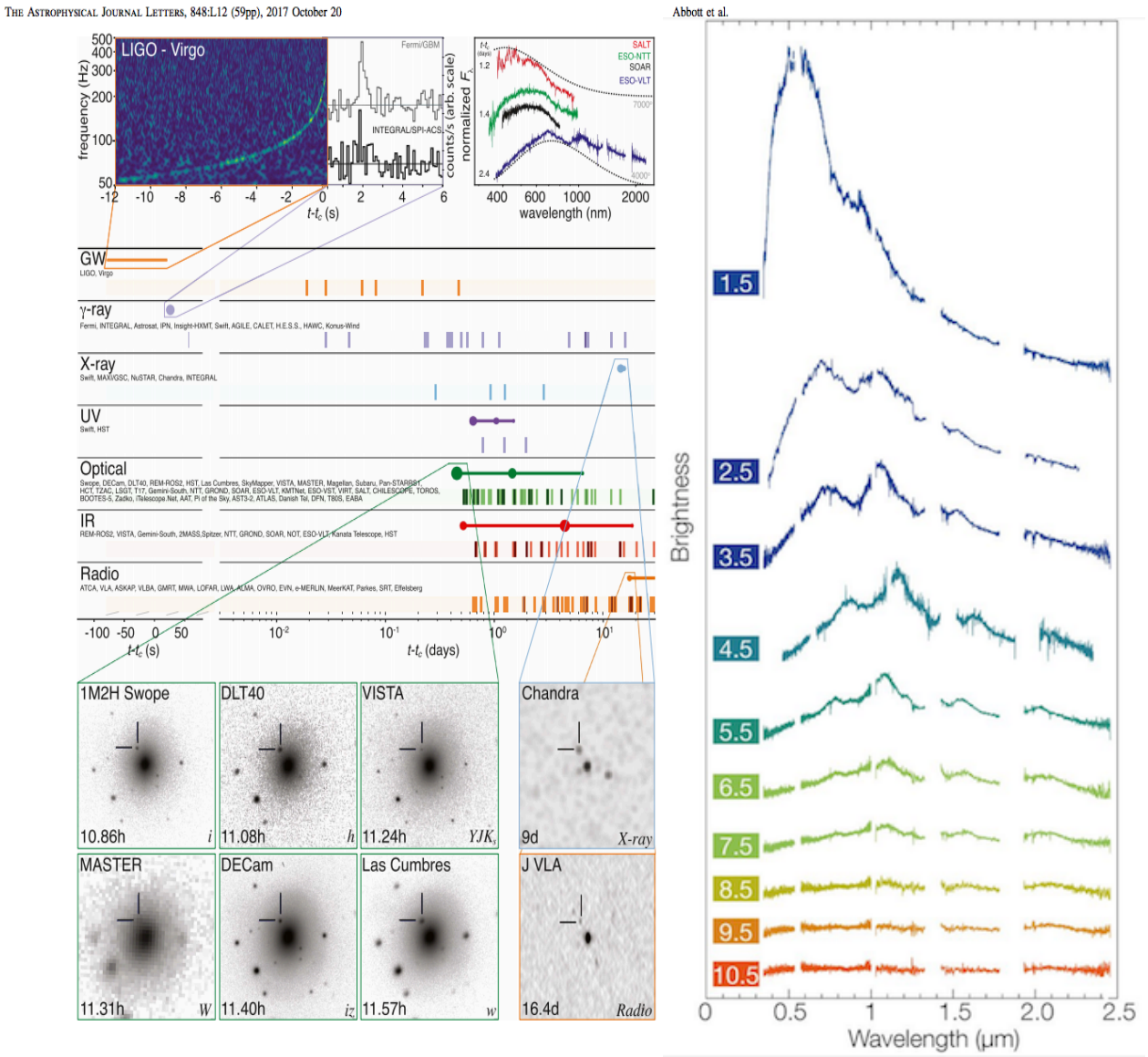
Extensions of VO standards for time domain astronomy

Ada Nebot for the CDS team

CENTRE DE DONNÉES
ASTRONOMIQUES DE STRASBOURG

(Some) identified needs of the multi-messenger transient community



- Multi-wavelength / messenger approach is needed
- Follow-up observations and reaction time for that can be crucial
- Visualisation & navigation through the data
- Coordination & transmission of information

The VO & IVOA should match user's needs

Related recent IVOA developments

1. **VOTable** REC for tabular data with time metadata included
2. **Search by time**:
   - **Cone search** REC — ongoing: extended to temporal search
   - **MOC** REC — dev: spatial and temporal indexing (todo: std)
3. Get the **photometric history of a source** (Note)
4. Planning of observations:
   - **ObjVisSAP** WD visibility of object to plan observations
   - **ObsLocTAP** WD to facilitate coordination of observations
5. Transmission of alerts:
   - **VOEvents** REC
   - **VOEvent Transport protocol** REC

REC = IVOA recommendation
WD = working draft
Note = idea

1 - VOTable time medatada

KEY POINT: IVOA Standardisation of time annotation

Time Scale: UTC, TT, TAI, TCB,…

Format: JD, MJD, ISO, truncated ISO,…

Offset: e.g. JD-XXX (e.g. Gaia…)

Reference position: Topocentre, Geocentre, Barycentre,… (light-travel correction)

TIMESYS element in VOTables (Demleitner, M., Nebot, A., Bonnarel, et al. 2018)

2 - Search: know where & when

Cone search extension to add a time interval for search in cats

- Extend the protocol to query catalogs by an interval of time
  - Align definition with DALI (time interval = UTC, ref. position unknown)
- The response returns a list of astronomical sources from the catalog whose time values lie within the time interval, formatted as a VOTable.

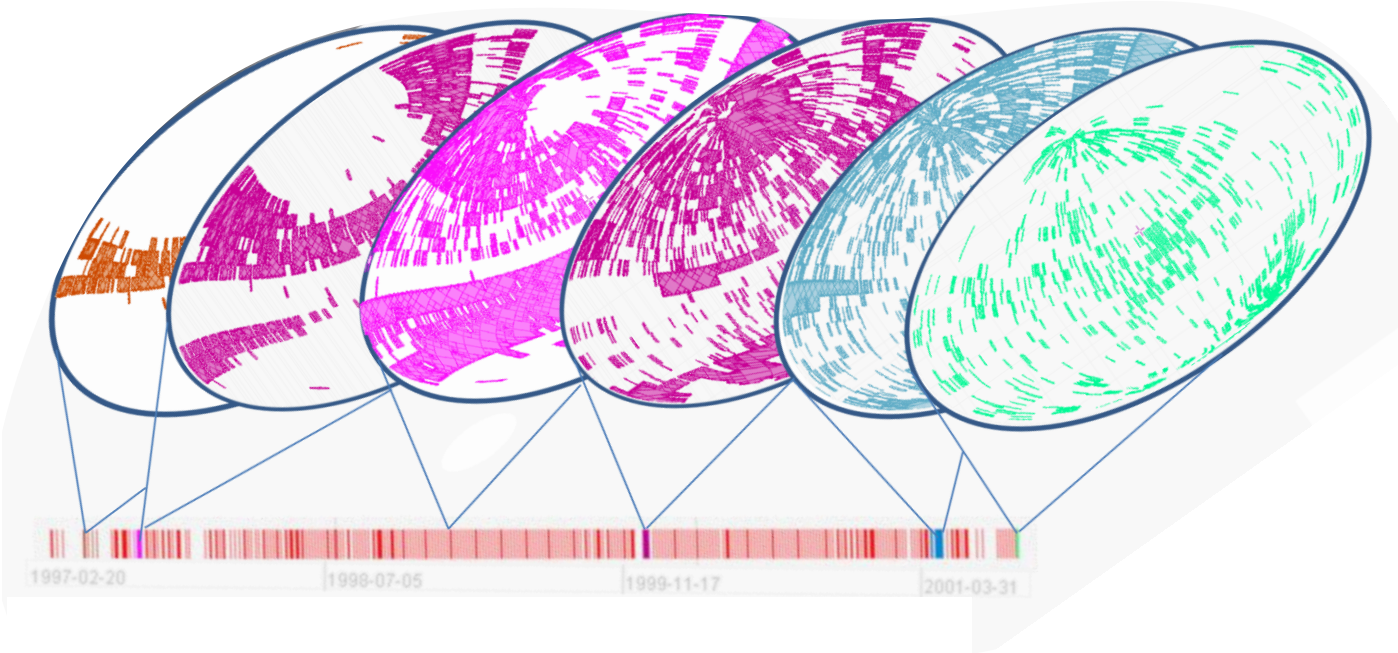
For complicated large areas in the sky (GWs, neutrinos) a cone search is not representative of the sky localisation…

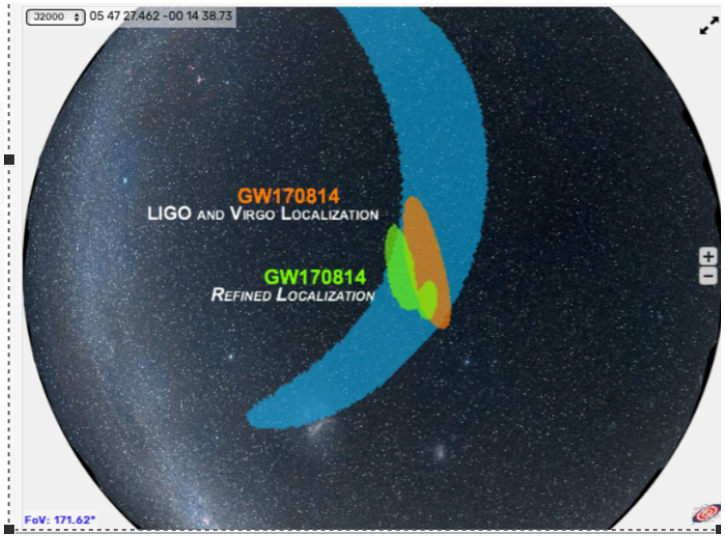
2 - Search: know where & when

Search by temporal+spatial coverage of surveys for the more complicated areas : **ST-MOC = space-time multi-order coverage map**

http://www.ivoa.net/documents/stmoc/index.html

https://github.com/cds-astro/mocpy





2 - Search: know where & when

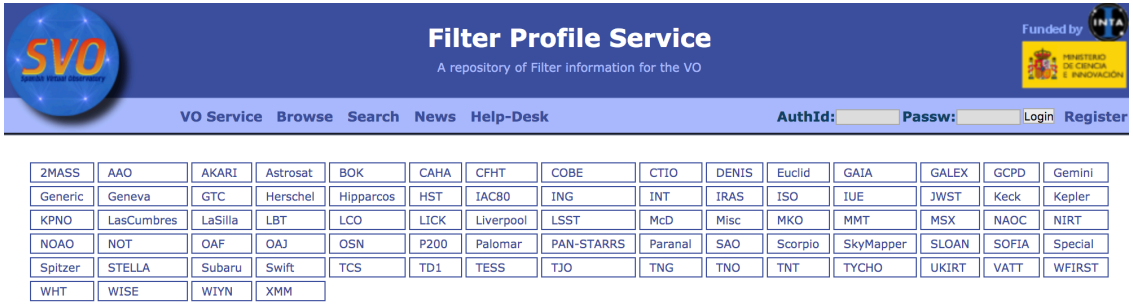
Video Aladin + mocpy & Notebook

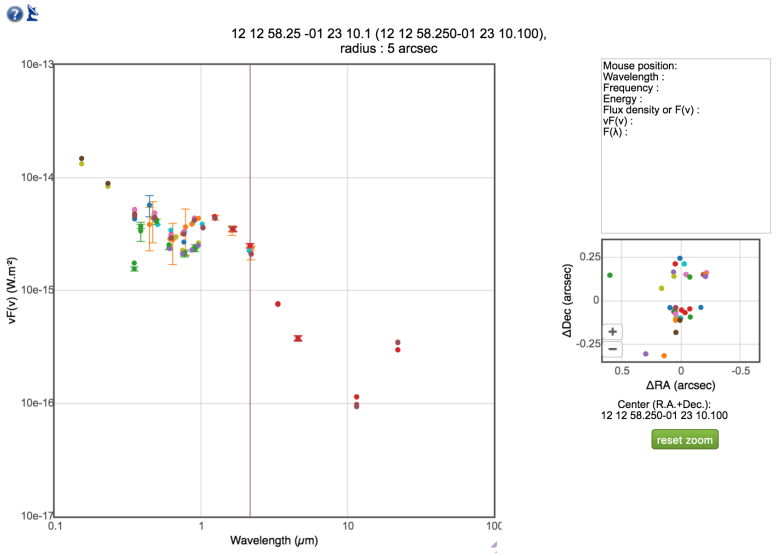
https://github.com/cds-astro/mocpy/tree/master/notebooks

https://github.com/cds-astro/mocpy/blob/master/notebooks/Space%20%26%20Time%20coverages.ipynb

3 - Get the history of a source

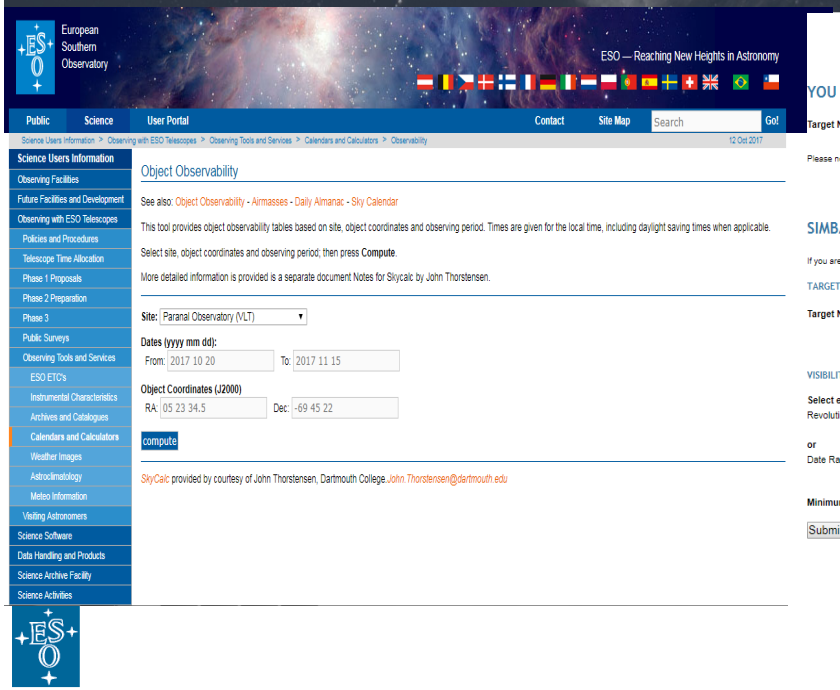
- History of a source (around a position)
  - Build on the fly “SED-like” — photometric viewer
  - Build on the fly the “light-curve”
- Need to annotate:
  - Position
  - Time
  - Photometric band

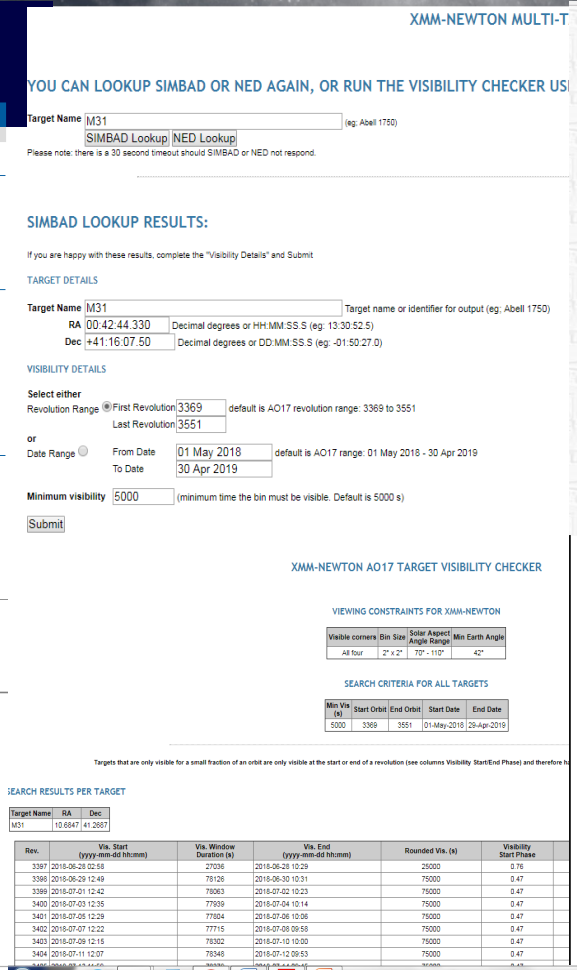


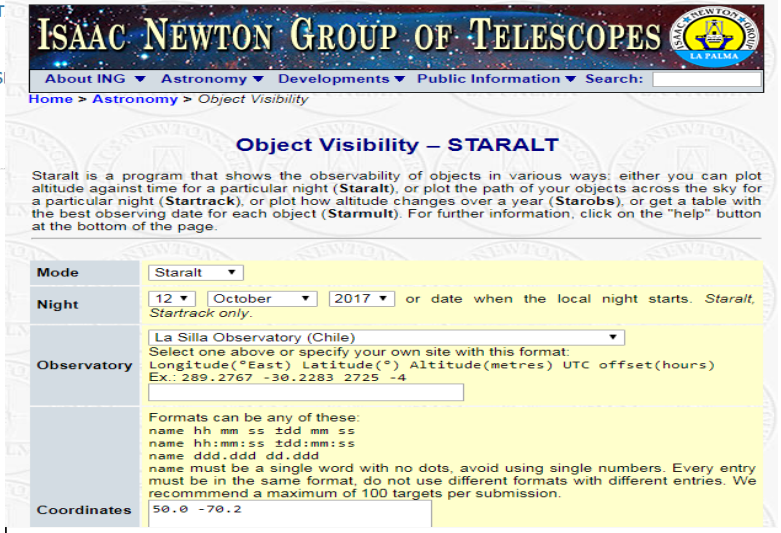


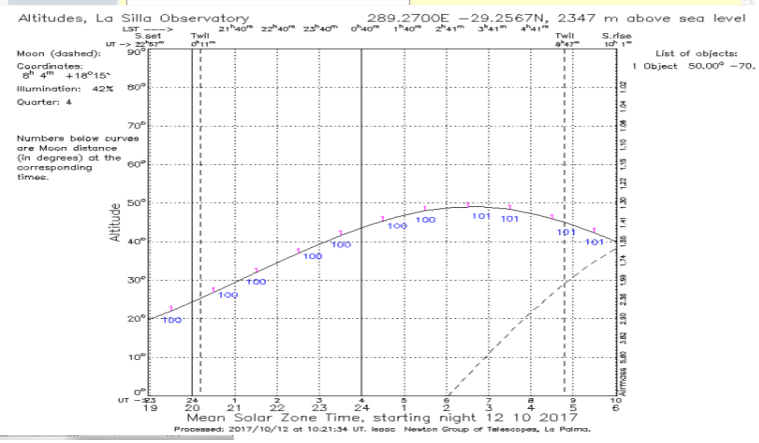
Very first draft:
https://wiki.ivoa.net/twiki/bin/view/IVOA/TimeSeries2020

4 - Visibility of an object









See also Object Observability - Airmasses - Daily Almanac - Ephemerides

Observability for 05 23 34.5 -69 45 22

Paranal Observatory (VLT)

RA & dec: 5 23 34.5, -69 45 22, epoch 2000.0
Site long&lat: +4 41 36.8 (h.m.s) West, -24 37 30 North.

Shown: local eve. date, moon ph ht, (2) natural center of night, ar r of nighttime hours during which ob Night (and twilight) is define

The ESO Sky Calendar Tool

Date (eve)	moon	eve HA	eve sec.z	cent HA	cent sec.z	morn HA	morn sec.z	night hrs@sec.z: <3	<2	<1.5
2017 Nov 3	F	-6 52	3.1	-2 45	1.6	+1 21	1.5	8.0	6.0	3.3
2017 Nov 17	N	-5 44	2.4	-1 49	1.5	+2 07	1.5	7.8	6.7	3.8

SkyCalc provided by courtesy of John Thorstensen, Dartmouth College. John.Thorstensen@dartmouth.edu

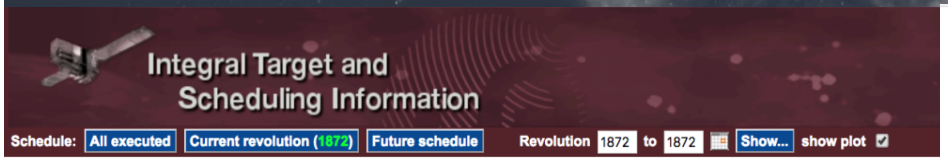
Different services have different inputs / outputs

Facilitate the work by having some level of standardisation inputs / outputs

Object Visibility Simple Access Protocol, Aitor Ibarra, Richard Saxton, Jesús Salgado et al. 2019

http://www.ivoa.net/documents/ObjVisSAP/index.html

4 - Coordination of observations



Schedule for revolution 1872

(this list is also available in csv-format, click here to download)

Rev	Start time (UTC)	End time (UTC)	Exp. time (s)	Target	Ra (J2000)	Dec (J2000)	Pattern	PI	Propo
1872	2017-10-10 13:29:15	2017-10-10 17:10:51	12600	Gal. Bulge region	17:45:36.00	-28:56:00.0	HEX	Erik Kuulkers	14200
1872	2017-10-10 17:13:34	2017-10-11 07:55:55	50000	Galactic Center	17:52:11.21	-25:21:49.7	5x5 Seq	Joern Wilms	14200
1872	2017-10-11 08:16:46	2017-10-11 11:58:32	12600	Galaxy (l=0, b=0)	17:42:23.76	-29:38:02.4	HEX	Rashid Sunyaev	14200
1872	2017-10-11 12:26:36	2017-10-11 12:56:36	1800	Galaxy (l=0, b=-30)	20:02:16.80	-41:20:31.2	HEX	Rashid Sunyaev	14200
1872	2017-10-11 13:27:21	2017-10-11 14:29:17	3600	Galaxy (l=0, b=-30)	19:59:40.80	-41:05:16.8	HEX	Rashid Sunyaev	14200
1872	2017-10-11 15:00:12	2017-10-11 17:38:07	9000	Galaxy (l=0, b=-30)	19:59:40.80	-41:05:16.8	HEX	Rashid Sunyaev	14200
1872	2017-10-11 18:41:00	2017-10-12 08:01:56	45000	GRS 1915+105	19:15:11.79	+10:56:45.7	5x5 Seq	Jerome Rodriguez	14200
							HEX	Rashid Sunyaev	14200
							HEX	Rashid Sunyaev	14200

Short Term Schedule

XMM-NEWTON SHORT-TERM SCHEDULE

The Short-term Schedule gives an overview of scheduled observations covering the time range from the past week until the upcoming ~2-4 weeks.

Background: The planning and scheduling procedure is described in Sect. 8.2 of the Policies and Procedures. In addition, the process of scheduling XMM-Newton observations is described in A guided tour to the scheduling of an XMM-Newton orbit.

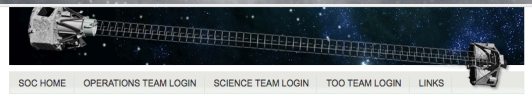
Description: Each row lists the revolution number (REV#), Observation Identifier (ObsID), target name, pointing coordinates plus position angle (PA), start and stop times, prime instrument, accumulated exposure times (in kiloseconds) for each instrument (without overhead), and name of the Principal investigator (PI). The start and stop times refer to the instrument activities required to perform the observation. The exposure times are accumulated over all exposures taken with the same instrument. Especially for OM, the observation can be split in shorter exposures with different filter/mode. EPIC exposure times in brackets indicate that one or all exposures use the closed filter. Details can be seen when clicking on the ObsID.
The row marked in blue indicates the target that is scheduled for the time of the last table update. The creation date is given at the top of the table.

Caveats: The scheduling of an XMM-Newton revolution may have to be revised (see Sects. 8.2, 8.3, and 5.2.2 of the Policies and Procedures). Contingencies of any type and solar flaring activity may impact at different levels the scheduled programme. The Observation Log Browser can be checked to see what was actually done.

Update frequency: Every 8 hours or when the schedule is updated (new revolution planned or any existing updated). The latest available version can be viewed after clearing the browser buffer from the contents of any previous sessions.

Last updated on: 2017-10-10 12:42:00 UT (Current Rev = 3267)

Revn #	Obs Id.	Target Name	RA hh:mm:ss	DEC dd:mm:ss	PA ddd.dd	UTC Obs Start yyyy-mm-dd hh:mm:ss	UTC Obs End yyyy-mm-dd hh:mm:ss	Prime Instr.	PN Dur Ks	MOS1 Dur. Ks	MOS2 Dur. Ks	RGS1 Dur. Ks	RGS2 Dur. Ks	OM Dur. Ks	PI
3276	0805150401	ESO 018-G009	08:24:07	-77:46:57	88.63	2017-10-29 19:34:26	2017-10-30 00:54:26	EPIC	16.7	18.1	18.1	18.2	18.2	18.0	Peter Boorman
3276	0801870801	HD 81809	09:27:46	-06:04:17	92.00	2017-10-29 15:00:13	2017-10-29 18:20:13	EPIC	9.5	10.9	10.9	11.0	11.0	10.8	Fabio Favata
3276	0561381201	zeta Puppis	08:03:40	-40:00:36	112.00	2017-10-29 01:21:41	2017-10-29 14:08:21	RGS	44.5	44.9	44.9	45.0	45.0	37.3	Fred Jansen XMM-Newton MM
3276	0803950401	SDSS 102714.77+35431	10:27:14	+35:43:17	119.93	2017-10-28 15:44:35	2017-10-28 23:31:15	EPIC	25.5	26.9	26.9	27.0	27.0	26.8	Guido Risaliti
3276	0803240201	J072637.95+394558.0	07:26:37	+39:45:58	91.37	2017-10-28 11:02:32	2017-10-28 14:55:52	EPIC	11.5	12.9	12.9	13.0	13.0	12.9	Nathan Secrest
3275	0801990201	0457-6739	04:57:33	-67:39:06	136.67	2017-10-27 12:22:47	2017-10-28 01:07:47	EPIC	43.4	44.8	44.8	44.9	44.9	43.7	Patrick Kavanagh
3275	0801990401	0449-6903	04:49:34	-69:03:34	138.62	2017-10-26 23:32:47	2017-10-27 12:02:47	EPIC	42.5	43.9	43.9	44.0	44.0	42.8	Patrick Kavanagh
3275	0803952601	SDSS	08:26:19	+31:48:48	101.78	2017-10-26	2017-10-26	EPIC	36.0	37.4	37.4	37.5	37.5	37.3	Guido



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Observing schedules

Short Range Observatory Schedule

Download

This is the confirmed schedule of NuSTAR observations. This sequence of observations has been uploaded to the spacecraft and will execute autonomously unless interrupted by a new schedule, Target of Opportunity, or instrument and spacecraft anomalies. This schedule will cover various time ranges depending on the exposure time goal of the observations, but will usually be for a period of at least one week.

The times reported here are the start and end of the on-target period (day of year UTC). The estimated exposure time takes into account Earth occultation and the SAA passage time where detector background is increased. The end time of the observation is the start of the slew to the next target. Please examine the NuSTAR As-Flown Timeline (AFT) for the log of past observations.

Table Header Explanations

obs_start	obs_end	sequenceID	Name	J2000_RA	J2000_Dec	Exp	Notes
2017:281:19:05:02	2017:283:00:30:00	90201021006	Kepler	262.671620	-21.491957	60.6	DDT
2017:283:01:11:23	2017:283:02:40:00	90311211001	Sol_17282_AR2683_POS11	195.15715	-6.38520	3.4	ToO
2017:283:02:40:32	2017:283:04:20:00	90311212001	Sol_17282_AR2683_POS12	195.21879	-6.41062	3.4	ToO
2017:283:04:20:32	2017:283:05:50:00	90311213001	Sol_17282_AR2683_POS13	195.28046	-6.43604	3.4	ToO
2017:283:06:55:11	2017:284:09:20:00	60376001002	2MASXJ19301380p3410495	292.557500	34.180500	55.3	Extragalactic Legacy Survey
2017:284:09:45:09	2017:284:20:35:00	60360008002	SDSSJ152132d21p391206d9	230.3874232	39.2007671	22.0	Extragalactic Legacy Survey
2017:284:21:10:03	2017:285:21:00:00	90301320002	NGC_6440	267.218083	-20.358944	49.5	ToO
2017:285:21:20:06	2017:286:08:20:00	30302020004	GRS_1915p105	288.79813	10.94578	21.9	(2/4) coordinated with XMM and VLT
2017:286:08:35:06	2017:286:19:30:00	60160701002	2MASXJ18560128p1538059	284.00210000	15.63200000	23.3	BAT AGN
2017:286:20:05:11	2017:287:15:05:00	60376007002	UGC06728	176.316800	79.681500	61.4	Extragalactic Legacy Survey
2017:287:15:50:11	2017:288:03:20:00	60368001002	NGC_1144	43.80083	-0.18361	22.0	
2017:288:04:05:09	2017:288:23:00:00	60301004002	ESO_103m35	279.58458	-65.4275	50.3	
2017:288:23:30:08	2017:290:05:45:00	30301026002	AX_J1841d0m0536	280.25179	-5.59625	59.7	phase constrained
2017:290:06:00:04	2017:290:17:00:00	60160670002	2E1739d1m1210	265.47600000	-12.19700000	23.5	BAT AGN
2017:290:17:15:01	2017:291:04:20:00	30363001002	GX_3p1	266.98333	-26.56361	21.8	

Long Range Observatory Schedule

Download

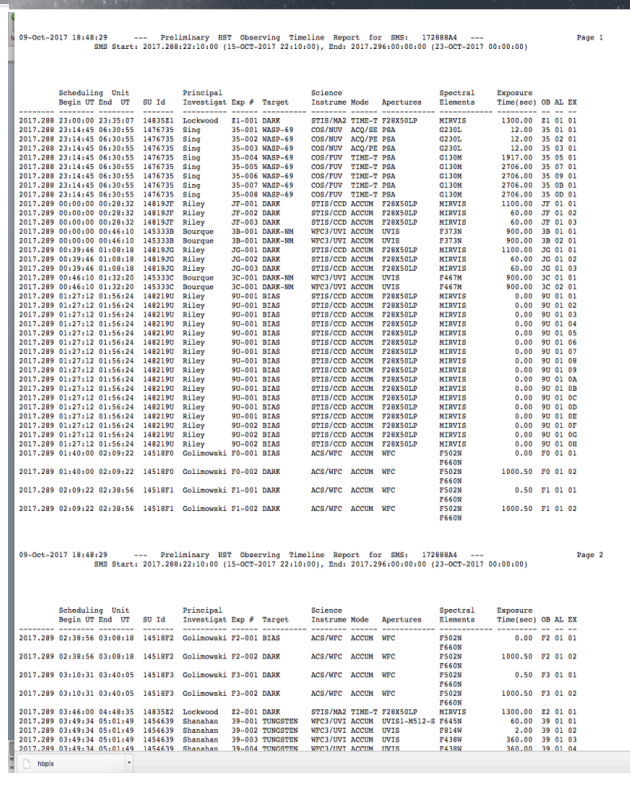
This is the latest NuSTAR long-term schedule. Observations have been sorted into one-week intervals, taking into account Sun, Moon, required exposure time, and other constraints. So the date is the Monday of the week in which the observation is scheduled to begin.

E.g. An observation with a date **2017-12-18** in this table is scheduled to have the observation ***starting*** sometime between **2017-12-18 0000Z** and **2017-12-25 0000Z**.

Currently the schedule is driven by the large number of observations coordinated with other observatories and the need to complete the NuSTAR Guest Observer programs. The exposure goal for targets allotted within one week may appear to fill more than the available NuSTAR exposure time in that week (average is 330 ks per week) but many observations start in one week and complete in the following week.

Targets of opportunity and any instrument or spacecraft anomalies may also cause the observing times of targets to shift. This long-term schedule is our present estimate of the future order of observations. Please be aware of the uncertainties.

ToO = Target of Opportunity **DDT** = Directors Discretionary Time **NO3** = NuSTAR GO cycle-3 **I15** = INTEGRAL GO cycle-15
X16 = XMM-Newton GO cycle-16 **C18** = Chandra GO cycle-18 **ELS/GLS** = Extragalactic/Galactic legacy surveys



09-Oct-2017 18:48:29 --- Preliminary NST Observing Timeline Report for SMS: 172888A4 --- Page 1
SMS Start: 2017.288:22:10:00 (15-OCT-2017 22:10:00), End: 2017.296:00:00:00 (23-OCT-2017 00:00:00)

Scheduling Unit Begin UT	End UT	SU Id	Principal Investigat	Exp #	Target	Science Instrume	Mode	Apertures	Spectral Elements	Exposure Time(sec)	OB	AL	EX
2017.288 23:00:00	23:35:07	14835E1	Lockwood	E1-001	DARK	STIS/NA2	TIME-T	F28X50LP	MIRVIS	1300.00	E1	01	01
2017.288 23:14:45	06:30:55	1476735	Sing	35-001	WASP-69	ACS/HRC	ACCUM	WFC	G230L	12.00	35	01	01
2017.288 23:14:45	06:30:55	1476735	Sing	35-002	WASP-69	COS/NUV	ACQ/PE	PSA	G230L	12.00	35	02	01
2017.288 23:14:45	06:30:55	1476735	Sing	35-003	WASP-69	COS/NUV	ACQ/PE	PSA	G230L	12.00	35	03	01
2017.288 23:14:45	06:30:55	1476735	Sing	35-004	WASP-69	COS/FUV	TIME-T	PSA	G130M	1917.00	35	05	01
2017.288 23:14:45	06:30:55	1476735	Sing	35-005	WASP-69	COS/FUV	TIME-T	PSA	G130M	2706.00	35	07	01
2017.288 23:14:45	06:30:55	1476735	Sing	35-006	WASP-69	COS/FUV	TIME-T	PSA	G130M	2706.00	35	09	01
2017.288 23:14:45	06:30:55	1476735	Sing	35-007	WASP-69	COS/FUV	TIME-T	PSA	G130M	2706.00	35	0B	01
2017.288 23:14:45	06:30:55	1476735	Sing	35-008	WASP-69	COS/FUV	TIME-T	PSA	G130M	2706.00	35	0D	01
2017.289 00:00:00	00:28:32	14819ZF	Riley	JF-001	DARK	STIS/CCD	ACCUM	F28X50LP	MIRVIS	1100.00	JF	01	01
2017.289 00:00:00	00:28:32	14819ZF	Riley	JF-002	DARK	STIS/CCD	ACCUM	F28X50LP	MIRVIS	60.00	JF	01	02
2017.289 00:00:00	00:28:32	14819ZF	Riley	JF-003	DARK	STIS/CCD	ACCUM	F28X50LP	MIRVIS	60.00	JF	01	03
2017.289 00:00:00	00:46:10	145333B	Bourque	3B-001	DARK-NM	WFC3/UVI	ACCUM	UVIS	F373N	900.00	3B	01	01
2017.289 00:00:00	00:46:10	145333B	Bourque	3B-001	DARK-NM	WFC3/UVI	ACCUM	UVIS	F373N	900.00	3B	02	01
2017.289 00:39:46	01:08:18	14819ZG	Riley	JG-001	DARK	STIS/CCD	ACCUM	F28X50LP	MIRVIS	1100.00	JG	01	01
2017.289 00:39:46	01:08:18	14819ZG	Riley	JG-002	DARK	STIS/CCD	ACCUM	F28X50LP	MIRVIS	60.00	JG	01	02
2017.289 00:39:46	01:08:18	14819ZG	Riley	JG-003	DARK	STIS/CCD	ACCUM	F28X50LP	MIRVIS	60.00	JG	01	03
2017.289 00:46:10	01:32:20	145333C	Bourque	3C-001	DARK-NM	WFC3/UVI	ACCUM	UVIS	F467M	900.00	3C	01	01
2017.289 00:46:10	01:32:20	145333C	Bourque	3C-001	DARK-NM	WFC3/UVI	ACCUM	UVIS	F467M	900.00	3C	02	01
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-001	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	01
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-001	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	02
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-001	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	03
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-001	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	04
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-001	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	05
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-001	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	06
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-001	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	07
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-001	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	08
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-001	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	09
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-001	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	0A
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-001	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	0B
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-001	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	0C
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-001	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	0D
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-001	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	0E
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-002	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	0F
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-002	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	0G
2017.289 01:27:12	01:56:24	14821YU	Riley	9U-002	BIAS	STIS/CCD	ACCUM	F28X50LP	MIRVIS	0.00	9U	01	0H
2017.289 01:40:00	02:09:22	14818F0	Golimowski	F0-001	BIAS	ACS/WFC	ACCUM	WFC	F502N F660N	0.00	F0	01	01
2017.289 01:40:00	02:09:22	14818F0	Golimowski	F0-002	DARK	ACS/WFC	ACCUM	WFC	F502N F660N	1000.50	F0	01	02
2017.289 02:09:22	02:38:56	14818F1	Golimowski	F1-001	DARK	ACS/WFC	ACCUM	WFC	F502N F660N	0.50	F1	01	01
2017.289 02:09:22	02:38:56	14818F1	Golimowski	F1-002	DARK	ACS/WFC	ACCUM	WFC	F502N F660N	1000.50	F1	01	02

09-Oct-2017 18:48:29 --- Preliminary NST Observing Timeline Report for SMS: 172888A4 --- Page 2
SMS Start: 2017.288:22:10:00 (15-OCT-2017 22:10:00), End: 2017.296:00:00:00 (23-OCT-2017 00:00:00)

Scheduling Unit Begin UT	End UT	SU Id	Principal Investigat	Exp #	Target	Science Instrume	Mode	Apertures	Spectral Elements	Exposure Time(sec)	OB	AL	EX
2017.289 02:38:56	03:08:18	14818F2	Golimowski	F2-001	BIAS	ACS/WFC	ACCUM	WFC	F502N F660N	0.00	F2	01	01
2017.289 02:38:56	03:08:18	14818F2	Golimowski	F2-002	DARK	ACS/WFC	ACCUM	WFC	F502N F660N	1000.50	F2	01	02
2017.289 03:10:31	03:40:05	14818F3	Golimowski	F3-001	DARK	ACS/WFC	ACCUM	WFC	F502N F660N	0.50	F3	01	01
2017.289 03:10:31	03:40:05	14818F3	Golimowski	F3-002	DARK	ACS/WFC	ACCUM	WFC	F502N F660N	1000.50	F3	01	02
2017.289 03:46:00	04:48:35	14835E2	Lockwood	E2-001	DARK	STIS/NA2	TIME-T	F28X50LP	MIRVIS	1300.00	E2	01	01
2017.289 03:49:34	05:01:49	1454639	Shanahan	39-001	TUNGSTEN	WFC3/UVI	ACCUM	UVIS1-M512-8	F645N	60.00	39	01	01
2017.289 03:49:34	05:01:49	1454639	Shanahan	39-002	TUNGSTEN	WFC3/UVI	ACCUM	UVIS	F814W	2.00	39	01	02
2017.289 03:49:34	05:01:49	1454639	Shanahan	39-003	TUNGSTEN	WFC3/UVI	ACCUM	UVIS	F438W	360.00	39	01	03
2017.289 03:49:34	05:01:49	1454639	Shanahan	39-004	TUNGSTEN	WFC3/UVI	ACCUM	UVIS	F438W	360.00	39	01	04

What object has been (or will be) observed when and in which wavelength?

Observation Locator Table Access Protocol, Aitor Ibarra, Jesús Salgado et al. 2019
http://www.ivoa.net/documents/ObsLocTAP/

International

Virtual

Observatory

Alliance

Observation Locator Table Access Protocol

Version 1.0

IVOA Working Draft 11 February 2020

This version:
http://www.ivoa.net/documents/ObsLocTAP/20200211/
Latest version:
http://www.ivoa.net/documents/ObsLocTAP/
Previous version(s):
http://www.ivoa.net/documents/ObsLocTAP/20190909/

Working Group:
http://www.ivoa.net/twiki/bin/view/IVOA/IvoaDAL

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TBC: Representatives of a large multi-observatory collaboration

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Object Visibility Simple Access Protocol

Version 0.5

IVOA Working Draft 19 March 2019

This version:
ObjVisSAP-0.5-20190319
Latest version:
ObjVisSAP-0.4-20180912

Previous version(s):

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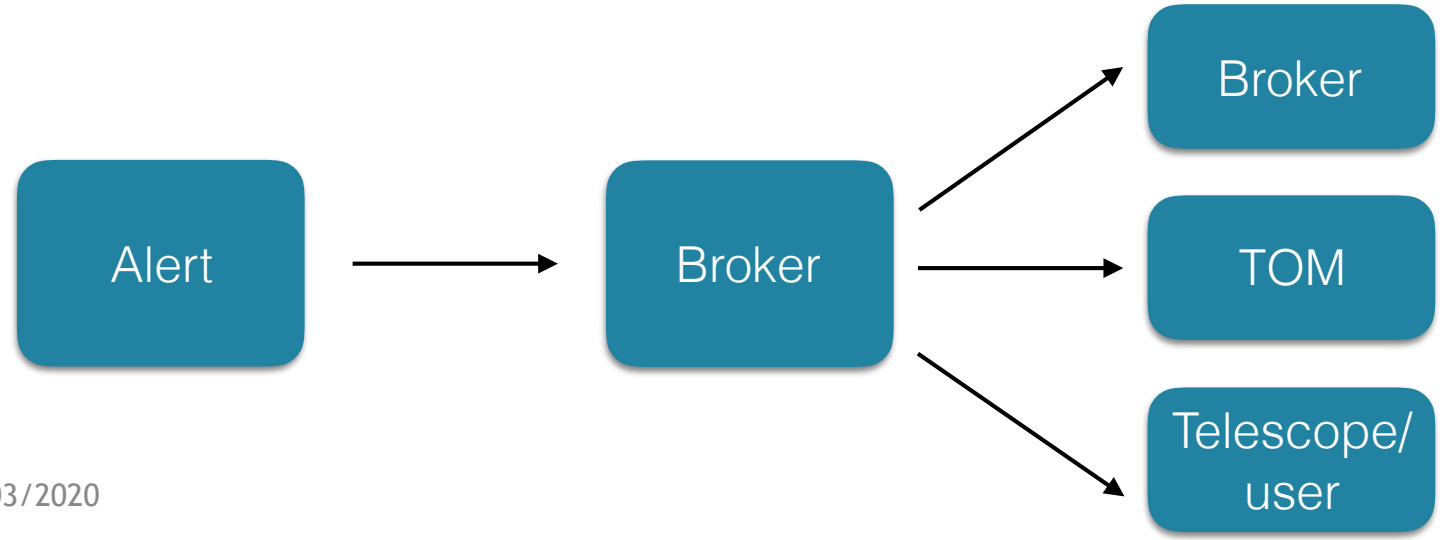
5 - Alerts

1. VOEvent (REC):
    1. Container —> XML
    2. Content —> defined by the community: FRB, (GRB, SN, Neutrino,…)
2. VOEvent Transport protocol (REC):
    1. Works for low rates (10 Hz)
    2. Might not scale well for very high rates (10^3Hz)
3. Open questions:
    1. A VOEvents validation library is missing
    2. How to find who distributes alerts? Register in the registry



What next?

- How to find distributed timeseries in the VO?
  - Obscore "*dataproduct_type = timeseries*"
  - Conesearch extension to time interval
  - *timeseries* distributed as *SSA products*
    - Registry : adding "*dataproduct_type = timeseries*" as metadata to SSA capability — SimpleDALRegExt
  - Datalink: align with Obscore "*dataproduct_type = timeseries*"