Cassini RSS T12 Titan Bistatic and Occultation on DOY 077-078

Bistatic Calibrations Quick Overview

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DSN Antennas Supporting T12

Station	Pre-cal	BOT	EOT	Post-Cal
DSS-25	077/1930	077/2245	078/0300	078/0400
DSS-63	077/1955	077/2300	078/0300	078/0400
DSS-14	077/2000	077/2315	078/0300	078/0400
DSS-26	077/2000	077/2300	078/0300	078/0400
DSS-55	077/2000	077/2300	078/0300	078/0400

Note new Pre-cal and BOT for DSS-25

Equipment scheduled:

- 2 closed-loop receivers per antenna
- All RSRs and VSRs at Goldstone
- All RSRs and VSRs at Madrid
- WVSR at Goldstone and Madrid

RSR/VSR Assignment

DSS	Operator	Station	RSRs or VSRs	RSR Assignment
14	Gene	rsops1	RSR1 and RSR2	RSR1A -> XRCP
				RSR1B -> XLCP
				RSR2A -> SRCP
				RSR2B -> SLCP
25	Kamal	PC via rsops1	RSR3	RSR3A -> XLCP
				RSR3B -> KRCP
26	Danny	PC via rsops2/rsops3	VSR1 and VSR2	VSR1A -> XRCP
				VSR1B -> XLCP
				VSR2A -> KRCP
				VSR2B -> KLCP
63	Don	rsops3	VSR1 and VSR2	VSR1A -> XRCP
				VSR1B -> XLCP
				VSR2A -> SRCP
				VSR2B -> SLCP
55	Elias	rsops2	RSR1 and RSR2	RSR1A -> XRCP
				RSR1B -> XLCP
				RSR2A -> KRCP
				RSR2B -> KLCP

Roberto will operate WVSRs

Why are Ground Antenna Calibrations Required?

Why are ground antenna pre-cal and post-cal calibrations required for Bistatic observations, and not occultation experiments?

Essam:

In occultations, we track the strong direct signal during the baseline and use that as the reference for what happens to the signal during occultation. For bistatic, we observe a possible reflected weak broadband echo above the noise floor, hence need to carefully calibrate the noise floor around the observation time by looking at the sky sometimes and at noise diodes some other times during the pre-cal/post-cal periods.

Antennas Capabilities

Simultaneous Band and Polarization

Goldstone			Madrid	
DSS-14	DSS-25	DSS-26	DSS-63	DSS-55
X-RCP X-LCP	X-RCP X-LCP	X-RCP X-LCP	X-RCP X-LCP	X-RCP X-LCP
S-RCP S-LCP	K-RCP	K-RCP K-LCP	S-RCP S-LCP	K-RCP K-LCP

All-Band Dependent Polarizations

Same-Band Dependent Polarizations

Independent Polarizations

All-Band Dependent: Ambient Load or Cold Sky changes will impact both polarizations/both bands
Same-Band Dependent: Ambient Load or Cold Sky changes will impact both polarizations/same band
Independent: Ambient Load or Cold Sky changes will only impact polarization being changed

Either KLCP or monopulse enable at DSS-26 and DSS-55

Bistatic Calibrations

- Calibrations will be performed during
  - Pre-cal (antennas at stow)
    - 3-hr pre-cal periods were scheduled
      - Normally 60 minutes at 70-m and 90-m at BWG for Ka-band support
  - Observation (mini-cals)
    - Pre-determined and carefully selected times (during turns or while in occultation)
      - More from Essam
  - Post-Cal (antennas at stow)
    - 1-hr post-cal periods were scheduled
      - Normally 15 minutes

- Pre-cal Calibrations are the longest of the three

Bistatic Calibrations – Cont'd

- Basic Steps

1. Cold Sky, Noise Diodes OFF
   RSSG do attenuation auto
2. Ambient load, Noise Diode OFF
   Get Ambient Load Temp
   RSSG do attenuation auto (no more att auto after this point)
3. Ambient load, 12.5 Noise Diode ON
4. Cold Sky, 12.5 Noise Diode ON
5. Cold Sky, 12.5 Noise Diode OFF

- Original plan: Calibrate all 5 antennas at the same time, starting with X-band at all, and then S-band at the 70-m with Ka-band at the 34-m
  - Thought it would be too complicated
  - Some antennas have different configuration/switching
  - Limitation: Number of closed-loop receivers at station
    - Need to switch between bands as they are being calibrated
  - NOPE has visibility into what stations are doing, and wants to monitor, but difficult to monitor all five at the same time?
  - More complicated for RS
    - Communications with stations
    - Too many receivers to monitor at the same time (18 total!)
- Next plan: Calibrate 70-m antennas together, DSS-26 and DSS-55 together, and DSS-25 last (will discuss order later)
  - Give stations more time to set up for track while others are being calibrated
  - Realized during ORTs on DOY 070 and 071 that we don't have enough time to do this!
    - Also, did not take into consideration time it takes antennas to go from stow to point
- Final plan: Calibrate all antennas at the same time
  - Practiced during ORTs on DOY 070 and 071

Bistatic Calibration for 70-m **DSS-** **Operator**

		Time	SLCP RSR	SRCP RSR	XLCP RSR	XRCP RSR
1	X-band Out the horn (cold sky), diode OFF					
	Begin XRCP and XLCP 16 KHz recording					
	Att Auto XLCP and XRCP only					
	ADC Amplitude					
	Att Setting					
2	X-band in the ambient load					
	Att auto (Final for XRCP and XLCP)					
	No Att Auto during post-cal					
	Ambient Load Temp					
	ADC Amplitude					
	Att Setting					
	Monitor Att Setting from here on. It should not change					
	Weather					
	(Temp, Humidity, Pressure, Wind Speed, Sky condition)					
3-4	XRCP 12.5K diode ON					
	Wait 1-2 minutes for next step					
	XLCP 12.5K diode ON					
	ADC Amplitude					
5	X-band Out the horn, diode ON					
	ADC Amplitude					
6-7	XRCP diode OFF					
	Wait 1-2 minutes for next step					
	XLCP diode OFF					
	ADC Amplitude					
	Stop recording XRCP and XLCP, This completes X-band					

DSS- **Operator**

Begin SRCP

		Time	SLCP RSR	SRCP RSR	XLCP RSR	XRCP RSR
8	Configure both DTTs for S-band					
9	SRCP Out the horn (cold sky), diode OFF					
	Begin SRCP and SLCP 16 KHz recording					
	Att Auto SRCP only					
	No Att Auto during post-cal					
	ADC Amplitude					
	Att Setting					
10	SRCP in the ambient load					
	Att auto (Final for SRCP)					
	Ambient Load Temp					
	ADC Amplitude					
	Att Setting					
	Monitor Att Setting from here on. It should not change					
11	SRCP 12.5K diode ON					
	ADC Amplitude					
12	SRCP Out the horn, diode ON					
	ADC Amplitude					
13	SRCP diode OFF					
	ADC Amplitude					

End SRCP

DSS- **Operator**

Begin SLCP

		Time	SLCP RSR	SRCP RSR	XLCP RSR	XRCP RSR
14	SLCP Out the horn (cold sky), diode OFF					
	Continue SRCP and SLCP 16 KHz recording					
	Att Auto SLCP only					
	ADC Amplitude					
	Att Setting					
15	SLCP in the ambient load					
	Att auto (Final for SLCP)					
	No Att Auto during post-cal					
	Ambient Load Temp					
	ADC Amplitude					
	Att Setting					
	Monitor Att Setting from here on. It should not change					
16	SLCP 12.5K diode ON					
	ADC Amplitude					
17	SLCP Out the horn, diode ON					
	ADC Amplitude					
18	SLCP diode OFF					
	ADC Amplitude					
	Stop recording SRCP and SLCP. This completes S-band					

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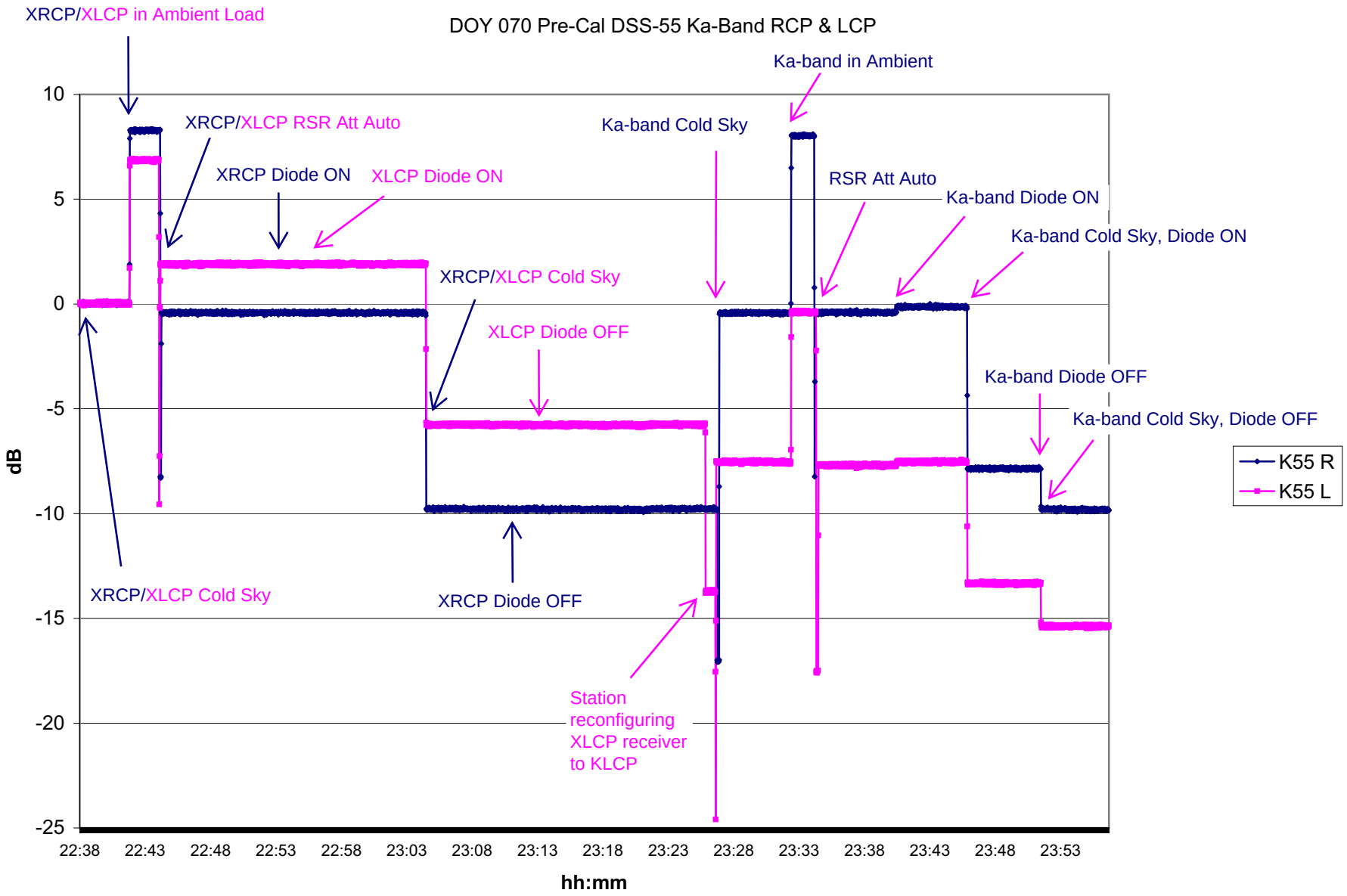
Plot of Power in RSR Complex Data Samples During Pre-Cal



Plot by Danny Kahan