S82 T99 Titan Gravity Observation

- S82 Rev202 T99 Titan Gravity Experiment
    - C/A 065/1746 ERT, Altitude 1500 km
    - Telemetry ON, Coherent mode (2-way and 3-way)
    - Covered by all complexes
        - Madrid -> Goldstone -> Canberra -> Madrid
- Previous Titan gravity experiment was T89 in February, 2013
- Next (and final) is T122 in August, 2016

- Science Highlights (from Luciano Iess)

During the Cassini Solstice Mission, the main science objectives of gravity measurements at Titan are:

1) Improve the determination of the $k2$ Love number by measuring the short-period changes of the gravity field induced by Saturn's tidal field (eccentricity tides). If $k2$ is confirmed at the current central values (about 0.6) it means that either the percentage of salts in the ocean and the icy crust is large, or that the silicate interior and ice is involved in the deformation (i.e. the interior is soft.

2) Determine the geoid of the satellite and the presence of large scale gravity anomalies.

3) Determine the rheology of the icy crust by correlative analysis with altimetric data.

4) Determine $J4$, to assess if tidal deformations are the likely mechanism for the shape of Titan, which is fatter at the equator than expected from quadrupole gravity.

DSN Antennas

- DSN Coverage

	Pre	BOT	EOT	Post						
14 064	1245	1415	2315	2330	DSS-34 CAS	TP RS202-GSE	6002	N750	1A1	GSE
14 064	1315	1415	2315	2330	DSS-43 CAS	TKG PASS SEQ	6002	N003	1A1	GSE
14 065	0110	0240	0905	0920	DSS-55 CAS	TP RS202-T99GRAV	6002	N750	1A1	Grav
14 065	0610	0740	1655	1710	DSS-25 CAS	TP RS202-T99GRAV	6002	N748	1A1	Grav
14 065	1100	1230	0045	0100	DSS-34 CAS	TP RS202-T99GRAV	6003	N750	1A1	Grav
14 065	2250	0020	0615	0630	DSS-55 CAS	TP RS202-T99GRAV	6003	N750	1A1	Grav
14 066	1030	1200	1400	1415	DSS-25 CAS	TP RS202-TI GSE	6003	N748	1A1	GSE
14 066	1210	1340	2300	2315	DSS-34 CAS	TP RS202-TI GSE	6004	N750	1A1	GSE

Prime gravity passes are DSN Level 3 activity

- Receivers scheduled
  - 2 closed-loop receivers per BWG antenna
  - Open-loop receivers
  - LCP not required. Only RCP

- Closed-loop data are prime. Open-loop data are backup
  - Requested an expedited delivery (by EOD Friday) of the closed-loop data so that the science team can provide near real-time results to the project
    - RMDCT said that they can support delivery

S82 T99 Open-Loop Assignments

DSS	Operator	Station	Open-loop Receiver	Channels	Subchannels	Bandwidths KHz
55	Elias/Danny	rsops1	RSR2	RSR2A -> XRCP RSR2B -> KRCP	1, 2, 3, 4 1, 2, 3, 4	1, 8, 16, 50 1, 8, 16, 50
25	Elias/Danny/ Aseel	rsops2	RSR1	RSR1A -> XRCP RSR1B -> KRCP	1, 2, 3, 4 1, 2, 3, 4	1, 8, 16, 50 1, 8, 16, 50
34	Danny/Aseel/ Dustin	rsops1	RSR2	RSR2A -> XRCP RSR2B -> KRCP	1, 2, 3, 4 1, 2, 3, 4	1, 8, 16, 50 1, 8, 16, 50
55	Dustin/Elias	rsops2	RSR2	RSR2A -> XRCP RSR2B -> KRCP	1, 2, 3, 4 1, 2, 3, 4	1, 8, 16, 50 1, 8, 16, 50

RSSG will be in Ops Room from 4:50 pm on Wed 3/5 (065/0050) until 11:00 pm on Thu, 3/6 (066/0700)

RSSG shifts:

Dustin   Wed, 3/5, 4:45 am – 12:00 pm   (Inbound GSE. Partially supported)

ELIAS   Wed, 3/5, 4:50 pm – 12:00 am   T99 Gravity
DANNY   Wed, 3/5, 10:30 pm – 4:00 am
ASEEL   Thu, 3/6, 3:30 am – 10:30 am
DUSTIN   Thu, 3/6, 7:00 am – 5:00 pm
ELIAS   Thu, 3/6, 3:00 pm – 11 pm

Aseel   Fri, 3/7, 3:30 am (1-hr into pre-cal) - 7:00 am   (Outbound GSE. Partially supported)
Danny   Fri, 3/7, 6:30 am – 10:30 am

ORTs

Completed

ORT on DOY 056 (Feb 25 PST) over DSS-55, X- and Ka-band

14 056 2330 0100 0815 0830 DSS-55 CAS   TP RSS GRVORT MC 5994 N750   1A1

- Also prime tracking pass
- First Ka-band track after ALB installation at Madrid on DOY 047
- At beginning of pre-cal, ACE asked station what Ka-band receiver they'll be using. Station said ALB didn't assign one, but they are deciding which one to use
    - DCC 7 was used for Ka-band
- Fluctuating Ka-band power. Due to weather (wind and humidity)?
- First 1-way monopulse on-point cal unsuccessful. Was repeated

Upcoming

ORT on DOY 059 (Feb 28) over DSS-25 and DSS-34, X- and Ka-band

14 059 1255 1425 1720 1735 DSS-25 CAS   TP RSS GRVORT MC 5996 N748   1A1

14 059 1255 1425 2300 2315 DSS-34 CAS   TP RSS GRVORT MC 5997 N750   1A1

- DSS-34 prime tracking pass
- Verify monopulse, acquire pointing data

ORT on DOY 060 (Mar 1) over DSS-25 and DSS-34, X- and Ka-band

14 060 1245 1415 1715 1730 DSS-25 CAS   TP RSS GRVORT MC 5997 N748   1A1

14 060 1245 1415 2315 2330 DSS-34 CAS   TP RSS GRVORT MC 5998 N750   1A1

- DSS-34 prime tracking pass
- Verify monopulse, acquire pointing data

ALB Software

- Already installed at Goldstone and Madrid

- Will be installed Canberra just before the Inbound GSE tracks
  - Inquired about moving the installation, but DSN said no. Difficult to move downtime
    064 0640 0640 1240 1240 DSS-40 DSN NMC ALB SOAK NONE 2C2
  - Installation window ends 064/1240z. DSS-34 pre-cal 064/1245

- Was told that ALB developers will be present during the few tracks following installation

- GSE supports are DSN Level 4 so no NOPE support

- Manual link build if there are issues with ALB?
  - Will necessary resources be available?
  - Is there a way to ensure that a Ka-band receiver remains available for the Cassini track?
  - Canberra tracks that overlap with Cassini's T99 track pre-cal

    065 1015 1025 1115 1115 DSS-45 MMS2   GSOT TEST   0065 N056 K 2C3
    CCP,NMC,RRPA,SHMT,STXL,TLPA,UPL;

    065 1025 1125 1425 1440 DSS-43 MOM   TKG PASS   0065 N064 K 1A1
    CCP,NMC,RNG,RRPA,SHMT,STXL,TLPA,UPL;

    065 1100 1230 0045 0100 DSS-34 CAS   TP RS202-T99GRAV 0065 N750   1A1
    CCP,KHMT,NMC,RNG,RRPA,RRPB,RSR=2,TLPA,TLPB,UPL,XHMT,XTXL;

Misc

Uplink Plan
- Ramped uplink predicts throughout
    - Based on Sandy's analysis, unramped uplink predicts not possible
- Per SOE/DKF, except very last transmitter off
    - DKF has DSS-55 TXR off at 066/030808. Use 066/031300
- Gap due to transmitter limits during Canberra-Madrid overlap (no uplink transfer)
    - DSS-34 transmitter OFF 066/002615
    - DSS-55 transmitter ON   066/004500
    - Coherent gap RTLT later is 066/030333 to 048/032218

Pointing Plan
- Enable monopulse throughout observation. If problematic, stay with blind pointing
    - Are 4th-order pointing models good? Need good models in case monopulse is problematic
- Disable 3-4 minutes before 1-way to 2-way mode changes
- Stations to wait for RSSG to request monopulse enable/disable during T99
    - Can follow timeline during GSEs
- Watch for monopulse enables at low Elevation angles. Wait till ~10 degrees

Equipment status?
- NOPEs? (DSS-25, DSS-34, DSS-55)

SNT
- Enable at all throughout

Closed-loop Receivers during closest approach
- High signal dynamics. Widen carrier loop bandwidth?