.040

0.08000

cnts/quad
(cm²-sr-s-keV)⁻¹

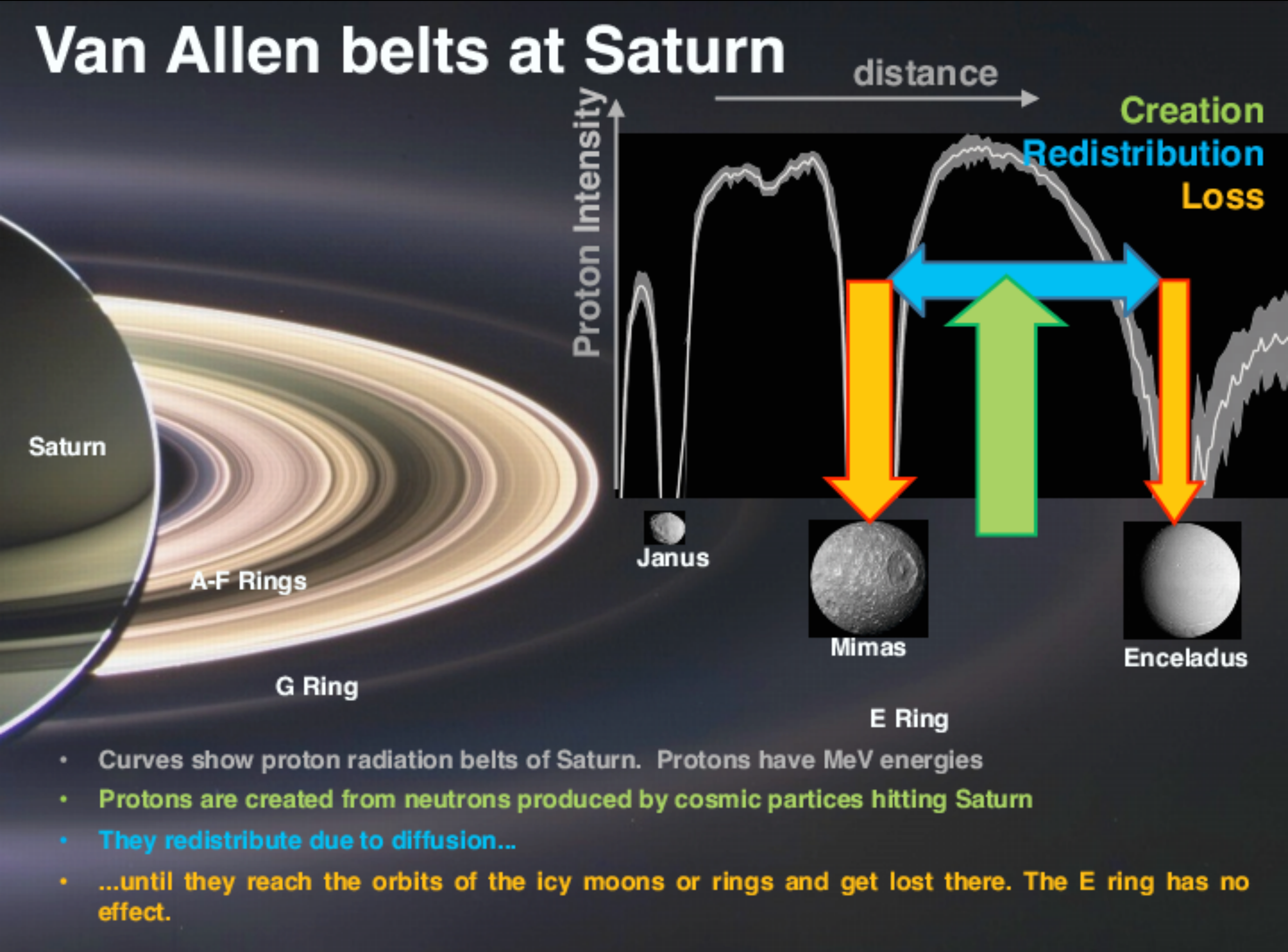
Salum: ,SZS,SKR

Body shift 1919 secs
Image shift 1919 secs
Stare Ave: 16 Wth: 1

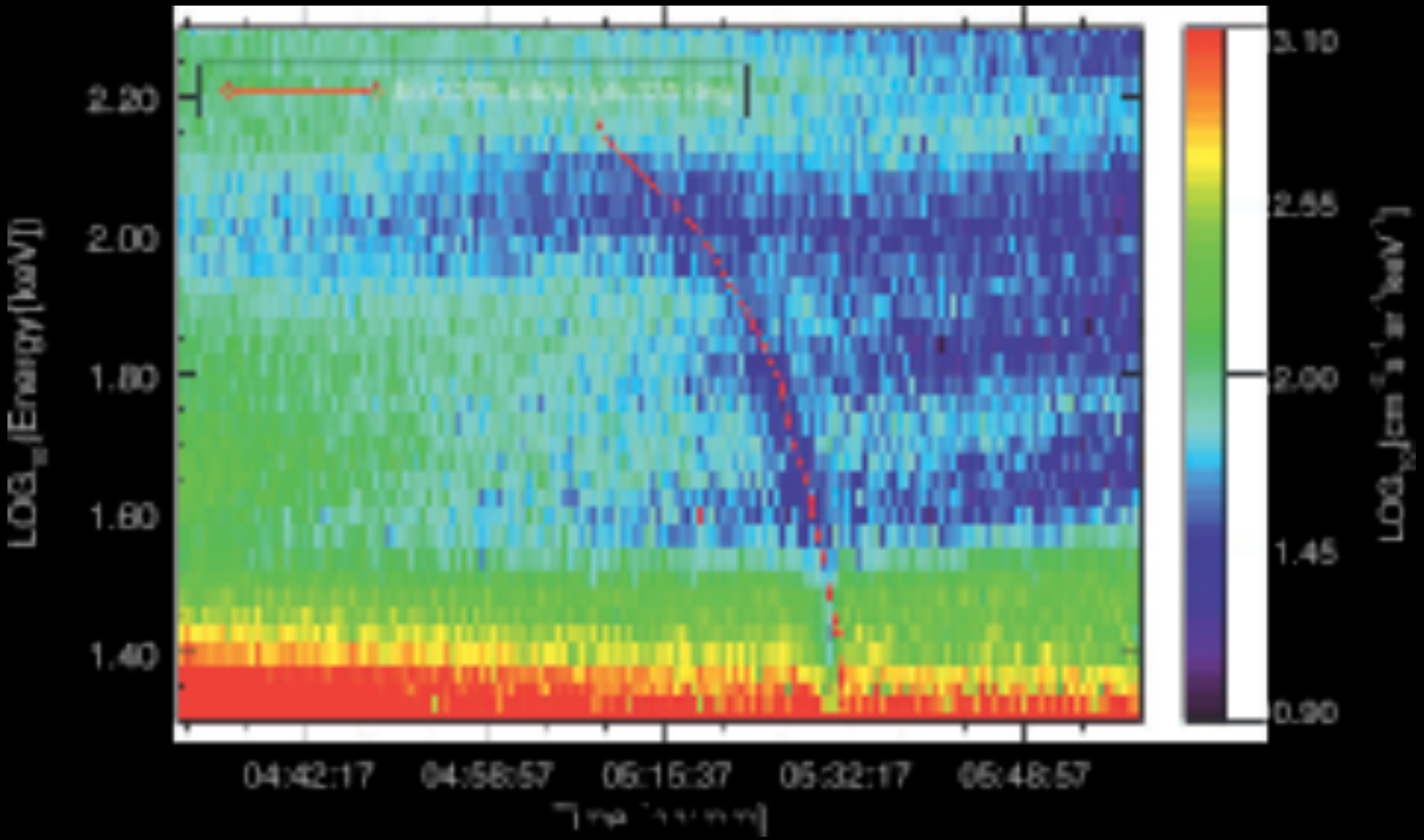
Rs	17.62
Lat	32.38
LT	1113
L	24.70
Lon$_{skr-wl}$	229.61

2009-015T15:15:56

Van Allen belts at Saturn



- Curves show proton radiation belts of Saturn. Protons have MeV energies
- Protons are created from neutrons produced by cosmic partices hitting Saturn
- They redistribute due to diffusion...
- ...until they reach the orbits of the icy moons or rings and get lost there. The E ring has no effect.


2.20
2.00
1.80
1.40
3.10
2.55
2.00
1.45
0.90
04:42:17
04:58:57
05:15:37
05:32:17
05:48:57

Trapped energetic electrons and ions bounce north and south, guided by Saturn's magnetic field

E-ring core

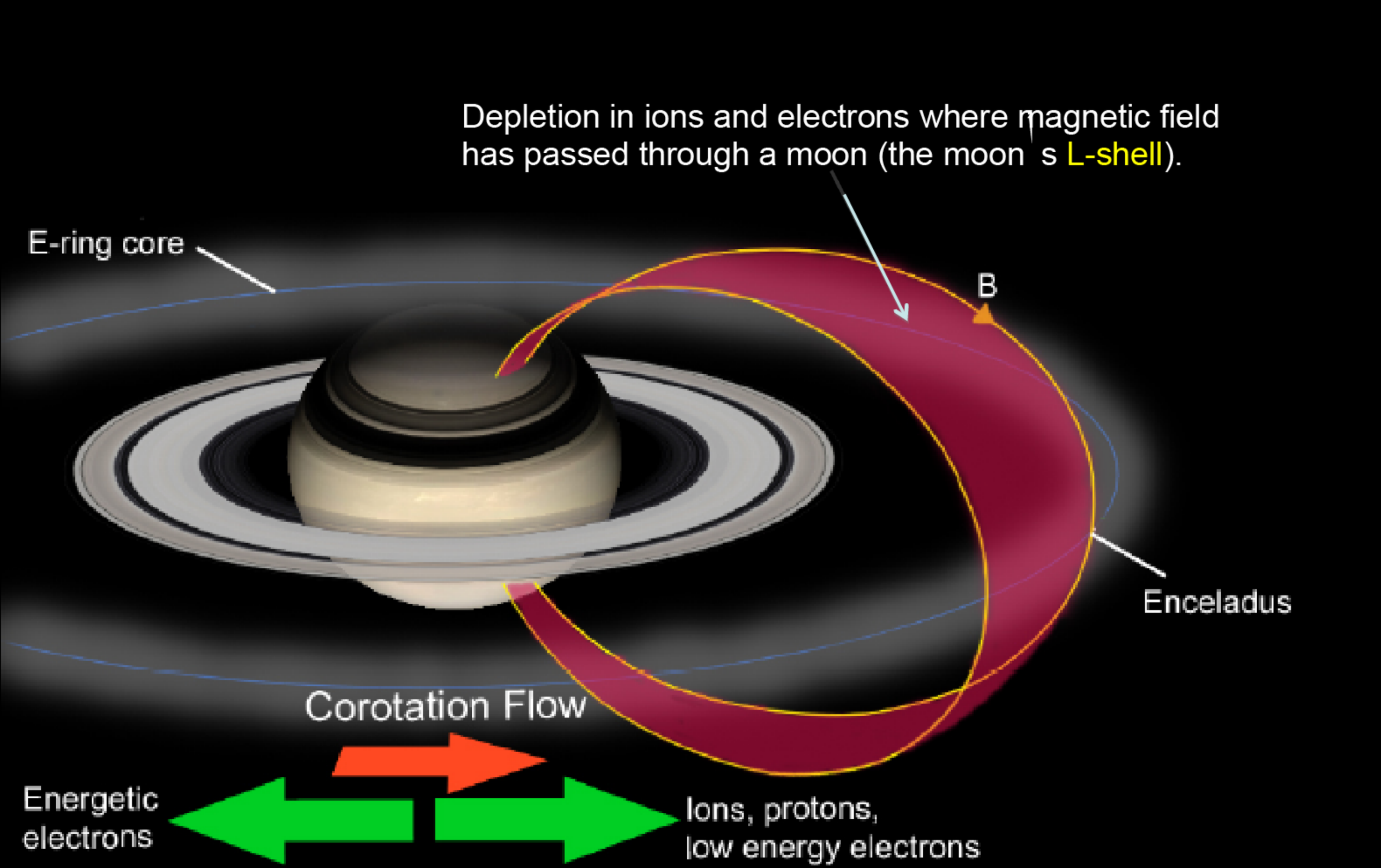
B

Enceladus

Corotation Flow

Energetic electrons

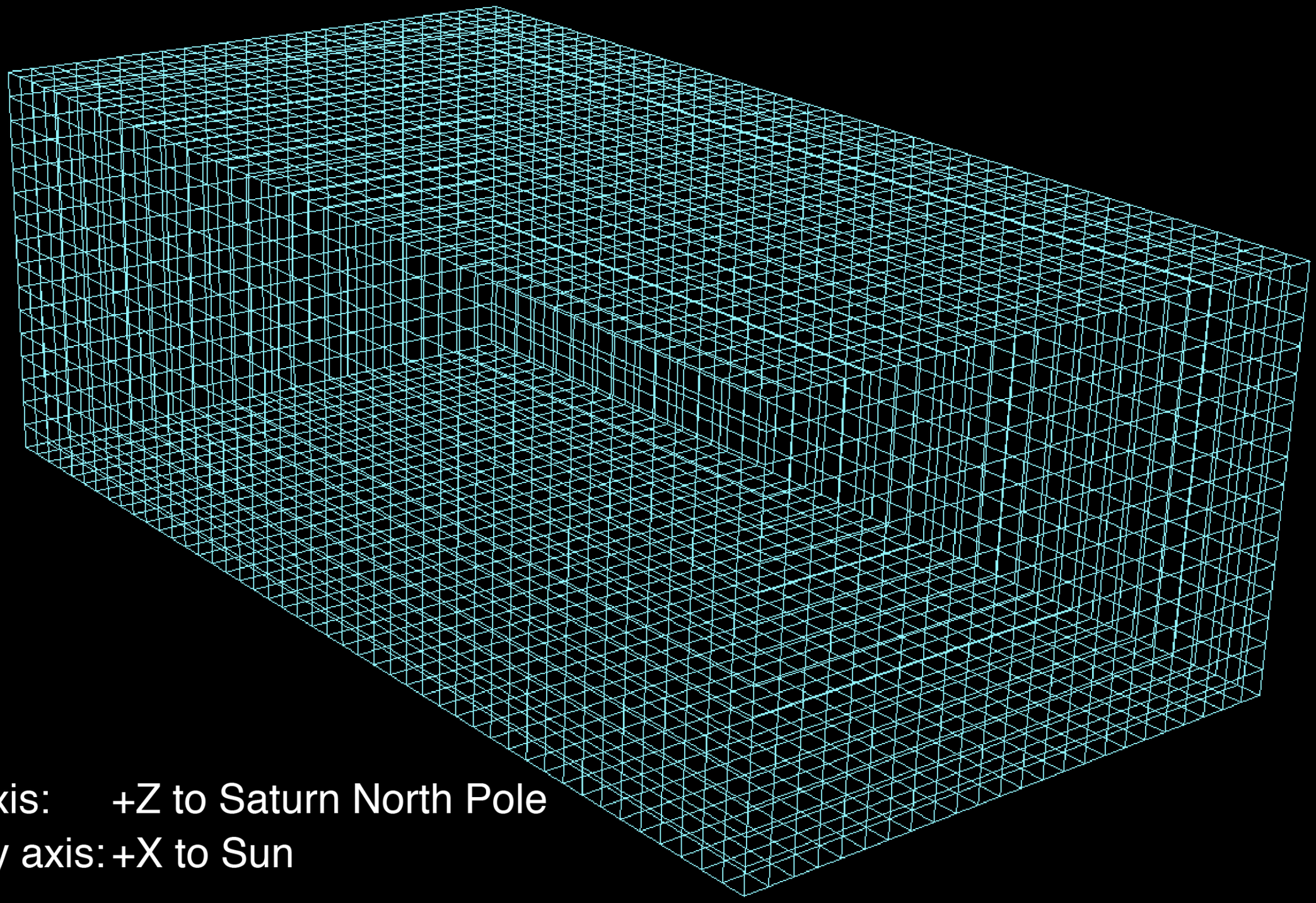
Ions, protons, low energy electrons


Depletion in ions and electrons where magnetic field has passed through a moon (the moon's L-shell).
E-ring core
B
Enceladus
Corotation Flow
Energetic electrons
Ions, protons, low energy electrons

Euler potentials

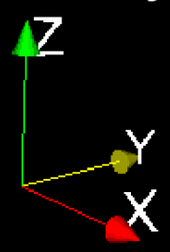
In progress

@10:15



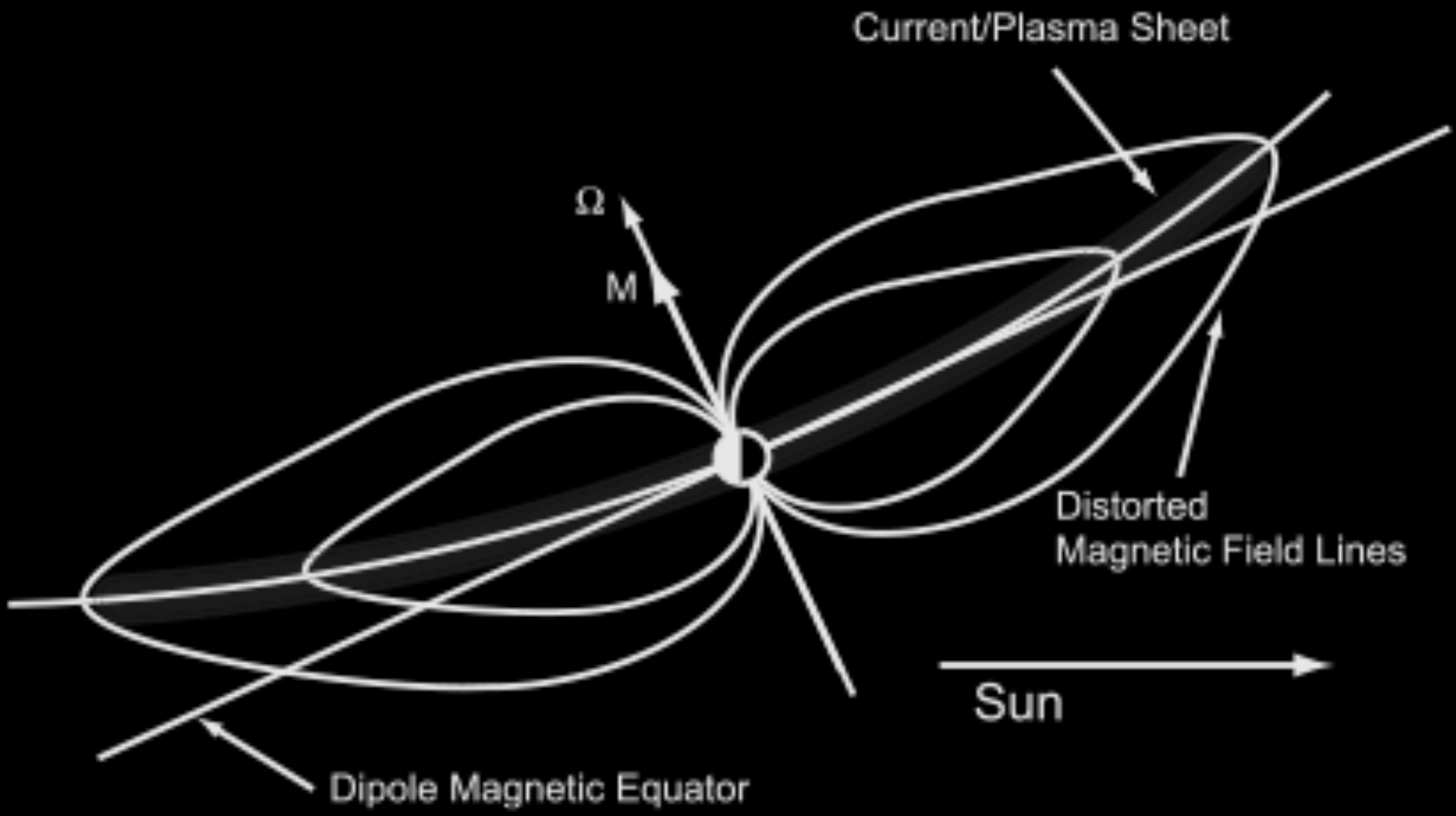
SZS

Primary axis: +Z to Saturn North Pole
Secondary axis: +X to Sun



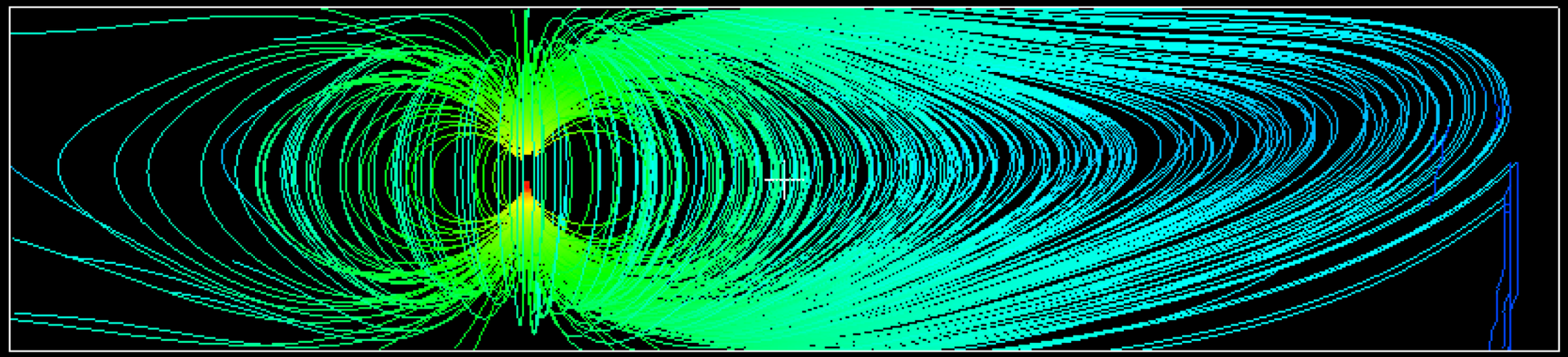
(KSM: Kronocentric Solar Magnetospheric)

Saturn's bowl-shaped magnetodisc

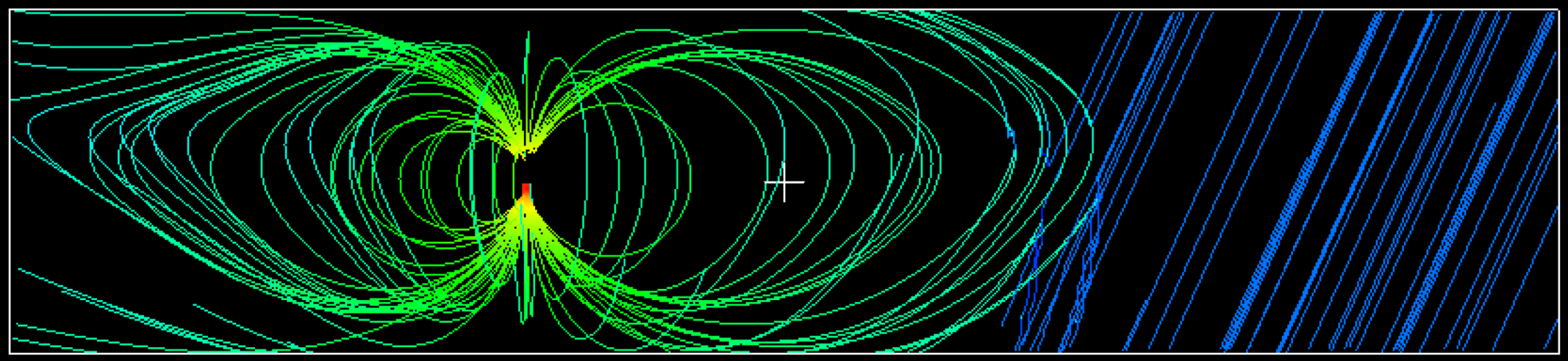


Arridge et al., 2008

B-field: X-Z View



Dynamic Pressure = 0.01 nPa



Dynamic Pressure = 0.10 nPa

Saturn's Planetary Magnetic Field

$$B_r = -\frac{\partial V}{\partial r} = \sum_{n=1}^{\infty} \sum_{m=0}^{n} \left[(n+1) \left(\frac{a}{r} \right)^{(n+2)} \left[g_{nm} \cos(m\phi) + h_{nm} \sin(m\phi) \right] - n \left(\frac{r}{a} \right)^{(n-1)} \left[G_{nm} \cos(m\phi) + H_{nm} \sin(m\phi) \right] \right] P_{nm} \cos(\theta)$$

$$B_\theta = -\frac{1}{r} \frac{\partial V}{\partial \theta} = -\sum_{n=1}^{\infty} \sum_{m=0}^{n} \left[\left(\frac{a}{r} \right)^{(n+2)} \left[g_{nm} \cos(m\phi) + h_{nm} \sin(m\phi) \right] + \left(\frac{r}{a} \right)^{(n-1)} \left[G_{nm} \cos(m\phi) + H_{nm} \sin(m\phi) \right] \right] \frac{dP_{nm} \cos(\theta)}{d\theta}$$

$$B_\phi = -\frac{1}{r \sin\theta} \frac{\partial V}{\partial \phi} = \frac{1}{\sin\theta} - \sum_{n=1}^{\infty} \sum_{m=0}^{n} \left[m \left(\frac{a}{r} \right)^{(n+2)} \left[g_{nm} \sin(m\phi) - h_{nm} \cos(m\phi) \right] + \left(\frac{r}{a} \right)^{(n-1)} \left[G_{nm} \cos(m\phi) + H_{nm} \sin(m\phi) \right] \right] P_{nm} \cos(\theta)$$