

solar orbiter



RPW cruise phase operations (LTP01&02)

September 30, 2019

RPW consortium meeting, Paris

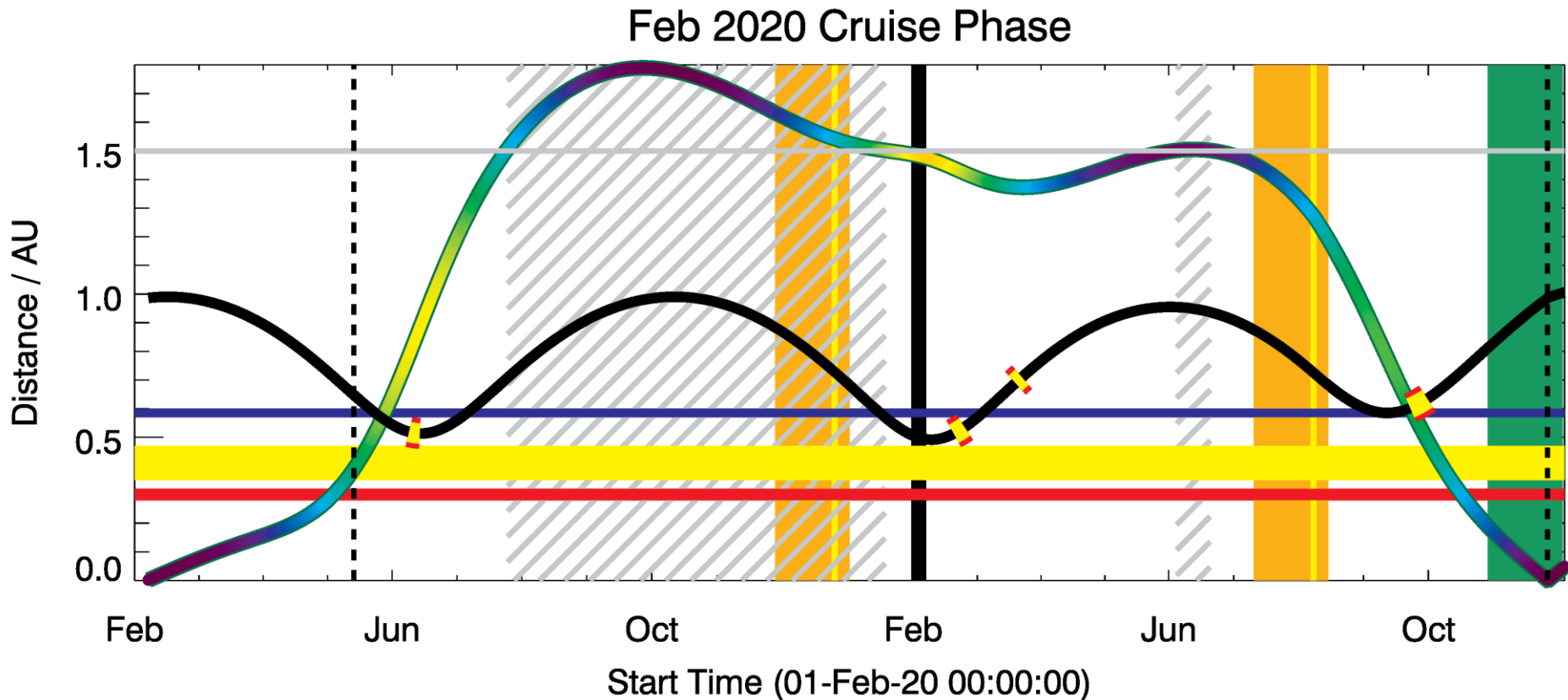
RPW operation planning

- ❑ Overview of the first cruise phase period
 - May-December 2020
- ❑ High rate operations in the very beginning of cruise
 - May to early June
- ❑ In-situ burst coordination
- ❑ Testing of inter-instrument communication during commissioning

Cruise phase overview

- ❑ Cruise starts at the end of NECP. Baseline: 14 May 2020
 - This may be slightly different depending on how commissioning goes.
- ❑ In situ science starts immediately
 - PSP perihelion 27th September (interesting alignments +/- ~2 weeks)
- ❑ Remote sensing instruments have 1 checkout window (17-22 June 2020).
 - Warm Checkout window ($\sim 0.51 \text{ AU}^*$)

Cruise phase overview



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.

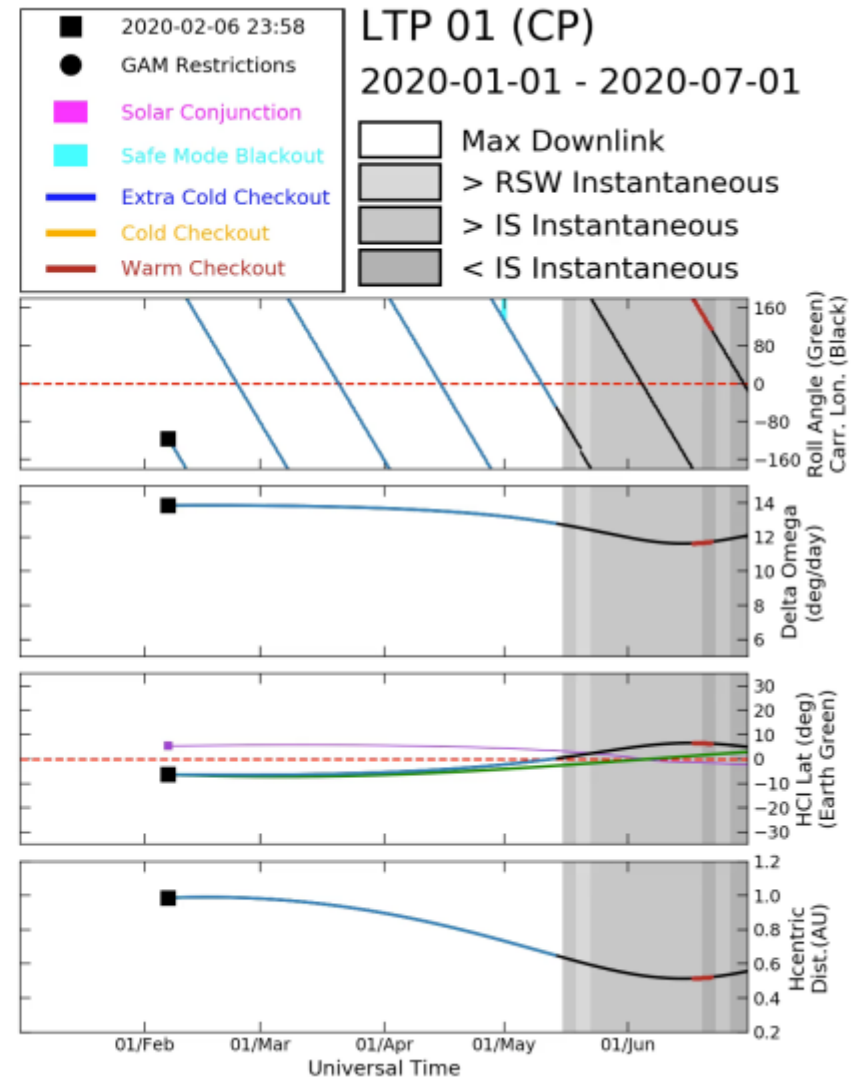
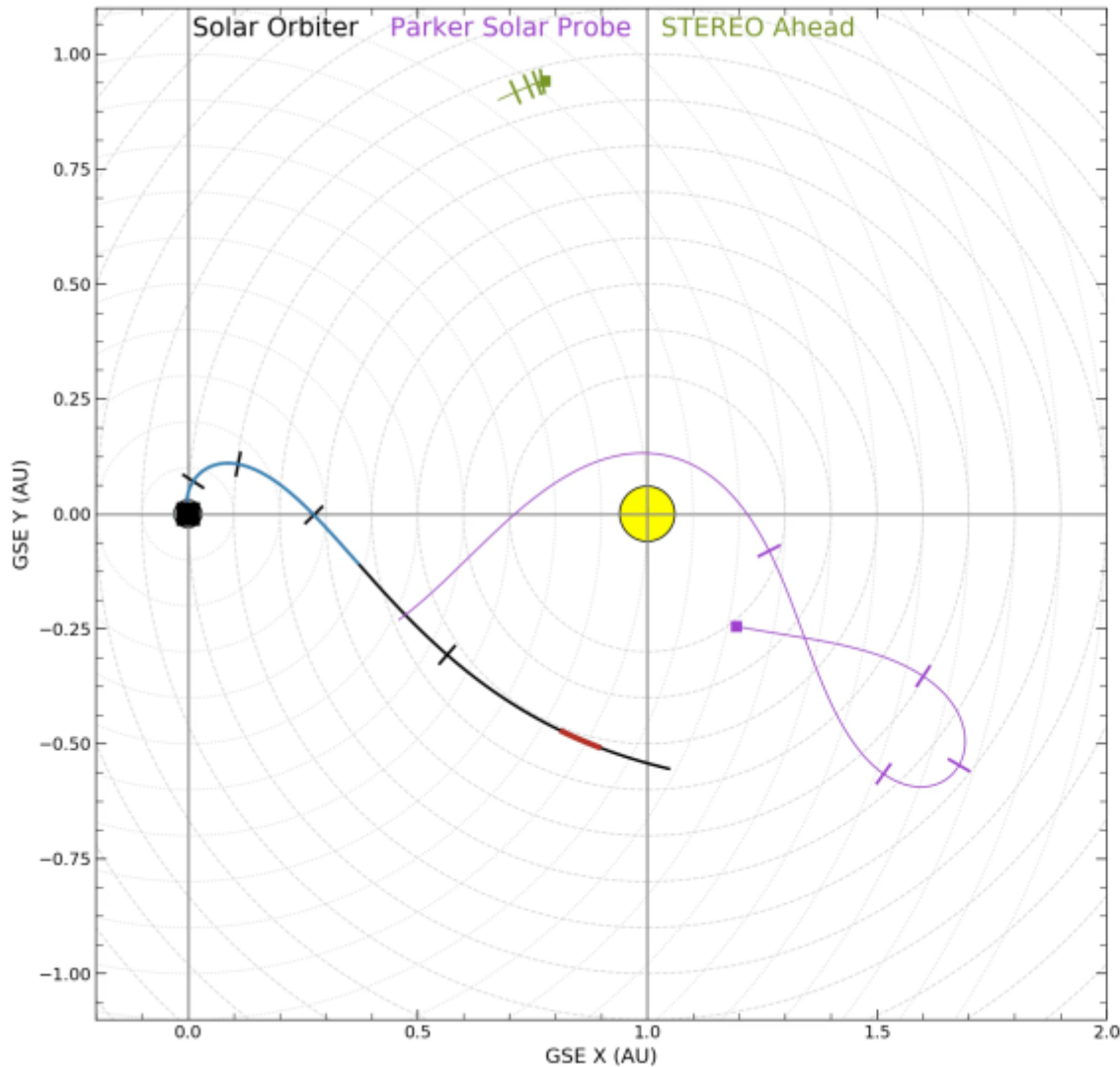
+ 150% TM allocation to RPW & MAG during Remote Sensing instrument operations.

RPW modes now available in SOOP kitchen

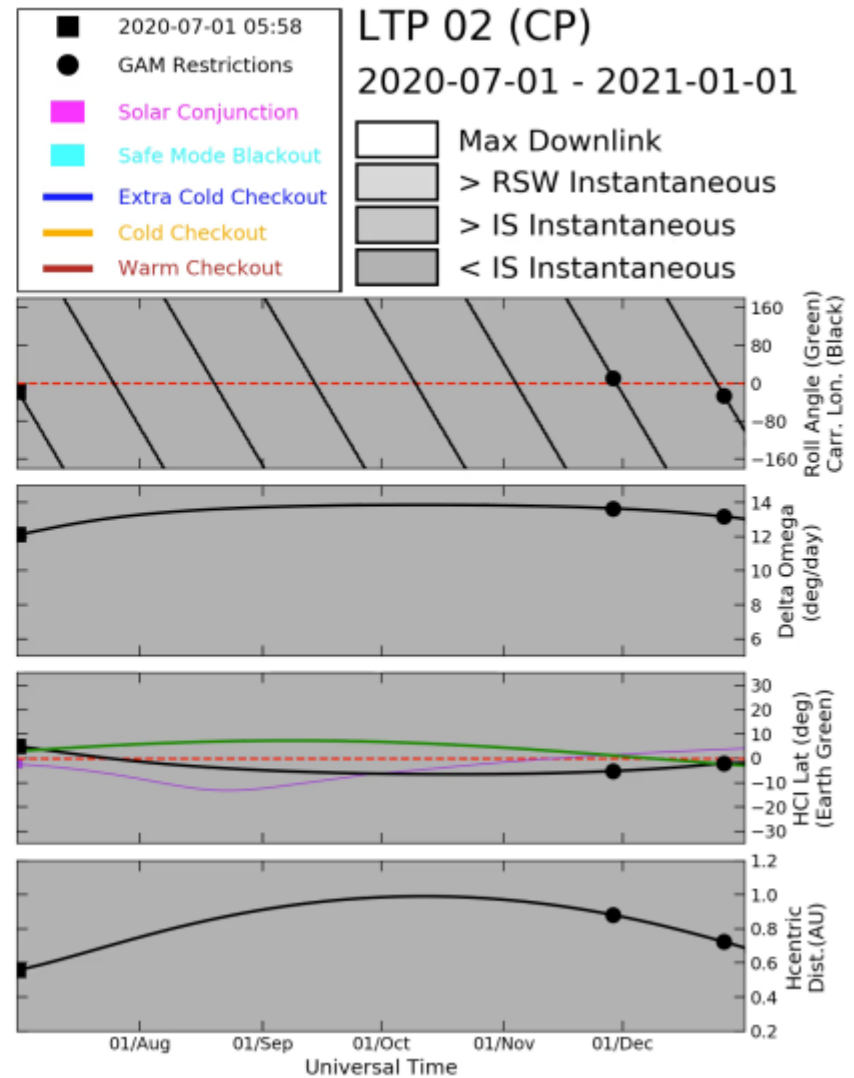
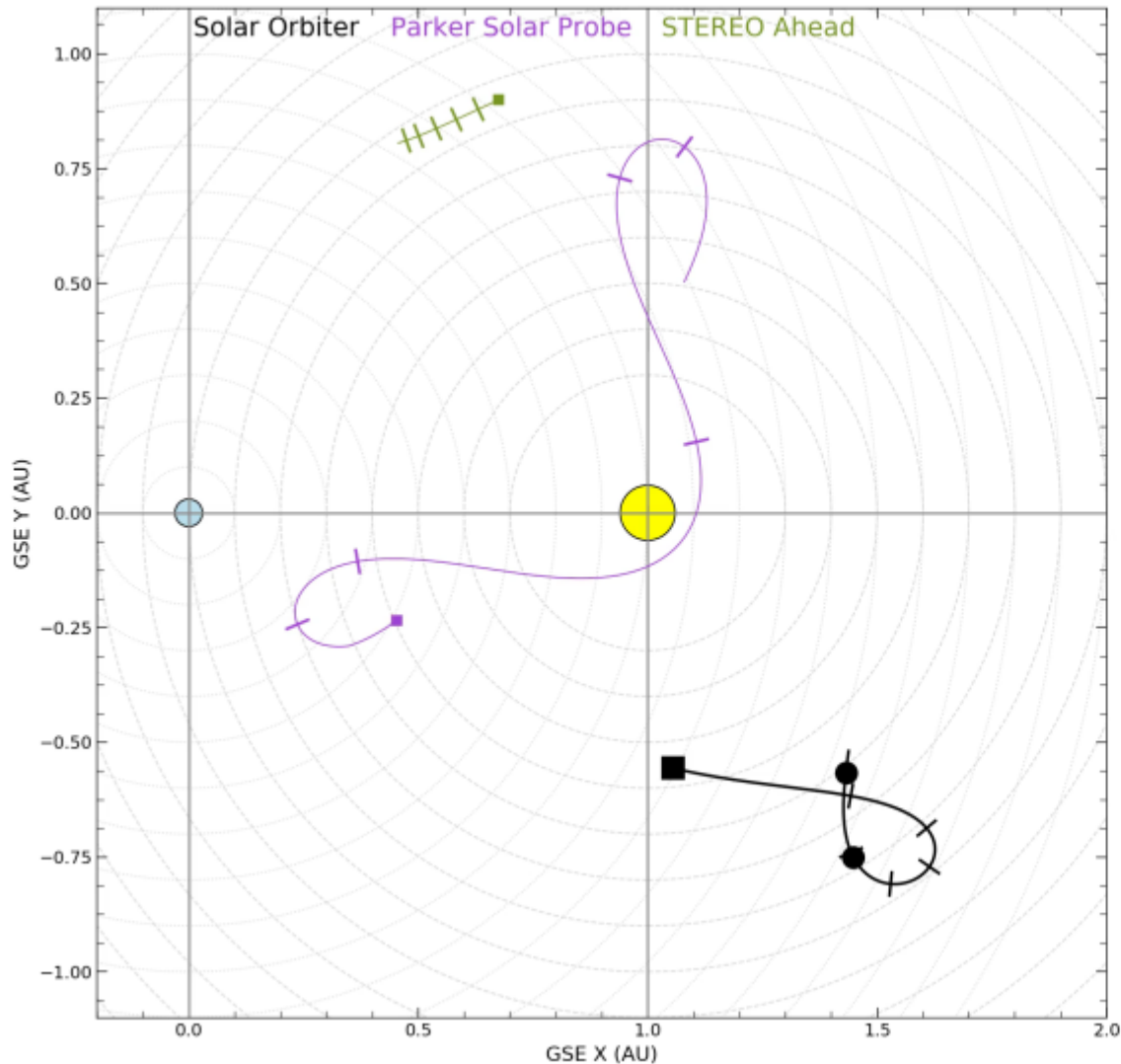


RPW config	Description	What data	TM rate (avg.) bps
DEFAULT	Default EID-A	Includes 10min/day of BURST + SBMx data	4 800
BURST	Standard BURST	continuous waveform at 256 Hz. No LFR snapshots, but better spectra.	20 000
LOW RATE 1	Low rate	Snapshot cadence reduced to 30 minutes. Spectra reduced.	2 800
LOW RATE 2	Low rate allowing SBM	Snapshot cadence reduced to 60 minutes. Spectra reduced further..	2 300
HIGH RATE 1	TDS mode	TDS & LFR snapshot every 30s. 512 TDS triggered snapshots per day.	29 700
HIGH RATE 2	Balanced mode	TDS & LFR snapshot every 30s. 256 TDS triggered snapshots per day. More LFR spectra. THR resolution 4x better.	35 000

LTP01 (Launch – June 30th)



LTP02 (July 1st – December 31st)

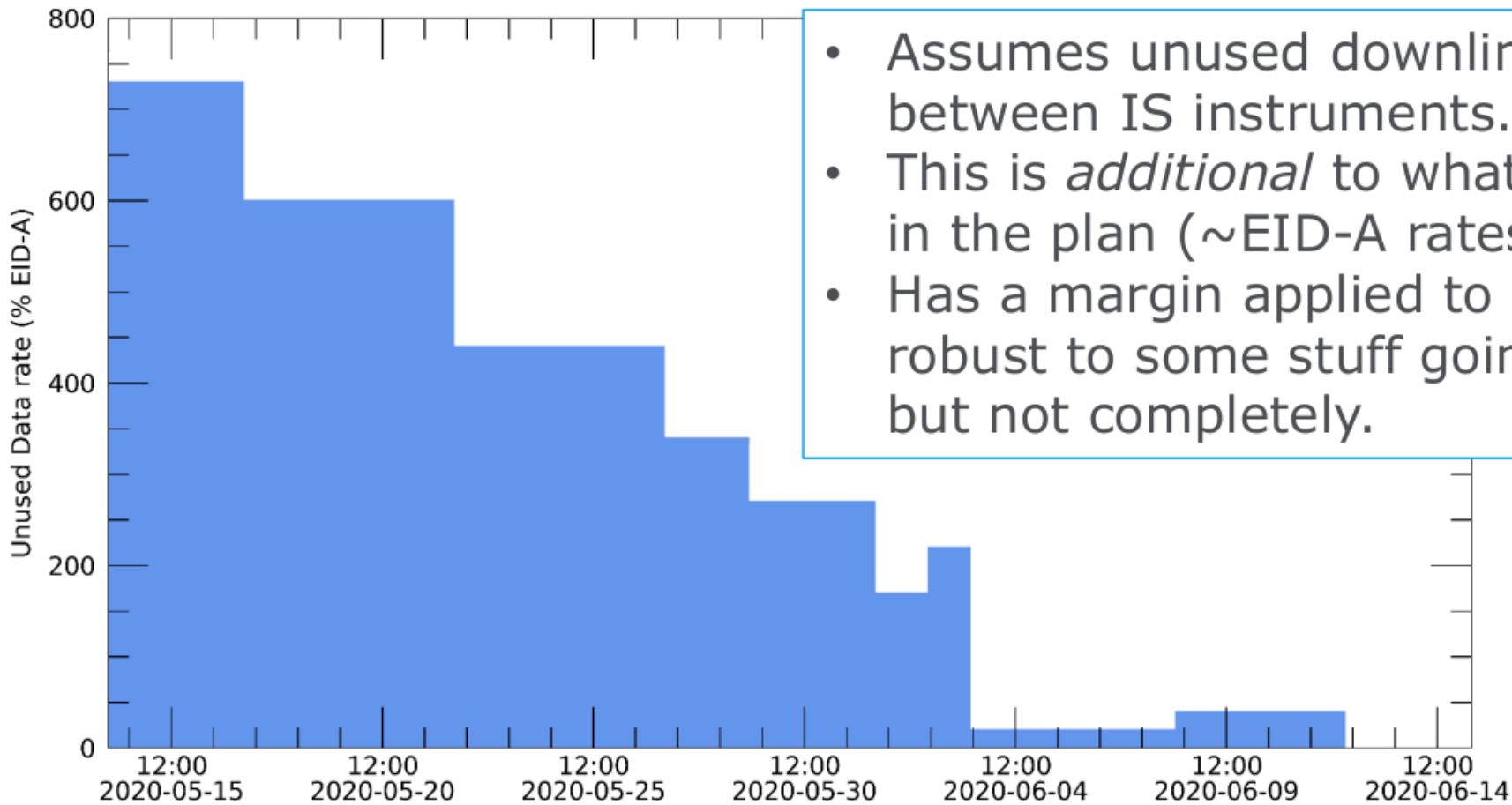


2020 telemetry constraints



- ❑ DEFAULT or higher rate until July
- ❑ LOW rate (50% of default) from mid July to end of 2020
- ❑ RPW, MAG and SWA will have 100% rate around the September PSP conjunction
- ❑ Very high rate available very early in cruise (until early June)
 - In-situ instruments will take advantage of this.
 - RPW high rate modes will be used.
 - Not guaranteed (commissioning can be longer, etc.), but likely.
 - Planning for this period done and is in SOOP kitchen.

TM allocation



- Assumes unused downlink split between IS instruments.
- This is *additional* to what's currently in the plan (~EID-A rates).
- Has a margin applied to we're robust to some stuff going wrong, but not completely.

TM allocation per instrument

Assuming a pro-rata split

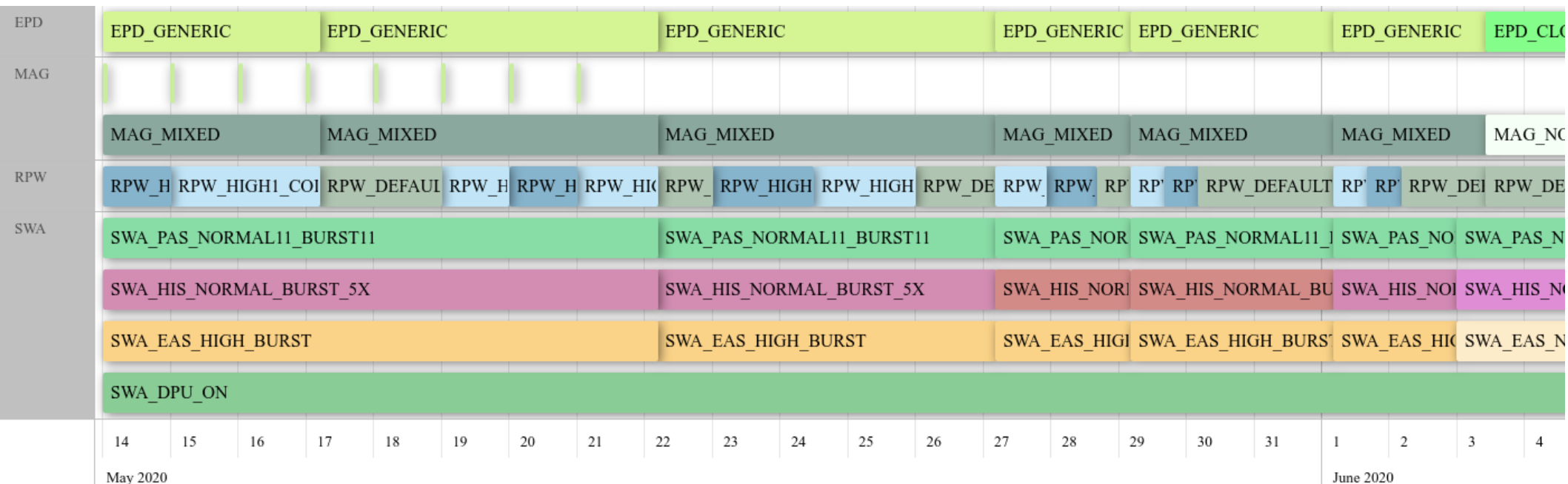
Start Applicability	End Applicability	Unused Data (% EID-A)	EPD Rate (kb/s)		MAG Rate (kb/s)		RPW Rate (kb/s)		SWA Rate (kb/s)	
			Extra	Total	Extra	Total	Extra	Total	Extra	Total
2020-05-14 00:00:00	2020-05-17 04:47:00	730	26.28	29.94	9.49	10.74	40.15	45.04	105.85	118.17
2020-05-17 04:47:00	2020-05-22 04:33:00	600	21.60	25.16	7.8	9.05	33	37.89	87	99.32
2020-05-22 04:33:00	2020-05-27 04:22:00	440	15.84	19.4	5.72	6.97	24.2	29.09	63.8	76.12
2020-05-27 04:22:00	2020-05-29 04:18:00	340	12.24	15.8	4.42	5.67	18.7	23.59	49.3	61.62
2020-05-29 04:18:00	2020-06-01 04:13:00	270	9.72	13.28	3.51	4.76	14.85	19.74	39.15	51.47
2020-06-01 04:13:00	2020-06-03 10:17:00	170	6.12	9.68	2.21	3.46	9.35	14.24	24.65	36.97



RPW planning

- Cycle in 1-2 day intervals between
 - HIGH RATE 1 (TDS mode) + 240 min/day of BURST mode
 - HIGH RATE 2 (Balanced mode) + 240 min/day of BURST mode
 - DEFAULT mode with 100% BURST mode coverage, later dropping to ~50%.

- SBM1/SBM2 modes scheduled in the beginning
 - Probably triggered by TC and downloaded 100% (no selection).



Other instruments

□ MAG

- More or less all the time in 64 Hz mode
- Periods of 128 Hz and 1920 Hz synchronized with our BURSTS

□ EPD

- Higher resolution histograms and calibration data

□ SWA

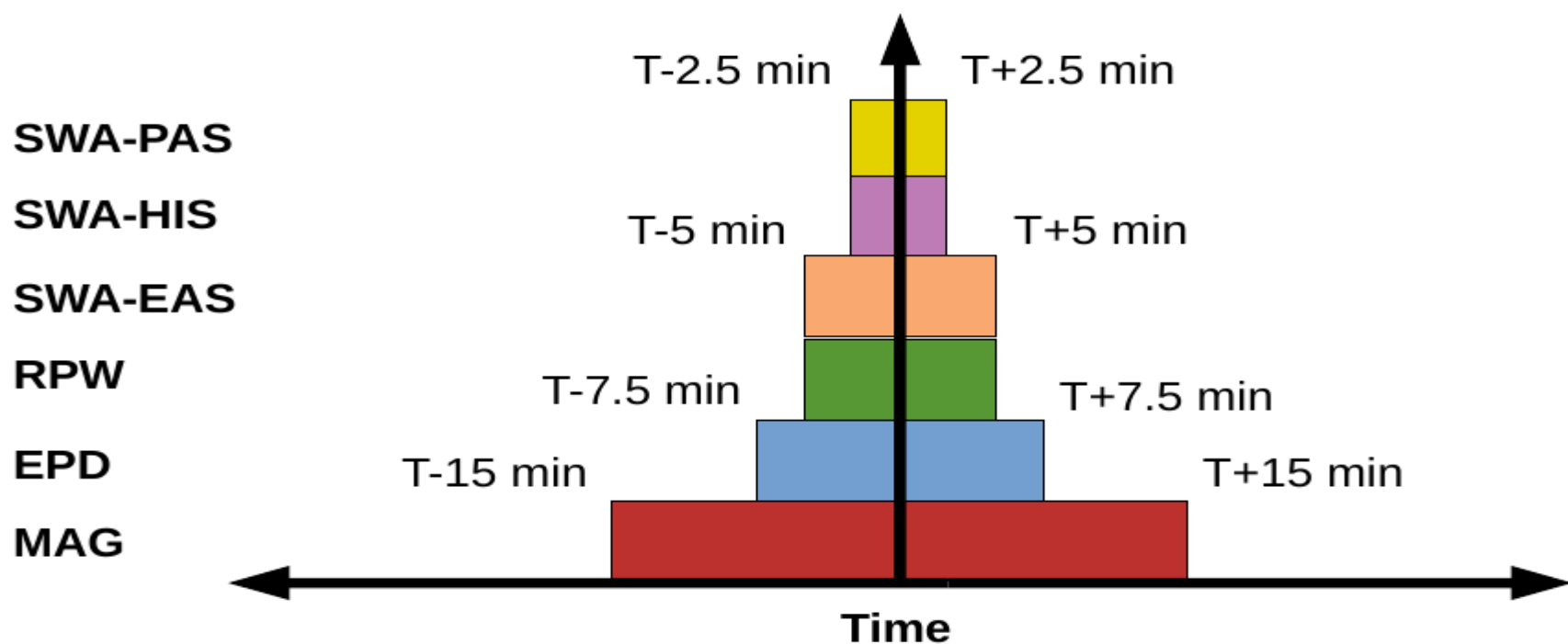
- High cadence electron 3D VDFs at 10 seconds (EAS)
- Higher rate proton 3D VDFs (PAS)
- Highest resolution data limited to 5 minute bursts. These will be scheduled more.

SWA operations

Start Applicability	End Applicability	EAS		HIS		PAS		Data rate (kb/s)	Target
		Normal	Burst	Normal	Burst	Normal	Burst		
2020-05-14 00:00:00	2020-05-17 04:47:00	High-cadence mode (3D VDFs @ 10 secs)	240 mins per day	PHA and VDFs at 5x EID-A rate	240 mins per day	Normal 11 CEM mode (3D VDF's @ 4 secs)	240 mins per day	~ 79	118.17
2020-05-17 04:47:00	2020-05-22 04:33:00		240 mins per day		240 mins per day		240 mins per day		
2020-05-22 04:33:00	2020-05-27 04:22:00		180 mins per day		180 mins per day		180 mins per day		
2020-05-27 04:22:00	2020-05-29 04:18:00		120 mins per day	PHA and VDFs at 3x EID-A rate	120 mins per day		~ 57	120 mins per day	61.62
2020-05-29 04:18:00	2020-06-01 04:13:00		90 mins per day		90 mins per day			90 mins per day	
2020-06-01 04:13:00	2020-06-03 10:17:00		30 mpd	2x EID-A	30 mpd		~36 on average	30 mpd	36.97
Return to regular Ops at 2020-06-03 0000 UT									

In-situ burst mode coordination

- MAG, SWA and RPW all have a short burst mode planned
 - SWA: 5 minutes 2 x per day (4 second moments, 8 Hz PA distributions)
 - MAG: 64 Hz data (> 10 minutes per day)
 - RPW: Our BURST mode (1 per day) with 256 kHz waveform



In-situ burst mode coordination

- ❑ It is essential that the burst modes are synchronized
 - One of SWA 5 minutes can be synchronized with our 10 min burst (out of the 2 per day).
 - A part of short term planning. Commanding has to be done properly to get this synchronization.
 - Planning can only be done after launch
 - It is not clear how this will be managed, but the instruments must be involved.
 - MOC will probably propose EMC quiet periods and we will complete the details.

Inter-instrument communication test campaign

- ❑ A campaign to test the SBM modes of RPW and the response of other in-situ instruments shall be run during NECP.
- ❑ Three tests:
 - 1) SBM1 triggered by TC. Response of other instruments checked
 - 2) SBM2 triggered by TC. Response of other instruments checked. SBM2 duration to be reduced.
 - 3) MAG will send RPW artificial discontinuity and RPW should trigger. The test will require a special configuration of the triggering coefficients.
- ❑ For all 3 tests, we intend to collect all data, including SBMx data.