

About the Occultation

- S74 Rev 169 Saturn rings and atmospheric occultation
 - Ingress only
 - Telemetry OFF, Ranging OFF, 2-way/3-way mode
 - Covered by Canberra

- From Essam Marouf:

Two 2-way Cassini Radio Science (RSS) experiments will be implemented on Rev 169. The first is an ingress ionospheric and atmospheric occultation probing near equatorial latitude of about 5 degrees South. It will be the first deliberate Cassini atmospheric occultation conducted in 2-way and 3-way configurations using an uplink signal from DSS-43 to provide a reference signal to replace the one usually provided by the Cassini UltraStable Oscillator (USO). It will provide an electron density profile of the ionosphere, high spatial resolution profile of the thermal structure of the neutral atmosphere, dispersive microwave absorptivity profiles, and information about the equatorial winds. The atmospheric occultation will also allow comparison of results with those from an earlier set of near-equatorial atmospheric occultations completed back in 2005, hence providing important information regarding potential atmospheric temporal/seasonal variability. The second occultation is an ingress ring occultation, which will be the third in a group of four occultations planned during the June to August 2012 period. They are specifically designed to sample new range of ring opening angle (~12.5 to 13.5 degrees), while covering complementary range of ring longitudes. The four occultations are on Revs 167 to 170. The occultations are expected to yield high resolution radial profiles of ring structure. In addition, measurements of the strength and shape of the collective forward scattering function are expected to shed more light on physical properties of multitude of ring features. In both occultations, measurements at three radio wavelengths (0.94, 3.6, and 13 cm; Ka-, X-, and S-bands) will be collected at the Canberra complex (DSS-43 and DSS-34).

DSN Antennas

- DSN Coverage

	Pre	BOT	EOT	Post							
12 204	0410	0510	1320	1335	DSS-43	CAS	RS169-RI/SA	OCC	5409	1639	1A1
12 204	0610	0740	1320	1335	DSS-34	CAS	RS169-RI/SA	OCC	5409	N750	1A1

- 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

- Antennas Band and Polarization Capabilities

DSS-43	DSS-34*
X-RCP X-LCP	X-RCP
S-RCP S-LCP	K-RCP

*KLCP capability exists, but cable not connected

- LCP data are enhancement. Prime are RCP
- Only RCP will be recorded
 - 2-way/3-way and 1-way modes

RSR/WSR/WVSR Assignment

Aseel: VOCA

Don: Ops Room Displays

DSS	Operator	Station	Open-loop Receiver	RSR Assignment
43 (2-way)	Elias	rsops1	RSR1	RSR1A -> XRCP RSR1B -> SRCP
43 (1-way)	Danny	rsops4	WVSR1	WVSR1A -> XRCP WVSR1B -> SRCP
34 (2-way)	Don	rsops2	RSR2	RSR2A -> XRCP RSR2B -> KRCP
34 (1-way)	Danny	rsops4	WVSR2	WVSR2A -> XRCP WVSR2B -> KRCP

RSSG will be in Ops Room at 9 pm on Saturday, July 21st (204/0400)

ORTs

ORT on DOY 194 (July 12) over DSS-43, X- and S-band

12 194 0255 0355 1230 1245 DSS-43 CAS TP RS169-OCCORT 5399 1639 1A1

- Verified X- and S-band signals
- Heavy rain
- Looked for X-band ~0.5 dB power fluctuations reported by Essam in DOY 180 and 167 data (see next page), but hard to see in real-time
 - Fluctuations due to rain made it harder

ORT on DOY 196 (July 15) over DSS-34, X- and Ka-band

12 196 0200 0330 1230 1245 DSS-34 CAS RS169-OCCORT MC 5401 N750 1A1

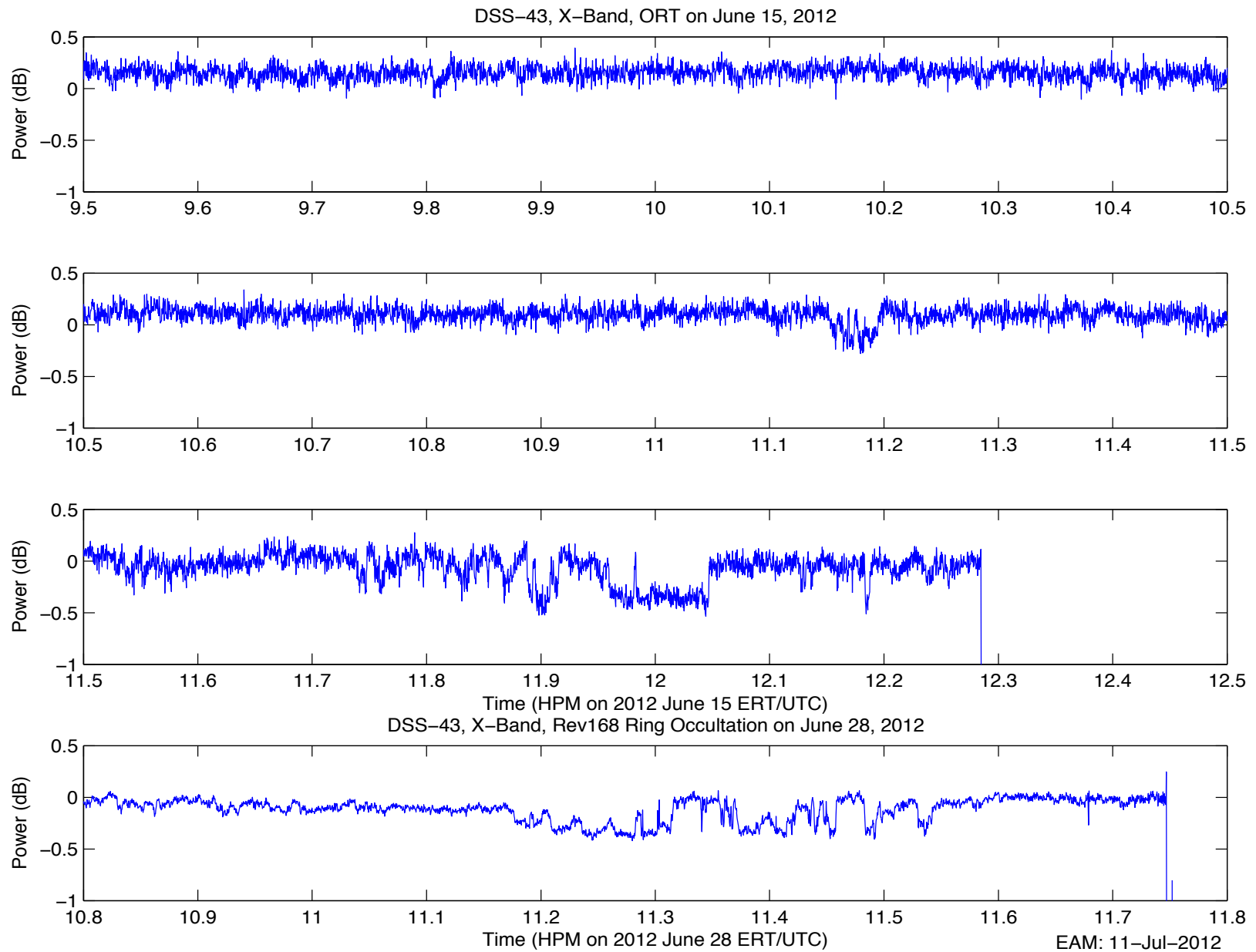
- Scattered showers, overcast
- Some signal level fluctuations in addition to S/C Rolling, most likely due to weather
- Monopulse successful
 - ~2dB jump in power when monopulse was first enabled (in 1-way mode). No jump when monopulse was re-enabled after switching to 2-way

Upcoming

ORT on DOY 201 (July 19) over DSS-34, X- and Ka-band

12 201 0200 0330 1215 1230 DSS-34 CAS RS169-OCCORT MC 5406 N750 1A1

- To verify X-band and Ka-band data and acquire pointing/monopulse data



Top 3 panels cover last three hours of ORT on DOY 167 (2-way data)
The 4th panel covers a 1 hr 2-way baseline data period on DOY 180 (ring occultation experiment)

Predicts

- Uplink (ETX) predicts should compensate for Doppler shift due to Saturn's atmosphere
 - Capability used to exist in the DSN but was deleted
- Originally, asked SPS if they could do that
 - RSS provided a Doppler profile
- SPS engineers are very busy with MSL (issues with MSL's EDL ephemeris)
- SPS asked if RSS can apply the Doppler shifts to an ETX file provided by the DSN and send it back to SPS
 - They would then introduce the augmented file into the dataflow, so it goes to the station and is used in the uplink controller
- Paul Schinder said he could modify the file

Predicts Test #1 (DOY 180, Rev 168 occultation)

- Sent Paul ETX file for Rev 168 (DOY 180) as a test
- Also sent specs (0323-sps-ulc_RevD-L2-09-Jul-2012.pdf)
- Paul modified ETX file for DOY 180:
 - Wrote a code that constructs a piecewise linear approximation which is bounded by a settable error bound (in this case, 2 Hz)
 - Can they handle the rapid changes at the "kink"

Predicts cont'd

Predicts Test #2 (DOY 204)

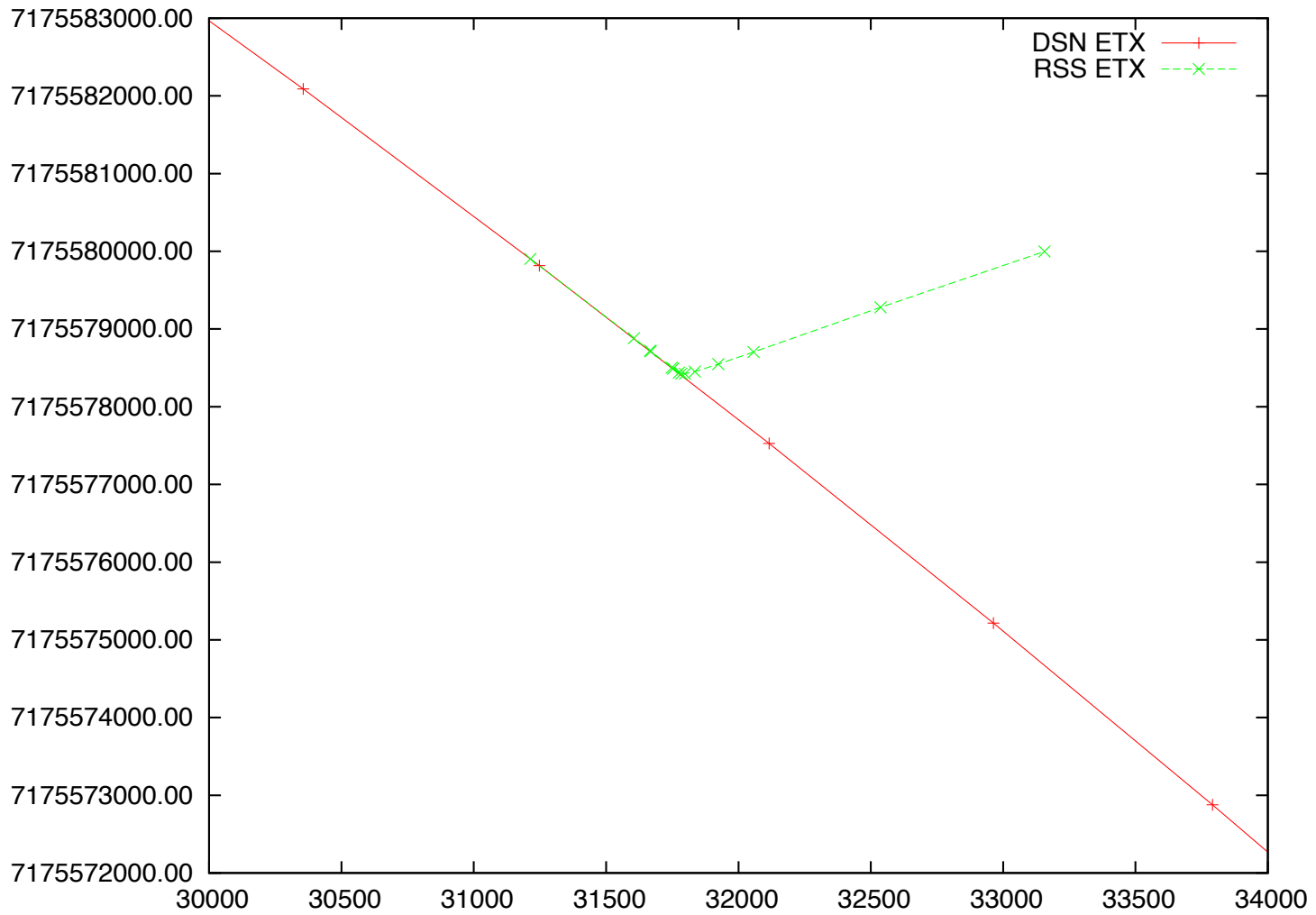
- Yesterday, asked SPS for DOY 204 ETX file using special NAV delivery on July 16th
- SPS generated predicts, and ETX file was forwarded to Paul
- Paul modified the file
 - See plots on next two pages
 - Made some assumptions based on specs for predicts file
 - Only modified the *ULF part of the ETX file, and left the *XA alone, on the assumption that the *ULF drives the actual uplink
 - Cut and pasted the snippet of ETX he created into the larger file, which means that it ends at the bottom of my atmospheric model, and at the end there will be a sudden several thousand Hz transition back to the vacuum solution
 - Should try to do something about that or just leave it? At that point, we should have lost uplink contact with the spacecraft anyway
 - He could extend the last linear segment a few hundred seconds to make sure, and/or do something to make the transition back to the vacuum solution less abrupt
 - Didn't pay much attention to the header of the file except to change the number of ULF lines
- Forwarded Paul's modified ETX to the NOPEs to check
 - Plot from Sandy on Page 9

Actual Predicts for DOY 204:

- NAV expects to deliver OD on Thursday or Friday, but most likely Thursday
- How long does Paul need to modify the file?

From Paul Schinder
DOY 204 ETX

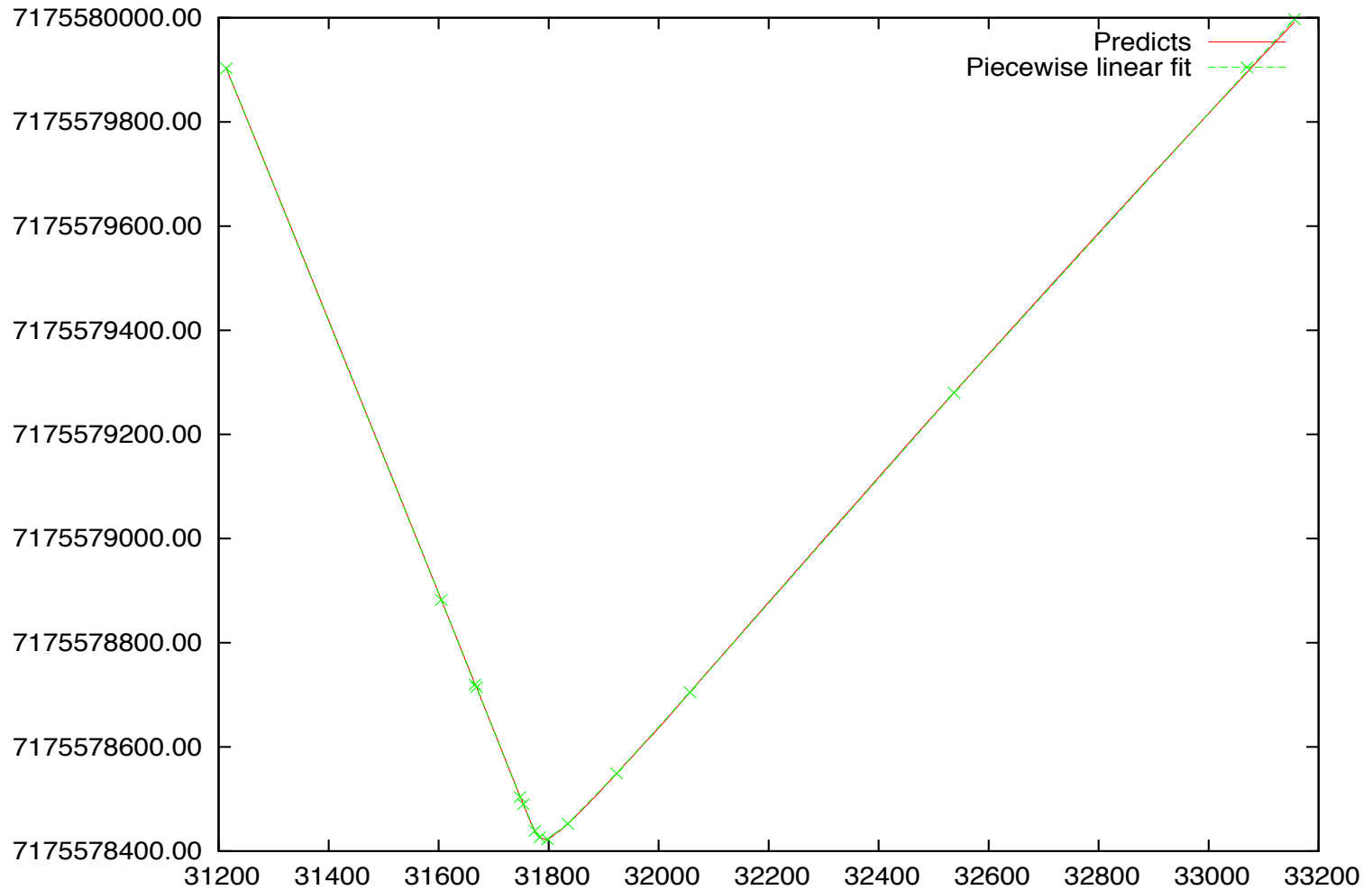
Comparison between the DSN piecewise linear fit and RSS, including the effect of the atmosphere



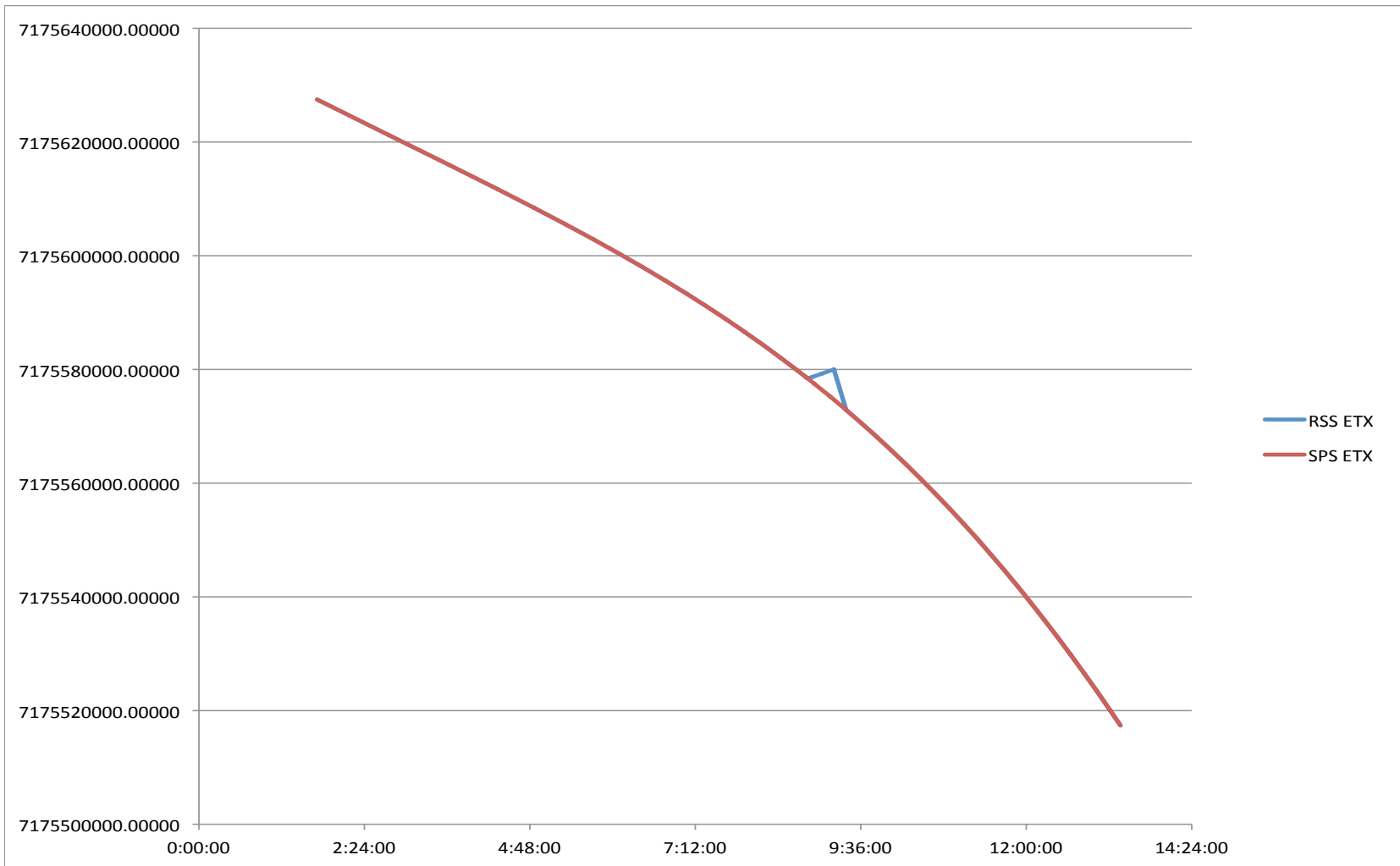
From Paul Schinder

Plot showing how well the RSS linear fit tracks the RSS 1 per second predictions of the uplink frequency
(these have both been scaled to match the DSN ETX at first contact with the atmospheric model)

The x axis is transmit time, and the y axis frequency



From Sandy Kwan
Calculated the missing STEP and SLOPE at 09:12:36 UTC and graphed the comparison of the
SPS generated ETX and the RSS one



Misc

Uplink at DSS-43: 18 kW

DKF – Does not have accurate AOS/LOS and uplink times. Use times in RSS timeline

Real-time change:

A Goldstone DSS-14 OTM backup pass immediately precedes the occultation Canberra supports and overlaps DSS-43 by 35 minutes:

12 203 1945 2045 0545 0600 DSS-14 CAS OTM-328 T85A BU 5408 N003 1A1

- DKF currently has an uplink transfer from DSS-14 to DSS-43 at 0520
- Delete transfer to allow RSS to acquire 1-way baseline
- 0520 DSS-14 transmitter off (instead of transfer)

NOPEs - Equipment Status?

NOPEs – Will BM be modified to eliminate confusion about DSS-34 Ka-band configuration?

(For Rev168, station did monopulse calibrations with Switch 43 in B position, so monopulse did not work at first)

Plan for Cassini Specific 4th Order Pointing Models

- David Rochblatt is at MDSCC
- He will review pointing data from there and work with Canberra (Graham Baines) on the model as needed
- Don sent David pointing data from first ORT. Will send more data after second ORT tomorrow evening

Misc cont'd

SNT

- Enable X only at DSS-34 throughout
- Conduct SNT measurements

Open-loop Recording bandwidths

- All except Ka-band 1-way: 1, 16, 50, 100 KHz
- Ka-band 1-way: 1, 2, 16, 50 KHz

Closed-loop receiver lock-up - Will be intermittent during Ring B

OTM-328 prime pass is Friday evening

12 203 0155 0255 1200 1215 DSS-45 CAS TP OTM-328 T85A 5408 N006 1A1