eROSITA early mission phase

Diogo Coutinho

Ringberg, Oct. 24 – 26, 2018

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- Activities during early mission and commissioning

- Organization of commissioning phase

- Detailed operations

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Introduction

- Launch and early operations comprises the time between launch until start of CalPV.

- During this time, the following activities have to be carried out:
  - Interface and Thermal Controller (ITC) commissioning
  - Thermal control system commissioning
  - Opening of telescope cover
  - 7 x Camera Electronics (CE) commissioning
  - Cool CCD Detectors
  - Switch on and commission CCD Detectors

- All this must be done in parallel to S/C and ART-XC commissioning

Organization - Logistics

- eROSITA instrument team will be located at NPOL.
  - Ground support equipment capable of displaying eROSITA telemetry will be available (EGSE)

- Interface of eROSITA team is IKI, not NPOL
  - Where will ART-XC team be located during this phase?
  - Who will be eROSITA team interface from IKI during this critical phase?
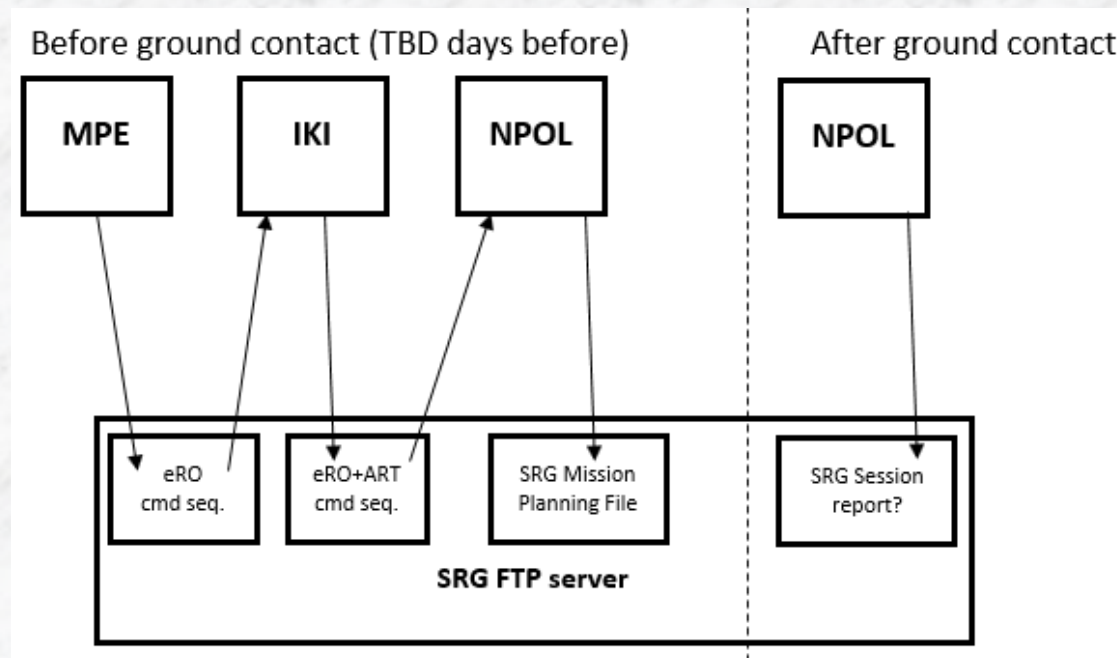
Organization – Ground contact

- Typical ground contact will be organized in the following sequence:
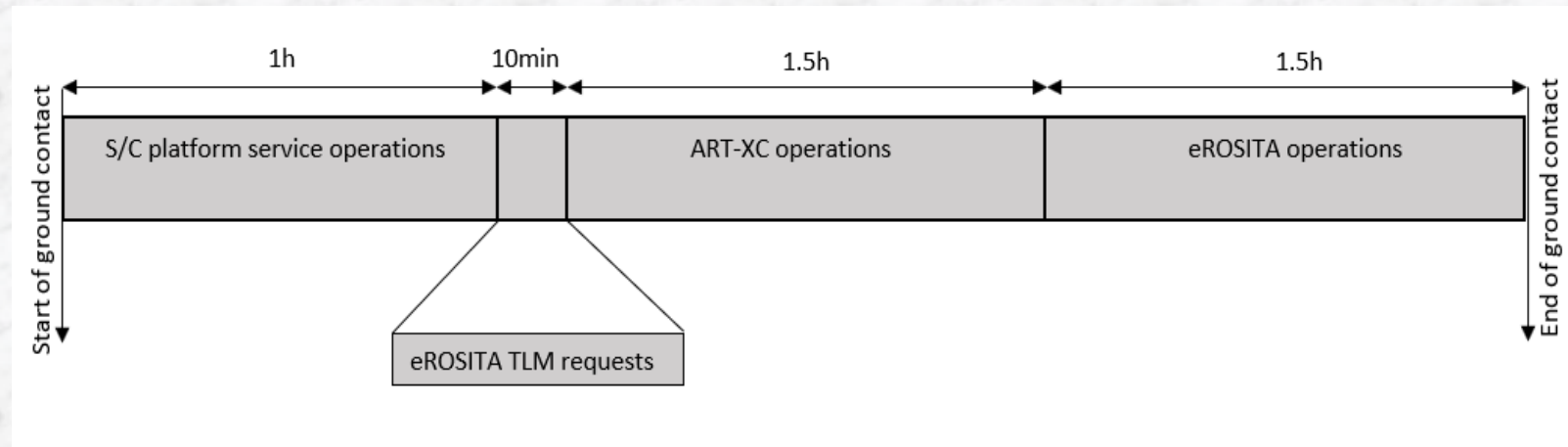
- During this phase operations will be planned on a day to day basis.
- Command sequences for eROSITA operations will be delivered to IKI over FTP server, as defined per MPE/IKI ICD.

Organization – Telecommanding

- MPE instrument team responsible for generating daily command sequences to operate eROSITA.

- Unplanned commands during session -> 10mins delay

Organization – Telecommanding

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Organization – Telemetry

- Near real time data stream is supplied by NPOL to eROSITA EGSE.
  - Diagnostic temperature sensors
  - Telemetry over MIL1553 interface
  - Radiocomplex interface

- Interface from NPOL telemetry ground system to eROSITA EGSE is still under development (socket connection).
  - This interface should be tested during the next ground test campaigns (SEANCE 58?)

- NRTA software developed by Bamberg
  - Problem, at MPE it has not been used before

Organization – Telemetry

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Commissioning operations - Constraints

- eROSITA ITC must be switched on less than 5h after launch.

- eROSITA cover will not be opened before the 11th day, due to risk of contamination (1st correction burn occurs on day 10).

- CCD cooling not before minimum of 21 days outgassing (filter wheel open)

- CCD cooling not before 3rd optional correction burn (day 40)

- eROSITA activities will be performed always during ground contact.

ΔV4: T0+40days
Trajectory correction burn #3 (optional)

ΔV3: T0+20days
Trajectory correction burn #2

ΔV2: T0+10days
Trajectory correction burn #1

L2

Parking Orbit

Launch: T0

ΔV1: T0+1.6h
L2 transfer burn
Blok-DM separation

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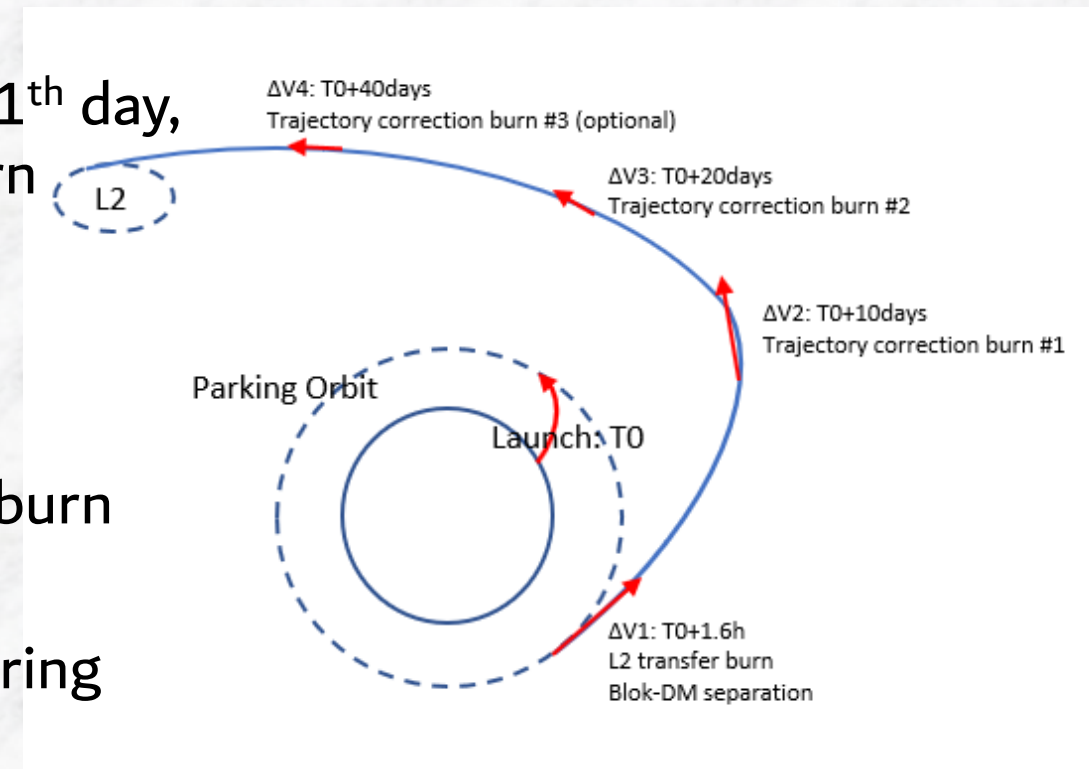
Commissioning operations - Constraints

T0+3.6h	Switch on of ITC Nominal. Possible to send telecommands. Reception of telemetry over MIL1553 Sub Address 10. Initial ITC health check, thermal control start-up and optimization.
T0+3d	ITC software verification. ITC / RC interface verification in test mode.
T0+11d	eROSITA cover opening. CEs switch on and health check. Open Filter wheels. Operational test part 1.
T0+20d	eROSITA set into safe mode (filter wheel closed) before trajectory correction
T0+21d	eROSITA re-open filter wheel to continue outgassing, after trajectory correction. Operational test part 2.
T0+41d	CCD Camera cooling.
T0+43d	CCD Camera 1 switch on, health test and commissioning.
T0+46d	Pointed observation target SN1987A.
T0+47d	CCD Camera 2 switch on, health test and commissioning.
T0+50d	Pointed observation target SN1987A.
T0+51d	CCD Camera 3 to 7 switch on, health test and commissioning.
T0+66d	Pointed observation target LMC.

- When are SED26 star trackers commissioned??

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Day	eROSITA Activity	Command Sequence	Telemetry requirement			Duration	# of tele commands	Special requirements	Comments
			.SENS	.MPD	.KNA				
0	Temperature diagnostics monitoring	-	x						
1	ITC switch on & initial check	ITCON	x	x			1+TBD		ECS alternating, MIS heaters off, bracket heaters used
2	ITC health monitoring & thermal control monitoring	-	x	x					No specific activities are planned for this time, as S/C service activites will be performed. Despite that, if possible, test mode RC interface could be tested. Only monitoring activities will be carried out. If adjustments to thermal control are needed, then there is availability to send telecommands.
3	ITC health monitoring & thermal control monitoring	-	x	x					
4	ITC health monitoring & thermal control monitoring	-	x	x					
5	ITC health monitoring & thermal control monitoring	-	x	x			TBD		
6	ITC health monitoring & thermal control monitoring	-	x	x					
7	ITC health monitoring & thermal control monitoring	-	x	x					
8	ITC health monitoring & thermal control monitoring	-	x	x					
9	ITC health monitoring & thermal control monitoring	-	x	x					
10	1st Trajectory correction								
11	Cover opening	eROCOVER	x	x		4h	10		After opening cover thermal environment changes. Telecommands to adjust temperatures might be necessary. 4h refers to monitoring time, as thermal stability takes long to reach.
12	Thermal control adjustment. ITC tables / software uploads.		x	x			TBD		In case needed, thermal control can be adjusted and new software tables uploaded.
13	CE1 to CE7 switch on	CEON	x	x	x	3h	25		CEs will be switched on. Sequence of switch on; CE6,CE3,CE4,CE7,ECS OFF,CE1,CE2,CE5. 15mins per camera + time for thermal stabilization of CEs.
14	FW1 to FW7 opening	FWOPEN	x	x	x	0.5h	14		All filter wheels will be opened for outgassing.
15			x	x	x	1h	TBD		

Day	eROSITA Activity	Command Sequence	Telemetry requirement			Duration	# of tele commands	Special requirements	Comments
			.SENS	.MPD	.KNA				
16			x	x	x	1h	TBD		
17	Can be used for CE diagnostic/software/tables uploading		x	x	x	1h	TBD		
18			x	x	x	1h	TBD		
19			x	x	x	1h	TBD		
20	2nd Trajectory correction		x	x	x				SOC command is sent to eROSITA 30mins before correction; filter wheels will close automatically
21	FW1 to FW7 opening	FWOPEN	x	x	x	0.5h	14		All filter wheels will be re-opened to continue outgassing.
22			x	x	x	1h	TBD		
23			x	x	x	1h	TBD		
24			x	x	x	1h	TBD		
25			x	x	x	1h	TBD		
26			x	x	x	1h	TBD		
27			x	x	x	1h	TBD		
28			x	x	x	1h	TBD		During this period memory checks can be performed. An assessment of radiation environment and bit flips in memory locations can be made. Possibility of testing time tagged commands (SUSPEND and FLIGHT).
29	Can be used for various diagnostic/software/tables uploading		x	x	x	1h	TBD		
30			x	x	x	1h	TBD		
31			x	x	x	1h	TBD		
32			x	x	x	1h	TBD		
33			x	x	x	1h	TBD		
34			x	x	x	1h	TBD		
35			x	x	x	1h	TBD		
36			x	x	x	1h	TBD		
37			x	x	x	1h	TBD		

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Day	eROSITA Activity	Command Sequence	Telemetry requirement			Duration	# of tele commands	Special requirements	Comments
			.SENS	.MPD	.KNA				
38			x	x	x	1h	TBD		
39			x	x	x	1h	TBD		
40	3rd Trajectory correction (optional)		x	x	x				SOC command is sent to eROSITA 30mins before correction; filter wheels will close automatically
41	CCD Cooling valve opening	CCDCOOL	x	x	x	6h	10	Usurisk support	Filling valves are opened and CCD start cooling. CCD thermal control still set to 20°C.
42	CCD thermal adjustment	CCDSETTEMP	x	x	x	6h	10	Usurisk support	Check valve opening. Set thermal control to 95°C.
43	CCD Camera 1 switch on (w/ on-chip filter)	CCDON1	x	x	x	1.5h	100		CCD1 switch on sequence. Threshold adjustment
44	CCD Camera 1 calibration	CCDCAL1	x	x	x	2.5h	10		Calc and dump Offset/noise maps, Calibration source performance test PMWORK, close FW and leave it in PMENV2
45	CCD Camera 1 monitoring		x	x	x	1.5h	TBD		Margin for CCD Camera activities
46	Pointed observation		x	x	x	2h	10		Open FW. Observe target SN1987A during ground contact.
47	CCD Camera 2 switch on (wo/ on-chip filter)	CCDON2	x	x	x	1.5h	100		CCD2 switch on sequence. Threshold adjustment
48	CCD Camera 2 calibration	CCDCAL2	x	x	x	2.5h	10		Calc and dump Offset/noise maps, Calibration source performance test PMWORK, close FW and leave it in PMENV2
49	CCD Camera 2 monitoring		x	x	x	1.5h	TBD		Margin for CCD Camera activities, in case more time needed.
50	Pointed observation		x	x	x	2h	10		Open FW. Observe target SN1987A. Real time data downlink.
51	CCD Camera 3 switch on	CCDON3	x	x	x	1.5h	100		CCD3 switch on sequence. Threshold adjustment
52	CCD Camera 3 calibration	CCDCAL3	x	x	x	2.5h	10		Calc and dump Offset/noise maps, Calibration source performance test PMWORK, close FW and leave it in PMENV2
53	CCD Camera 3 monitoring		x	x	x	1.5h	TBD		Margin for CCD Camera activities, in case more time needed.

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Day	eROSITA Activity	Command Sequence	Telemetry requirement			Duration	# of tele commands	Special requirements	Comments
			.SENS	.MPD	.KNA				
54	CCD Camera 4 switch on	CCDON4	x	x	x	1.5h	100		CCD4 switch on sequence. Threshold adjustment
55	CCD Camera 4 calibration	CCDCAL4	x	x	x	2.5h	10		Calc and dump Offset/noise maps, Calibration source performance test PMWORK, close FW and leave it in PMENV2
56	CCD Camera 4 monitoring		x	x	x	1.5h	TBD		Margin for CCD Camera activities, in case more time needed.
57	CCD Camera 5 switch on	CCDON5	x	x	x	1.5h	100		CCD5 switch on sequence. Threshold adjustment
58	CCD Camera 5 calibration	CCDCAL5	x	x	x	2.5h	10		Calc and dump Offset/noise maps, Calibration source performance test PMWORK, close FW and leave it in PMENV2
59	CCD Camera 5 monitoring		x	x	x	1.5h	TBD		Margin for CCD Camera activities, in case more time needed.
60	CCD Camera 6 switch on	CCDON6	x	x	x	1.5h	100		CCD6 switch on sequence. Threshold adjustment
61	CCD Camera 6 calibration	CCDCAL6	x	x	x	2.5h	10		Calc and dump Offset/noise maps, Calibration source performance test PMWORK, close FW and leave it in PMENV2
62	CCD Camera 6 monitoring		x	x	x	1.5h	TBD		Margin for CCD Camera activities, in case more time needed.
63	CCD Camera 7 switch on	CCDON7	x	x	x	1.5h	100		CCD7 switch on sequence. Threshold adjustment
64	CCD Camera 7 calibration	CCDCAL7	x	x	x	2.5h	10		Calc and dump Offset/noise maps, Calibration source performance test PMWORK, close FW and leave it in PMENV2
65	CCD Camera 7 monitoring		x	x	x	1.5h	TBD		Margin for CCD Camera activities, in case more time needed.
66	Pointed observation		x	x	x	2.5h	20		Observe target LMC with all CCD Cameras. Open 7 FWs. Real time data downlink.
End of commissioning phase									

Commissioning phase – open points

- Logistics during early phase -> IKI and MPE teams location

- Socket connection development and test -> critical for eROSITA telemetry reception

- eROSITA never tested with Flight Control teams (always ground test team)

- Commissioning of eROSITA cameras occurs at same time of ART-XC Cal-PV
  - Could it be a conflict?

- Commissioning CCD Cameras -> activities and criteria

- Share our preliminary plan with IKI/NPOL
  - Release eROSITA early phase and commissioning plan

Thank you for your attention.

Questions?

email: d.coutinho@mpe.mpg.de

Diogo Coutinho

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SRG Commissioning Timeline

Diogo Coutinho

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