S59 Rev130 Saturn Atmospheric Occultation & Enceladus Gravity

- S59 Rev 130 Saturn atmospheric occultation and Enceladus E9 gravity
  - Saturn atmospheric ccultation experiment followed by Enceladus gravity
    - Inbound GSE prior to occultation
    - Outbound GSE after gravity
  - Atmospheric occultation ingress and egress
    - Telemetry OFF, 1-way mode
  - Enceladus gravity
    - TLM ON, coherent mode (2- and 3-way)
  - Covered by all complexes

- About the Saturn atmospheric occultation - From Essam Marouf:

  The S59/Rev130 Radio Science Saturn atmospheric occultation is one of only few Cassini occultations able to probe Saturn's low northern latitudes. Capturing this latitude range is only possible when it's not obstructed by the rings, hence only when the rings are nearlly closed (as they are during this period of the Equinox Mission). The low northern latitudes probed are about 18 and 13 degrees on the ingress and egress sides, respectively (measured near-the top of the troposphere). Because of the association of the Rev 130 occultation with an Enceladus gravity observation, no limb-track maneuvers will be implemneted and hence useful 3-frequency observations will be limited to the ionosphere and the upper part of the atmosphere (stratosphere). The Ka/X/S signals reaching Earth through the denser lower atmosphere (troposphere) will successively "walk out" of the main-lobe of the Cassini HGA as the ray bending angle systematically increases when the signals probe deeper in the atmosphere. Because of the broad S-band HGA lobe, the S-band signal will still be observable almost till it's fully extinguished by atmospheric gaseous absorption. In contrast, the narrow HGA Ka-band beam will cause the Ka-band signal to be lost almost immediately after it starts bending in the lower atmosphere. The X-band signal is an intermediate case and will be observable only through part of the lower atmosphere. The collective data will provide useful information about the small- and large-scale structure and physical properties of the ionosphere, the upper atmosphere, and the limited regions of the lower atmosphere partially probed.

- About the Enceladus Gravity - From Nicole Rappaport

  The Enceladus gravity experiment is conducted by Doppler tracking of the spacecraft for 26 hours, including Enceladus Closest Approach period. The objective of the experiment is to detect a diapir under the south pole and determine the gravity field of Enceladus (J2 and C22)

- What is a diapir?

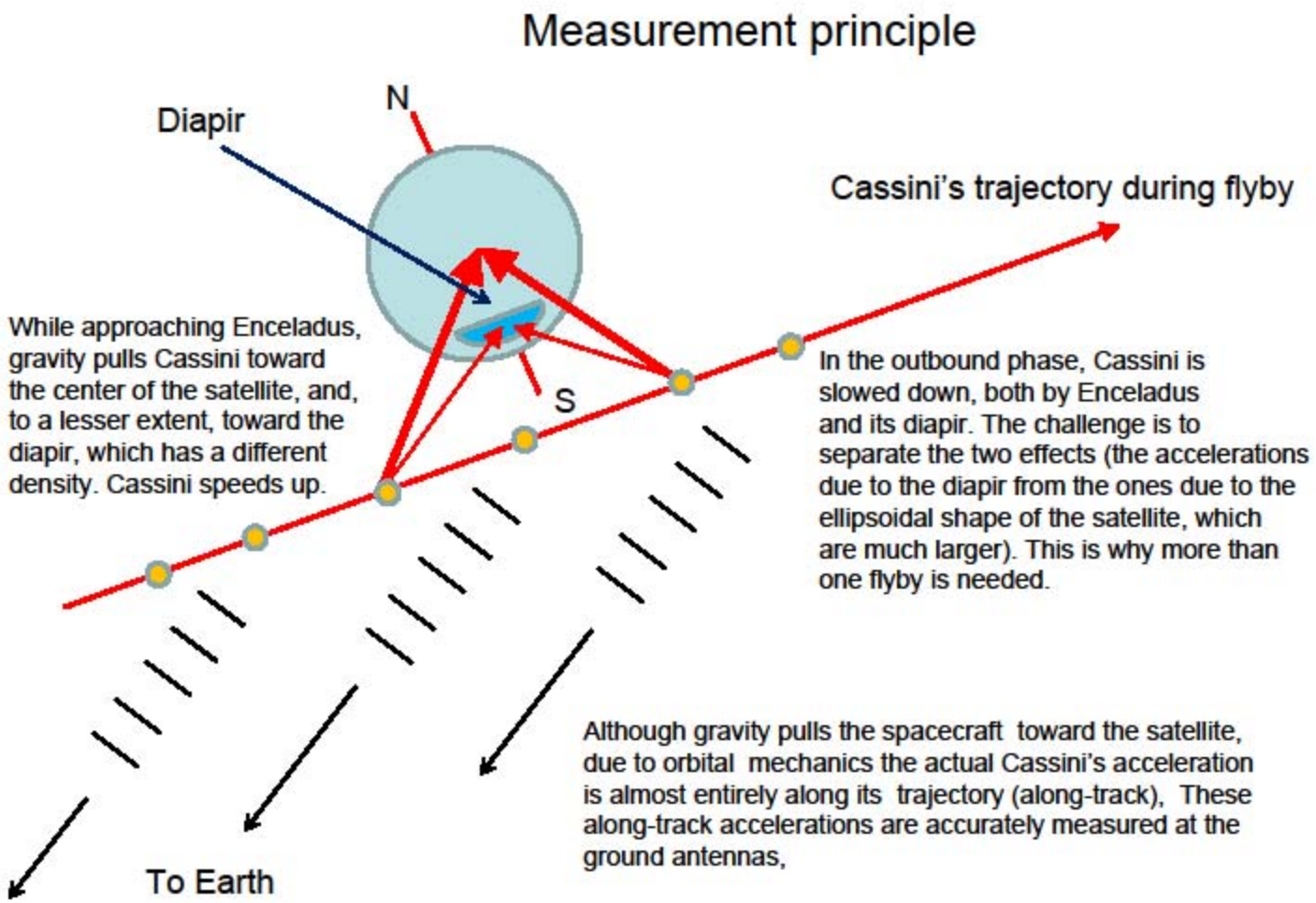
  A diapir is, like a mascon, a gravity anomaly. We don't know how big and deep the diapir can be. If it's deep, then it will appear as a mass deficiency, but if it's shallow (like a spherical segment) it will be a mass concentration. In practice, it would be an underwater sea localized under the South Pole, although the presence of a global ocean cannot be completely rejected. The presence of this diapir would explain the hot spots and plumes.

  The difficulty is in separating the global gravity field (J2, C22) from a local effect in the line of sight acceleration. I am not sure that the three flybys will be sufficient but the experiment MUST be attempted, without any promise to anyone. We should at least be able to give a combination of upper limits on the size of the diapir and the density contrast between the diapir and the surrounding ice.

- Detecting a diapir requires at least three flybys:

  E9 (Apr 2010), E12 (Dec 2010), E19 (May 2012)

From Luciano Iess



DSN Antennas

- DSN Coverage

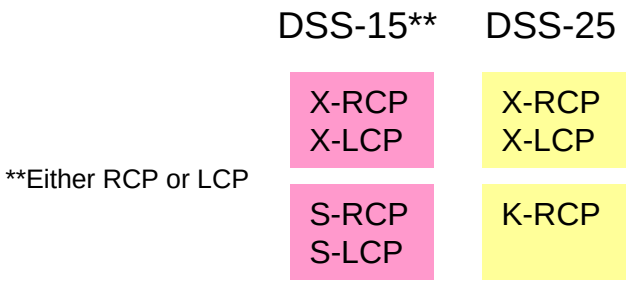
		Pre	BOT	EOT	Post						
10	116	2230	0000	1100	1115	DSS-25	CAS	TP RS130-ENKDWN	4589	N748	1A1	GSE OCC
10	116	2355	0055	0330	0345	DSS-63	CAS	TKG PASS	4589	N003	1A1	GSE
10	117	0630	0800	1700	1715	DSS-34	CAS	TP RS130-SAOCC1	4590	N750	1A1	OCC GRAV
10	117	0700	0800	1100	1115	DSS-15	CAS	TP RS130-SAOCC1	4589	0624	1A1	OCC
10	117	0700	0800	1600	1615	DSS-43	CAS	TP RS130-SAOCC1	4590	1639	1A1	OCC
10	117	1450	1620	0310	0325	DSS-55	CAS	TP RS130-ENGRV1	4590	N750	1A1	GRAV
10	117	2215	2345	1100	1115	DSS-25	CAS	TP RS130-ENGRV2	4590	N748	1A1	GRAV
10	118	0505	0635	1655	1710	DSS-34	CAS	TP RS130-ENGRV3	4591	N750	1A1	GRAV
10	118	1445	1615	0215	0230	DSS-55	CAS	TP RS130-ENKDWN2	4591	N750	1A1	GRAV GSE
10	118	1615	1715	0215	0230	DSS-63	CAS	TKG PASS	4591	N003	1A1	GSE

DSS-63 passes for telemetry support

DSS-15 instead of DSS-14 for S-band support since DSS-14 is unavailable due to ~8-month long Life Extension downtime

- Receivers scheduled
  - 2 closed-loop receivers per antenna
  - Occultation: Open-loop data are prime. Closed-loop data are backup
  - Gravity: Closed-loop data are prime, open-loop are backup
- LCP data are enhancement. Prime are RCP

Antennas Band and Polarization Capabilities



*Either KLCP (switch 43 in B position)
or monopulse (switch 43 in A position)

RSR/VSR/WVSR Assignment

Aseel: VOCA

DSS	Operator	Station	Open-Loop Receiver	RSR Assignment
25	Don/Danny	rsops1	RSR1	RSR1A -> XRCP
				RSR1B -> KRCP
63	Don	rsops1	RSR1	RSR1A -> XRCP
15	Danny	rsops1	RSR2	RSR2A -> XRCP
				RSR2B -> SRCP
34	Elias	rsops2	RSR1	RSR1A -> XRCP
				RSR1B -> KRCP
43	Elias	rsops2	RSR2	RSR2A -> XRCP
				RSR2B -> SRCP
55		rsops1	RSR1	RSR1A -> XRCP
				RSR1B -> KRCP
25		rsops2	RSR1	RSR1A -> XRCP
				RSR1B -> KRCP
34		rsops1	RSR1	RSR1A -> XRCP
				RSR1B -> KRCP
55		rsops2	RSR1	RSR1A -> XRCP
				RSR1B -> KRCP
63		rsops2	RSR2	RSR2A -> XRCP

RSSG will be in RS Ops Room at 3:00 pm on Monday April 26th (116/2200)

ORTs

ORT on DOY 111 (4/20 local) over DSS-25 and DSS-55, X- and Ka-band
10 110 2345 0115 1015 1030 DSS-25 CAS TP RS130-OCCORT1 4583 N748 1A1
10 110 2345 0115 0340 0355 DSS-55 CAS TP RS130-OCCORT1 4583 N750 1A1

- DSS-25 is prime
- Collect pointing data (monopulse) to update the 4th-order blind pointing model

ORT on DOY 112 (4/21 local) over DSS-15 and DSS-43, X- and S-band
10 112 0015 0115 1015 1030 DSS-15 CAS TP RS130-OCCORT2 4584 0624 1A1
10 112 0600 0700 1015 1030 DSS-43 CAS TP RS130-OCCORT2 4585 1639 1A1

- DSS-15 is prime
- Verify X- and S-band signals, RCP and LCP

ORT on DOY 113 (4/22 local) over DSS-25 and DSS-34, X- and Ka-band
10 112 2345 0115 1015 1030 DSS-25 CAS TP RS130-OCCORT2 4585 N748 1A1
10 113 0525 0655 0745 0800 DSS-34 CAS TP RS130-OCCORT3 4586 N750 1A1

- DSS-25 is prime
- Collect pointing data (monopulse) to update the 4th-order blind pointing model

Also provide David with monopulse data from:
DSS-34 RTS track on DOY 103
DSS-25 USO track on DOY 107

Misc

Support schedule:

- Long experiment!!
  - DSS-25 pre-cal at 116/2230 (Mon 4/26, 3:30 pm PDT), but critical activities don't start until several hours later. However, must ensure that station is configured correctly during pre-cal
    - Plan to have RSS person support pre-cal and first hour of track (likely Don)
  - GSEs will be partially supported and then scripted
  - Multiple RSS persons starting at 117/0600 (Mon 4/26, 11 pm PDT) to support occultation experiment (likely Aseel, Danny, Elias)
  - Then 1-2 RSS persons during gravity experiment. Critical times are:
    - Uplink transfers
    - Tracking mode switches
    - Pre-cal and BOT periods
    - Closest Approach period
- NOPEs and ACEs plan?
- David Rochblatt real-time support not required since there will be no Monopulse offsets decisions during experiment, but welcome to join us during occultation!
  - If special actions are needed for pointing (for example, manual offsets), David please let us know

Unramped uplink predicts?

- Sent email to Telecom and NOPEs asking if that's possible

DSS-34 returning from a 3-month AZ Track Replacement downtime

- Return-To-Service (RTS) track with Cassini on DOY 103

Monopulse

- Plan to enable throughout gravity observation, and at specific times during occultation (Essam's timeline)
- Watch for monopulse enables at low Elevation angles. Wait till ~10 degrees

Misc continued

Cassini Specific 4th Order Pointing Models

- Don to send monopulse (pointing) data to David Rochblatt
- More important to have updated models for DSS-25 and DSS-34 since they'll be suporting the occultation

DSS-55 LQG Coefficients

DOY 117, Track 1620 to 0310, AZ 92.03 - 265.27 degrees

DOY 118, Track 1615 to 0215, AZ 91.89 – 256.61 degrees

Barely exceeds the 260 degrees limit on DOY 117. Can we still use LQG if needed?

SNT

- Enable X only at all BWG stations throughout
- Conduct SNT measurements
- Remember to change configuration during occultation so that values are recorded in NMC log
- Fluctuations
  - DSS-55 will be providing uplink. Expect fluctuations? Impact on experiment?
  - Small fluctuations observed during DSS-25 USO track on DOY 107 (4/17)

DSS-43

- Status of equipment
- Microwave Configuration
  - Configure SRCP low noise to the SP MASER to the 01 output
  - Configure SLCP through the diplexer to the SB HEMT to the 02 output

Mitch scheduled DSS-55 RSR on DOY 118. Overlaps CAS support by a couple of hours. Can Mitch delay or move his activity?