About the Experiment

- S83 Rev204 T101 Titan Bistatic and Occultation Observations
  - First in 5 years!
  - First Titan bistatic or occultation observation after failure of USO!
  - Bistatic inbound and outbound: 1-way mode
  - Occultation: 2-way/3-way mode
  - Telemetry OFF, Ranging OFF
  - Covered by Canberra

Science Highlights
From Essam Marouf and RSS Team

The RSS Titan observations on T101 include ionospheric/atmospheric occultations and bistatic surface scattering on both the ingress and egress sides. T101 is the first RSS Titan occultation or bistatic observation to be conducted in five years!

The ingress occultation probes 46.6 S latitude. The egress occultation probes 67.7 N latitude. The occultation will: 1) determine seasonal changes in the high latitude atmosphere, specifically the temperature structure and formation and breakup of the winter polar vortex; 2) determine tropospheric winds from radio occultation measurements of tropospheric temperature profiles; and 3) determine the atmospheric and ionospheric structure at all levels.

During the bistatic observation period, the Cassini HGA boresight is continuously maneuvered to point to the region on Titan's surface where mirror-like (specular) reflection can be observed at the NASA DSN ground receiving stations at Canberra. The T101 outbound bistatic ground track is the first ever to target known liquid region of Titan's surface. It crosses Ligeia Mare and covers roughly the 75N to 78N latitude region between 225W and 300W longitude. It terminates within the northern tip of Kraken Mare. It captures scattering angles decreasing from about 80 to 60 degrees. The associated inbound bistatic covers the region (20S, 15W) to (40S, 25W) and covers incidence angle increasing from about 40 to 70 degrees. Measurements of the absolute strength of the co-polarized (RCP) and cross-polarized (LCP) surface echo components, when detectable, yield information about the surface status (liquid/solid), surface dielectric constant and possible composition, and surface roughness

DSN Antennas

- DSN Coverage

		Pre	BOT	EOT	Post						
14	137	1005	1310	1945	2045	DSS-34 CAS	RS T101 BIST/OCC	6075	N750	1A1
14	137	1010	1310	1945	2045	DSS-43 CAS	RS T101 BIST/OCC	6075	1647	1A1

- DSS-43 will provide uplink for the occultation part

- Receivers scheduled
  - 2 closed-loop receivers per antenna
  - Open-loop receivers (RSRs, WVSRs, VSRs)
  - Open-loop data are prime. Closed-loop data are backup
    - Will need ramp info in closed-loop data for processing
  - RCP and LCP will be recorded
    - 1-way and 2-way/3-way modes

S83 T101 Open-Loop Receivers Assignment
Preliminary

DSS Prdx Mode	Operator	Station	Open-loop Receiver	Channels	Subchannels	Bandwidths KHz
43	Danny	rsops4	WVSR1	WVSR1A -> XRCP WVSR1B -> XLCP	1, 2, 3, 4 5, 6, 7, 8 1, 2, 3, 4 5, 6, 7, 8	1, 16, 50, 100 1, 16, 50, 100 (with offset) 1, 16, 50, 100 1, 16, 50, 100 (with offset)
43	Elias	rsops5	WVSR2	WVSR2A -> SRCP WVSR2B -> SLCP	1, 2, 3, 4 5, 6, 7, 8 1, 2, 3, 4 5, 6, 7, 8	1, 16, 50, 100 1, 16, 50, 100 (with offset) 1, 2, 16, 50 1, 2, 16, 50 (with offset)
34	Dustin	rsops1	RSR1	RSR1A -> XRCP RSR1B -> XLCP	1, 2, 3, 4 1, 2, 3, 4	1, 16, 50, 100 1, 16, 50, 100
34	Dustin	rsops1	RSR2	RSR2A -> KRCP RSR2B -> KLCP	1, 2, 3, 4 1, 2, 3, 4	1, 16, 50, 100 1, 16, 50, 100

RSSG will be in Ops Room at 2:15 am on Saturday, May 17th (237/0915)

VSR is backup

Aseel – VOCA
Dustin - Ops Room Displays
Danny – Check WVSR/VSR availability & RSR/WVSR/VSR disk space

Bistatic Calibrations

- Calibrations will be performed during
  - Pre-cal (antennas at stow)
    - 3-hr pre-cal periods are scheduled
  - Observation (mini-cals)
    - Pre-determined and carefully selected times (during turns)
    - Must be completed within 8-9 minutes
  - SNT Measurements
    - Completed within 3-4 minutes
  - Post-Cal (antennas at stow)
    - 1-hr post-cal periods are scheduled
- Pre-cal calibrations are the longest

- Working with Lu Nguyen on updating the bistatic procedure

DSS-34 KLCP

- Canberra recently completed the implementation of a temporary Engineering Change Request (ECR) to add Ka-LCP capability at DSS-34
  - Many thanks to everyone involved!
- The Ka-LCP signal was verified during the DOY 117/April 27 Cassini ORT and looked good
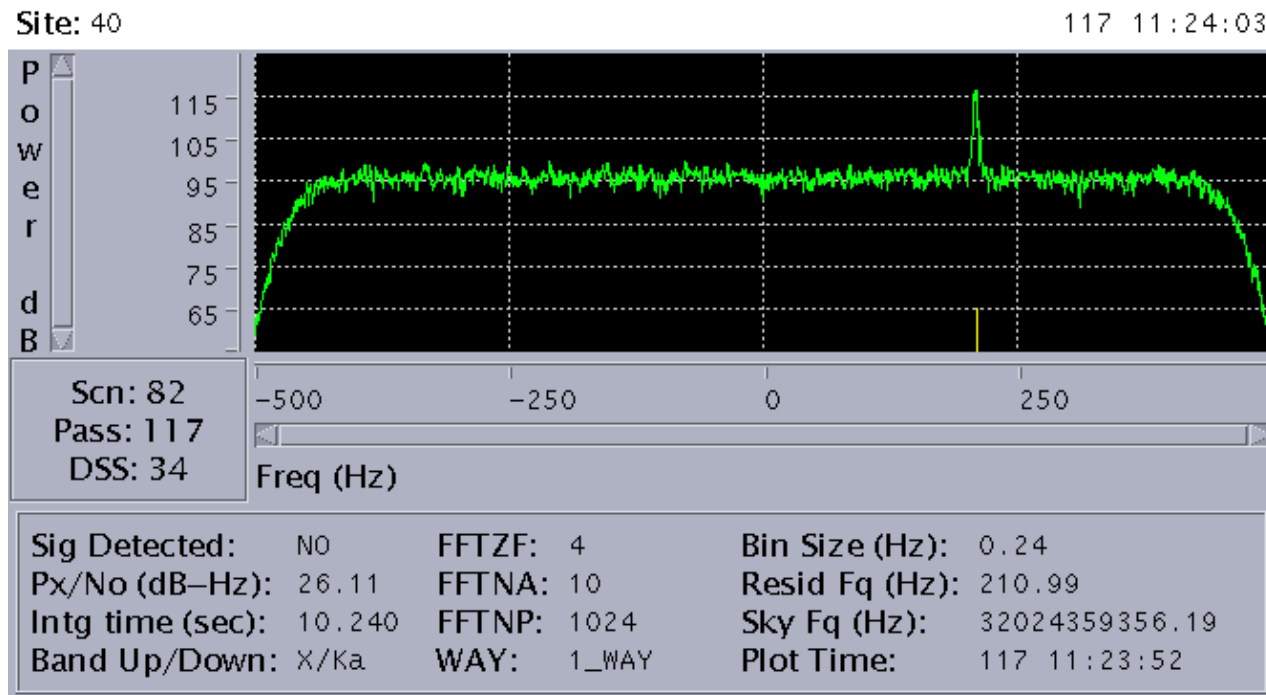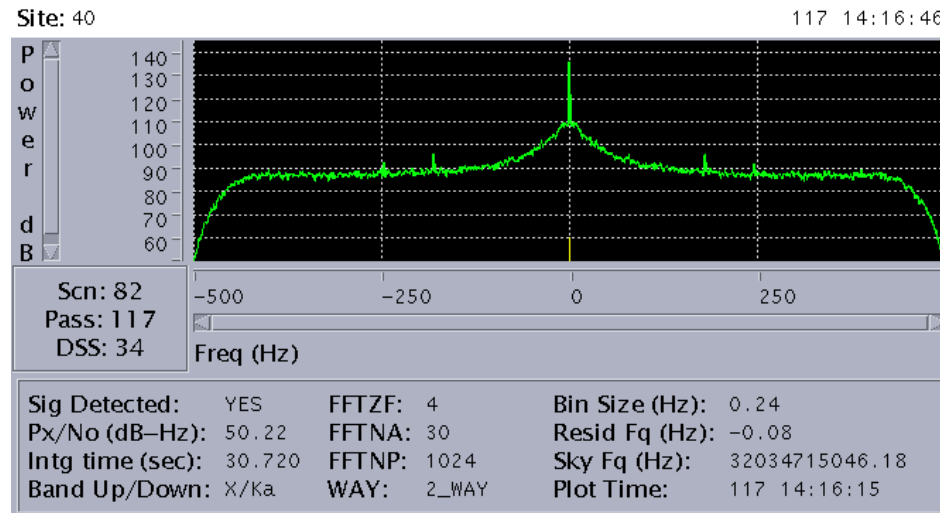
ORTs

1. ORT on DOY 117 (April 17 PDT) over DSS-34, X- and Ka-band   Completed

14 117 1000 1130 1930 1945 DSS-34 CAS   TP RSS OCCORT MC 6055 N750   1A1

- Also prime TP

- KLCP verified

- Monopulse data acquired, except when switched to KLCP

- KRCP Spurs (DR C110161)

    - Visible in 1-way and 2-way mode

    - +/- 180 Hz from carrier. +/- 245/250 spurs visible after switch to 2-way

    - No X-band or KLCP spurs visible

- Attempted to switch one RSR to XLCP, but got error:

    "Could not find 34_X_LCP cable"

- Simultaneous XRCP and XLCP not possible at DSS-34

    - "DSS-34 only has a single channel downconverter for X-band and therefore cannot provide dual capability"

ORTs cont'd

2. ORT on DOY 119 (April 29 PDT) over DSS-34, X- and Ka-band   Completed

14 119 0845 1015 1915 2115 DSS-34 CAS   TP RS BISTORT MC 6057 N750   1A1

- Also prime TP

- Continue seeing KRCP spurs (DR C110162)

- SNT was disabled/re-enabled by station a few times and did not update at all
    - When disabled, SNT showed 26.600 K. When enabled, SNT showed 100.000 K exactly
    - Disabling SNT caused ~2 dB singal power increase in the appropriate band and enabling caused a ~2 dB decrease
    - Kept SNTs disabled until NOAs checked and corrected configuration. SNT updated nominally

- Ka-band power degradations
    - Due to rain?

- Station did not use correct directives to enable Monopulse, but values were updating

- Practiced bistatic calibrations during 2-hr post-cal
    - Monitored by Lu – Was a big help!
    - Station seemed to be able to switch receivers to KLCP though IF switch
        - They couldn't do it on the next ORT. Not possible!
    - First Mini Cal took about 10 minutes. Second one took 6 minutes

Post-pass:

- Bistatic procedure was updated to include more detailed steps for the Mini Cal

ORTs cont'd

3. ORT on DOY 121 (May 1 PDT) over DSS-34, X- and Ka-band   Completed

14 121 0715 1015 1915 1930 DSS-34 CAS   TP RS BISTORT MC 6059 N750   1A1

- Also prime TP

- Practiced bistatic procedure during 3-hr Pre-cal
  - Station confused about step to switch receivers to KLCP on 02 output
    - Does not have ability to configure receivers to output 2
    - Station noted that when Ka-band diode is enabled, RS should see change on both KRCP and KLCP
      - Agreed with what we were seeing
    - Can calibrate both KRCP and KLCP at the same time
  - Skipped KLCP calibration steps and will clarify with NOAs post-pass
  - Mini Cal completed quickly without problems
- Brief KLCP test at beginning
- Continue seeing KRCP spurs (DR C110177)
- Acquired Monopulse data
  - 0.7 dB jump in Ka power when first enabled

Post-Pass

- Station sent email about KLCP:
  - Monopulse connection is 02 output, but not normally used as standard DTT IF connection
  - Ka-band has one set of diodes that are visible on both RCP and LCP paths
  - No need to change the DTT configuration
- Confirms that KRCP and KLCP can be calibrated at the same time
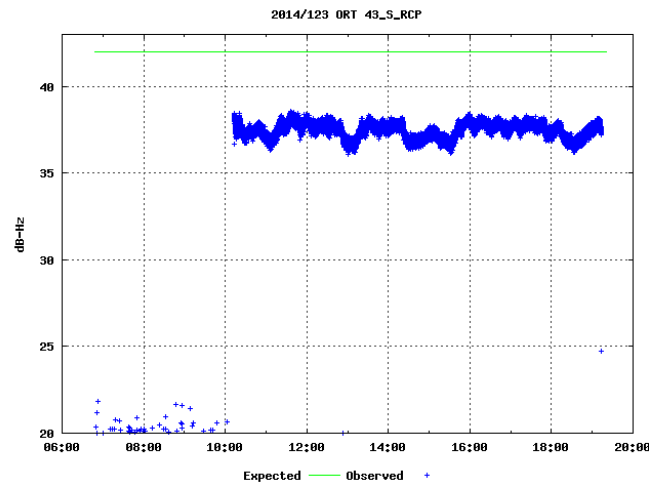- Will update bistatic procedure

ORTs cont'd

4. ORT on DOY 123 (May 3 PDT) over DSS-43, X- and S-band   Completed

14 123 0715 1015 1915 1930 DSS-43 CAS   TP RSS BISTATORT 6061 1647   1A1

- Also prime TP

- Use new configuration for S-band RCP and LCP since don't have S-band Maser anymore

- Practiced bistatic procedure during 3-hr Pre-cal

- Station unable to put SRCP in the ambient load without breaking the LCP path

  - Will check with the NOPE/NOA post-pass

- Conscan enabled at our request

  - Pointing data sent to David

- SRCP power levels fluctuating and below expected levels. Reason still unknown

2014/123 ORT 43_S_RCP

Post-Pass

- Checked with NOA about S-band configuration

  - Will go back to old configuration even though there's no S-band Maser anymore

  - Works for MEX (recently completed two bistatic experiments over DSS-43)

- Will update bistatic procedure

ORTs cont'd

Upcoming

5. ORT on DOY 136 (May 16 PDT) over DSS-43, X- and S-band

14 136 0815 0915 1815 2015 DSS-43 CAS   TP SEQ RS BI-ORT 6074 1647   1A1

- Also prime TP
- Will practice bistatic calibrations during 2-hr Post-cal

Predicts

- DSS-43 uplink (ETX) predicts should compensate for Doppler shift due to Titan's atmosphere
- NAV's last OD delivery prior to the occultation was delivered on May 13
- When can SPS provide DSS-43 ETX files?
- RSS (Paul Schinder) will apply the Doppler shifts to the ETX files. Modified files will be sent to the NOPEs within 24 hours after the ETX files are made available to RSS
- Elias, Dustin and Danny will start the work on the predicts as soon as the SPS ETX files are available
- RSS usually uses three sets of downlink predicts in the open-loop receivers for occultations:
  - #1: Coherent with atmospheric compensation: generated using Nicole's PREDICTs software and SPS nominal (unmodified) ETX
  - #2: 1-way coherent:1-way predicts generated using PREDICTS and the Doppler file produced by Paul, offset in real-time to coherent downlink frequency
  - #3: 1-way (no offset): For the times when the DST is not in lock on the uplink
- May use either 1 or 2 this time to simplify operations

Misc

Uplink Strategy
- DSS-43, 18 kW, ramped, sweep

DKF – Does not have the correct uplink or AOS/LOS times. Use times in RSS timeline

Don't expect closed-loop receivers to lock up during bistatic part

Plan for DSS-34 Cassini Specific 4th Order Pointing Model?
- Crucial to have good pointing models since we can't utilize monopulse throughout
- David has data from DOY 117, 119 and 121

DSS-43 Pointing
- Acquired Conscan data during DOY 123 ORT

Observation ends at ~8 degrees in elevation (193623z)

No Backup simultaneous XRCP and XLCP data
- No station currently has capability except for DSS-43
    - DSS-35 will have in October
- DSS-43 will provide only data set

Problems with eDMD displays freezing
- Have workaround, but eDMD is most convenient

RS to discuss switching open-loop receivers from bistatic to occultation mode
- Predicts, attenuations