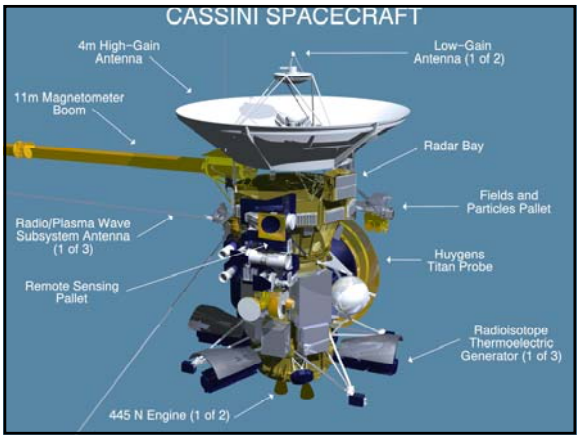
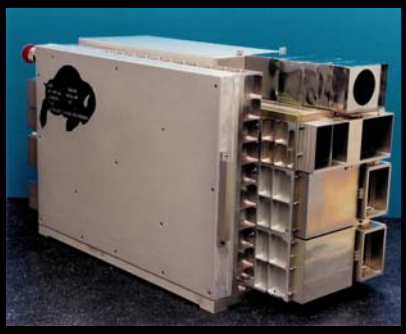
Cassini Mission Update

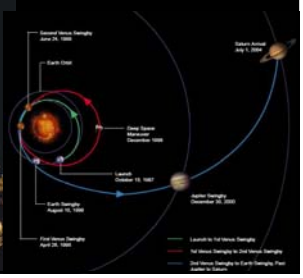
Larry W. Esposito
LASP Seminar
25 October 2007



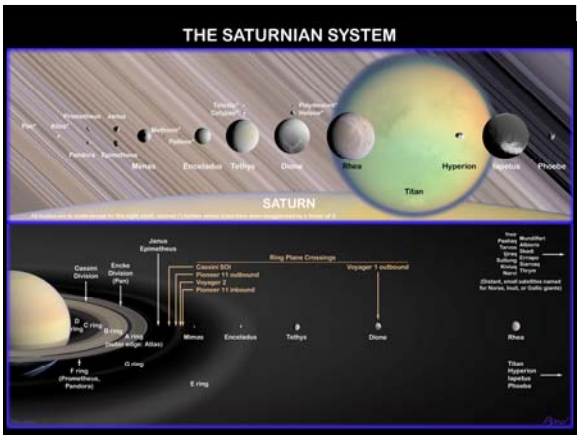


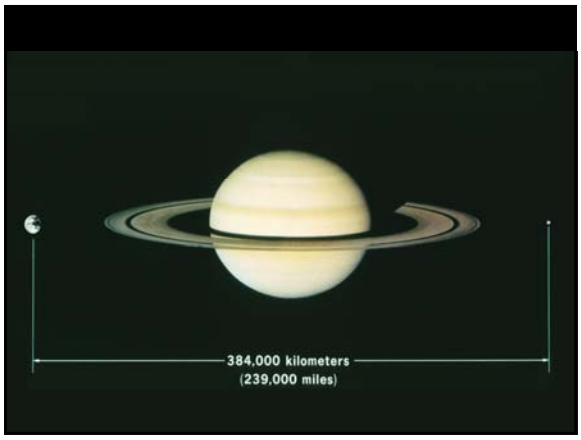
Launched on October 15, 1997 from KSC

7 Year cruise on Venus-Venus-Earth-Jupiter Gravity Assist trajectory

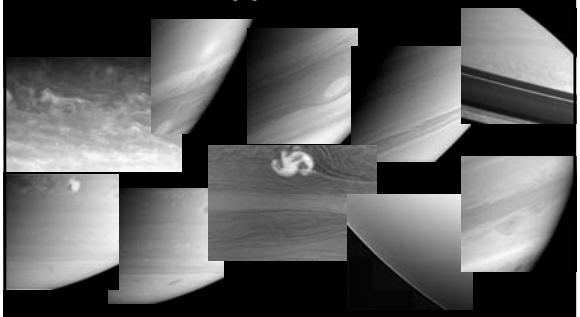


30 June / 1 July 2004



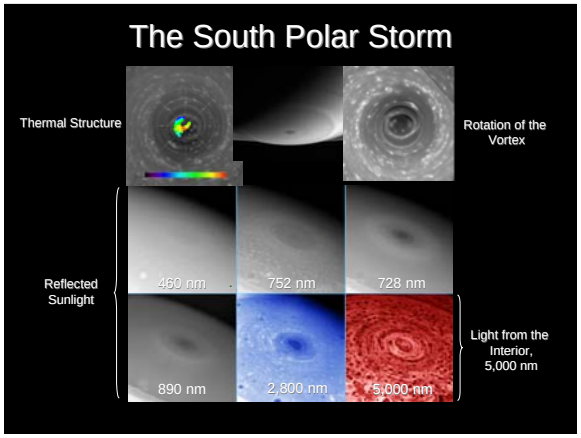


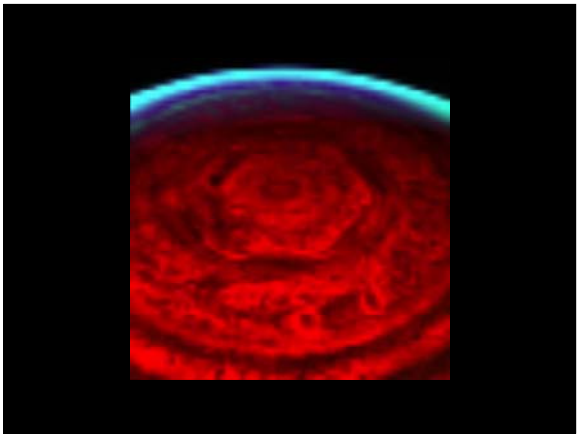
Saturn's Upper Level Clouds



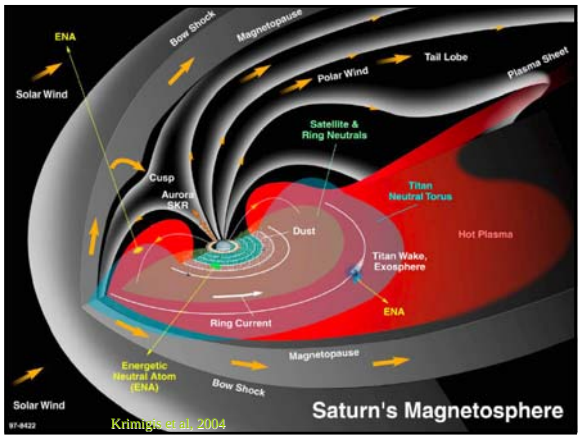
Montage of diverse atmospheric phenomena.

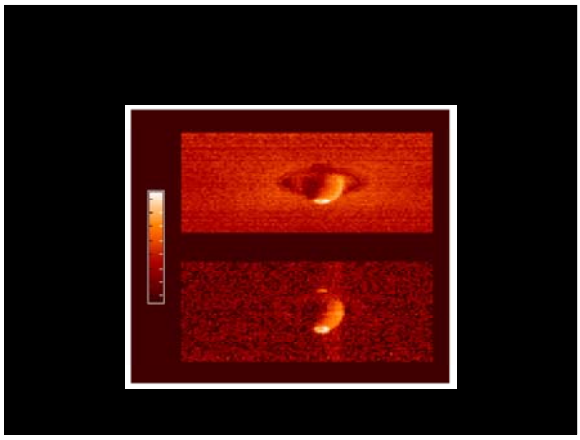
The South Polar Storm

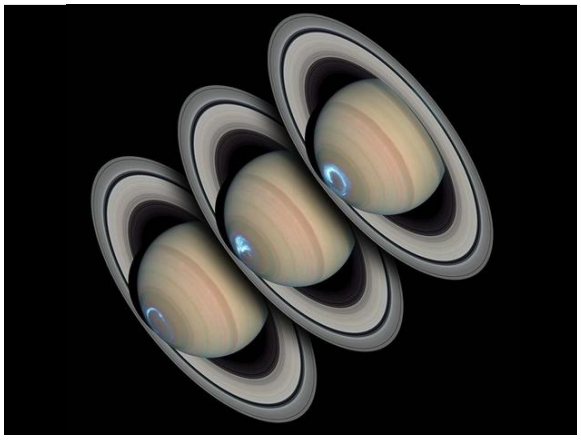


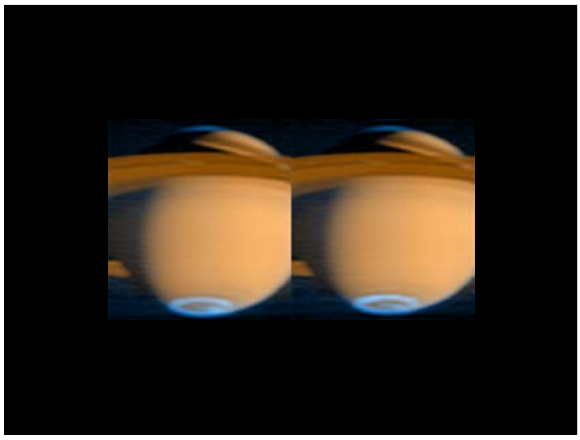


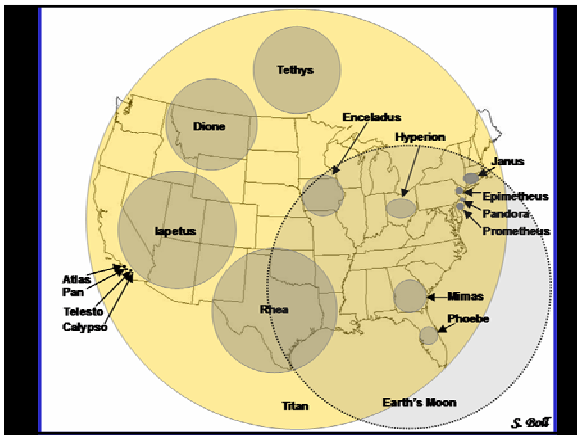
Rev 28 High Phase Observation (Sun obscured by planet)

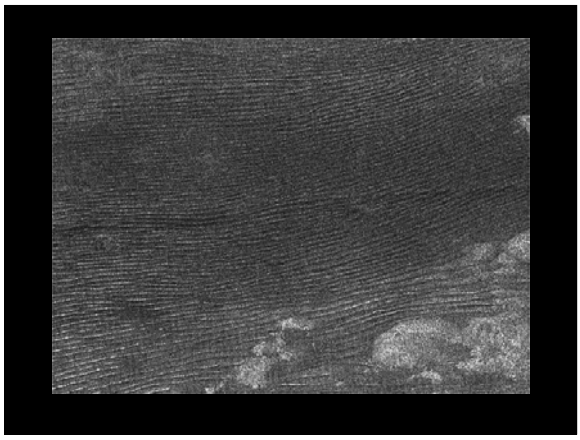

ENA
Solar Wind
Bow Shock
Magnetopause
Polar Wind
Tail Lobe
Plasma Sheet
Satellite & Ring Neutrals
Cusp
Aurora SKR
Titan Neutral Torus
Dust
Hot Plasma
Titan Wake, Exosphere
ENA
Ring Current
Magnetopause
Energetic Neutral Atom (ENA)
Bow Shock
Solar Wind
Saturn's Magnetosphere
Krimigis et al, 2004

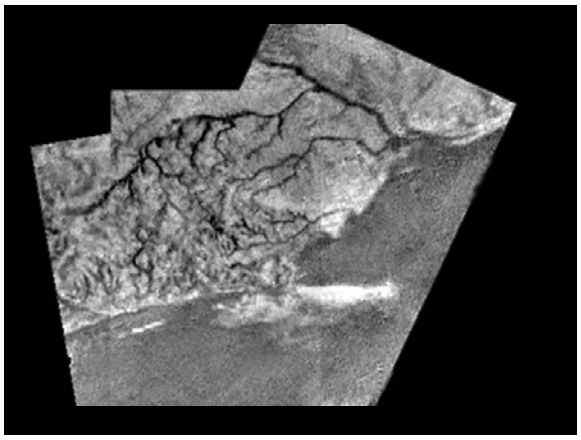


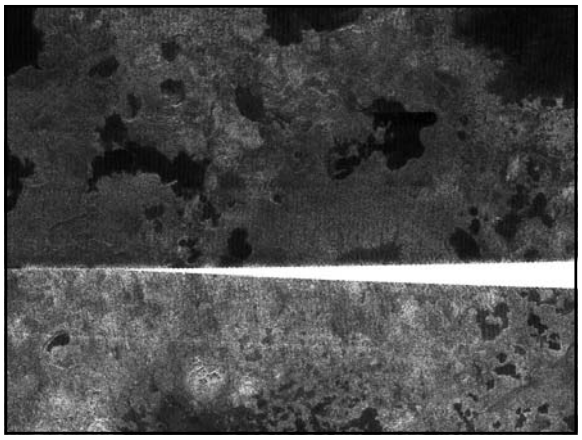


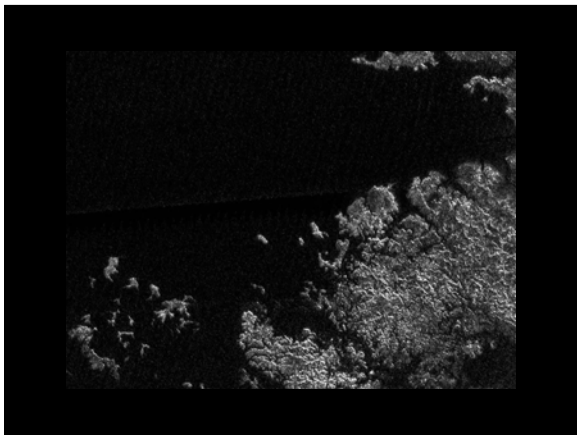


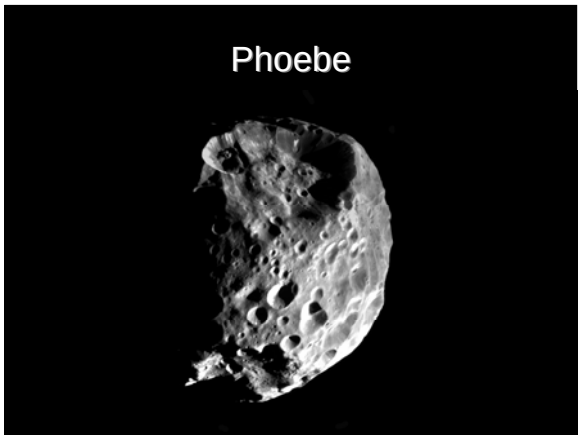

Tethys
Dione
Enceladus
Hyperion
Janus
Epimetheus
Pandora
Prometheus
Iapetus
Atlas
Pan
Telesto
Calypso
Rhea
Mimas
Phoebe
Titan
Earth's Moon
S. Bell

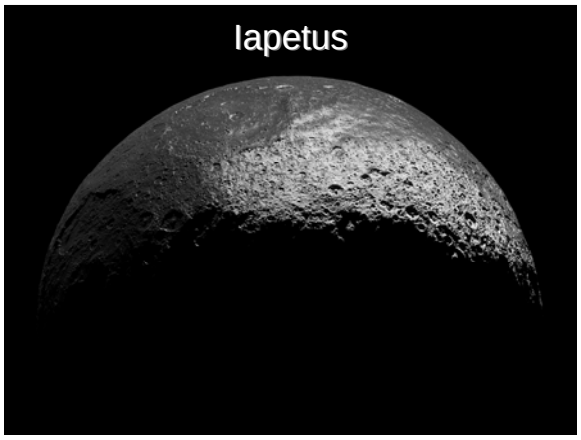


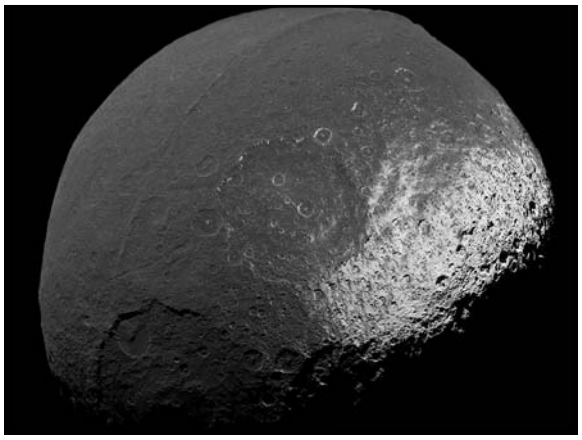




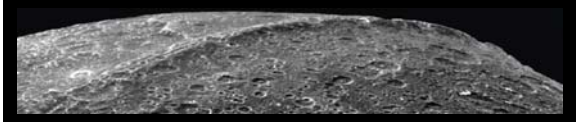



Phoebe


Iapetus



RIDGE CHARACTERISTICS



Porco *et al.* (2005)

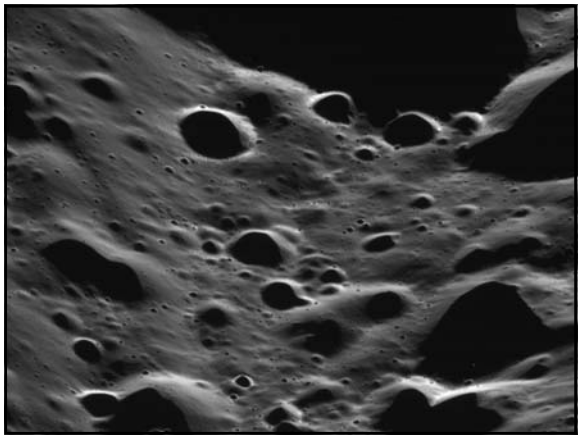
Length ~ 4680 km

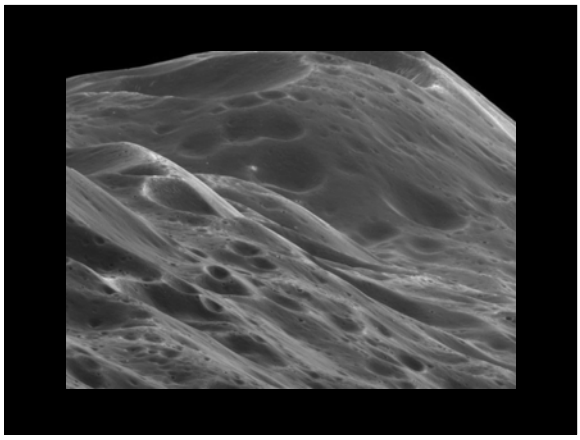
Width ~ 100 km

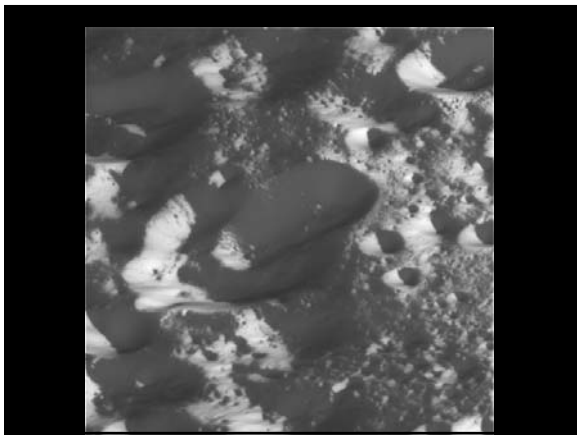
Height up to 20 km
Very steep flanks, slope angle partly >30°!

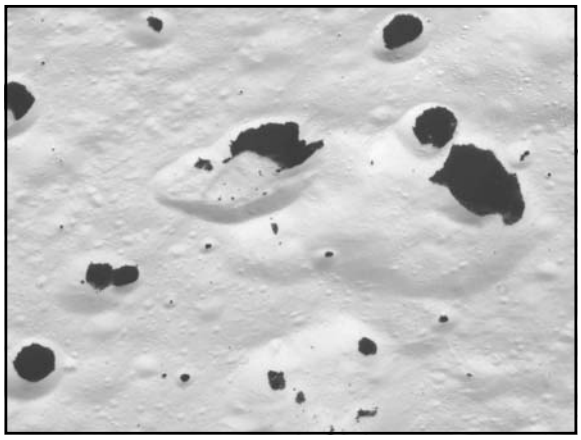
Age ~ same as surroundings (4.4 - 4.5 By)

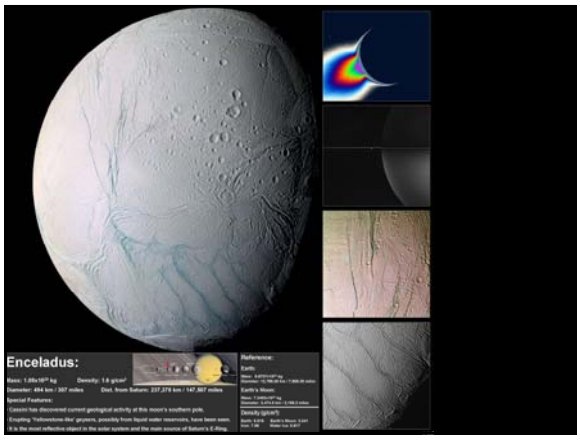
Structure: single or double ridge

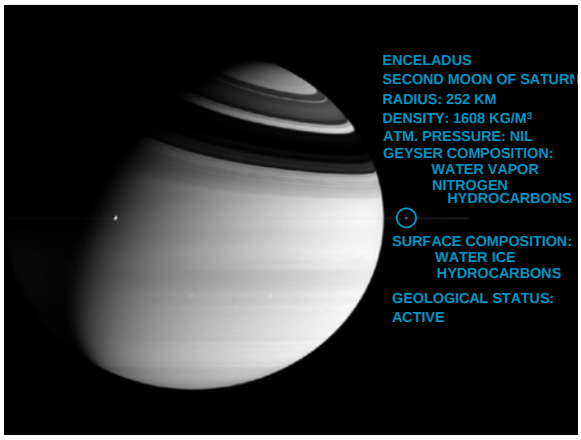


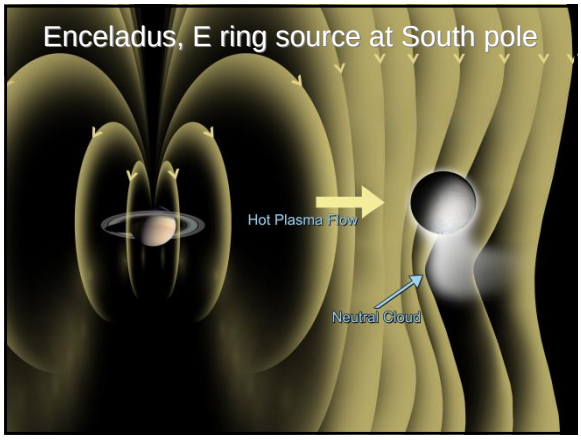


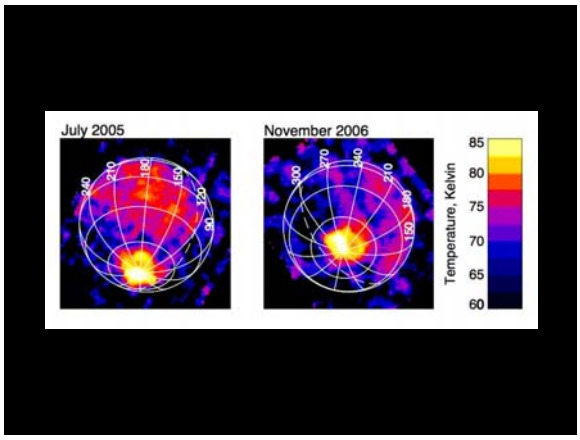


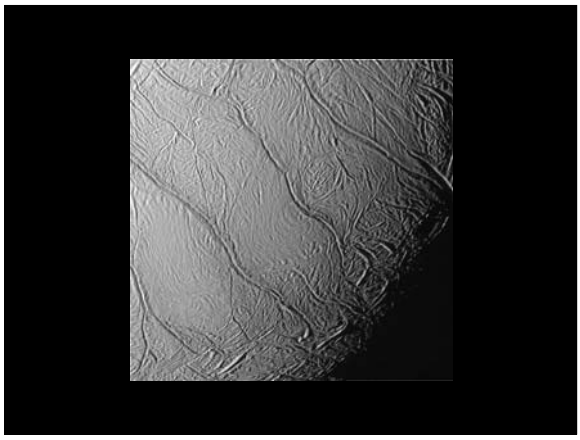


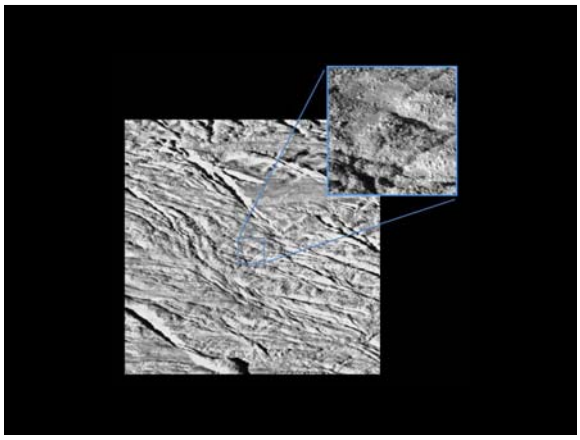

Enceladus:

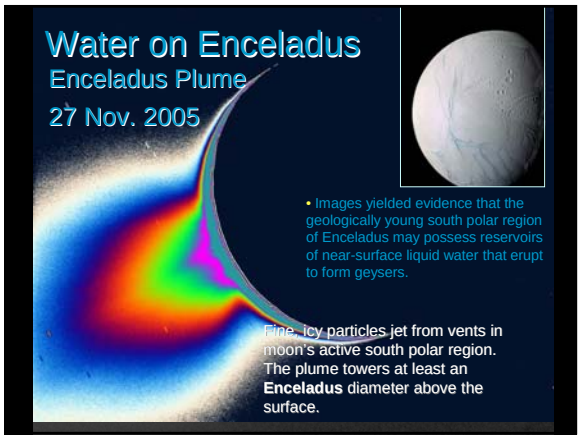

ENCELADUS
SECOND MOON OF SATURN
RADIUS: 252 KM
DENSITY: 1608 KG/M³
ATM. PRESSURE: NIL
GEYSER COMPOSITION:
WATER VAPOR
NITROGEN
HYDROCARBONS
SURFACE COMPOSITION:
WATER ICE
HYDROCARBONS
GEOLOGICAL STATUS:
ACTIVE

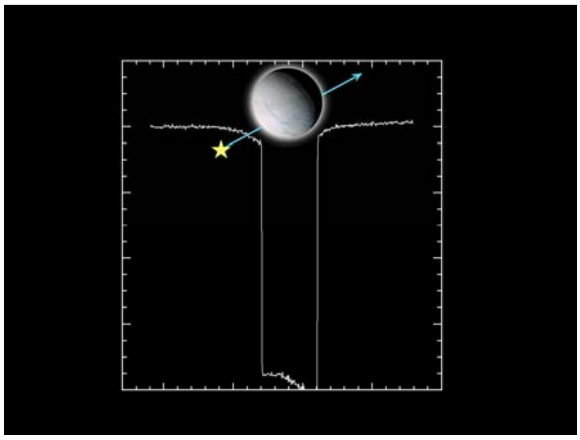

Enceladus, E ring source at South pole
Hot Plasma Flow
Neutral Cloud

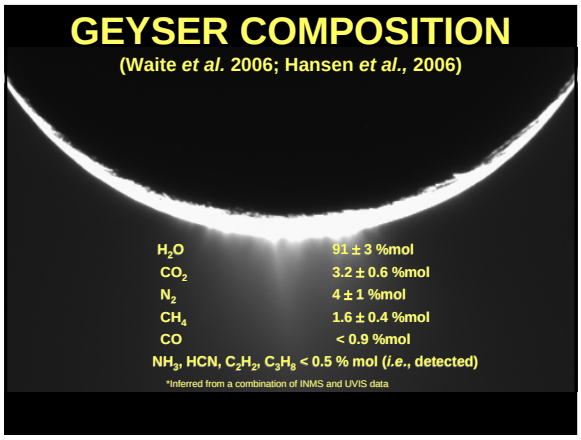

July 2005
November 2006
Temperature, Kelvin
85
80
75
70
65
60

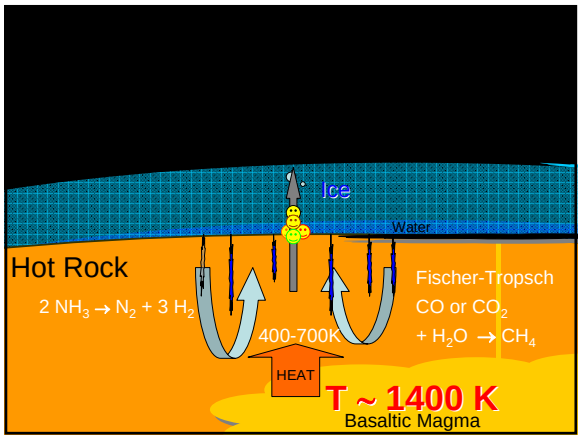


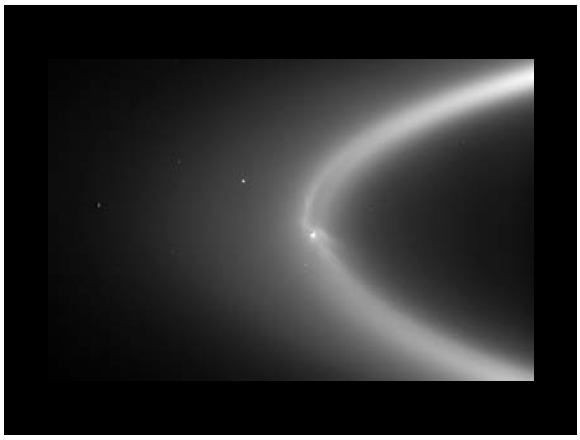


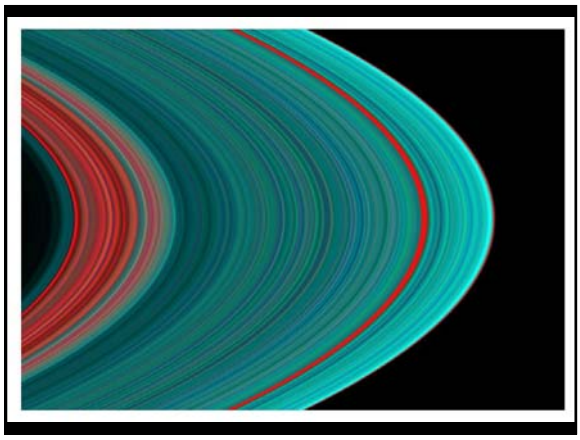

Water on Enceladus
Enceladus Plume
27 Nov. 2005
• Images yielded evidence that the geologically young south polar region of Enceladus may possess reservoirs of near-surface liquid water that erupt to form geysers.
Fine, icy particles jet from vents in moon's active south polar region. The plume towers at least an Enceladus diameter above the surface.

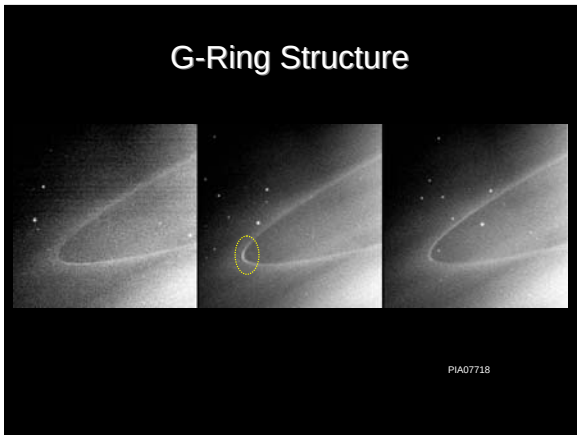


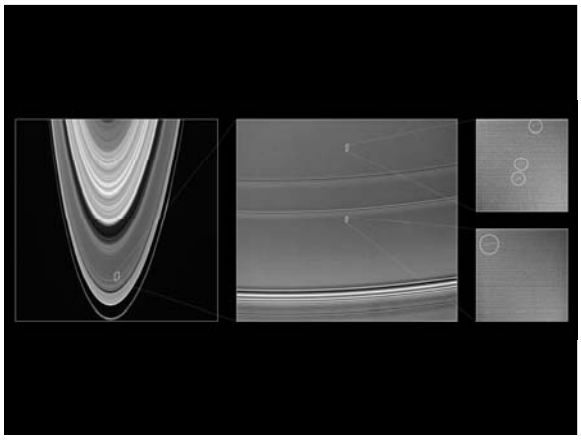

GEYSER COMPOSITION
(Waite et al. 2006; Hansen et al., 2006)
H2O 91 ± 3 %mol
CO2 3.2 ± 0.6 %mol
N2 4 ± 1 %mol
CH4 1.6 ± 0.4 %mol
CO < 0.9 %mol
NH3, HCN, C2H2, C3H8 < 0.5 % mol (i.e., detected)
*Inferred from a combination of INMS and UVIS data

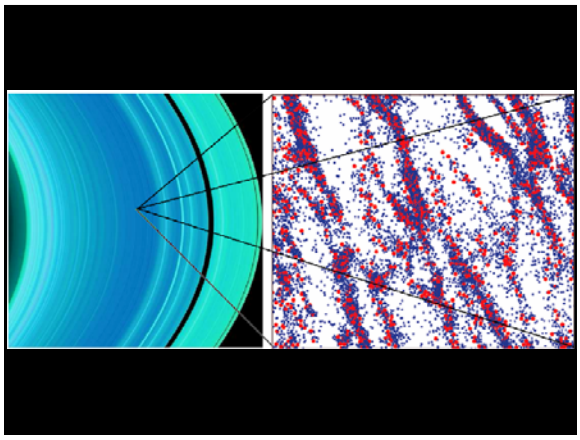

Ice
Water
Hot Rock
2 NH3 → N2 + 3 H2
400-700K
HEAT
Fischer-Tropsch
CO or CO2
+ H2O → CH4
T ~ 1400 K
Basaltic Magma

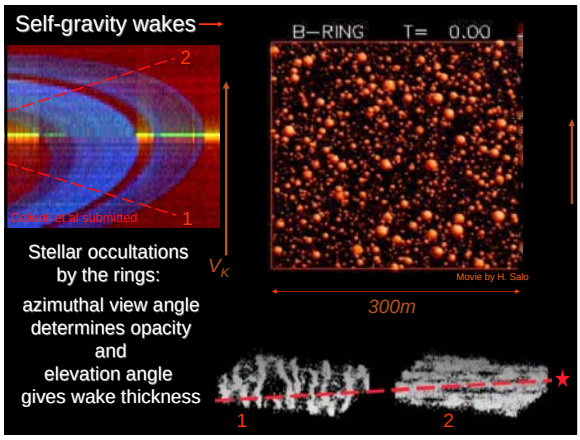





G-Ring Structure
PIA07718






Self-gravity wakes
2
1
Colwell et al submitted
Stellar occultations
by the rings:
azimuthal view angle
determines opacity
and
elevation angle
gives wake thickness
V_K
B–RING T= 0.00
Movie by H. Salo
300m
1
2

UVIS
VIMS

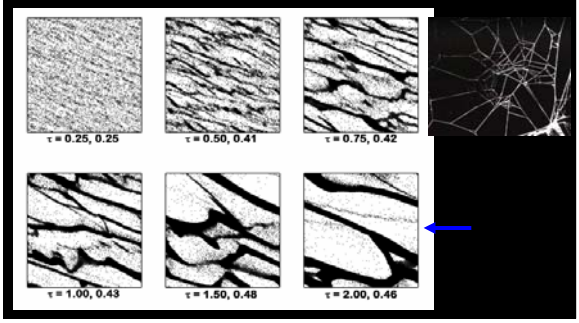
Colwell et al. 2006, 2007
Hedman et al. 2007

measured transmission
strong function of the observation geometry

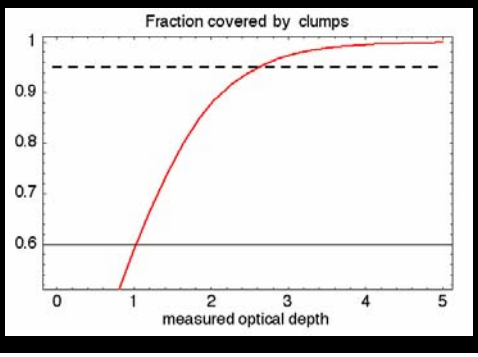
They do not measure the mass inside the clumps!

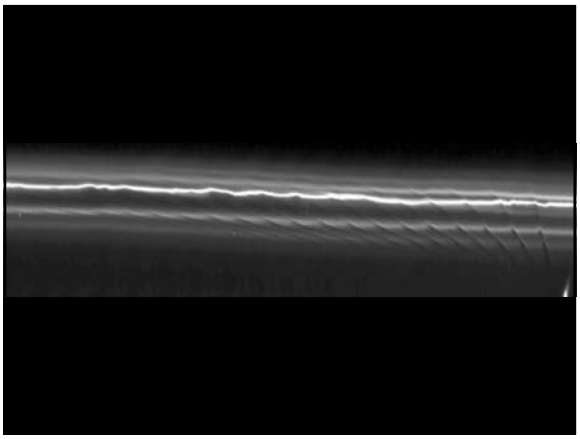
Colwell's Granola bar model

connectivity

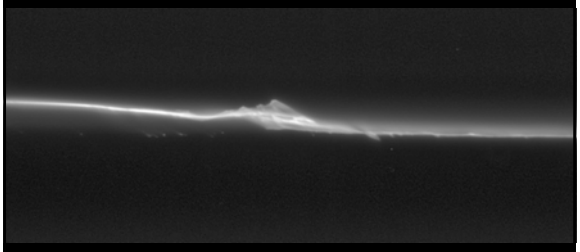


Fraction of surface covered by high-density clumps is > 95% for measured optical depth > 3

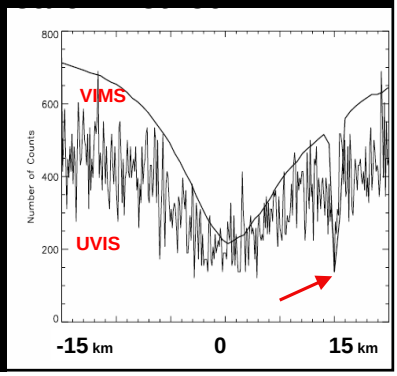


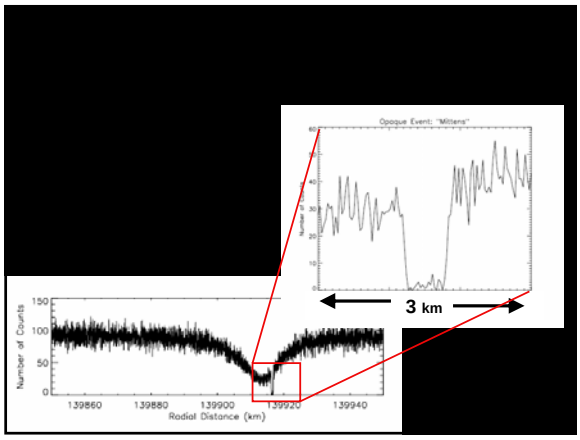


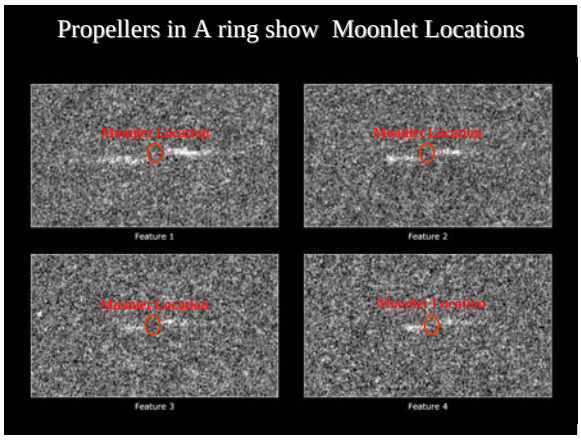
Puzzling F ring Gossamer Structures

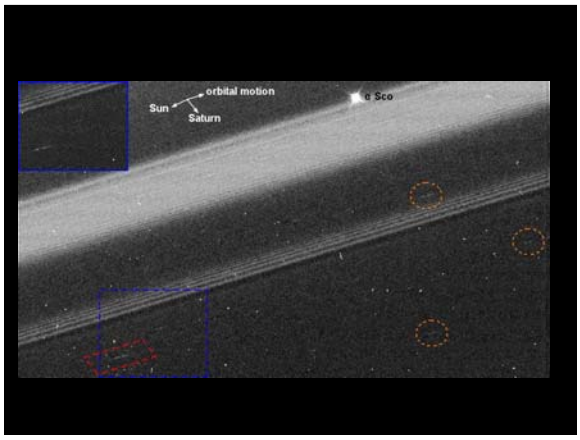


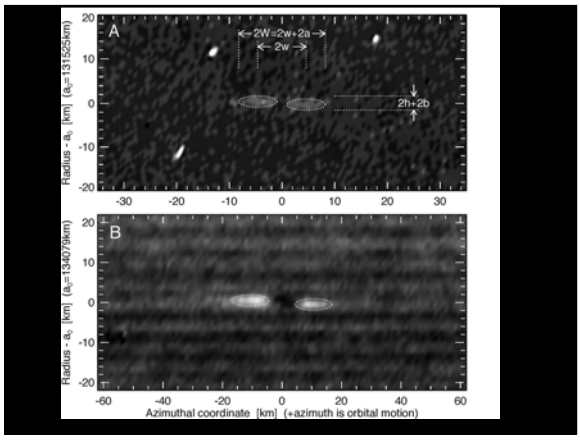
In this high phase angle image of the F ring, gossamer structures suggest that unseen objects are perturbing the ring.

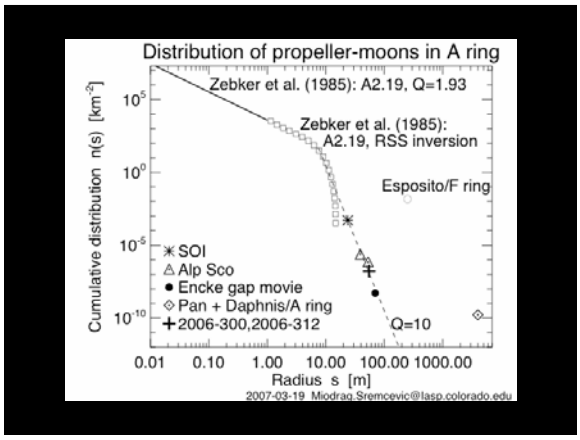


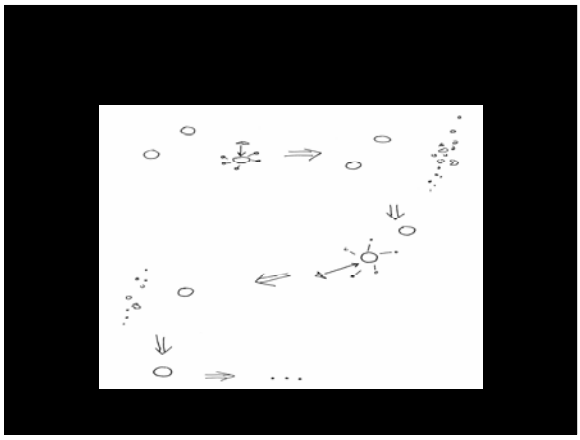

Opaque Event: "Mittens"
3 km
Number of Counts
Radial Distance (km)

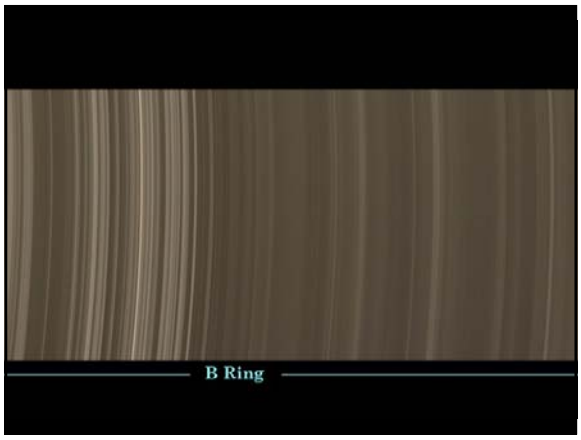

Propellers in A ring show Moonlet Locations
Moonlet Location
Feature 1
Feature 2
Feature 3
Feature 4

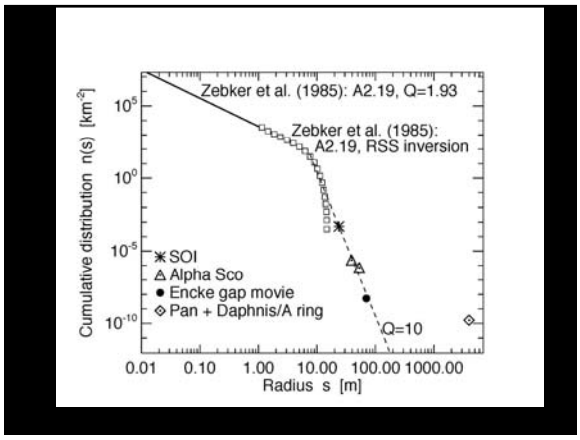

orbital motion
Sun
Saturn
α Sco

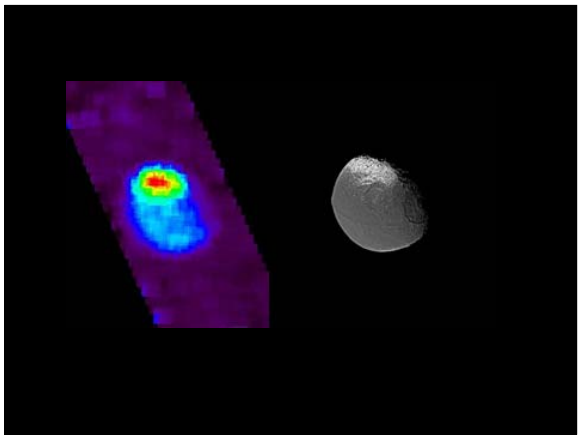

A
B
2W=2w+2a
2w
2h+2b
Azimuthal coordinate [km] (+azimuth is orbital motion)

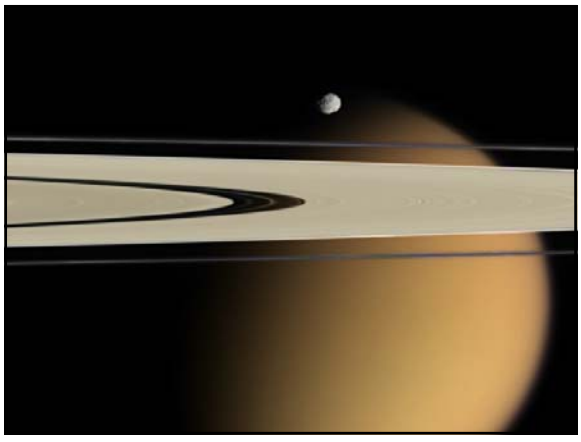

Distribution of propeller-moons in A ring
Zebker et al. (1985): A2.19, Q=1.93
Zebker et al. (1985): A2.19, RSS inversion
Esposito/F ring
SOI
Alp Sco
Encke gap movie
Pan + Daphnis/A ring
2006-300,2006-312
Q=10
Cumulative distribution n(s) [km⁻²]
Radius s [m]
2007-03-19 Miodrag.Sremcevic@lasp.colorado.edu

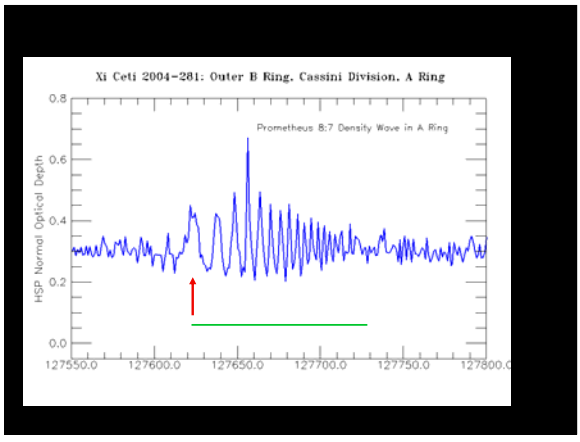


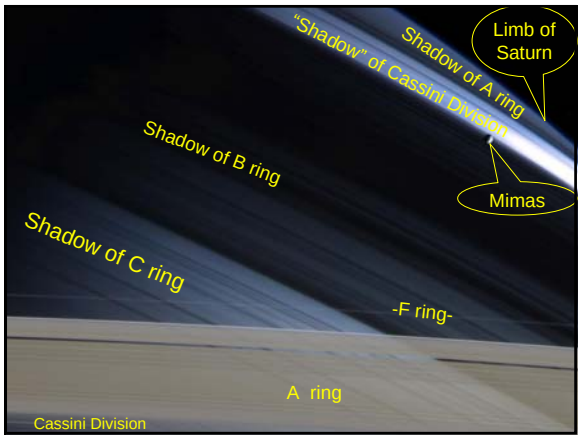

B Ring


Zebker et al. (1985): A2.19, Q=1.93
Zebker et al. (1985): A2.19, RSS inversion
SOI
Alpha Sco
Encke gap movie
Pan + Daphnis/A ring
Q=10
Cumulative distribution n(s) [km^-2]
Radius s [m]
0.01
0.10
1.00
10.00
100.00
1000.00

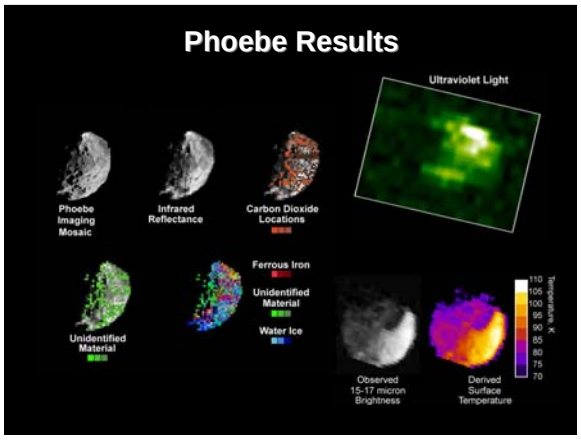





Xi Ceti 2004-281: Outer B Ring, Cassini Division, A Ring
Prometheus 8:7 Density Wave in A Ring
HSP Normal Optical Depth
0.0
0.2
0.4
0.6
0.8
127550.0
127600.0
127650.0
127700.0
127750.0


Limb of Saturn
"Shadow" of Cassini Division
Shadow of A ring
Shadow of B ring
Mimas
Shadow of C ring
-F ring-
A ring
Cassini Division


Phoebe:


Phoebe Results
Ultraviolet Light
Phoebe Imaging Mosaic
Infrared Reflectance
Carbon Dioxide Locations
Ferrous Iron
Unidentified Material
Water Ice
Unidentified Material
Observed 15-17 micron Brightness
Derived Surface Temperature
Temperature, K