

RPW cruise phase & high data rate operations

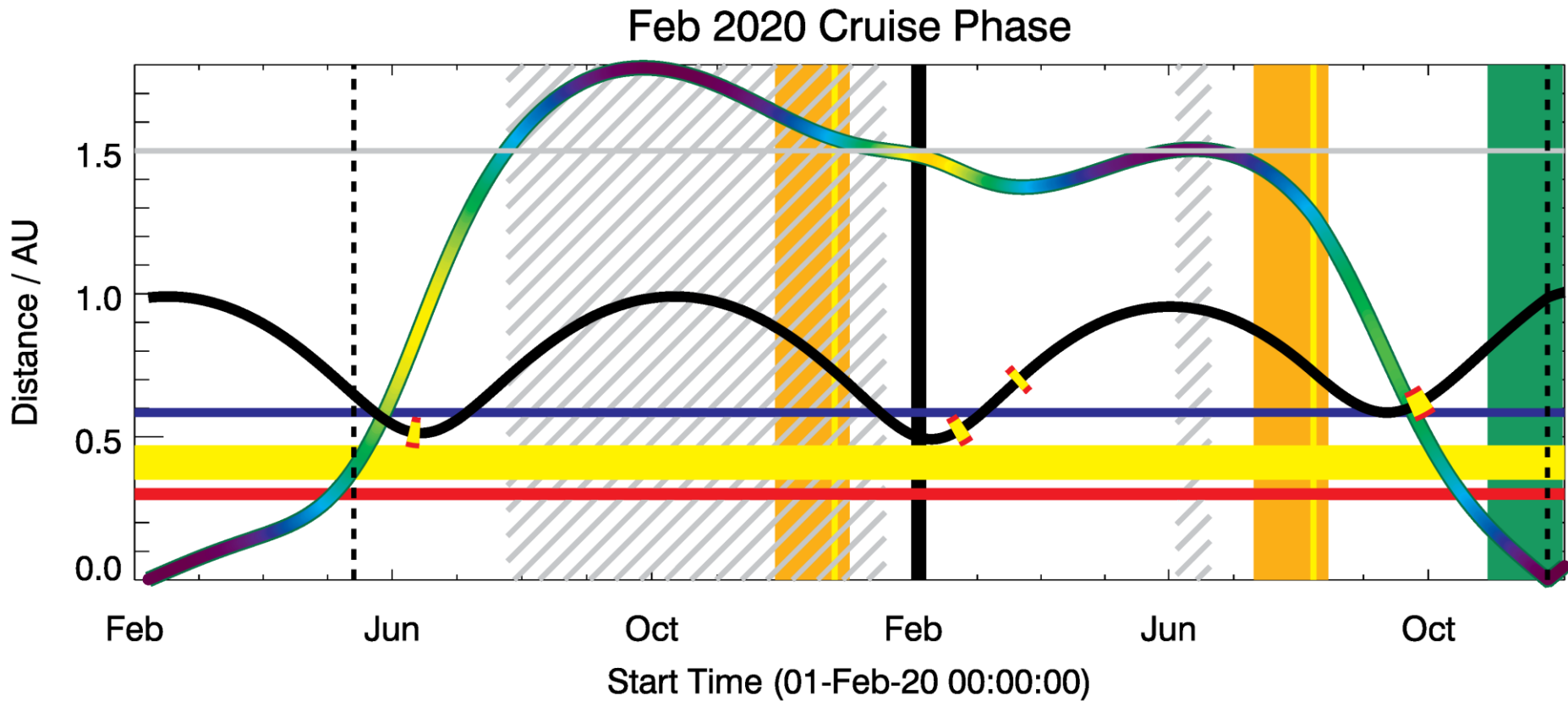
March 28, 2019

RPW consortium meeting, Kiruna

RPW operation planning

- ❑ We are now less than 1 year from launch
- ❑ It is time to start taking operations planning seriously
- ❑ SOOP kitchen: an elaborate and convenient tool for science planning
 - allows to prepare the timeline of instrument operations = the sequence of operation modes planned over months.
 - Needs a variety of preconfigured operation modes to be used
 - At the moment, we have NORMAL, BURST and SBM
 - We need more to have flexibility for low **and high** telemetry scenarios.

RPW cruise phase planning



TM allocation during cruise (as agreed by SWT/SOWG):

- 15 May 2020 - 15 July 2020: Higher rate (100%)
- 15 July 2020 - 31 December 2020: Lower rate (50%)
- 31 December 2020 - 22 March 2021: Higher rate
- 22 March 2021 - 13 August 2021: Lower rate
- 13 August 2021 - End: Higher rate.

+ 150% TM allocation to RPW & MAG during Remote Sensing instrument operations.

RPW cruise phase planning



- ❑ Use of selective downlink mode is uncertain
- ❑ After discussion within ROB two configurations prepared for 50% TM allocation
 - **LR1:** Configuration assuming no selective downlink
 - All TM in NORMAL & BURST mode
 - BURST TM unchanged
 - NORMAL telemetry reduced to
 - **LR2:** Configuration assuming selective downlink with TM allocation reduced to 50%
 - BURST TM unchanged
 - NORMAL telemetry reduced to
 - SBM1/SBM2 modes at the same TM rate, but with fewer events

RPW NORMAL mode



RPW mode	How often used	What data	TM rate (avg.) bps
SURVEY	when not in burst	Default science config	4281
BURST	10 min/day	continuous waveform at 256 Hz	150
SBM1 SBM2	13 min / 5 days 10 / year	high resolution data covering shocks and type 3 bursts	504
HK etc	continuously	Housekeeping	223
Total			5158

Breakdown of telemetry rate between different modes in normal science operations.

Low rate config 1 (no SBM)

RPW mode	How often used	What data	TM rate (avg.) bps
SURVEY	when not in burst	Default science (reduced)	2025
BURST	10 min/day (not changed)	continuous waveform at 256 Hz, better LFR spectra	150
SELECTIVE BURST	none	high resolution data covering shocks and type 3 bursts	0
HK etc	continuously	Housekeeping	223
Total			2398

Low rate config 1 (no SBM)



Reduced of cadence of NORMAL data:

- TDS&LFR regular snapshots once every **30 minutes** (was every 5 minutes)
- LFR Spectral products (< 10 kHz) cadence reduced to half:
 - basic parameters once every **8 seconds** (was every 4 seconds)
 - compressed spectral matrix once every 40 seconds (was 20 seconds)
- Thermal noise and radio spectra every **24 seconds** (was every 12 seconds)
- Fewer TDS triggered snapshots (48 down from 64)

RPW analyzer	Reduced TM (bps)	Nominal TM (bps)	Ratio reduced / nominal
TDS	438	906	48.4 %
LFR	1333	2872	46.4 %
THR	254	504	50.5 %
Total	2025	4282	47.3 %

Low rate config 2 (50% SBM)

RPW mode	How often used	What data	TM rate (avg.) bps
SURVEY	when not in burst	Default science (more reduced)	1490
BURST	10 min/day	continuous waveform at 256 Hz, better LFR spectra	150
SELECTIVE BURST	13 min every 10 days	high resolution data covering shocks and type 3 bursts	280
HK etc	continuously	Housekeeping	220
Total			2140

Reduced of cadence of NORMAL data:

- High res. waveform snapshots once every **60 minutes** (was every 5 minutes)
- Spectral products (< 10 kHz) once every **16 seconds** (was every 4 seconds)
- Thermal noise and radio spectra every **24 seconds** (was every 12 seconds)
- Other minor things: fewer triggered snapshots, histograms...

Low rate config 2 (no SBM)



Even more reduced of cadence of NORMAL data:

- TDS&LFR regular snapshots once every **60 minutes** (was every 5 minutes)
- LFR Spectral products (< 10 kHz) cadence reduced to half:
 - basic parameters once every **16 seconds** (was every 4 seconds)
 - compressed spectral matrix once every 60 seconds (was 20 seconds)
- Thermal noise and radio spectra every **24 seconds** (was every 12 seconds)
- Fewer TDS triggered snapshots (32 down from 64)

RPW analyzer	Reduced TM (bps)	Nominal TM (bps)	Ratio reduced / nominal
TDS	302.8	905.33	33.4 %
LFR	931.9	2872.17	32.4 %
THR	254.8	504.3	50.5 %
Total	1489.6	4281.8	34.8 %

Other cruise phase considerations

- ❑ Reduction of periodic data products had to be done
 - Waveform snapshots from 5 minutes to 30/60 minutes
 - Spectral data from 4 seconds to 8/16 seconds
- ❑ SWA will adjust their timeline to collect distributions consistently (so that we get 3D distribution at the same time as RPW snapshot).
- ❑ Special operations to be considered
 - What to increase during the Remote Sensing checkout windows (150% TM allocation)
 - Parker Solar Probe conjunctions during cruise phase. Several identified
 - in-situ instruments should go to 100% TM at the expense of the remaining cruise phase time and perhaps schedule more burst time.

Cruise phase periodic operations

□ Daily operations

- SURVEY_BURST window
- TDS TSWF dump (16 snapshots x 4)

□ Weekly operations

- THR internal calibration
- LFR internal calibration
- BIAS sweeping and current setting (cadence may increase when approaching perihelion)
- SBM selective downlink (not fully operational during cruise phase, punctual downlinks may be possible)

□ Monthly

- LFR K-coeff updates (every 8 to 10 days)

RPW high datarate operations



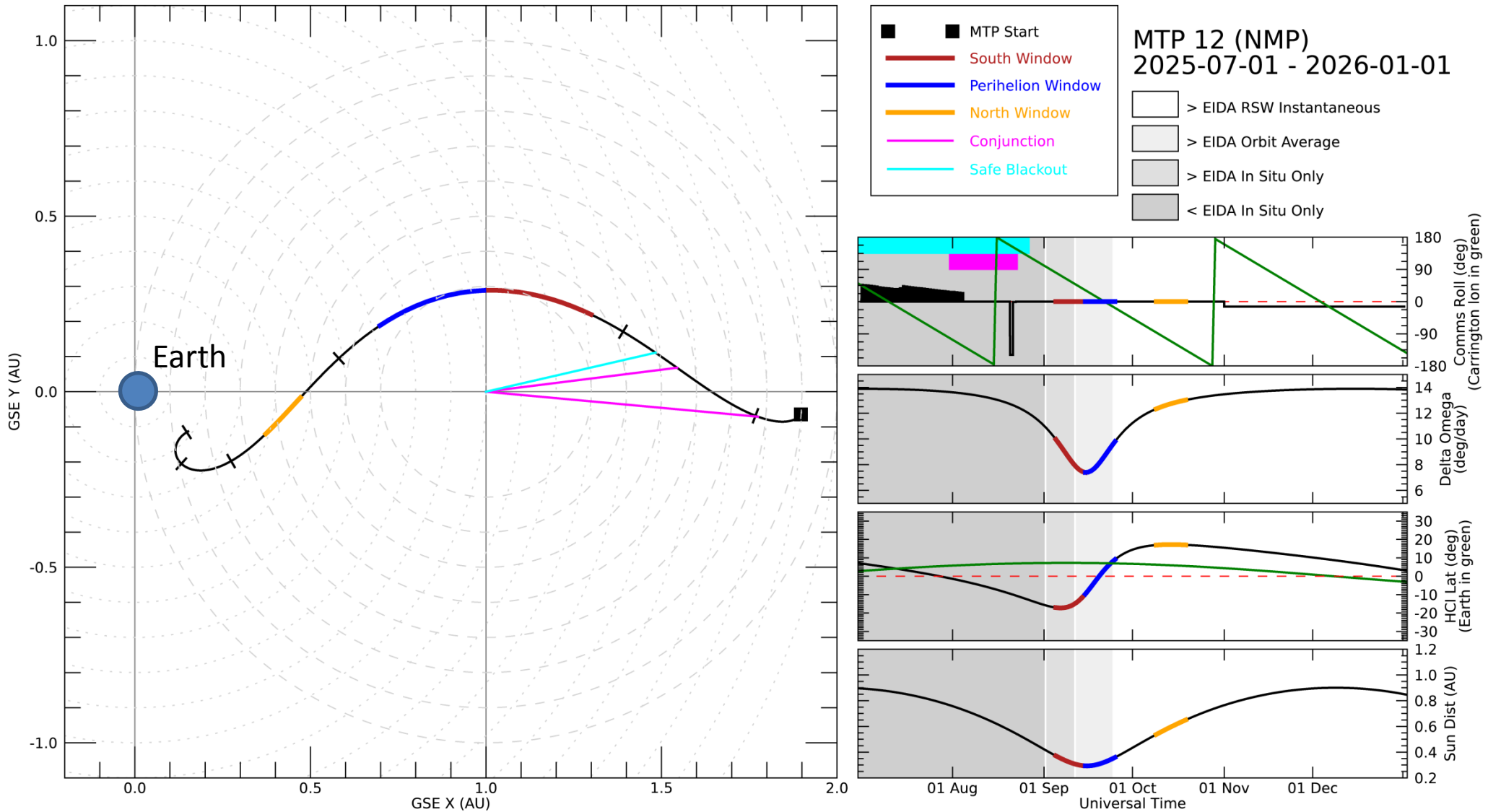
Motivation:

- ❑ It appears that during nominal mission phase, telemetry much larger than the baseline 5.5 kbps will be available to RPW (and also to other in-situ instruments).
- ❑ One example studied during last SOWG.
 - see next slide
- ❑ It is needed to define high datarate modes in the SOOP kitchen to make a good use of such periods.

RPW high datarate operations



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RPW high datarate operations



Options we have:

- ❑ Increasing duration of BURST mode to more than 10 minutes / day.
 - BURST datarate is 21 kbps (4 x the NORMAL rate)
 - For the July-December 2015 operation this was not sufficient.
- ❑ Increasing number of downloaded SBM1 / SBM2 events.
 - should definitely be done
 - depends on the number of events collected
- ❑ Define new modes
 - RPW will run in NORMAL or BURST mode, but with special configuration.

TDS high rate config



RPW mode	How often used	What data	TM rate (avg.) bps
SURVEY		TDS / LFR rate increased (see below)	28 760
BURST	10 min/day	Unchanged	150
SELECTIVE BURST	13 min every 10 days	Unchanged (can be increased arbitrarily if needed)	500
HK etc	continuously		220
Total		about 6 x the EID-A rate	29 630

Increased cadence of NORMAL data:

- TDS & LFR : High res. waveform snapshots once every **minute** (was every 5 minutes)
- TDS: Increased number of triggered snapshots from 64/day to 512/day
- THR: no change

LFR high rate config



RPW mode	How often used	What data	TM rate (avg.) bps
SURVEY		BURST all the time	0
BURST	all the time	BURST	21 430
SELECTIVE BURST	13 min every 10 days	Unchanged (can be increased arbitrarily if needed)	500
HK etc	continuously		220
Total		about 6 x the EID-A rate	22 150

- Increasing the datarate for LFR is not possible for BURST mode
- LFR high rate is currently equivalent to BURST
- The way forward would probably be a smart use of SBM1 mode
 - trigger SBM1 more often (several times per day)
 - download all SBM1 – no selection

Balanced high rate config



RPW mode	How often used	What data	TM rate (avg.) bps
SURVEY		NORMAL++ (see below)	34650
BURST	10 min/day	Unchanged	150
SELECTIVE BURST	13 min every 10 days	Unchanged (can be increased arbitrarily if needed)	500
HK etc	continuously		220
Total		about 7.5 x the EID-A rate	35 420

Increased cadence of NORMAL data:

- TDS & LFR : High res. waveform snapshots once every 30s (was every 5 minutes)
- LFR: full spectral matrix every 30 second
- TDS: 256 triggered snapshots / day
- THR: 2 x NORMAL datarate

RPW high datarate operations

- More options possible
 - THR high rate ?
 - Science driven modes
 - Proposals are welcome, but the number should be small
- Caveats:
 - The modes need to be validated and tested on RPW
 - It needs to be checked whether the datarate can be handled by RPW DPU (should be OK) and the spacecraft computer.
 - Special use of SBMx needs to be checked.