

First steps to standardise observatory services via VO standard protocols

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SCIENTISTS REQUIRE COORDINATED MULTIWAVELENGTH OBSERVATIONS



- Increasing interest to simultaneously observe the same target at different wavelengths. Example use cases:
 - X-ray binary ToOs
 - Gaia transients
 - Optical & radio transients
 - TDEs, GRBs
 - GW & neutrino follow-up
- Some observatory numbers:
 - **NuSTAR**: 30% of the observations are coordinated with other observatories.
 - XMM-Newton: ~12% coordinated observations (NuSTAR, HST, Chandra, VLT, Swift).
 - **INTEGRAL**: ~10% of the observations are coordinated with other observatories.
 - **Chandra** has expanded the time available via joint programs.



Middelton et al. 2017

MULTI-WAVELENGTH CAMPAIGNS CAN BE LARGE AND COMPLEX





Real Multi-wavelength campaign during the 2015 outburst of V404 Cygni (Credit: Tom Marsh)

ASASSN 14LI – TIDAL DISRUPTION EVENT





2.0

.0

0.5

Luminosity (10" erg s1)

ASAS-SN wide field transient detector

Time (in days since MJD 56983.6)



Rapid follow-ups by Swift, XMM, AMI, WSRT show 15 day lag between radio and X-ray indicating disk-jet coupling not seen previously in a Tidal Disruption Event

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IF IT IS NOT ENOUGH...



GW170817: A Global Astronomy Event (LIGO&VIRGO press release)

- First detection of a GW produced by colliding neutron stars
- ~70 groundand spacebased observatories
- Quick reaction time



"This detection opens the window of a long-awaited 'multi-messenger' astronomy" Dr. David H. Reitze

NEED FOR IMPROVED METHODS

- Recent workshops have discussed this issue:
 - Paving the Way to Simultaneous Multi-Wavelength Astronomy (Leiden: July 13, 2017)
 - White paper: (arXiv/1709.03520v3)
 - Astrophysics Mission Synergy Workshop (Caltech: March 31, 2017)
 - What coordinated observing could reveal
 - Issues faced in coordinated observing
 - Issues specific to coordinated simultaneous observing
 - Increasing demand for rapid follow-up & coordination

•What needs to be done

 Identify areas to improve coordination/communication (keeping track what is going on)

•Collaborative tools to share information efficiently (No more endless email discussions, please ;-))

•Standardised, automatically retrievable information from available facilities







All information needed to plan an observation (via AO or ToO) is currently in facilities own web pages.



This information is usually shown in a web page statically and is only accessible trough forms that have to be manually filled in.

ALL INFORMATION ABOUT TARGET VISIBILITY CHECKS IS THERE...





AND INFORMATION ABOUT SCHEDULED OBSERVATION...



Associated Universities, Inc.

NRA

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AND INFORMATION ABOUT PLANNED OBSERVATIONS



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OBSERVATORY SERVICES: STANDARDISATION



• Knowing that the information already exists in all facilities, the question is:

Why don't we standardise the information exchange to improve the efficiency to plan observations or coordinate observation campaigns?

MOVE FROM OBSERVATORY TOOLS TO OBSERVATORY SERVICES

Identify which observatory tools could be easily transform in services (if they are not already a service)

Target visibility checks Scheduled and planned observation logs

- Standardise the input parameters
- Standardise the output information and format



Virtual Observatory protocols

OBSTAP AS EXISTING STANDARD



... Core components of the Observation data model that are necessary to perform data discovery when querying data centres for astronomical observations of interest ...

Extend this standard to be used for visibility check and scheduled observation info

obs_id	unitless	String	Observation ID	OBS_ID
obs_publisher_did	unitless	String	Dataset identifier given by the publisher	?
access_url	unitless	String	URL used to access (download) dataset	TBD
access_format	unitless	String	File content format (see in App. Error! Reference source not found.)	NULL
access_estsize	kbyte	integer	Estimated size of dataset in kilo bytes	NULL
target_name	unitless	String	Astronomical object observed, if any	"Target" ?
s_ra	deg	double	Central right ascension, ICRS	RA
s_dec	deg	double	Central declination, ICRS	DEC
s_fov	deg	double	Diameter (bounds) of the covered region	Fixed value for each XMM- Newton Instrument
s_region	unitless	String	Sky region covered by the data product (expressed in ICRS frame)	TBD, not easy for RGS



International Virtual

Observatory

Alliance

Observation Data Model Core Components and its Implementation in the Table Access Protocol

THE XMM-NEWTON & INTEGRAL: VISIBILITY CHECK USE CASE



XMM-Newton

http://xmm.esac.esa.int/XMMVisCheck? startDate=11-10-2017& minduration=12.000& coordinates=equatorial& ra=192.063458& dec=17.77394

INTEGRAL

http://integral.esac.esa.int//IntegralVisCheck? startDate=11-10-2017& minduration=12.000& coordinates=equatorial& ra=192.063458& dec=17.77394

🗧 🔶 C 🗈 xmm.esac.esa.int/XMMVisCheck?ra=321&dec=34&minDuration=5000&startdate=20-Dec-2017&enddate=20-Dec-2018&coordinates=equatorial

[("SolarA": "09.3", "Rev": "3293", "VisStar": "2017-12-01 10:19", "AstroA": "241.2", "VisEnd": "2017-12-03 01:12", "StarPh": "0.12", "Round": "130000", "VisDur": "139362", "EndPh": "0.93"}, ["SolarA": "06.5", "Rev": "3294", "VisStar": "2017-12-03 10:11", "AstroA": "238.2", "VisEnd": "2017-12-05 00:54", "StarPh": "0.12", "Round": "130000", "VisDur": "139376", "EndPh": "0.93"}, ["SolarA": "06.5", "Rev": "3295", "VisStar": "2017-12-05 10:55", "AstroA": "238.2", "VisEnd": "2017-12-05 00:54", "StarPh": "0.12", "Round: "130000", "VisDur": "139318", "EndPh": "0.93"}, ["SolarA": "05.5", "Rev": "3296", "VisStar": "2017-12-07 09:55", "AstroA": "236.8", "VisEnd": "2017-12-09 00:39", "StarPh": "0.12", "Round: "130000", "VisDur": "139109", "EndPh": "0.93"}, ["SolarA": "05.1", "Rev": "3297", "VisStar": "2017-12-07 09:55", "AstroA": "236.8", "VisEnd": "2017-12-10 00:31", "StarPh": "0.12", "Round: "130000", "VisDur": "139109", "EndPh": "0.93"}, ["SolarA": "05.2", "Rev": "3297", "VisStar": "2017-12-10 09:53", "AstroA": "233.8", "VisEnd": "2017-12-10 00:12", "StarPh": "0.12", "Round: "130000", "VisDur": "139045", "EndPh": "0.93"}, ["SolarA": "06.9", "Rev": "3299", "VisStar": "2017-12-11 09:46", "AstroA": "233.3", "VisEnd": "2017-12-13 00:12", "StarPh": "0.12", "Round: "130000", "VisDur": "138278", "EndPh": "0.92"}, ["SolarA": "79.5", "Rev": "33000", "VisStar": "2017-12-15 09:31", "AstroA": "232.3", "VisEnd": "2017-12-15 00:03", "StarPh: "0.12", "Round: "130000", "VisDur": "138278", "EndPh": "0.92"}, ["SolarA": "79.5", "Rev": "33000", "VisStar": "2017-12-15 09:31", "AstroA": "232.3", "VisEnd": "2017-12-15 00:03", "StarPh: "0.12", "Round: "130000", "VisDur": "138278", "EndPh": "0.92"}, ["SolarA": "79.5", "Rev": "3301", "VisStar": "2017-12-17 09:23", "AstroA": "222.2", "VisEnd": "2017-12-18 23:47", "StarPh: "0.12", "Round: "130000", "VisDur": "138278", "EndPh: "0.92"}, ["SolarA": "76.1", "Rev": "3302", "VisStar": "2017-12-21 09:17", "AstroA: "222.7", "VisEnd": "2017-12-22 23:2", "StarPh: "0.12", "Round: "130000", "VisDur: "137



THE XMM-NEWTON & INTEGRAL: OBSERVATION INFO USE CASE



XMM-Newton

http://xmm.esac.esa.int/XMMVisCheck? coordinates=equatorial& ra=192.063458& dec=17.77394

INTEGRAL

http://integral.esac.esa.int//IntegralVisCheck? coordinates=equatorial& ra=192.063458& dec=17.77394

← → C b xmm.esac.esa.int;XMM_ObsTap?ra=184.584&dec=47.13125	
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SCIENTIFIC COLLABORATIVE TOOL: SCIAPP



2016-12-04 14-29-36

2014 12 04 14-24-49

- Web tool focused on the information sharing between scientist
- It is based on astronomical source conversations (candidate list DB)
- Interface with services provided by observing facilities
- Observation campaign functionality

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2017	7-12-03 10:11	CAMPAIGNS LIST								5-12-04 15:21:31	2	016-12-04 15:49	:57	1400
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2017	7-12-15 09:31	Status	PROGRESS	>	Status	ana	PROGRESS		>	7-06-08 01:02:06	2	017-06-08 04:19	:28	11662
2017	7-12-17 09:23									7-06-08 01:06:34	2	017-06-08 01:41	.:15	1760
2017	7-12-1909:17									7-06-08 01:07:13	2	017-06-08 04:19	:43	11490
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ON

ESASKY V3.0 NEW TIME-DOMAIN EXPLORATION



Constraint visibility checker option

Footprints for scheduled observations



BRINGING FACILITIES ON-BOARD















ObsTAP Protocol for Visibility & Observation DISCOVERY SERVICES













Standardize Observatory Services | Aitor Ibarra | SciOps Meeting | ESAC-16/10/2017 | Slide 17

European Space Agency