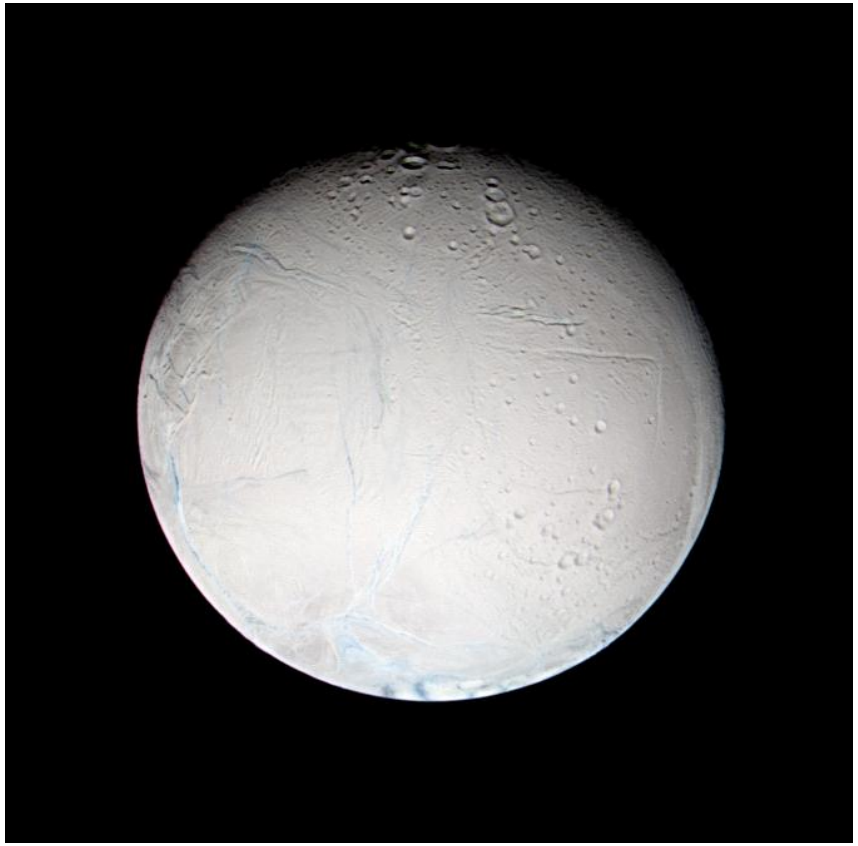
S09-Second Targeted Enceladus Flyby

Enceladus (004EN) Preview Overview



Amanda Hendrix, Bonnie Buratti, Rosaly Lopes

7 March 2005

Summary: 004EN

- Closest Approach:
  - 500 km (310 mi) altitude
    - Dust hazard at C/A
  - March 9 2005 09:09:04.8176 SCET (Wed. March 9 02:20 AM Pacific time)
  - 6.6 km/s
  - 43.1° phase at C/A (low phase inbound)
  - RWA control
- Data Return:
  - Short downlink outbound (~3 hr) (8-11 am Wed. PST) (1290 Mb)
  - Final Goldstone downlink (8 hr) (5:19 pm Wed.-12:13 am Thurs. PST) (3594 Mb)
- Science Highlights:
  - ORS inbound, outbound
  - Tethys observations
  - RADAR outbound

Enceladus 004EN Flyby

- First targeted Enceladus flyby
- Geometry complementary to 003EN
  - Some overlapping terrain at low resolutions
  - Highest res observations on leading/anti-Saturnian hemisphere
    - (highest res 003EN observations were on trailing/anti-Saturnian hemisphere)
- Dust hazard at C/A
  - Closest ORS look is at ~5740 km (EN-00:10)
  - Closest 003EN ORS at ~11,900 km (EN-00:25)

004EN Attitude Strategy

Request	Riders	Start (SCET)	Start (Epoch)	Duration	End (SCET)	Primary	Secondary	Comments
Sequence S009, length = 41 ...		2005-058T00:36:00	E003_SEQUENCE_009+000T00:00:00	041T04:39:00	2005-099T05:15:00			
SOST rev 4 Segment		2005-067T07:34:00		001T23:52:00	2005-069T07:26:00			
SP_004EN_WAYPTTURN067_PRIME		2005-067T07:35:00		000T00:30:00	2005-067T08:05:00	ISS_NAC to Enceladus	POS_X to NEP	turn duration=18.7 min from -Z to EA, +X to NEP
NEW WAYPOINT		**2005-067T08:05:00**		**001T01:19:01**	**2005-068T09:24:01**	**ISS_NAC to Enceladus**	**POS_X to NEP**	
VIMS_004SA_CYLMAP001_PRIME	C, U	2005-067T09:30:00		000T10:00:00	2005-067T19:30:00	ISS_NAC to Saturn	POS_X to NSP	
SP_004EA_DLTURN067_PRIME		2005-067T19:30:00		000T00:20:00	2005-067T19:50:00	XBAND to Earth	POS_X to NSP	turn duration = 12.4 min
SP_004EA_M70METNON067_PRIME		2005-067T19:50:00		000T03:50:00	2005-067T23:40:00	XBAND to Earth	POS_X to NSP	
SP_004EN_WAYPTTURN467_PRIME		2005-067T23:40:00		000T00:20:00	2005-068T00:00:00	ISS_NAC to Enceladus	POS_X to NEP	turn duration=10.5 min
VIMS_004TE_TETHYS001_PRIME	C, M, U	2005-068T00:00:00		000T01:31:00	2005-068T01:31:00	VIMS_IR to Tethys	POS_X to NEP	
SP_004NA_DEADTIME068_PRIME	**M**	**2005-068T01:31:41**		**000T00:15:00**	**2005-068T01:46:41**	**ISS_NAC to Enceladus**	**POS_X to NEP**	
CIRS_004EN_FP3MAP001_PRIME	M, U, V	2005-068T01:48:01	GMB_E004_Enceladus-000T07:20:00	000T01:04:00	2005-068T02:52:01	CIRS_FP3 to Enceladus	POS_X to NEP	
ISS_004EN_N3CPOL002_PRIME	C, M, U, V	2005-068T02:52:01	GMB_E004_Enceladus-000T06:16:00	000T00:15:00	2005-068T03:07:01	ISS_NAC to Enceladus	POS_X to NEP	
CIRS_004EN_FP3MAP002_PRIME	M, U, V	2005-068T03:07:01	GMB_E004_Enceladus-000T06:01:00	000T01:00:00	2005-068T04:07:01	CIRS_FP3 to Enceladus	POS_X to NEP	
ISS_004EN_N4COLR003_PRIME	C, M, U, V	2005-068T04:07:01	GMB_E004_Enceladus-000T05:01:00	000T00:30:00	2005-068T04:37:01	ISS_NAC to Enceladus	POS_X to NEP	
CIRS_004EN_FP1COMP001_PRIME	M, U, V	2005-068T04:37:01	GMB_E004_Enceladus-000T04:31:00	000T00:50:00	2005-068T05:27:01	CIRS_FP1 to Enceladus	POS_X to NEP	
Begin Custom		**2005-068T05:27:01**	**GMB_E004_Enceladus-000T03:41:00**	**000T00:01:00**	**2005-068T05:28:01**			
ISS_004EN_N4COLR004_PRIME	C, M, U, V	2005-068T05:27:01	GMB_E004_Enceladus-000T03:41:00	000T00:25:00	2005-068T05:52:01	ISS_NAC to Enceladus	POS_X to NEP	Pick up at ISS_NAC to Enceladus, POS_X to NEP; Hand off at ISS_NAC to Enceladus (0.0,-25.0,0.0 deg. offset), POS_X to NEP. At end of request, leave off at custom waypoint: ISS_NAC to EN, POS_X to NEP, with (0, -25, 0)deg offset
CIRS_004EN_FP3MAP003_PRIME	M, U, V	2005-068T05:52:01	GMB_E004_Enceladus-000T03:16:00	000T00:55:00	2005-068T06:47:01	CIRS_FP3 to Enceladus (0.0,-25.0,0.0 deg. offset)	POS_X to NEP	Pick up at ISS_NAC to Enceladus (0.0,-25.0,0.0 deg. offset), POS_X to NEP; Hand off at ISS_NAC to Enceladus (0.0,-25.0,0.0 deg. offset), POS_X to NEP
ISS_004EN_NGNPOL001_PRIME	C, M, U, V	2005-068T06:47:01	GMB_E004_Enceladus-000T02:21:00	000T00:40:00	2005-068T07:27:01	ISS_NAC to Enceladus (0.0,-25.0,0.0 deg. offset)	POS_X to NEP	Pick up at ISS_NAC to Enceladus (0.0,-25.0,0.0 deg. offset), POS_X to NEP; Hand off at ISS_NAC to Enceladus (0.0,-25.0,0.0 deg. offset), POS_X to NEP. Use custom waypoint: ISS_NAC to EN, POS_X to NEP, with (0, -25, 0)deg offset
CIRS_004EN_FP1DAY001_PRIME	M, U, V	2005-068T07:27:01	GMB_E004_Enceladus-000T01:41:00	000T00:20:00	2005-068T07:47:01	CIRS_FP1 to Enceladus (0.0,-25.0,0.0 deg. offset)	POS_X to NEP	Pick up at ISS_NAC to Enceladus (0.0,-25.0,0.0 deg. offset), POS_X to NEP; Hand off at ISS_NAC to Enceladus (0.0,-25.0,0.0 deg. offset), POS_X to NEP
ISS_004EN_REGEO002_PRIME	C, M, U, V	2005-068T07:47:01	GMB_E004_Enceladus-000T01:21:00	000T01:11:00	2005-068T08:58:01	ISS_NAC to Enceladus (0.0,-25.0,0.0 deg. offset)	POS_X to NEP	Pick up at ISS_NAC to Enceladus (0.0,-25.0,0.0 deg. offset), POS_X to NEP; Hand off at ISS_NAC to Enceladus, POS_X to NEP. Pick up at custom waypoint: , (0, -25, 0)deg offset. Turn back to standard waypoint: ISS_NAC to EN, POS_X to NEP, no offset
End Custom		**2005-068T08:58:01**	**GMB_E004_Enceladus-000T00:10:00**	**000T00:01:00**	**2005-068T08:59:01**			
SP_004DR_RAMAVOID068_PRIME	C, M	2005-068T08:58:01	GMB_E004_Enceladus-000T00:10:00	000T00:26:00	2005-068T09:24:01	NEG_Z to Dust_RAM (0.0,0.0,90.0 deg. offset)	NEG_X to 238.1/33.5	turn duration = 18.9
NEW WAYPOINT		**2005-068T09:24:01**		**000T01:16:00**	**2005-068T10:40:01**	**NEG_Z to Dust_RAM (0.0,0.0,90.0 deg. offset)**	**NEG_X to 238.1/33.5**	
MP_004DR_DUSTHAZRD001_PRIME	C, M	2005-068T09:24:01	GMB_E004_Enceladus+000T00:16:00	000T00:54:00	2005-068T10:18:01	NEG_Z to 164.9/-23.8 (0.0,0.0,30.0 deg. offset)	NEG_X to 238.1/33.5	
SP_004EN_WAYPTTURN468_PRIME	I, M, R, V	2005-068T10:18:01	GMB_E004_Enceladus+000T01:10:00	000T00:22:00	2005-068T10:40:01	ISS_NAC to Enceladus	NEG_X to 261.3/58.2	turn duration=14.9 min
NEW WAYPOINT		**2005-068T10:40:01**		**000T07:44:59**	**2005-068T18:25:00**	**ISS_NAC to Enceladus**	**NEG_X to 261.3/58.2**	
CIRS_004EN_FP1NIGHT001_PRIME	I, M, R, U, V	2005-068T10:42:01	GMB_E004_Enceladus+000T01:34:00	000T00:41:00	2005-068T11:23:01	CIRS_FP1 to Enceladus	NEG_X to 261.3/58.2	2nd axis for CDA; Mag field from 068T09:20 to 14:20
Begin Custom		**2005-068T11:23:01**	**GMB_E004_Enceladus+000T02:15:00**	**000T00:01:00**	**2005-068T11:24:01**			
VIMS_004TE_TETHYS004_PRIME	C, I, M, R, U	2005-068T11:23:01	GMB_E004_Enceladus+000T02:15:00	000T00:45:00	2005-068T12:08:01	ISS_NAC to Tethys	NEG_X to 261.3/58.2	Pick up at ISS_NAC to Enceladus, NEG_X to 261.3/58.2; Hand off at ISS_NAC to Tethys, NEG_X to 261.3/58.2.
RADAR_004EN_SCATTRAD001_PRIME	M	2005-068T12:08:01	GMB_E004_Enceladus+000T03:00:00	000T02:00:00	2005-068T14:08:01	NEG_Z to Enceladus	NEG_X to 261.3/58.2	Pick up at ISS_NAC to Tethys, NEG_X to 261.3/58.2; Hand off at ISS_NAC to Enceladus, NEG_X to 261.3/58.2. pick up at NAC to Tethys; no return to waypoint slew in support of Mag; Mag field from 068T09:20 to 14:20. RADAR must control primary and secondary..
End Custom		**2005-068T14:08:01**	**GMB_E004_Enceladus+000T05:00:00**	**000T00:01:00**	**2005-068T14:09:01**			
SP_004NA_DEADTIME468_PRIME	**M**	**2005-068T14:08:01**	**GMB_E004_Enceladus+000T05:00:00**	**000T00:13:40**	**2005-068T14:21:41**	**ISS_NAC to Enceladus**	**NEG_X to 261.3/58.2**	
SP_004EA_DLTURN068_PRIME	M	2005-068T14:22:00		000T00:24:00	2005-068T14:46:00	XBAND to Earth	POS_X to NEP	turn duration = 17.9 min
SP_004EA_M70METNON068_PRIME	M	2005-068T14:46:00		000T03:04:00	2005-068T17:50:00	XBAND to Earth	Rolling	CDA requests Rocking D/L
SP_004EN_WAYPTTURN568_PRIME	M, V	2005-068T17:50:00		000T00:35:00	2005-068T18:25:00	ISS_NAC to Enceladus (0.0,-10.0,0.0 deg. offset)	NEG_X to NEP	turn duration=17.9 min
NEW WAYPOINT		**2005-068T18:25:00**		**000T05:31:00**	**2005-068T23:56:00**	**ISS_NAC to Enceladus (0.0,-10.0,0.0 deg. offset)**	**NEG_X to NEP**	
ISS_004EN_OBSERV002_PRIME	C, M, U, V	2005-068T18:25:00		000T02:35:00	2005-068T21:00:00	ISS_NAC to Enceladus	NEG_X to 104.0/-75.0	direct turn from Enceladus to Tethys
ISS_004TE_OBSERV002_PRIME	C, M, U, V	2005-068T21:00:00		000T02:41:00	2005-068T23:41:00	ISS_NAC to Tethys (0.0,7.5,0.0 deg. offset)	POS_X to NEP	
SP_004EA_DLTURN468_PRIME		2005-068T23:41:00		000T00:15:00	2005-068T23:56:00	XBAND to Earth	NEG_Y to Saturn	turn duration = 10.4 min
NEW WAYPOINT		**2005-068T23:56:00**		**000T08:39:00**	**2005-069T08:35:00**	**XBAND to Earth**	**NEG_Y to Saturn**	
SP_004EA_G70METNON068_PRIME	M	2005-068T23:56:00		000T07:30:00	2005-069T07:26:00	XBAND to Earth	Rolling/SRU	CDA requests Rocking D/L

Flyby Geometry

Event Name at Event Time Only	SCET Date (YYYY-DOYTHH:MM:SS.FF) UTC	Hours wrt Event Epoch	Minutes wrt Event Epoch	S/C Range (km)	S/C Altitude (km)	S/C North Latitude (deg)	S/C West Longitude SMEQPM Date (deg)	S/C Inertial Velocity (km/s)	S/C Radial Inertial Velocity (km/s)	S/C Tangential Inertial Velocity (km/s)	Central Body Angular Diameter (mrad)	Phase = Sun-Central_Body-S/C Angle (deg)	Sun-S/C-Central_Body Angle (deg)	S/C Local True Solar Time wrt Central Body (hh:mm)	Sub-solar Latitude wrt Central Body (deg)	Sub-solar West Longitude wrt Central Body SMEQPM Date (deg)
	2005-067T09:08:00.99	-24	-1440	1,121,540.4	1,121,293.1	-0.2	6.0	18.592	-7.370	17.068	0.5	25.3	154.7	11.09	-22.4	-6.5
	2005-067T13:08:00.99	-20	-1200	971,460.9	971,213.6	-0.2	36.5	20.955	-13.188	16.285	0.5	22.2	157.8	12.03	-22.4	37.2
	2005-067T15:08:00.99	-18	-1080	868,548.4	868,301.1	-0.2	51.4	21.305	-15.289	14.837	0.6	23.4	156.5	12.30	-22.4	59.1
	2005-067T17:08:00.99	-16	-960	753,017.5	752,770.2	-0.2	66.2	21.056	-16.675	12.856	0.7	26.4	153.5	12.59	-22.4	81.0
	2005-067T19:08:00.99	-14	-840	630,338.4	630,091.1	-0.2	81.1	20.207	-17.265	10.499	0.8	30.7	149.3	13.27	-22.4	102.9
	2005-067T21:08:00.99	-12	-720	506,400.1	506,152.8	-0.3	96.3	18.786	-17.024	7.943	1.0	35.5	144.5	13.53	-22.4	124.8
	2005-067T23:08:00.99	-10	-600	387,155.6	386,908.3	-0.3	112.1	16.852	-15.969	5.382	1.3	40.3	139.7	14.18	-22.4	146.7
	2005-068T01:08:00.99	-8	-480	278,213.3	277,966.0	-0.4	128.8	14.502	-14.182	3.031	1.8	44.5	135.5	14.39	-22.4	168.6
	2005-068T03:08:00.99	-6	-360	184,288.1	184,040.8	-0.5	147.1	11.893	-11.839	1.137	2.8	47.5	132.5	14.53	-22.4	-169.5
	2005-068T04:08:00.99	-5	-300	143,962.7	143,715.4	-0.5	157.1	10.571	-10.561	0.452	3.6	48.3	131.7	14.57	-22.4	-158.6
	2005-068T05:08:00.99	-4	-240	108,223.9	107,976.6	-0.6	167.8	9.305	-9.305	0.057	4.7	48.5	131.5	14.58	-22.4	-147.6
	2005-068T06:08:00.99	-3	-180	76,818.5	76,571.2	-0.7	179.1	8.177	-8.173	0.262	6.7	48.2	131.8	14.56	-22.4	-136.7
	2005-068T07:08:00.99	-2	-120	49,086.3	48,839.0	-0.9	-169.0	7.291	-7.285	0.300	10.4	47.2	132.8	14.53	-22.4	-125.7
	2005-068T08:08:00.99	-1	-60	23,940.1	23,692.8	-1.4	-156.5	6.755	-6.749	0.285	21.4	45.6	134.4	14.46	-22.4	-114.8
	2005-068T08:38:00.99	-1	-30	11,919.9	11,672.6	-2.3	-149.1	6.634	-6.619	0.438	43.0	43.5	136.5	14.39	-22.4	-109.3
	2005-068T08:53:00.99	0	-15	5,987.5	5,740.2	-4.1	-143.2	6.607	-6.555	0.831	85.6	39.9	140.1	14.26	-22.4	-106.6
	2005-068T09:03:00.99	0	-5	2,115.4	1,868.1	-10.7	-129.4	6.601	-6.175	2.333	242.9	26.3	153.7	13.38	-22.4	-104.7
E1_4EN	2005-068T09:08:00.99	0	0	747.3	500.0	-30.0	-56.2	6.602	0.011	6.602	700.1	43.1	136.9	08.49	-22.4	-103.8
	2005-068T09:13:00.99	0	5	2,117.9	1,870.6	-9.6	16.2	6.602	6.178	2.329	242.6	112.3	67.7	04.03	-22.4	-102.9
	2005-068T09:23:00.99	0	15	5,992.3	5,745.0	-3.0	29.9	6.611	6.560	0.819	85.6	125.8	54.2	03.16	-22.4	-101.1
	2005-068T09:38:00.99	1	30	11,929.0	11,681.7	-1.2	35.6	6.634	6.622	0.390	43.0	129.3	50.7	03.04	-22.4	-98.4
	2005-068T10:08:00.99	1	60	23,920.9	23,673.6	-0.3	42.2	6.702	6.701	0.117	21.4	130.8	49.2	02.59	-22.4	-92.9
	2005-068T11:08:00.99	2	120	48,253.4	48,006.1	0.1	52.2	6.799	6.784	0.453	10.6	130.2	49.8	03.03	-22.4	-81.9
	2005-068T12:08:00.99	3	180	72,367.7	72,120.4	0.3	60.7	6.622	6.541	1.035	7.1	128.1	51.9	03.13	-22.4	-71.0
	2005-068T13:08:00.99	4	240	94,809.4	94,562.1	0.3	68.5	6.037	5.857	1.461	5.4	125.3	54.7	03.25	-22.4	-60.1
	2005-068T14:08:00.99	5	300	114,156.1	113,908.8	0.4	76.4	5.083	4.857	1.502	4.5	122.7	57.3	03.37	-22.4	-49.1
	2005-068T15:08:00.99	6	360	129,685.1	129,437.8	0.4	85.1	3.930	3.779	1.080	4.0	120.7	59.3	03.46	-22.4	-38.2
	2005-068T17:08:00.99	8	480	150,761.1	150,513.8	0.4	106.4	2.495	2.324	0.907	3.4	120.1	59.9	03.49	-22.4	-16.3
	2005-068T19:08:00.99	10	600	168,363.9	168,116.6	0.5	133.9	4.551	3.008	3.416	3.0	125.2	54.8	03.26	-22.4	5.6
	2005-068T21:08:00.99	12	720	200,236.7	199,989.4	0.4	165.3	7.730	6.177	4.647	2.6	133.5	46.5	02.48	-22.4	27.5
	2005-068T23:08:00.99	14	840	259,569.7	259,322.4	0.4	-164.9	10.895	10.293	3.574	2.0	140.0	40.0	02.17	-22.4	49.4
	2005-069T01:08:00.99	16	960	346,777.0	346,529.7	0.3	-139.7	13.787	13.757	0.911	1.5	142.6	37.4	02.04	-22.4	71.3
	2005-069T03:08:00.99	18	1080	454,944.5	454,697.2	0.2	-118.5	16.273	16.099	2.378	1.1	142.1	37.9	02.06	-22.4	93.2
	2005-069T05:08:00.99	20	1200	575,937.3	575,690.0	0.2	-99.8	18.264	17.333	5.757	0.9	139.4	40.5	02.19	-22.4	115.1
	2005-069T09:08:00.99	24	1440	826,320.1	826,072.8	0.1	-66.4	20.536	16.818	11.784	0.6	130.7	49.3	03.00	-22.4	158.8

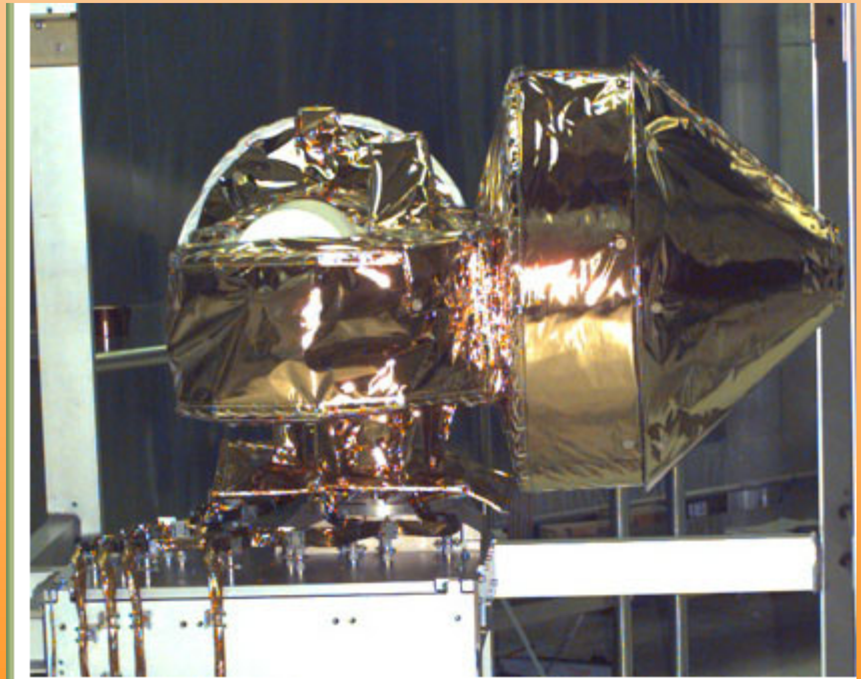
Enceladus 4 Preview: CIRS

John Spencer
Southwest Research Institute
Boulder, CO
John Pearl, Marcia Segura
and the CIRS Team
Goddard Spaceflight Center
Greenbelt, MD

Enceladus 4 Preview Meeting, March 7th 2005

CIRS: Composite Infrared Spectrometer

- Measures long-wavelength infrared (heat) radiation from Saturn, its rings, and moons.
- Sensitive to wavelengths between 7 and 300 microns (14 – 600 times longer wavelength than visible light)
- For objects with atmospheres (Saturn and Titan), CIRS provides detailed information on atmospheric composition and temperature.
- For objects without substantial atmospheres (Saturn's rings, and its smaller moons) CIRS provides mostly temperature information (though we might learn something about composition if we're lucky).



Long wavelengths (FP1 detector): High S/N, low spatial resolution
Short wavelengths (FP3 detector): Low S/N, high spatial resolution

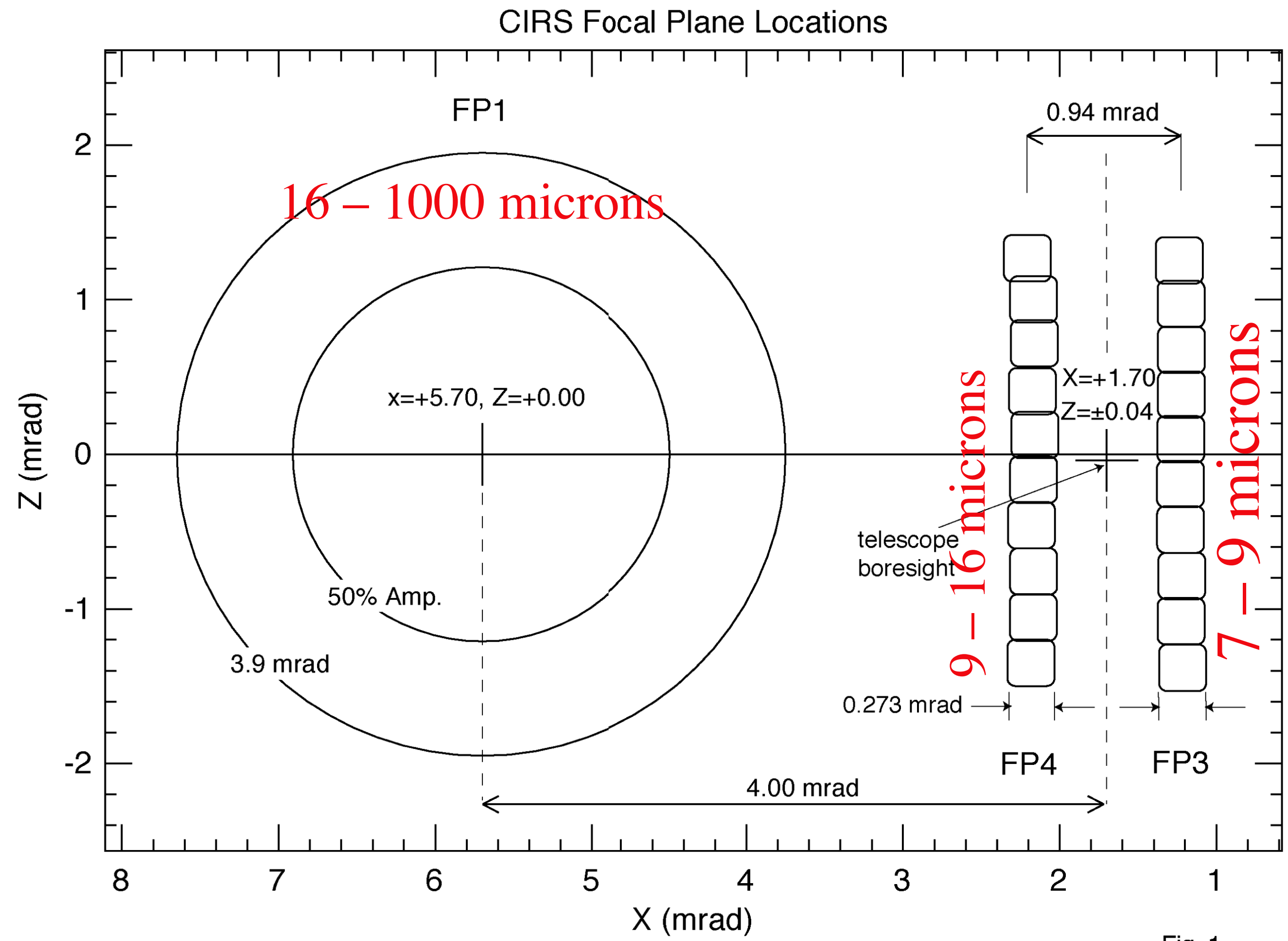
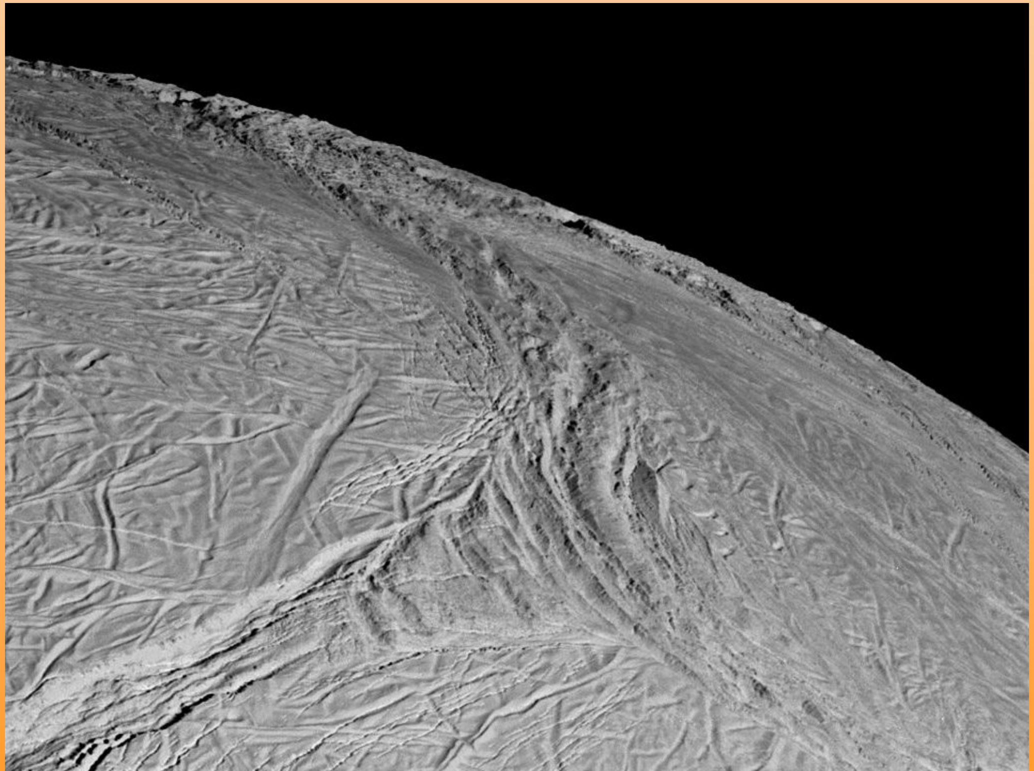


Fig. 1

CIRS Enceladus Goals

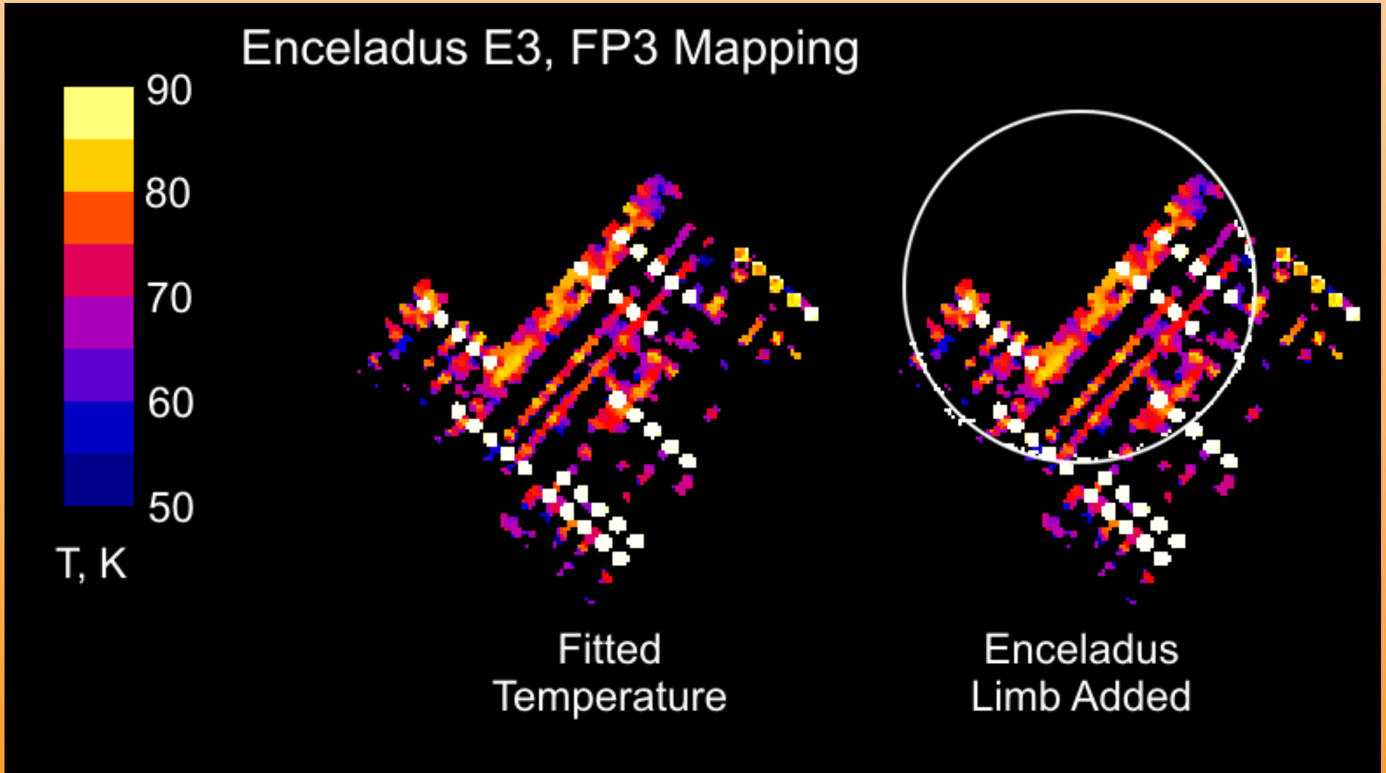
Very young, possibly active, surface

- Look for evidence of hot spots from active eruptions (unlikely but not impossible)
- Measure surface temperatures to help estimate interior temperatures and understand why the surface is so young.
- Constrain surface properties via thermal inertia



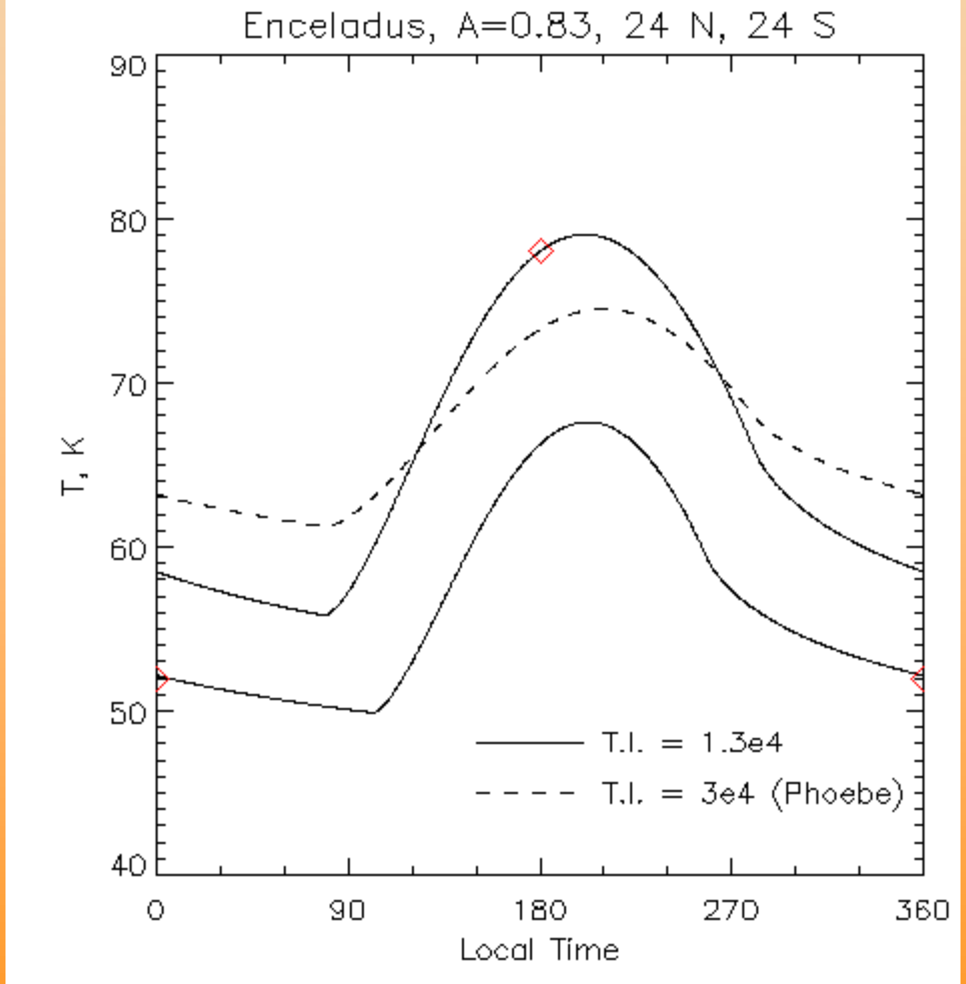
Rev. 3 Results

- Enceladus is a difficult target for FP3 detector (high spatial resolution): barely detectable due to low temperature
- Peak temperatures near 80 K
- Calibration problems: may be able to do better with more work



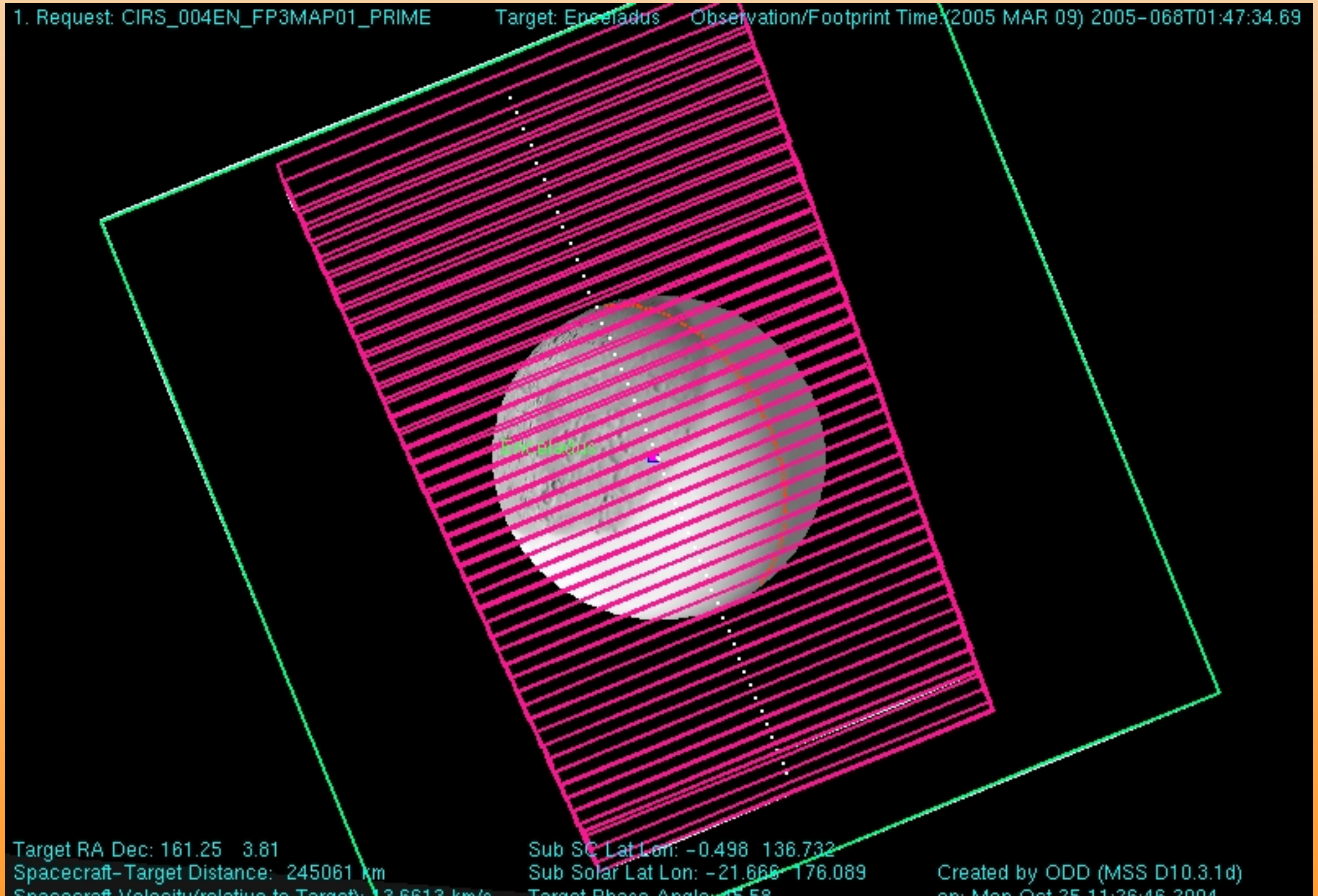
Rev. 3 Results, Contd.

- Strong detection of day and night temperatures with FP1
  - 78 K daytime
  - 52 K nighttime
- Allows constraint on thermal inertia (assuming both hemispheres are similar)
  - ~1.3 x 10^4 erg cm^{-2} $s^{-1/2}$ K^{-1}
  - Much lower than Iapetus or Phoebe (~3 x 10^4)
  - Related to the high albedo: coating of E-ring particles?
- Also constrains bolometric albedo
  - ~0.83



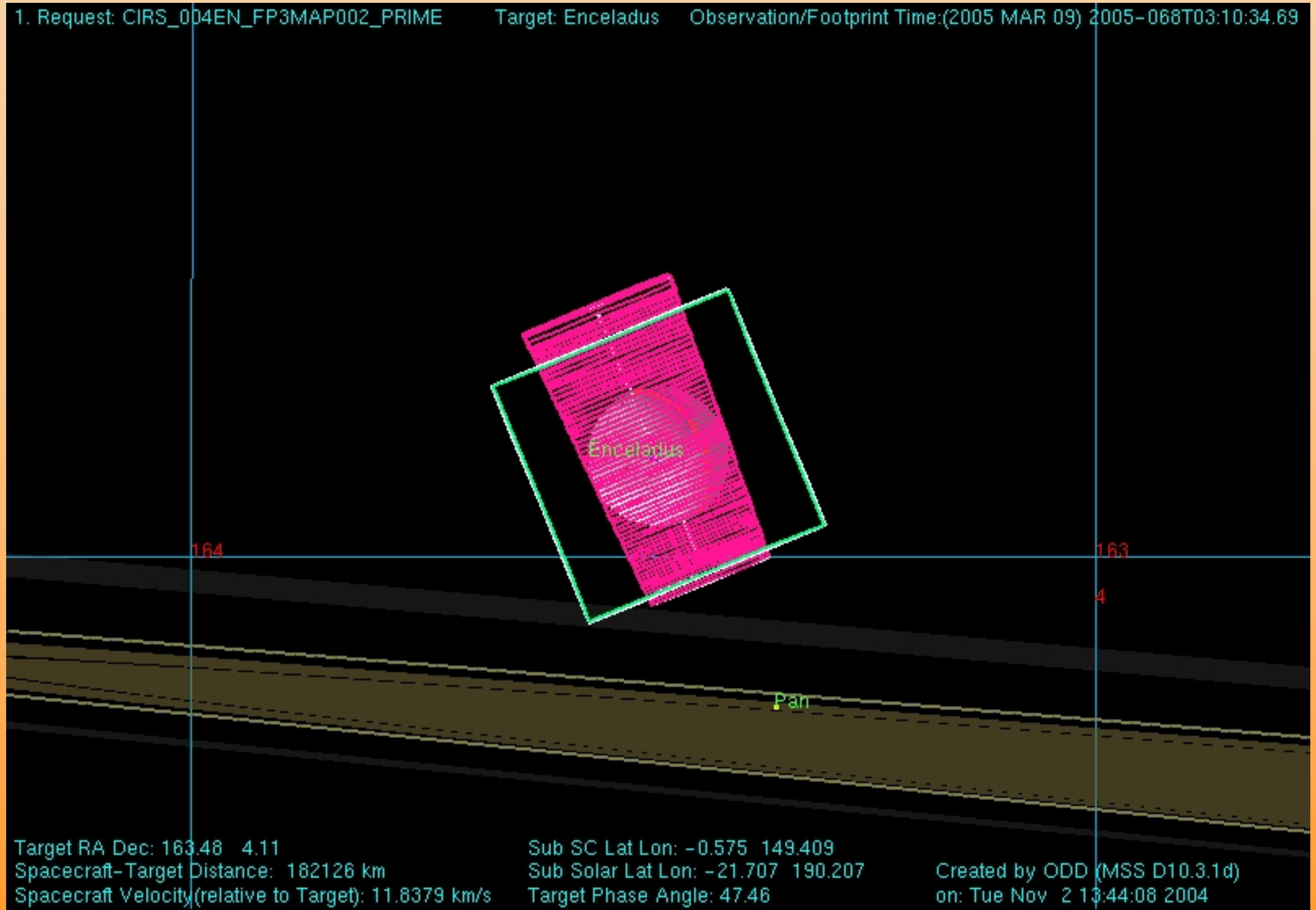
Rev. 4 Observation Plans

- FP3MAP001
- T –07:20, duration 01:04
- 15 cm-1 spectral resolution
- Best short-wave daytime temperature map



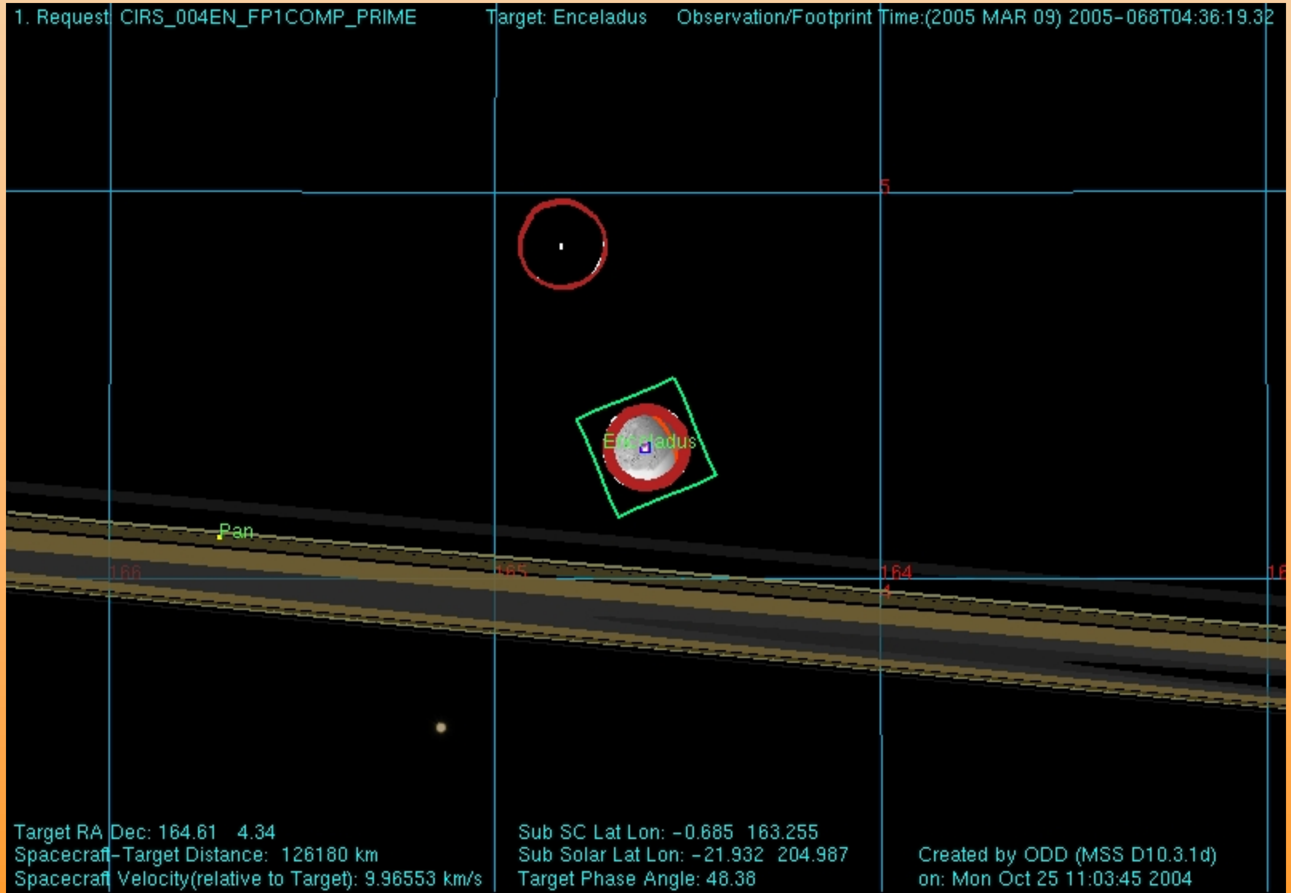
Rev. 4 Observation Plans

- FP3MAP002
- T –06:01, duration 01:00
- 3 cm^{-1}
- Hot spot, gas emission search



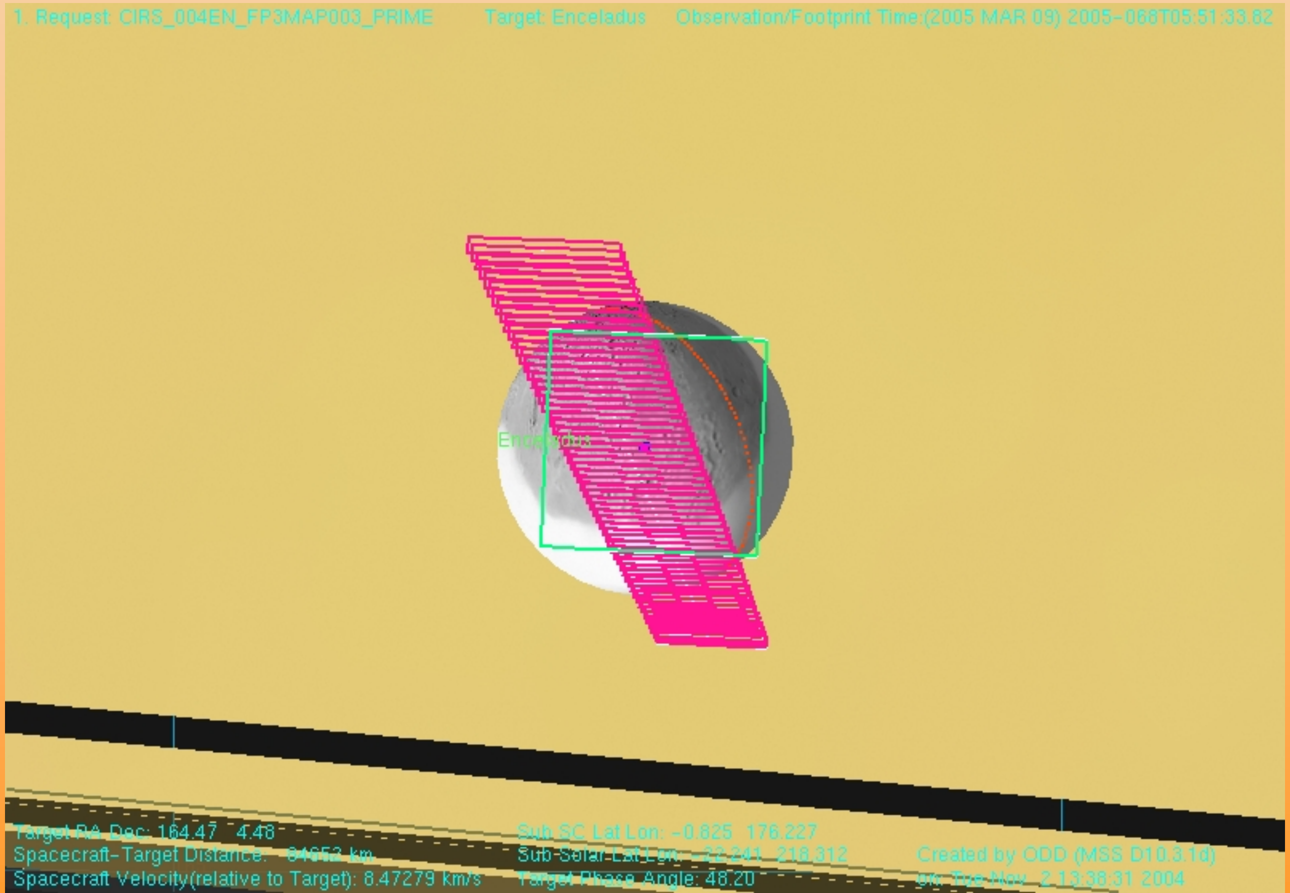
Rev. 4 Observation Plans

- FP1COMP001
- T –04:31, duration 00:50
- 3 cm^{-1}
- Best disk-integrated long-wave spectrum



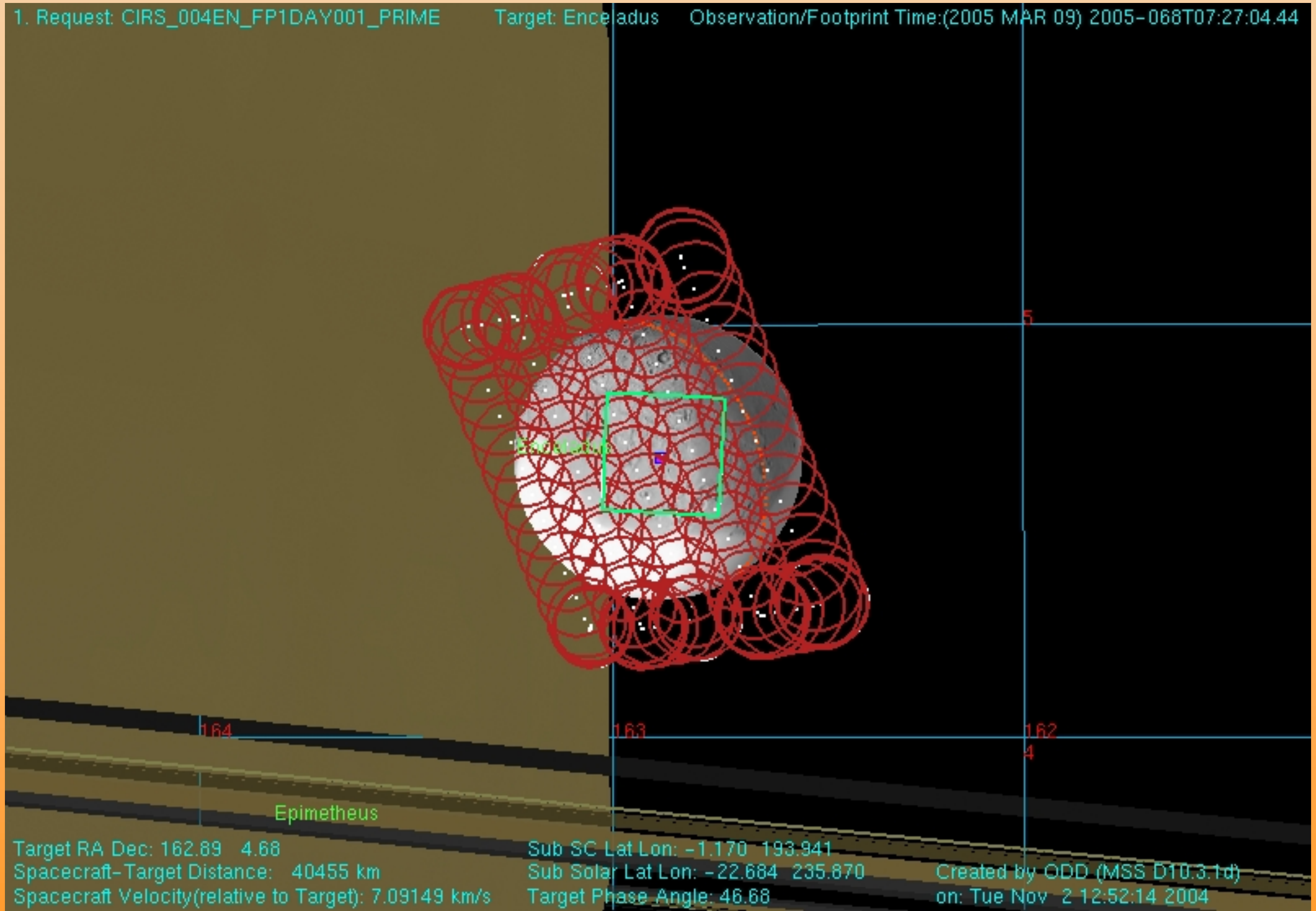
Rev. 4 Observation Plans

- FP3MAP003
- T –03:16, duration 00:55
- 3 cm^{-1}
- Hot spot, gas emission search



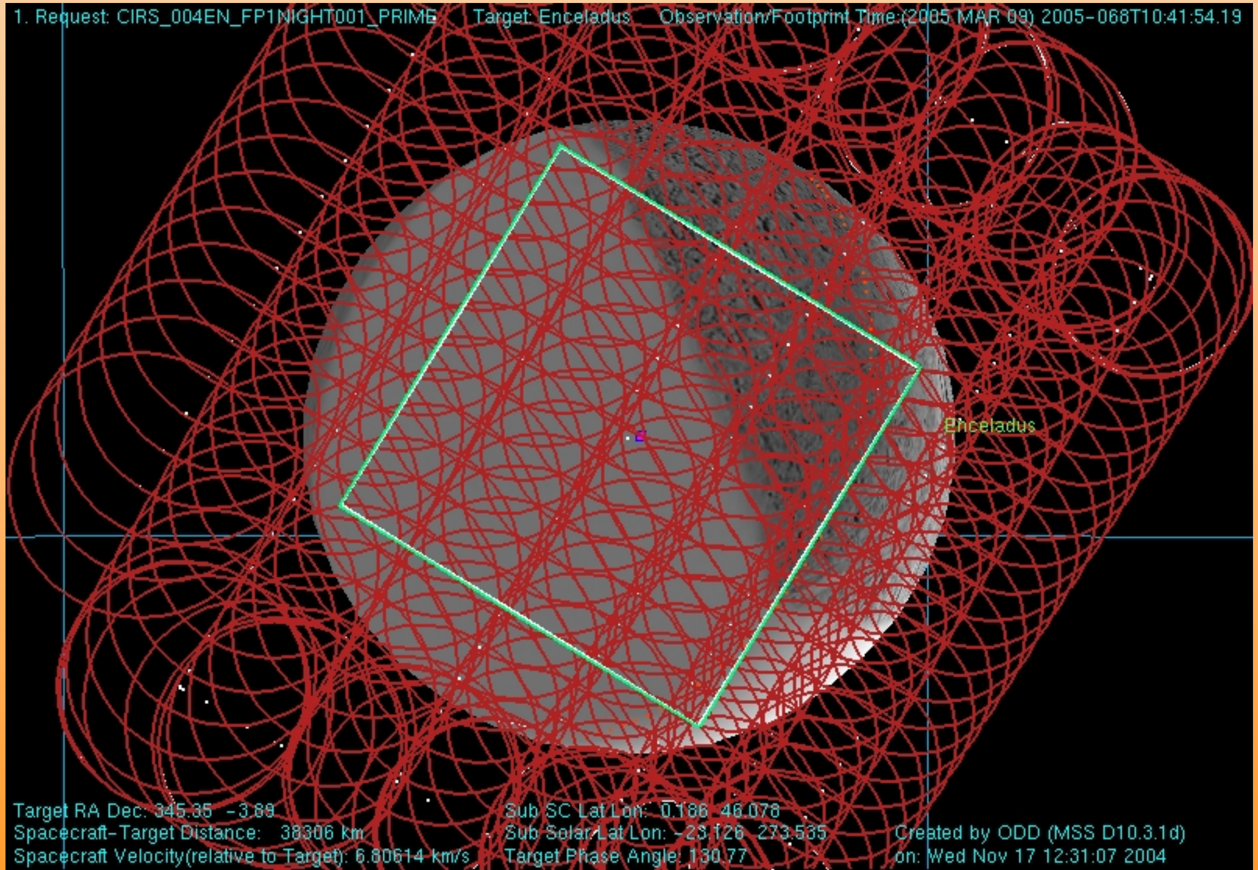
Rev. 4 Observation Plans

- FP1DAY001
- T –01:41, , duration 00:20
- 15 cm^{-1}
- Best daytime temperature map



Rev. 4 Observation Plans

- FP1NIGHT001
- T +01:34, duration 00:41
- 15 cm^{-1}
- Nightside temperature map: look for thermal inertia variations



UVIS Science at Enceladus

C. J. Hansen, A. Hendrix

7 March 2005

Enceladus Science Objectives

- UVIS Icy Satellite Science Objectives are to Investigate

· Surface age and evolution

· Surface composition and chemistry

· Tenuous atmospheres / exospheres

Surface Age and Evolution

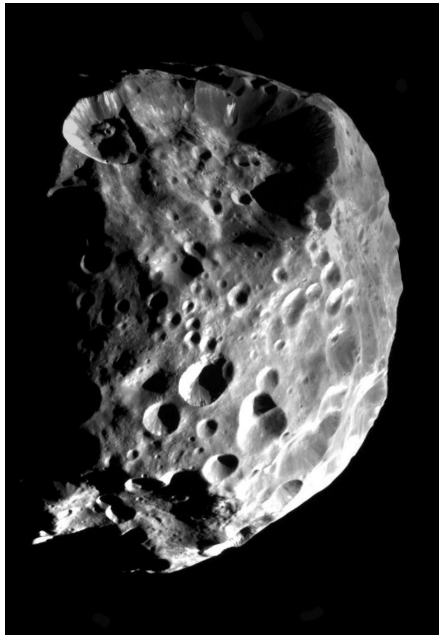
General

- The surface albedo of Saturn's icy satellites is affected by radiation and surface chemistry, and thus will vary with the amount of time a surface unit has been exposed to the magnetosphere's radiation and high energy particles. Leading / trailing side asymmetries are expected.
  - Also determined by nature of interactions (e.g. Ganymede radiation exposure affected by its own internal magnetic field)
- Moderate to high resolution global maps of the satellites orbiting in Saturn's magnetosphere will be used to analyze surface exposure, thus age. These global maps will be compared to Iapetus, Phoebe and Hyperion, which all orbit outside the magnetosphere.
- Surface microstructure will be investigated via the phase function. For example Voyager results on the albedo, color and photometric function properties of Enceladus show a degree of uniformity, regardless of surface age, that suggests the possibility of a thin ubiquitous layer of geologically fresh frost.

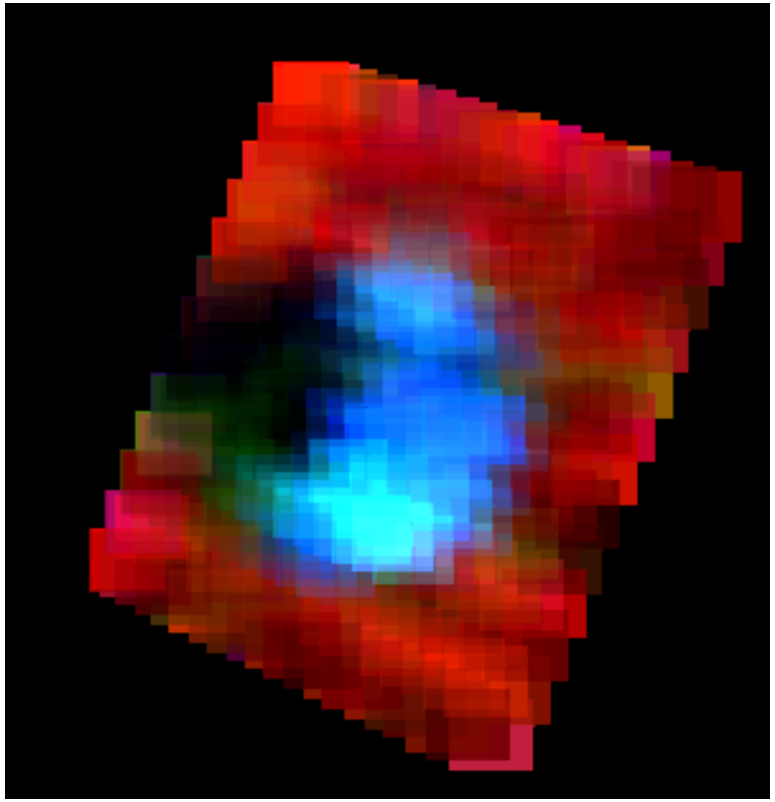
Enceladus

- Images of Enceladus suggest an extreme level of surface modification regionally. Regions of very young and very old terrain will be compared. UVIS uv albedo maps will be produced. We will look for uv albedo differences that correlate to geologic ages derived from the imaging data.
- Albedo and phase function should give us insight into Enceladus' interaction with Saturn's E ring.

Example: Phoebe UV Albedo Map



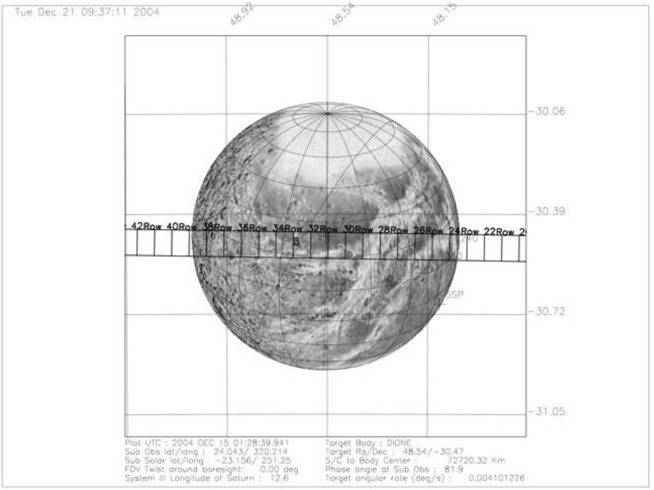
Similar geometry

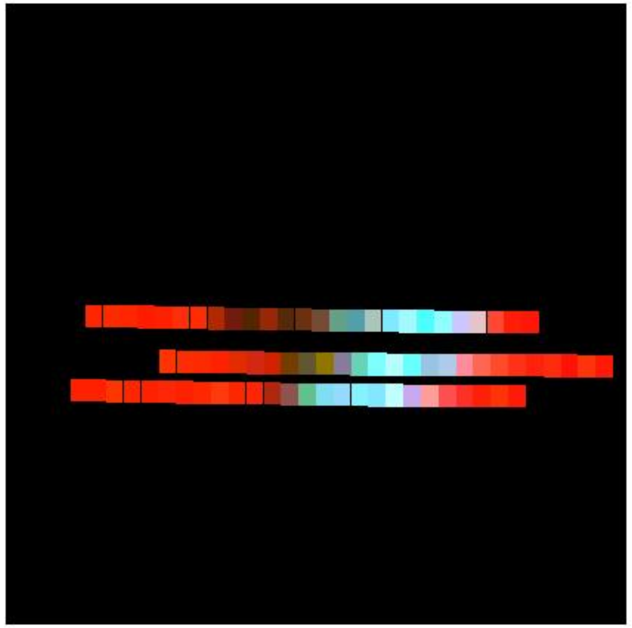


Time: C/A-01:22
Range: 31,300 km
Phase angle: 83°
Lat/Long: 21°S, 349°W

Blue/green=reflected solar
Red=background Ly-α (IPH)

Dione REGMAP





Surface Composition and Chemistry

General

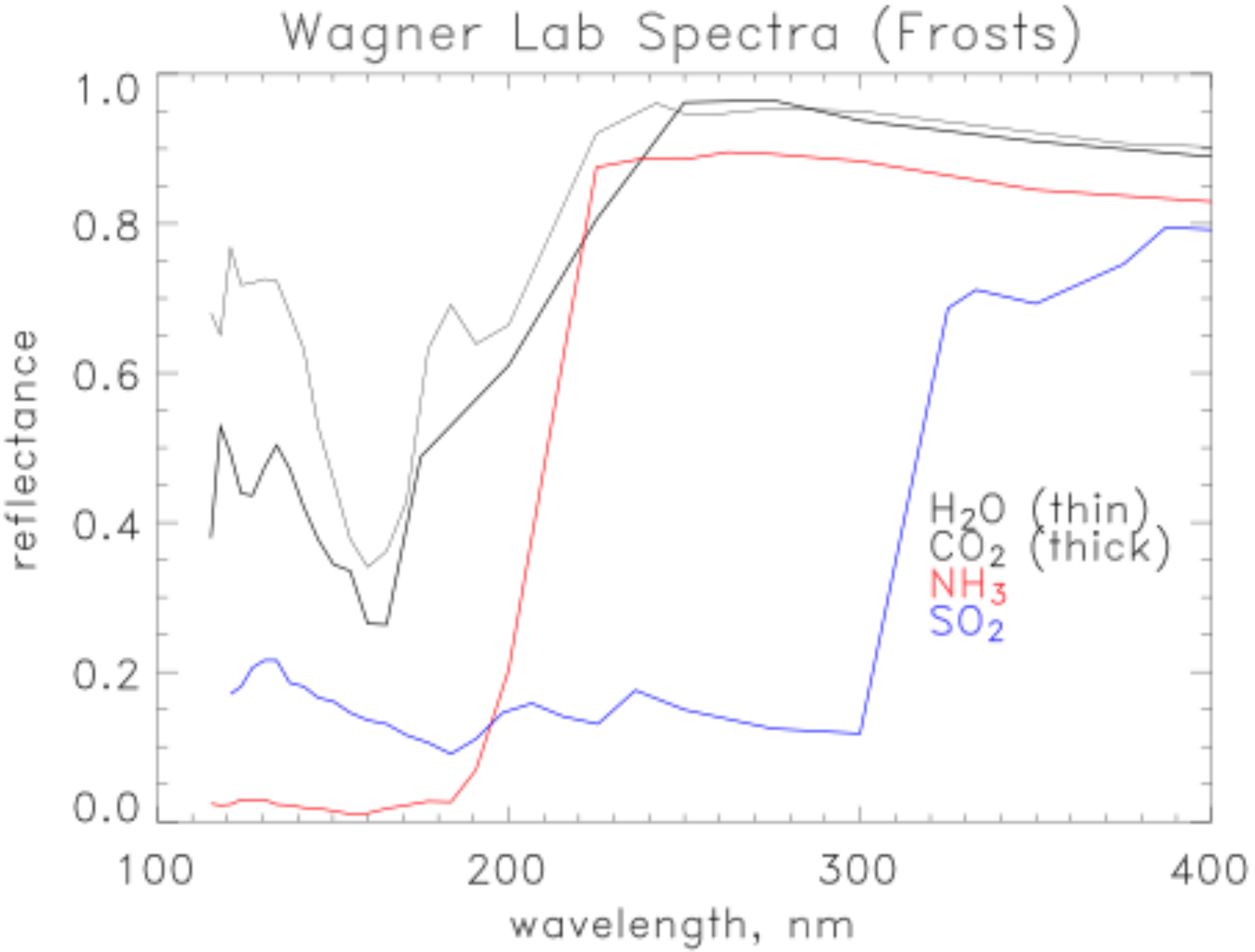
- Investigation of photolysis and radiolysis of water ice is currently a very active area of research, propelled by recent Galileo results, earth-based observations and laboratory work. UV radiation dissociates H_2O producing H, OH, H_2, O, and O_2. H and H_2 are quickly lost to thermal escape.
  - Surface composition and the existence of an atmosphere are affected by sputtering processes. Hydrogen peroxide was identified in the surface ice of Europa. Condensed O_2 has been detected at Ganymede. Spectral absorption suggestive of ozone has been detected by the Galileo UVS on Ganymede, and by HST on Ganymede, Rhea, and Dione. (Note however that these features are at longer uv wavelengths than the UVIS FUV channel.)
  - Cassini offers the opportunity to compare a suite of icy satellites even further from the sun than Jupiter's moons, in a different magnetospheric environment. Being able to compare surface ice oxygen chemistry at a variety of temperatures and radiation environments will help to investigate the process of evolution of surface composition.
- Theoretical and laboratory spectra of various ices are available (e.g. J. Wagner, G. Hansen, S. Warren) and can be compared to UVIS data to map surface composition. Water ice has been detected on all Saturnian satellites - we will show how the amount, distribution, and grain size varies.

Enceladus

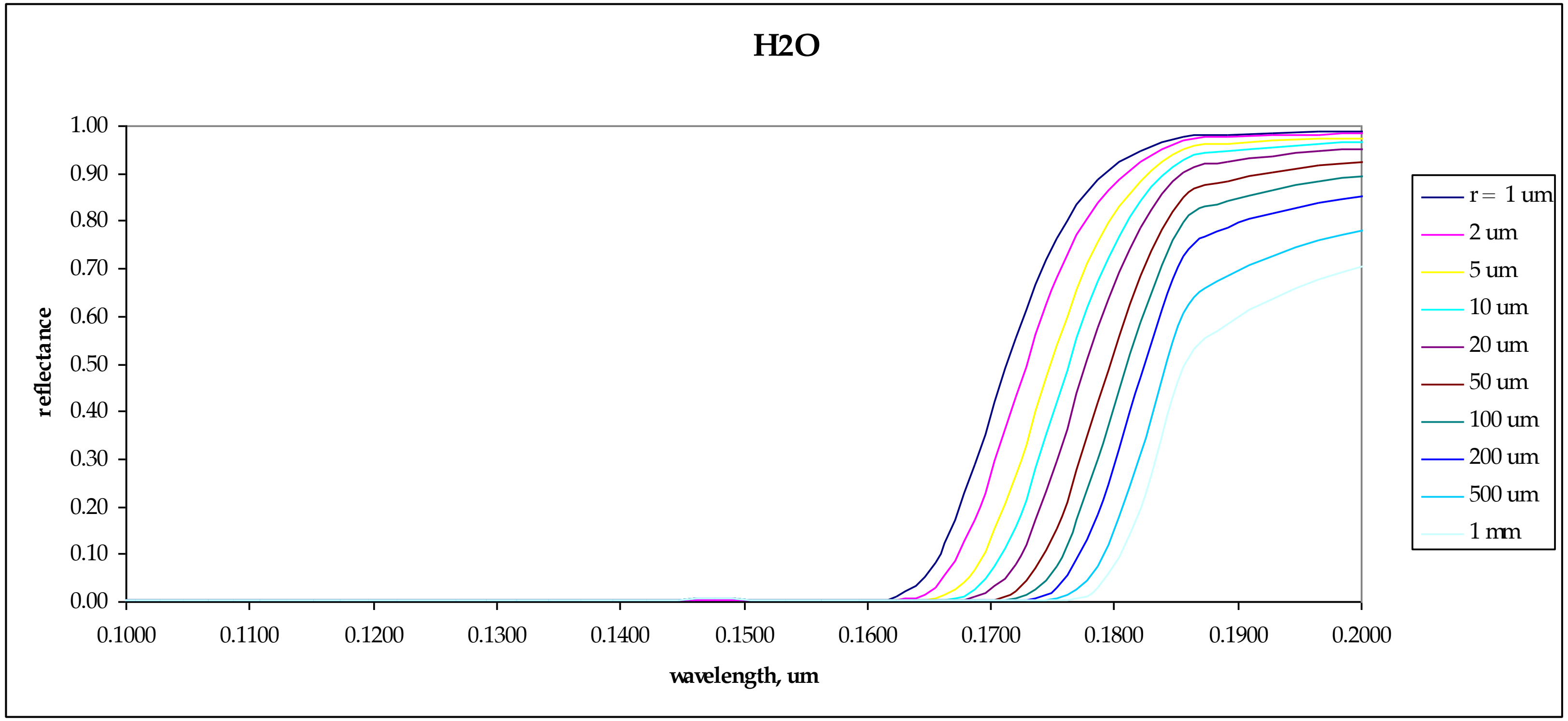
- Enceladus is known to have a predominantly water-ice surface. The water spectrum has a distinct upturn at FUV wavelengths, at a wavelength determined by the ice grain size. Predominant grain size will give us insight into surface modification processes.
- UVIS reflectance spectra are at shorter wavelengths than the Galileo UVS so we will be searching for somewhat different constituents. UVIS spectra may show evidence of CO_2, ammonia, or other interesting species.

UV Spectra of Candidate Materials

(Wagner, Hapke, Wells, 1987)

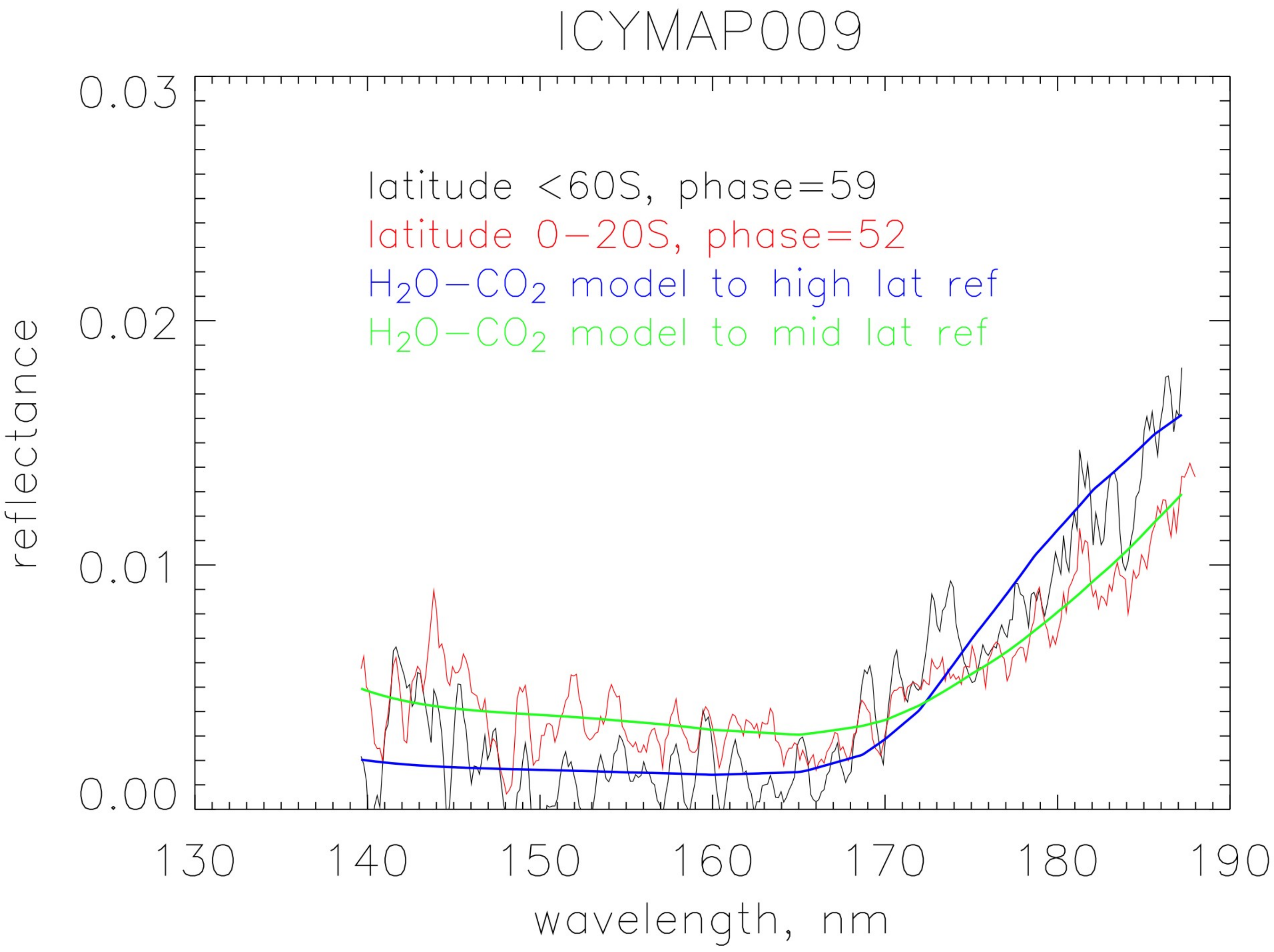


Water Ice Spectra, used for grain size discrimination

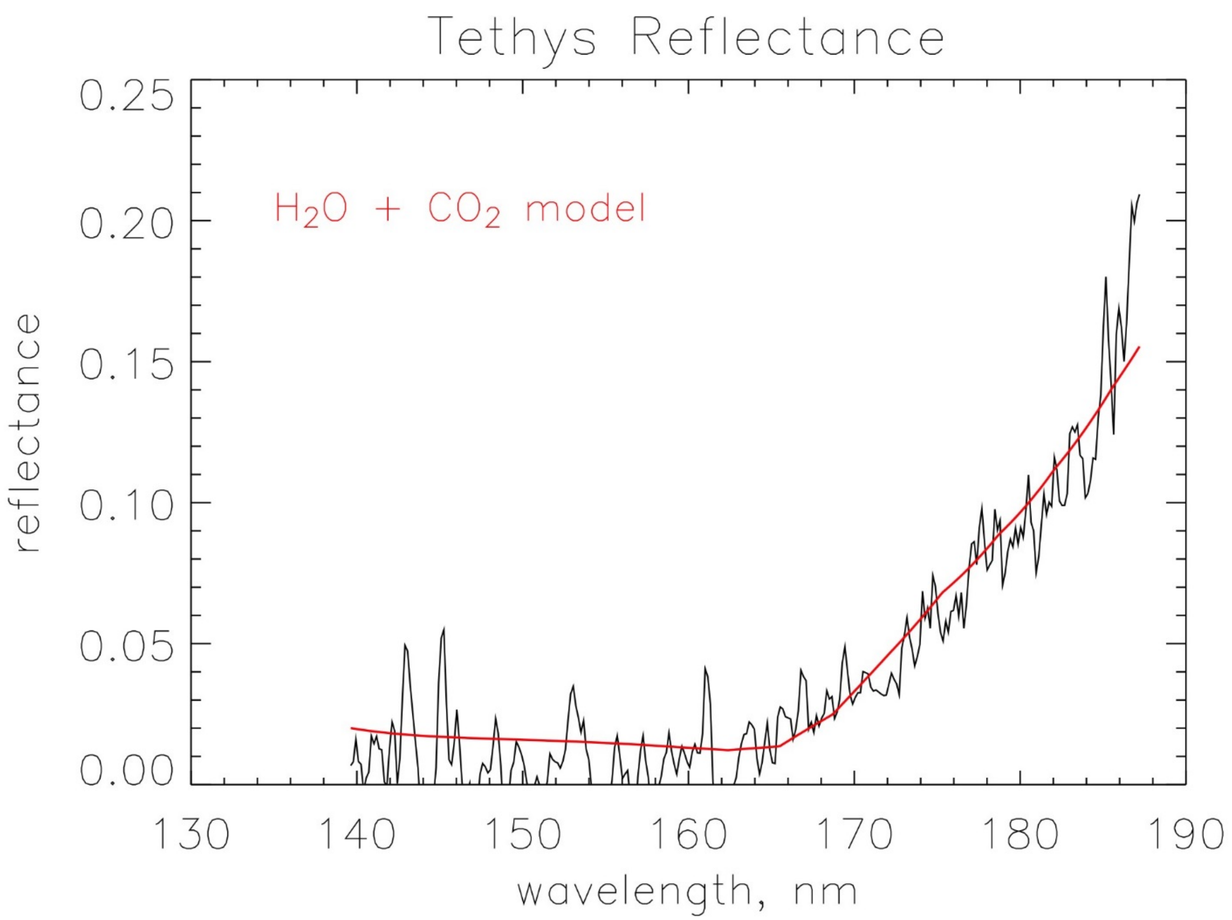


Spectra provided by Gary Hansen, combination of lab work and theoretical constraints

Phoebe's spectral variations with latitude



Tethys is ~10x brighter than Phoebe at similar phase angle



Need much more H_2O, less dark material to fit this Tethys spectrum, compared to Phoebe

Model uses smaller H_2O grain size

α=50°

Tenuous Atmospheres / Exospheres

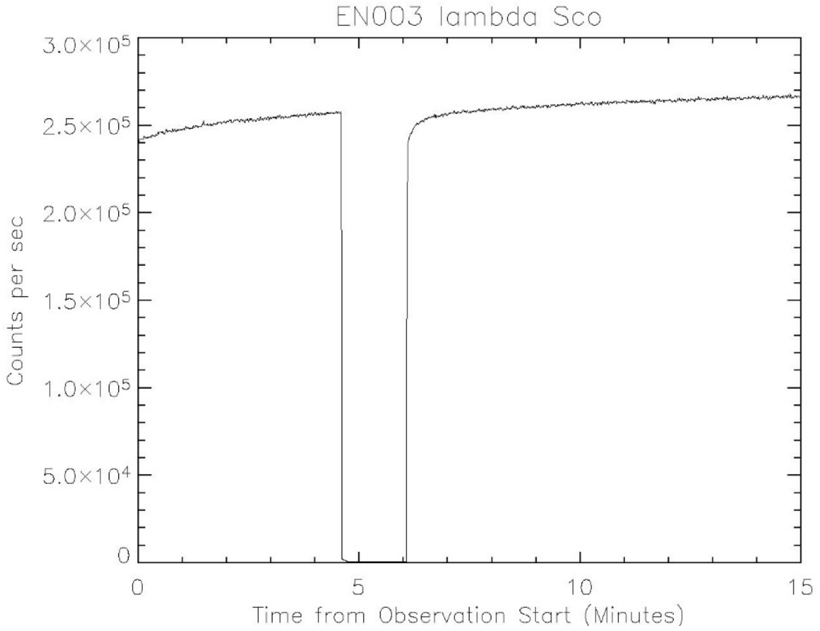
General

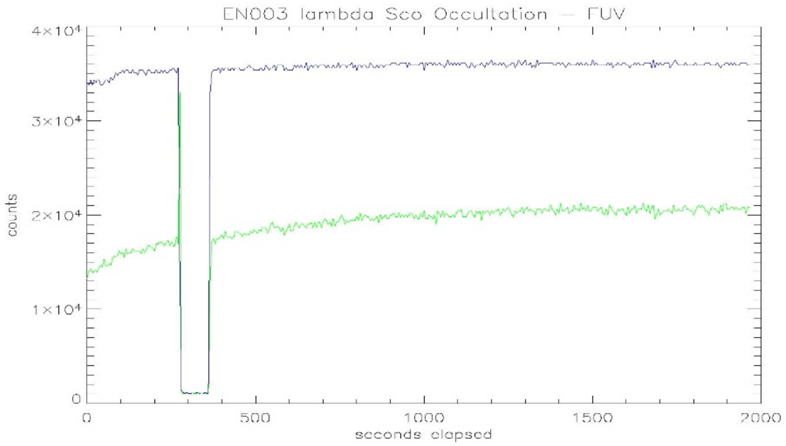
- Molecules are sputtered and sublimated from the surfaces of the icy satellites. Molecules sputtered from the surface are a source of neutrals in and influencing the magnetosphere. Determination of atmospheric density, and source and loss rates of atmospheric molecules feeds into models of the magnetospheric interaction. By determining the composition of these exospheres we may determine surface composition. Of particular interest are trace constituents such as NH_3. For example, an ammonia-water ice composition has been proposed to explain the young geology on Enceladus. The existence of an atmosphere may be indicative of active surface processes, such as the volcanoes on Io or the geysers on Triton (sputtering models indicate that only Rhea has the potential to retain a sputtered atmosphere, thus detection of an atmosphere will lead us to suspect eruptive activity).

Enceladus

- Enceladus' position at the peak of Saturn's E ring has always been a "smoking gun" as a potential source of the E ring. Its regionally young geology is also a tantalizing reason to link potential active geologic phenomena to the E ring. Sputtering is not a likely source for a detectable oxygen atmosphere - theoretical yields suggest that this process is not sufficient to be an important source of volatiles.
- The UVIS stellar occultation on Rev 3 was analyzed for evidence of the existence of a tenuous atmosphere, which would then be a strong indicator of eruptive activity (nothing obvious)
- UVIS spectra will be examined for emission features such as 130.4 and 135.6 nm (atomic and molecular oxygen), 149.3 nm (atomic nitrogen), etc.

Lamda Sco Occultation from EN003

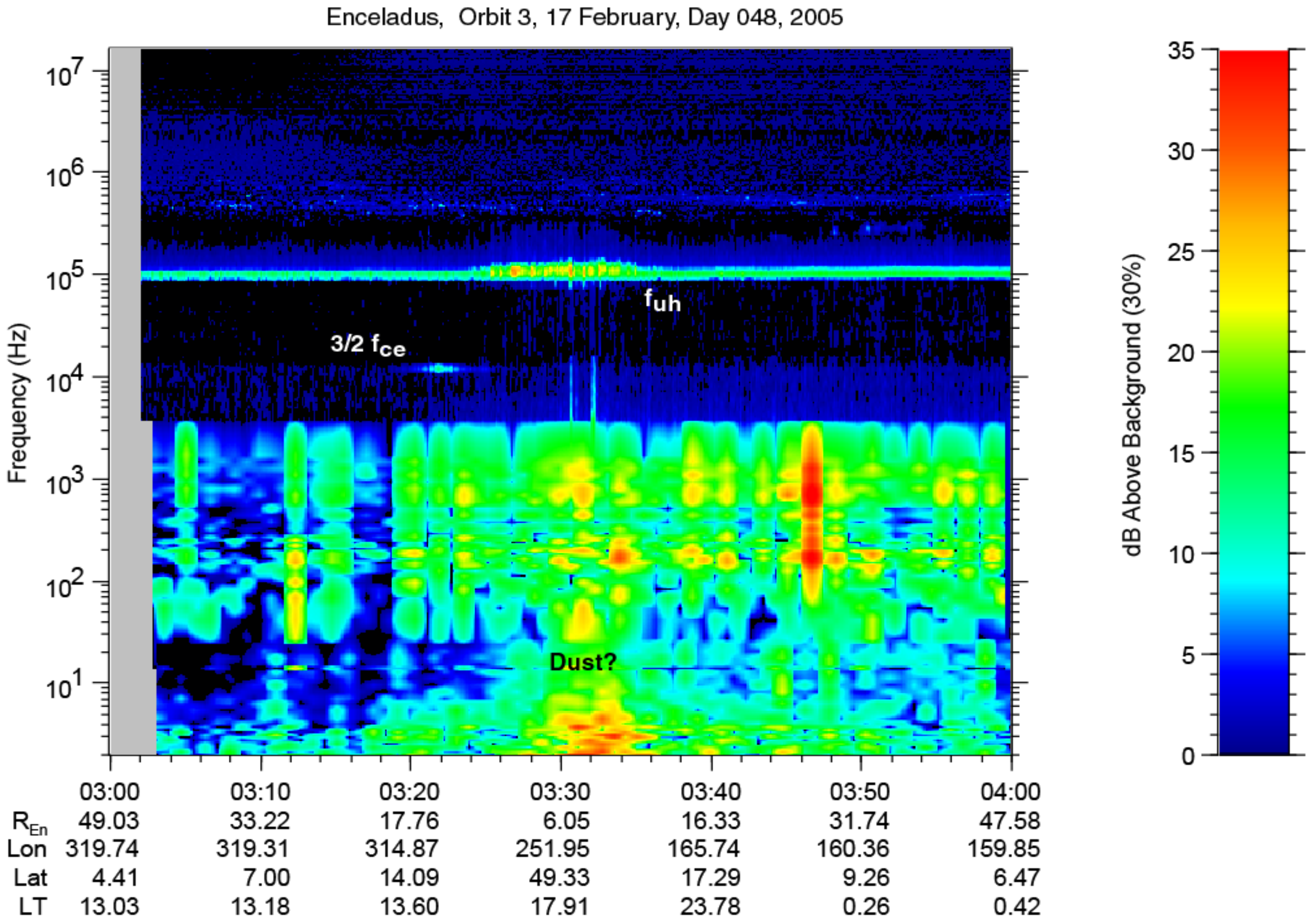




RPWS Enceladus 04 Preview

W. Kurth

7 March 2005



Enceladus, Orbit 3, 17 February, Day 048, 2005
Frequency (Hz)
10^7
10^6
10^5
10^4
10^3
10^2
10^1
f_uh
3/2 f_ce
Dust?
dB Above Background (30%)
35
30
25
20
15
10
5
0
03:00 03:10 03:20 03:30 03:40 03:50 04:00
R_En 49.03 33.22 17.76 6.05 16.33 31.74 47.58
Lon 319.74 319.31 314.87 251.95 165.74 160.36 159.85
Lat 4.41 7.00 14.09 49.33 17.29 9.26 6.47
LT 13.03 13.18 13.60 17.91 23.78 0.26 0.42

RPWS EN004 Preview

- The EN003 flyby was a surprise as we had not expected to see any in situ evidence for the nearby presence of Enceladus
  - Enhanced upper hybrid emission
  - Brief, weak 3/2 fce band
  - Evidence for enhanced dust flux (TBC)
- The plasma waves seen suggest a local modification of the electron distribution via some aspect of the magnetosphere – Enceladus interaction currently not understood. Is most reminiscent of upstream flybys of Europa.

RPWS EN004 Preview

- Given the interaction signatures observed on EN003, we expect stronger signatures at EN004 based on closer flyby altitude.
- Will use the 80 kHz wideband mode; it is possible we will see the upper hybrid band, although this is expected to be well above the 75-kHz rolloff of the receiver. Other electron cyclotron harmonic bands should be easier, if present. Also still possible to detect dust, but not as useful as 10-kHz mode.

Enceladus Press Activities

- Telecon to discuss initial results on Thursday (or Friday?)
- Possible press conference during LPSC?