

eROSITA/SRG - Mission planning

Jan Robrade

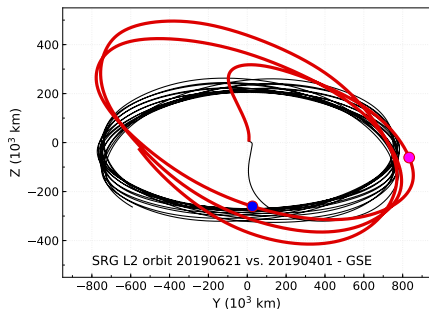
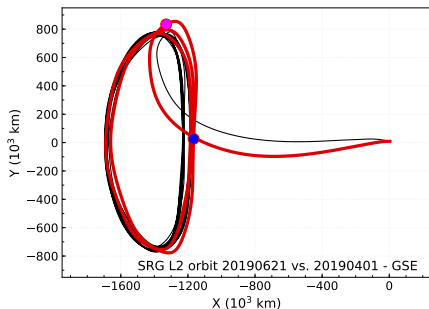
Hamburger Sternwarte

German eROSITA Consortium Meeting

Potsdam 04–07 March 2019

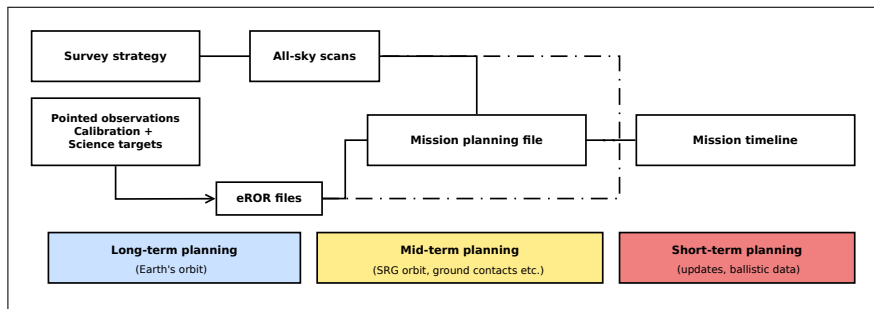


MPL - SRG spacecraft and trajectory



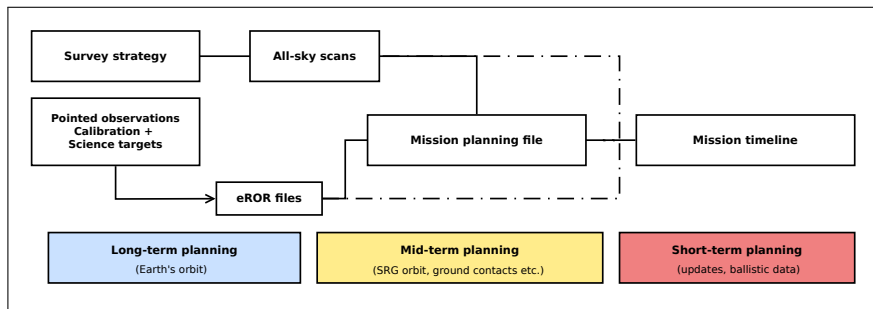
Technical basics and angular constraints

- **SRG launch:** 21/22 June 2019 (backup: 12/13 July)
- summer launch trajectory/orbit - **L2 orbit flipped & reversed**
- $\Delta \text{Sun}_{\text{max}} \pm 13$ deg vs. SC_{XOZ} plane
- $\Delta \text{Sun}_{\text{max}} \pm 20$ deg vs. SC_Z :: Sun vs. SC_X : 70–110 deg
- $\Delta \text{Earth}_{\text{max}} : \pm 24$ deg vs. SC_Z (at ground contacts)



MPL - Input

- SC trajectory & maneuvers, ground stations :: **update**
- instruments: technical constraints, calibration requests
- field scans: **aligned with SC_Y/SC_Z , NPOL template required**
- science teams: targets, preferences, strategies :: **CalPV update**



MPL - Russian partners & Documentation

- D/RU science planning : ...incl. M. Gilfanov/E. Churazov (IKI/MPA)
- D/RU ground segment : ...incl. I. Lapshov (IKI), P. Gureev (NPOL)
- SRG Science Ground Segment - IKI/MPE Interface Control Document
- eRO-HS-MPL documents : eROSITA Wiki@EroCat ...incl. H. Brunner (MPE)

eROSITA Mission Planning

Home

Viscal

More



eROSITA MPL

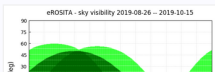
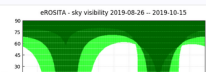
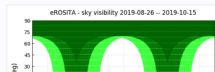
This page provides general mission planning information and tools to support eROSITA/SRG observation planning.

The current focus is on the CalPV phase, the first scientific phase of eROSITA. The SRG launch is planned for mid 2019. The CalPV phase starts roughly 65 days after launch and has a duration of about 50 days (30 days Cal + 20 days PV, mixed observations).

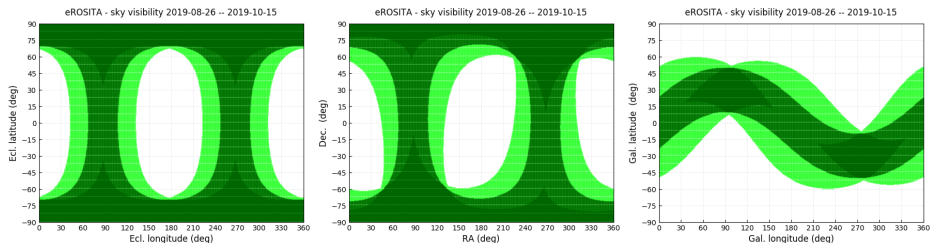
The CalPV time frame may change by up to 10 days independent of the launch date.

Mission planning website at Hamburger Sternwarte

- <https://www.hs.uni-hamburg.de/hserosita>
- linked in: [erosita.mpe.mpg.de](https://www.linkedin.com/company/erosita.mpe.mpg.de)
- MPL information and user support, regularly updated



eROSITA MPL - CalPV & early science



Basic sky visibility in a 50 d CalPV phase (colors: min. fraction 0.0, 0.5, 1.0)

eROSITA CalPV - scenario

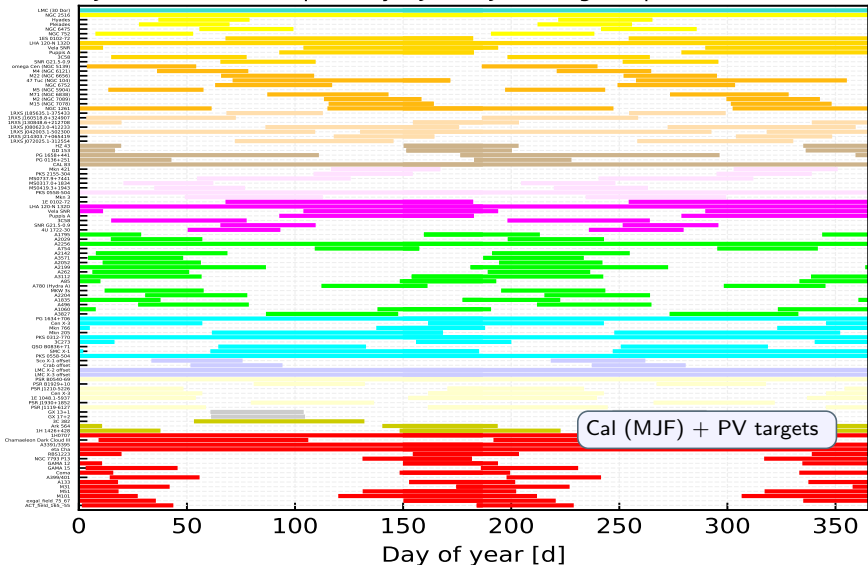
- SRG launch date + 65 ± 10 days
- duration: ~ 50 days, 30 d Cal + 20 d PV, interleaved observations
- end August - mid Oct. (21 June launch; 12 July: mid Sept. - early Nov.)



The CalPV phase- targets

eROSITA - visibility of CalPV targets

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec



Mission planning and CalPV mock timeline creation

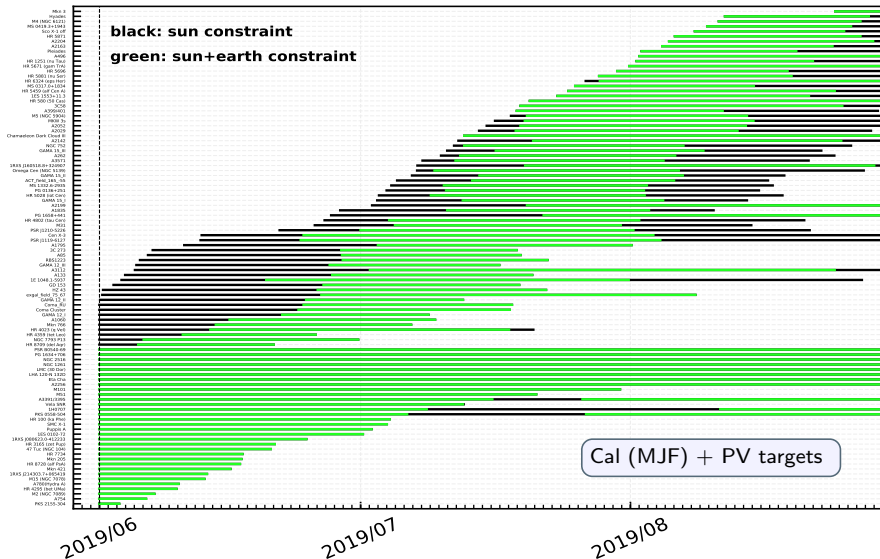
Achievements:

- Cal + PV program scheduled, 100 % complete (start: 06 June 2019)
- 48 days used, incl. 1 d survey test
- realistic calibration program and real PV targets (D/RU)
- no splits etc., always within sun+earth constraints

Caveats:

- **early April launch scenario** (CalPV early June - end July)
- no time loss included, no SC operations/parameters
- visibility depends on launch date (+ trajectory) - roughly 0.5 yr periodicity

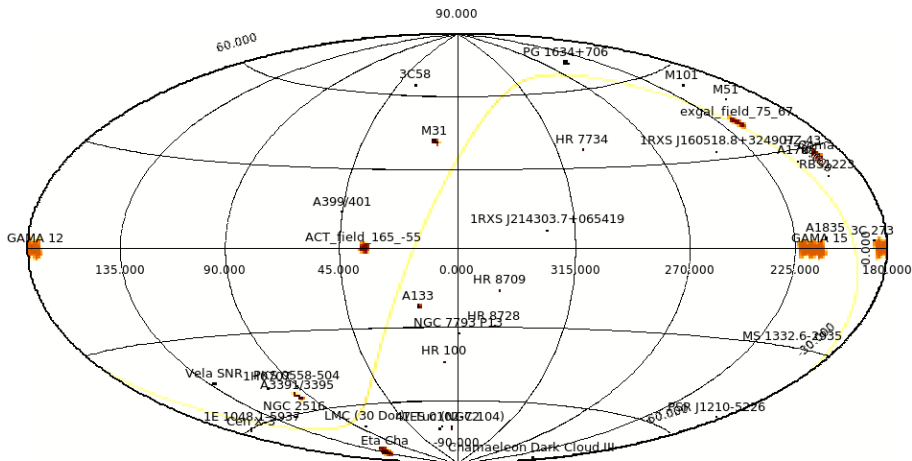
eROSITA - next visibilities of targets



interval start: 2019-06-01, duration: 90.0 d



The CalPV phase



Visualization example: sky maps in FITS / DS9 viewer



The CalPV phase

eROSITA Mission Timeline (UTC version):

Generated from mission planning file 'P.PLAN_190122_613105205_617231359.fits' at 2019-01-23.

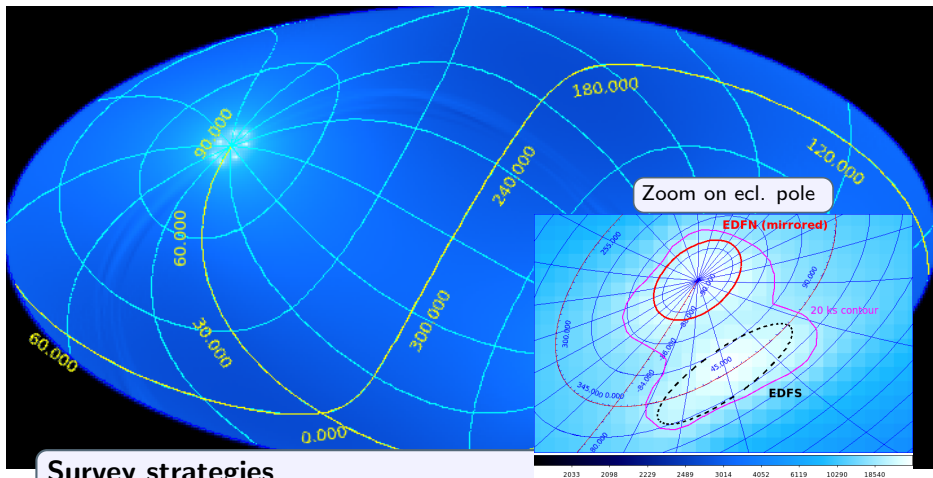
extract from planning file (FITS)

TSTART	TSTOP	OBSTAT	OBSD	OBI	TARGET	REMARKS
2019-06-06 00:00:00	2019-06-06 00:05:45 :: 0.345 ks	SIW	300010	501	Slew	90.0 -66.56:84.68 -69.02
2019-06-06 00:05:45	2019-06-07 03:52:25 :: 100.0 ks	MPE	300010	1	LMC (30 Dor)	First Light
2019-06-07 03:52:25	2019-06-07 04:01:24 :: 0.539 ks	SIW	700102	501	Slew	84.68 -69.02:120.19 -60.87
2019-06-07 04:01:24	2019-06-07 09:34:44 :: 20.0 ks	CAL	700102	1	NGC 2516	2x2: step=25 arcmin, psb
2019-06-07 09:34:44	2019-06-07 09:39:52 :: 0.308 ks	SIW	700103	501	Slew	120.19 -60.87:118.98 -60.87
2019-06-07 09:39:52	2019-06-07 15:13:12 :: 20.0 ks	CAL	700103	1	NGC 2516	2x2: step=25 arcmin, psb
2019-06-07 15:13:12	2019-06-07 15:18:17 :: 0.305 ks	SIW	700104	501	Slew	118.98 -60.87:119.58 -60.58
2019-06-07 15:18:17	2019-06-07 20:51:37 :: 20.0 ks	CAL	700104	1	NGC 2516	2x2: step=25 arcmin, psb
2019-06-07 20:51:37	2019-06-07 20:56:45 :: 0.308 ks	SIW	700105	501	Slew	119.58 -60.58:119.58 -61.16
2019-06-07 20:56:45	2019-06-08 02:30:05 :: 20.0 ks	CAL	700105	1	NGC 2516	2x2: step=25 arcmin, psb
2019-06-08 02:30:05	2019-06-08 02:44:23 :: 0.858 ks	SIW	700094	501	Slew	119.58 -61.16:6.98 -72.08
2019-06-08 02:44:23	2019-06-08 08:17:43 :: 20.0 ks	CAL	700094	1	47 Tuc (NGC 104)	2x2: step=25 arcmin, fil
2019-06-08 08:17:43	2019-06-08 08:22:51 :: 0.308 ks	SIW	700095	501	Slew	6.98 -72.08:5.07 -72.08
2019-06-08 08:22:51	2019-06-08 13:56:11 :: 20.0 ks	CAL	700095	1	47 Tuc (NGC 104)	2x2: step=25 arcmin, fil
2019-06-08 13:56:11	2019-06-08 14:01:16 :: 0.305 ks	SIW	700096	501	Slew	5.07 -72.08:6.02 -71.79
2019-06-08 14:01:16	2019-06-08 19:34:36 :: 20.0 ks	CAL	700096	1	47 Tuc (NGC 104)	2x2: step=25 arcmin, fil
2019-06-08 19:34:36	2019-06-08 19:39:44 :: 0.308 ks	SIW	700097	501	Slew	6.02 -71.79:6.02 -72.38
2019-06-08 19:39:44	2019-06-09 01:13:04 :: 20.0 ks	CAL	700097	1	47 Tuc (NGC 104)	2x2: step=25 arcmin, fil
2019-06-09 01:13:04	2019-06-09 01:37:55 :: 1.491 ks	SIW	700008	501	Slew	6.02 -72.38:325.77 6.91
2019-06-09 01:37:55	2019-06-09 23:51:15 :: 80.0 ks	CAL	700008	1	1RXS J214303.7+065419	sxr
2019-06-09 23:51:15	2019-06-10 00:16:33 :: 1.518 ks	SIW	700083	501	Slew	325.77 6.91:16.01 -72.03
2019-06-10 00:16:33	2019-06-10 16:56:33 :: 60.0 ks	CAL	700083	1	1ES 0102-72	on/+20/-20 arcmin off,cti
2019-06-10 16:56:33	2019-06-10 17:01:37 :: 0.304 ks	SIW	700084	501	Slew	16.01 -72.03:15.04 -71.89
2019-06-10 17:01:37	2019-06-11 09:41:37 :: 60.0 ks	CAL	700084	1	1ES 0102-72	on/+20/-20 arcmin off,cti
2019-06-11 09:41:37	2019-06-11 09:46:46 :: 0.309 ks	SIW	700085	501	Slew	15.04 -71.89:16.99 -72.17
2019-06-11 09:46:46	2019-06-12 02:26:46 :: 60.0 ks	CAL	700085	1	1ES 0102-72	on/+20/-20 arcmin off,cti
2019-06-12 02:26:46	2019-06-12 02:31:52 :: 0.306 ks	SIW	700086	501	Slew	16.99 -72.17:16.01 -71.83
2019-06-12 02:31:52	2019-06-12 16:25:12 :: 50.0 ks	CAL	700086	1	1ES 0102-72 off	12/18/24 arcmin off, off
2019-06-12 16:25:12	2019-06-13 20:21:54 :: 2.004 ks	SIW	700051	501	Slew	16.01 -71.63:303.52 36.6
2019-06-13 20:21:54	2019-06-13 20:55:18 :: 20.0 ks	CAL	700051	1	HR 7734	optf
2019-06-13 20:55:18	2019-06-14 02:28:38 :: 1.223 ks	SIW	700052	501	Slew	303.52 36.6:343.66 -15.82
2019-06-14 02:28:38	2019-06-14 02:49:01 :: 1.223 ks	SIW	700052	501	Slew	303.52 36.6:343.66 -15.82

...cross-check + approval :: transformation + transmission :: observation...

...continued on next page

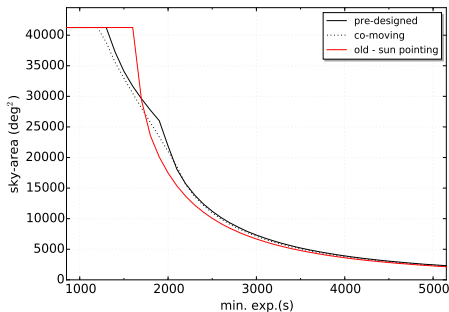
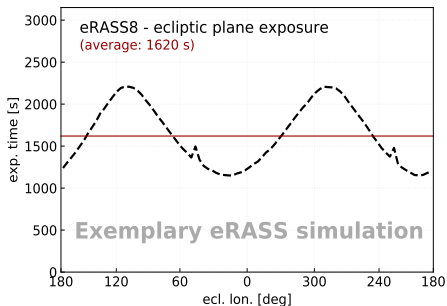




Survey strategies

- survey pole + survey rate + starting point
- start off 'easy': e.g. ecliptic pole + simple scan law
- alt. poles, e.g. EDFS - offsets up to 8-10 deg

eRASS all-sky exposure



eRASS8: global exposure distribution

- continuous operations - adjust SC_Z orientation/angular movement ($\angle SC\text{-Sun}/SC\text{-Earth} > \text{antenna cone}$)
- inhomogeneity accumulates :: L2-orbit \approx all-sky-scan ≈ 0.5 yr
- survey plane orientation (Z_{SC}): minimal solar angles favored
- survey rate (Z_{SPEED}): minimal, smooth changes favored

eRASS exposure - 4 yr / 100 % efficiency

- eRASS8 - exposure in ecliptic plane
 - shallow + deep zones
 - $\sim 1.2/1.4 - 2.0/2.2$ ks (strategy + orbit dependent)
- eRASS8 - exposure at survey poles

Strategy	max. T_{exp} [ks]	Sky area [deg ²] with exposure					[ks]
		≥ 10	≥ 15	≥ 20	≥ 30	≥ 40	
shallow	35	850	400	180	15	0	
medium	50	700	350	200	50	20	
deep	100	600	250	150	70	40	

- 'global' all-sky exposure is virtually independent of survey poles
- location of shallow/deep zones depends on launch date/trajectory

eROSITA mission planning - current status

- D/RU collaboration at technical level in good shape
- general planning and data exchange procedures defined (some open details and TBDs)
- MPL software tests and mock-timeline runs successful

eROSITA mission planning - next steps

- re-run CalPV planning (ongoing)
- complete MPL (HS/MPE) ↔ SCC (IKI/NPOL) chain
- approval procedure + strategies
- ...



SRG launch...

