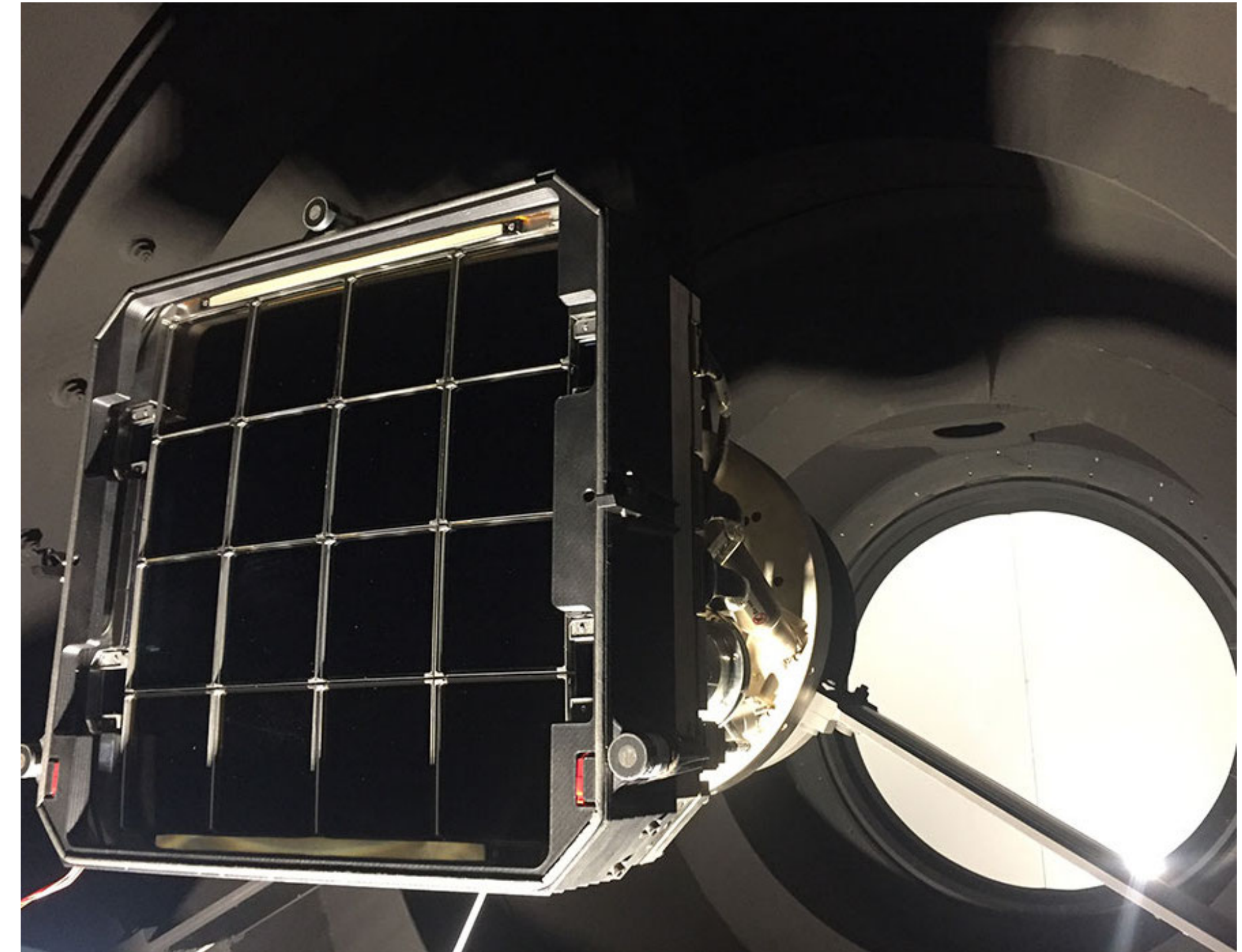
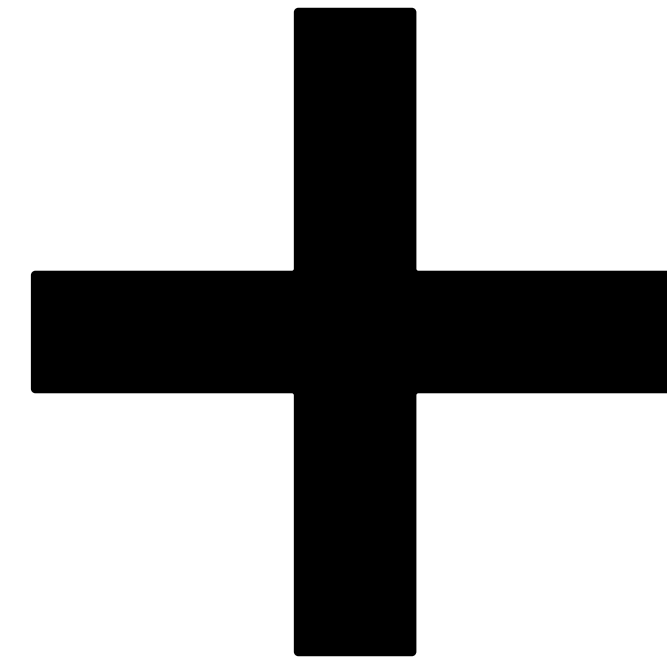
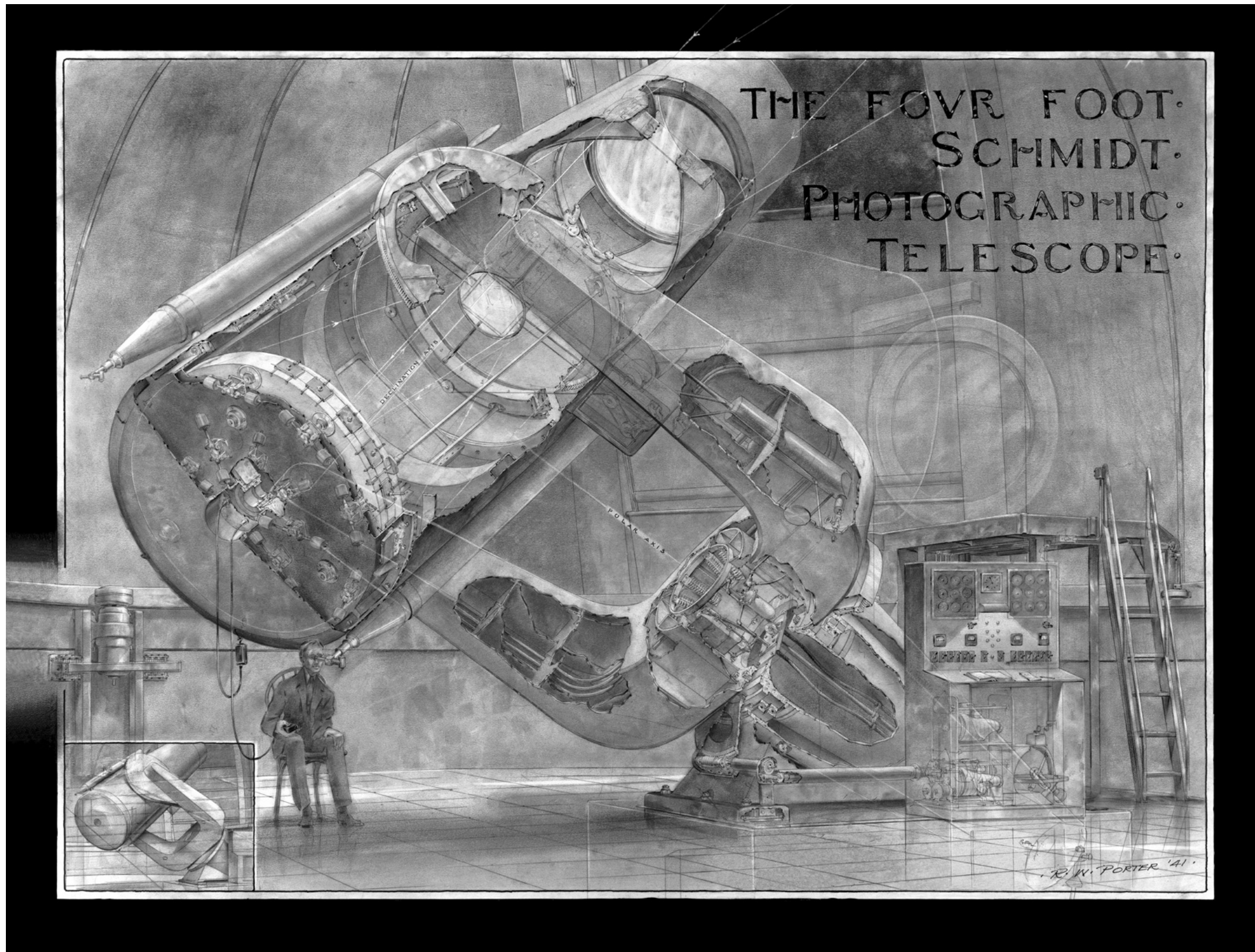


ZTF Science Data-System

Caltech/IPAC, 2023-02-13



Zwicky Transient Facility

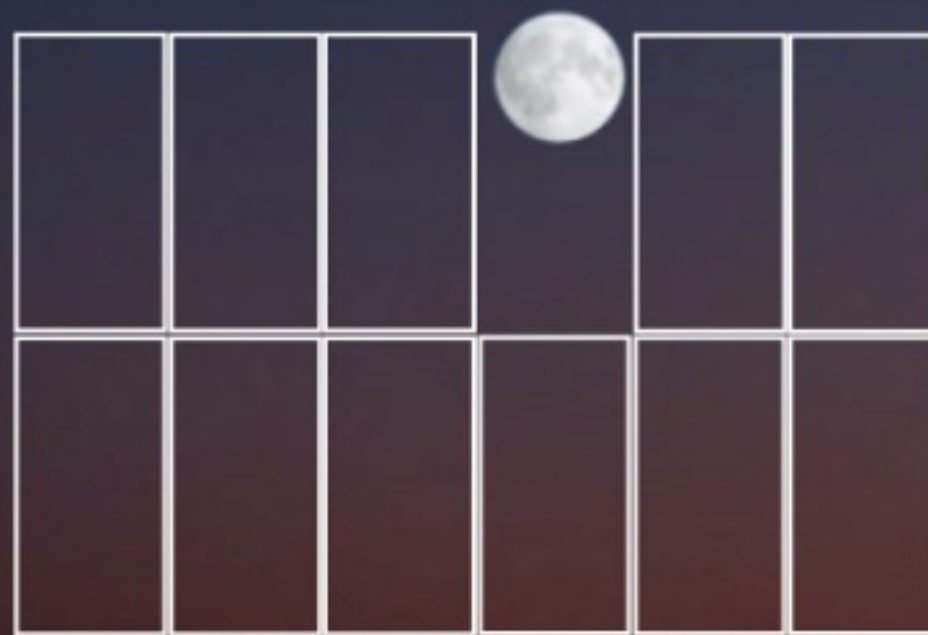


- Time-domain astronomical survey
- Wide-field Schmidt & large camera (FOV 47 deg², 660 MPix, sub 9s readout)
- Scans the entire Northern sky every two nights in *g*, *r*, *i* filters

HSC,
1.7 deg²



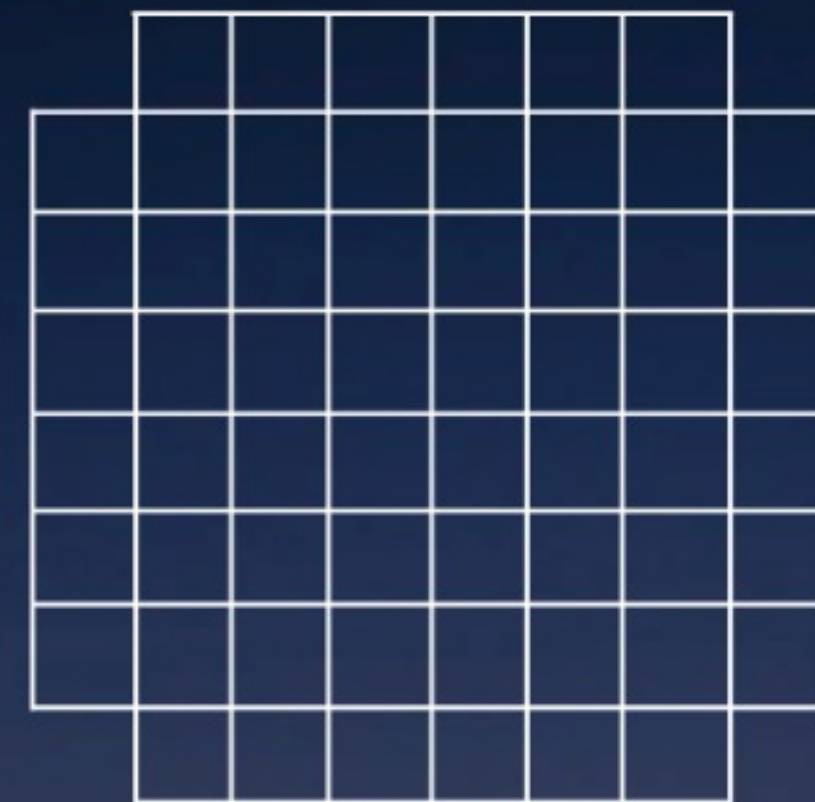
DES,
2.5 deg²



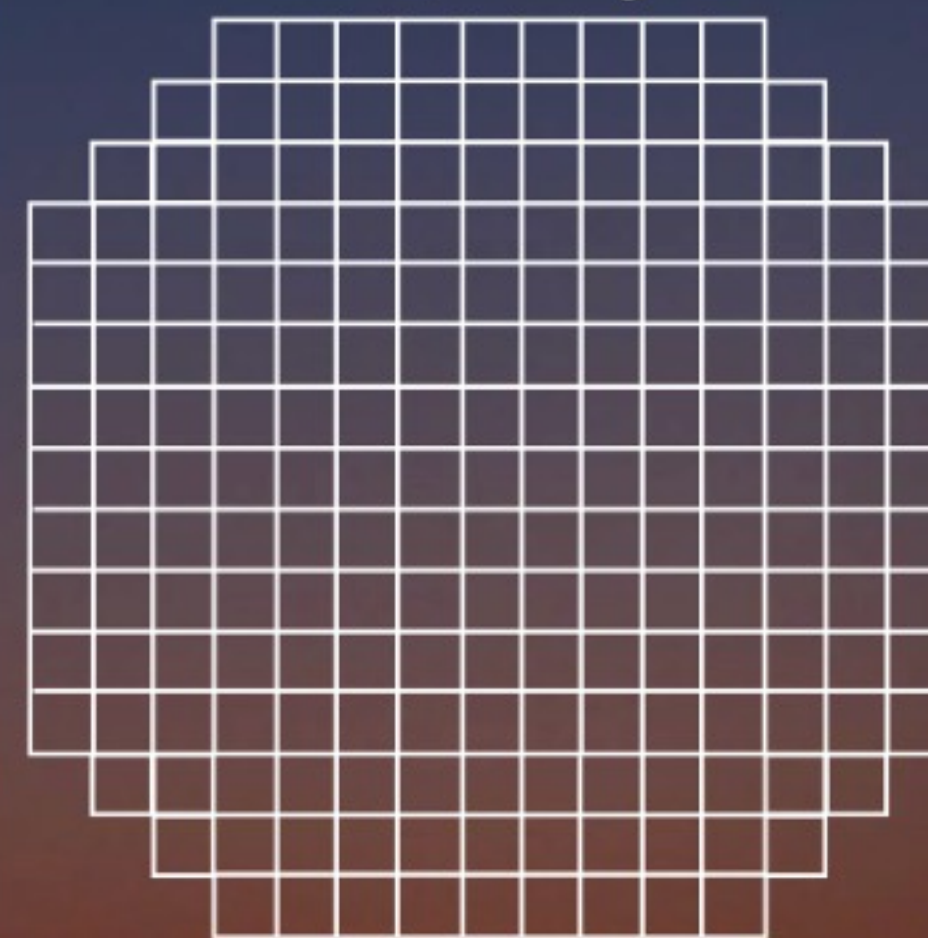
PTF/iPTF, 7.3 deg²



ZTF, 47 deg²



PS1, 7 deg²

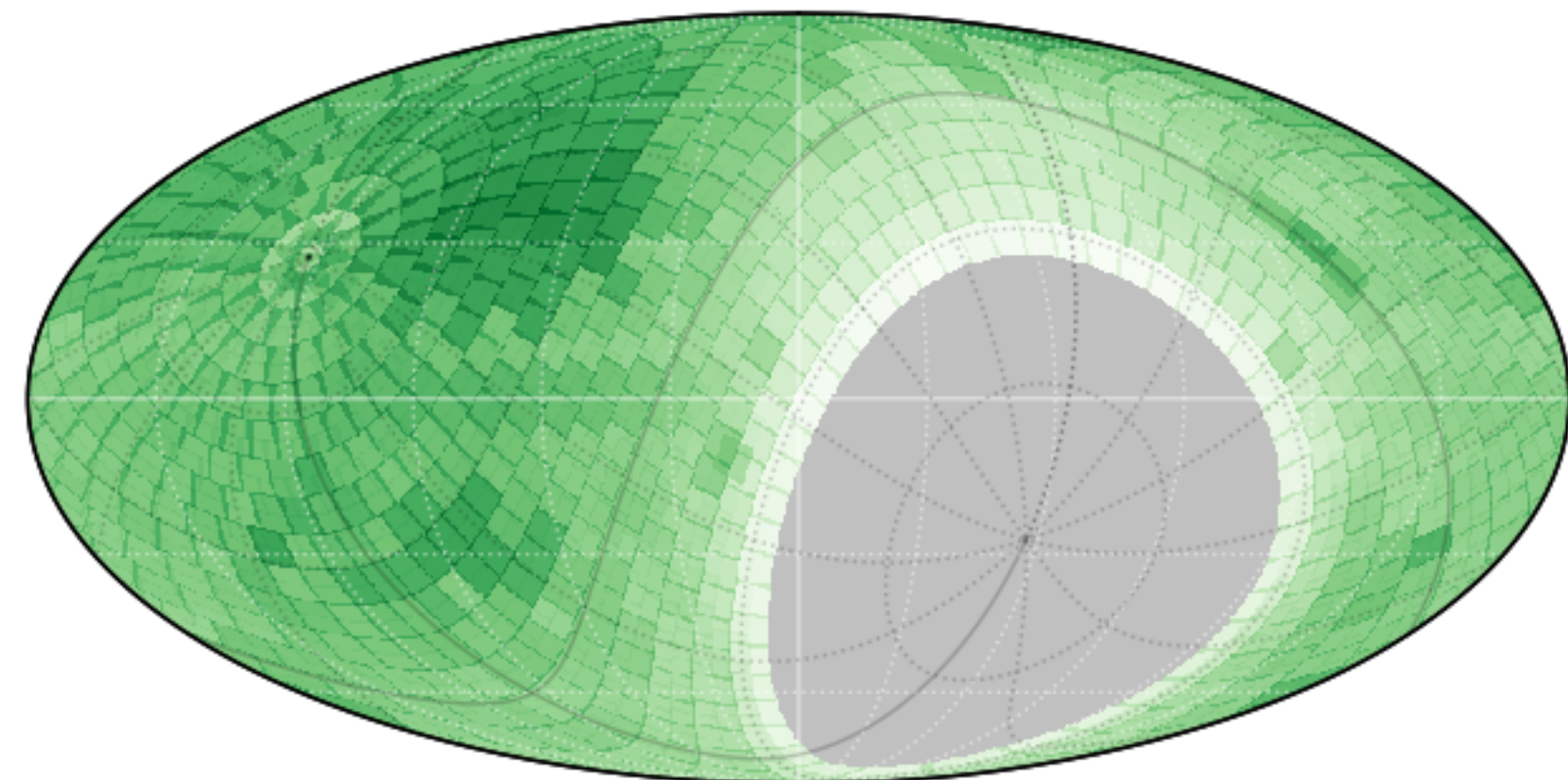


LSST, 9.6 deg²

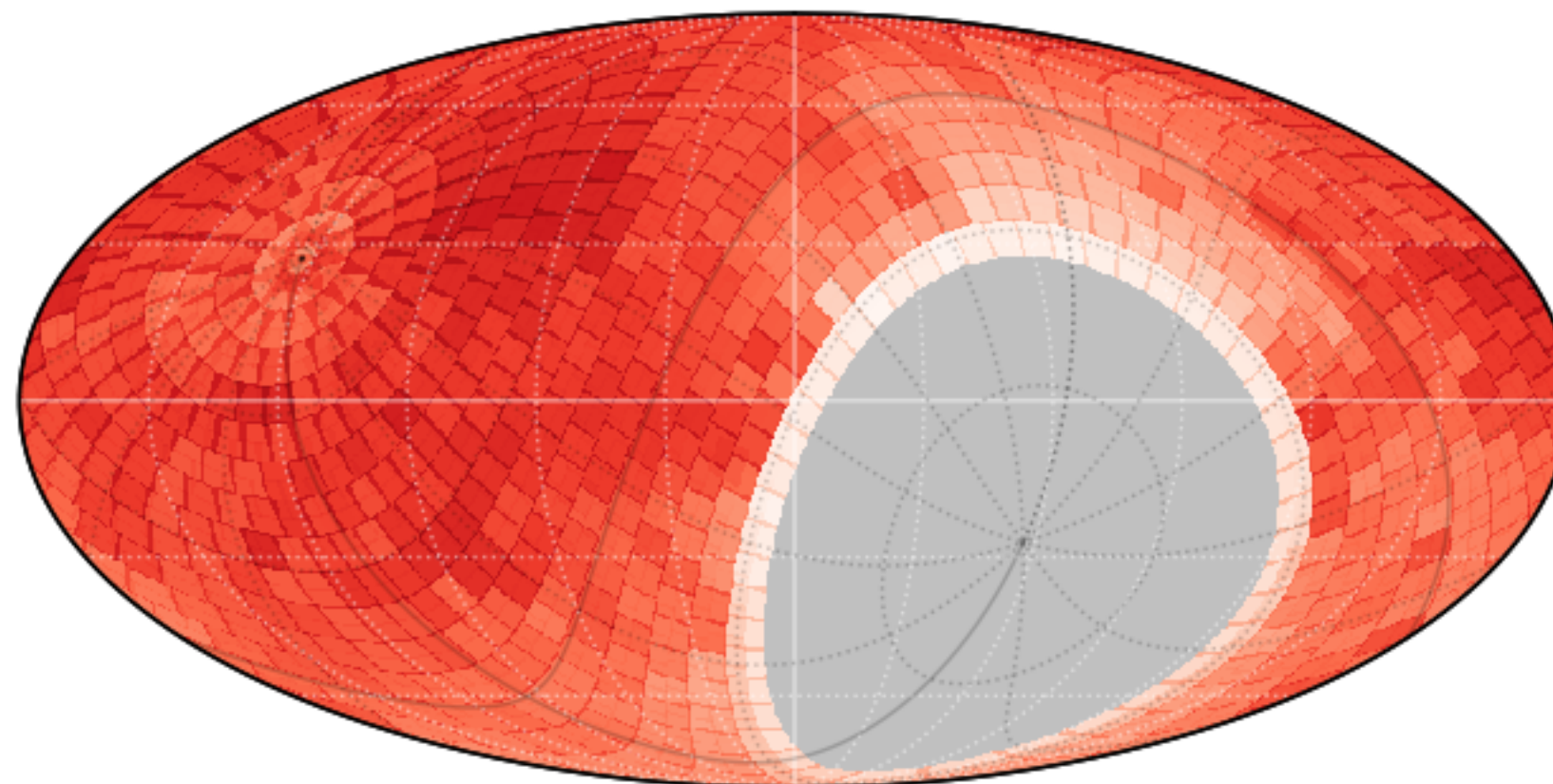
1 deg

Coverage

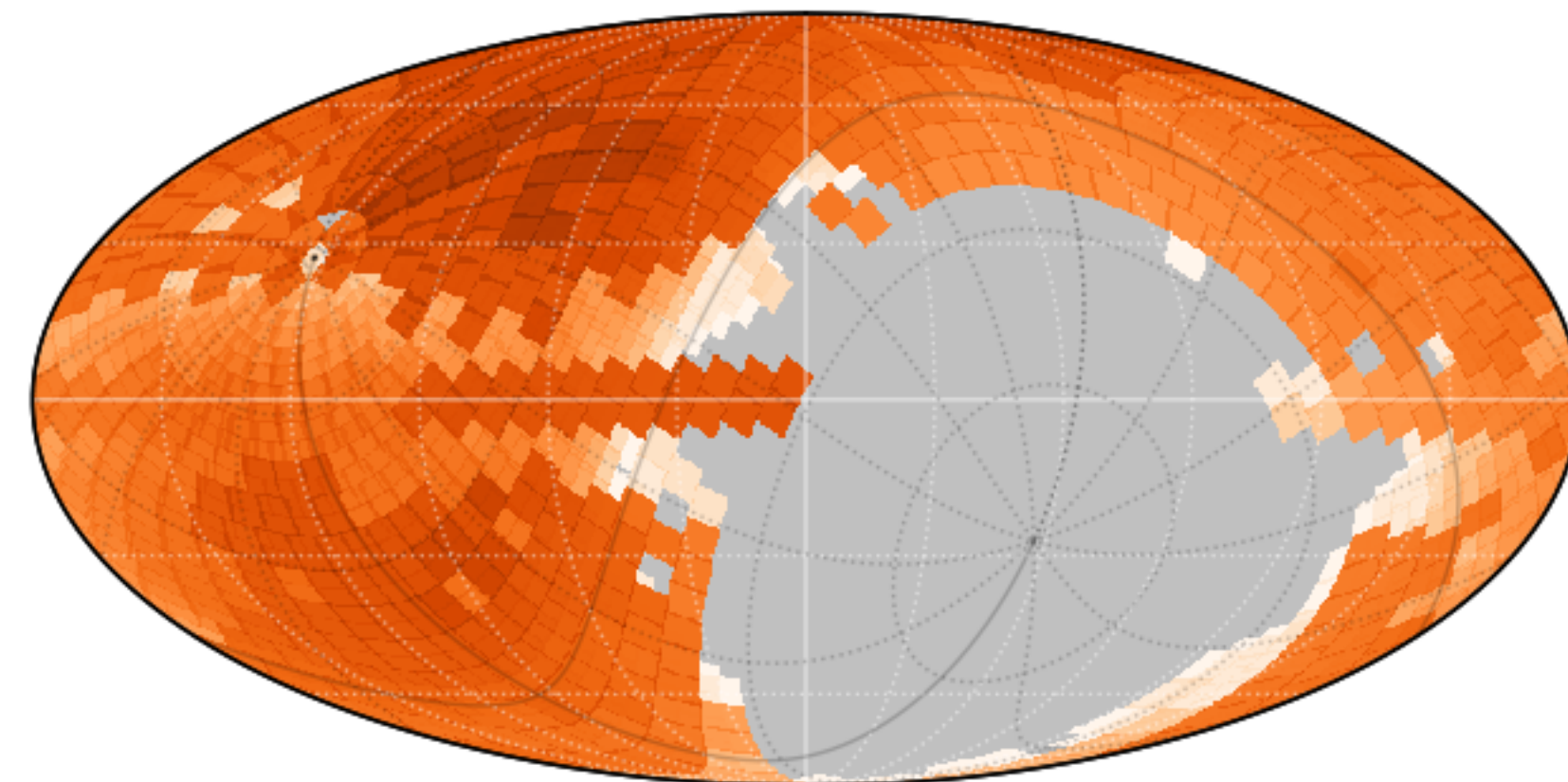
ZTF : G : Galactic : All Programs : Thru 2023-02-10 (1304/1553 Nights)



ZTF : R : Galactic : All Programs : Thru 2023-02-10 (1332/1553 Nights)



ZTF : I : Galactic : All Programs : Thru 2023-02-10 (942/1553 Nights)

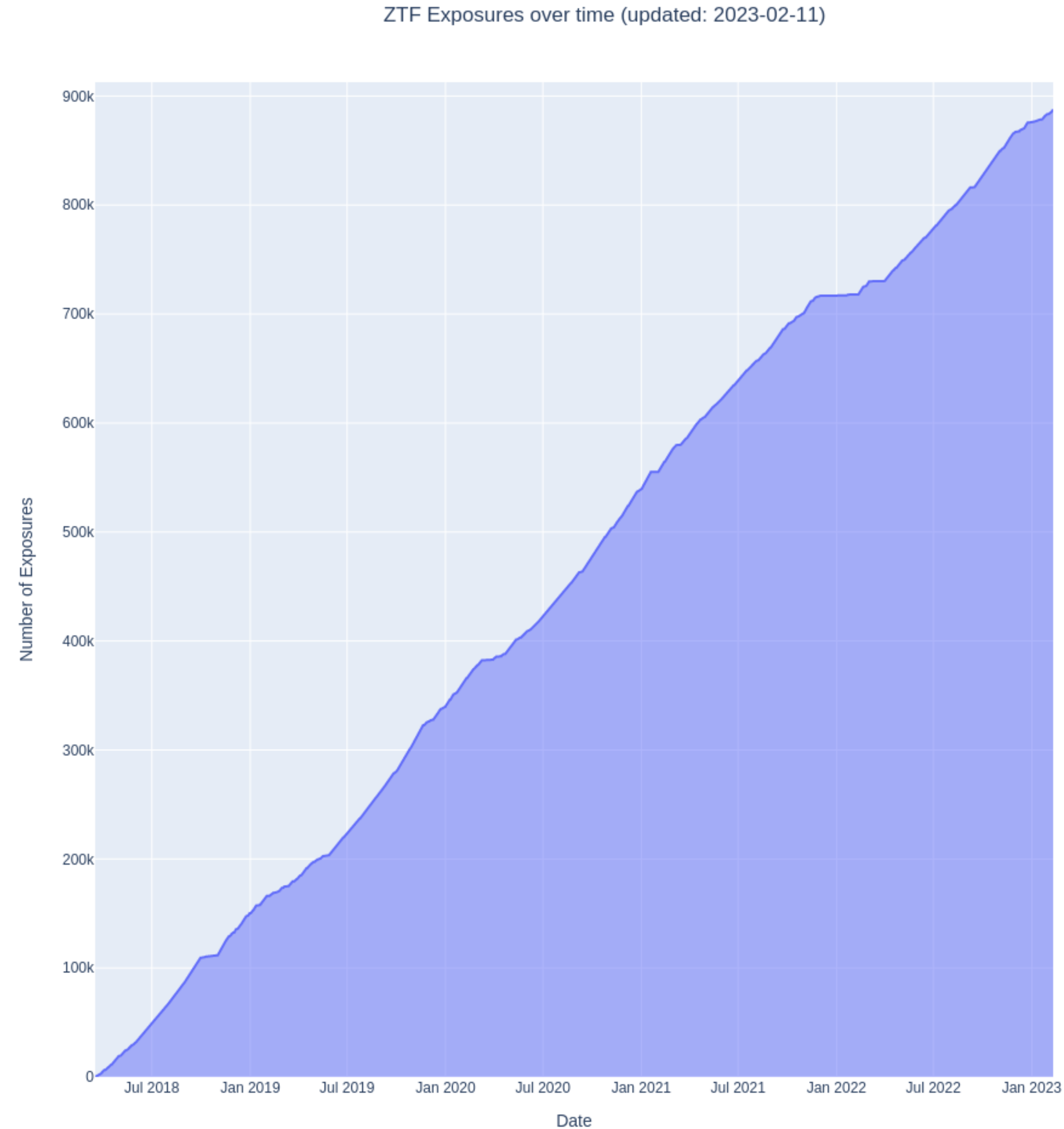


ZTF Science Data-System (ZSDS)

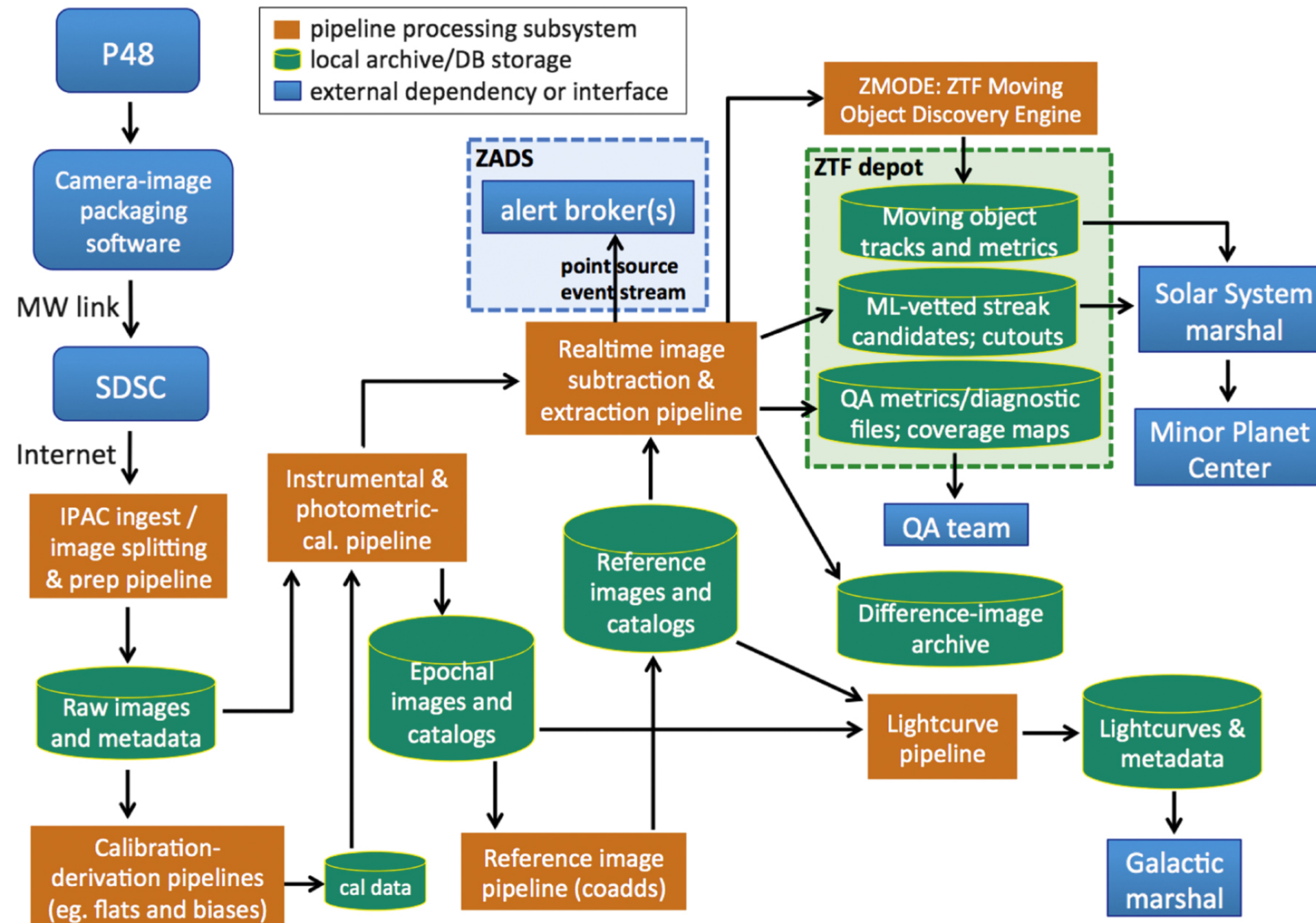
- IPAC responsibilities:
 - Realtime data processing (90% < 20 min)
 - Photometric & astrometric calibration
 - Image-differencing against reference images
 - Transient identification (including ML scoring)
 - Alert-streams for automated follow-up
 - Archiving (IRSA)
 - Updated simultaneously with processing
 - API, GUI, visualization & analysis tools
 - Access control per data-rights
 - Solar-System science (tracklets delivered daily to MPC)
 - Data-releases every 2 months (including light-curves)
 - Forced-photometry service

Headline Numbers

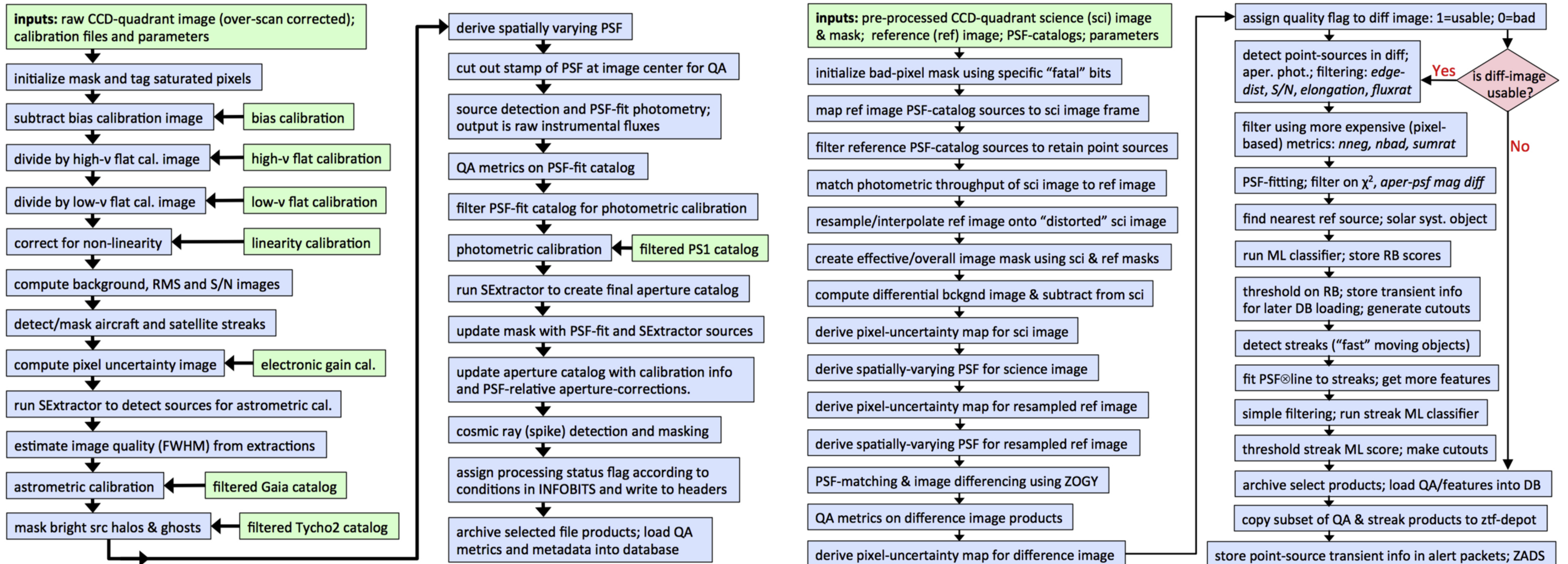
As of	2023-12-11
Nights	1,791
Observing Efficiency	77.35%
Total Exposures	1,032,647
Science Exposures	887,766
Reference Coverage	$g=97.30, r=97.27, i=65.54$
Latest Release	DR15 (2023-01-09)
Alerts	549 M (all programs)
Forced-Photometry Requests	209,181
Archive Size	4.76 PB
IRSA Data Served	7.40 PB



Processing Overview

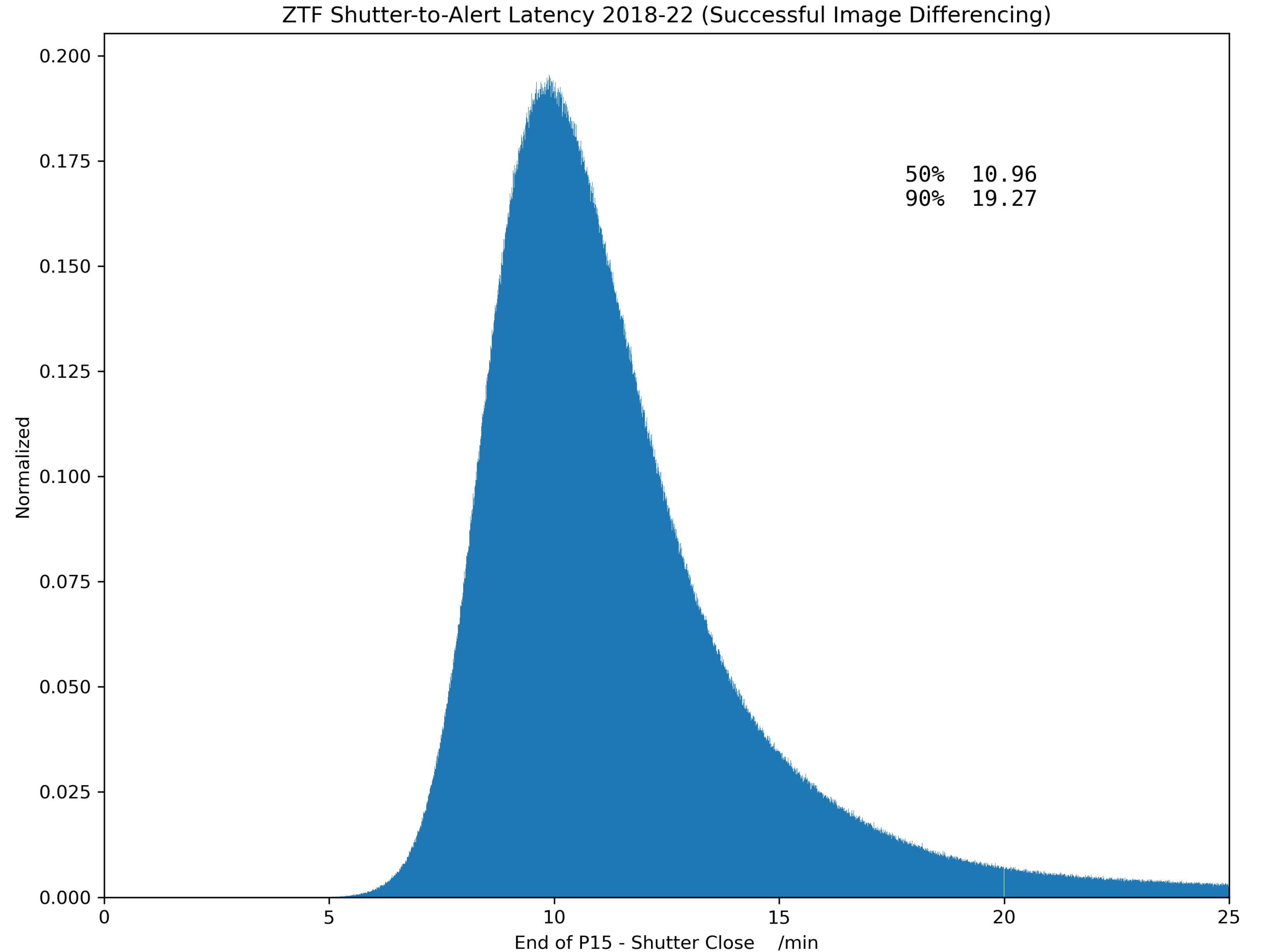


Pipeline Detail



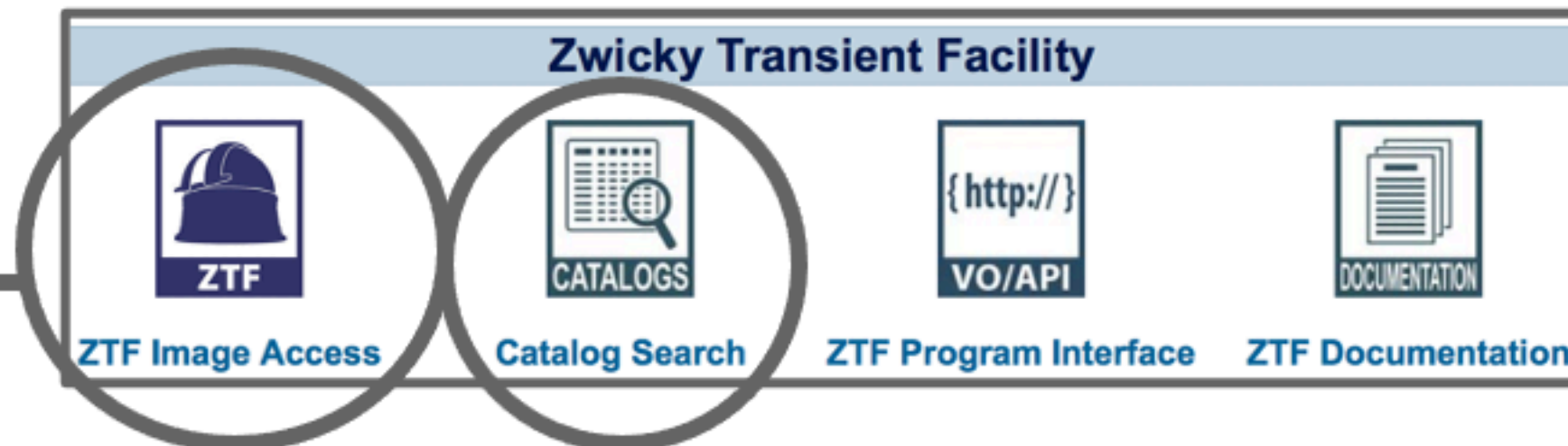
Latency

- Measured from end of exposure to complete processing
- Does not include pipelines which terminate early
- Median is < 11min
- 90% is < 20 min
- Tail is complex Galactic fields and HPWREN network issues



IRSA - Data Access, Visualization & APIs

4.76 PB of ZTF data, and counting (>1PB/yr)



Lightcurve retrieval / Time Series Tool

Lightcurve retrieval / Time Series Tool interface. It includes a Column Selection table, a plot of Input Data (mag vs mjd), and a grid of image thumbnails.

magerr	pflux	pfluxerr	psfmag	psfmagerr	catflag
0.0325878002	44952.2773	1337.30322	14.6323109	0.0320000015	0
0.0377060957	44213.0938	1490.41650	14.6610432	0.0370000005	0
0.0295559000	42692.2578	1120.64917	14.6845760	0.0289999992	0
0.0319281705	42889.3398	1240.37988	14.6808405	0.0309999995	0
0.0337643623	41299.7500	1262.87744	14.6791391	0.0329999998	0

Image viewer and product retrieval

IRSA ZTF Image viewer and product retrieval interface. It shows a search results table and a large image preview of a galaxy.

ra	dec	field	ccid	qid	fid	filtercode	obsdate
202.7169507000000	47.22087448000000	757	7	2	1	zg	2018-03-25 09:23:05+00
202.7328379400000	47.21753299000000	757	7	2	1	zg	2018-03-28 07:12:59+00
202.7361398000000	47.22155018000000	757	7	2	1	zg	2018-03-28 09:22:39+00
202.7197333600000	47.21063876000000	757	7	2	1	zg	2018-03-31 09:21:19+00
202.7231612500000	47.21021096000000	757	7	2	1	zg	2018-03-31 09:25:07+00
202.7210431900000	47.21017058000000	757	7	2	1	zg	2018-04-03 08:09:47+00
202.7140045800000	47.21577640000000	757	7	2	1	zg	2018-04-06 06:38:38+00
202.7156860000000	47.21889729000000	757	7	2	2	zr	2018-04-06 07:41:22+00
202.7176241600000	47.23116752000000	757	7	2	2	zr	2018-04-09 07:52:17+00
202.7183297700000	47.23047866000000	757	7	2	2	zr	2018-04-09 08:06:27+00
202.7176215000000	47.22770816000000	757	7	2	2	zr	2018-04-14 06:52:32+00
202.7180814500000	47.22717503000000	757	7	2	2	zr	2018-04-14 07:06:24+00
202.7179176200000	47.22829482000000	757	7	2	2	zr	2018-04-18 06:53:52+00
202.7207367200000	47.22868559000000	757	7	2	2	zr	2018-04-18 07:53:57+00
202.7181840100000	47.23849410000000	757	7	2	5	zg	2018-04-21 07:21:56.583+00
202.7156513100000	47.22622389000000	757	7	2	2	zr	2018-04-24 05:38:06.444+00
202.7170747800000	47.22845716000000	757	7	2	5	zg	2018-04-24 06:10:19.168+00
202.7216677900000	47.21827110700000	757	7	2	5	zg	2018-04-27 08:07:18.6+00
202.7138893200000	47.22022804000000	757	7	2	5	zg	2018-04-30 04:37:31.698+00
202.7140792700000	47.28600865000000	757	7	2	1	zg	2018-05-04 05:18:33.215+00
202.7223835700000	47.21735155000000	757	7	2	5	zg	2018-05-07 06:50:04.127+00
202.7255652000000	47.21730320000000	757	7	2	2	zr	2018-05-07 08:18:41.18+00

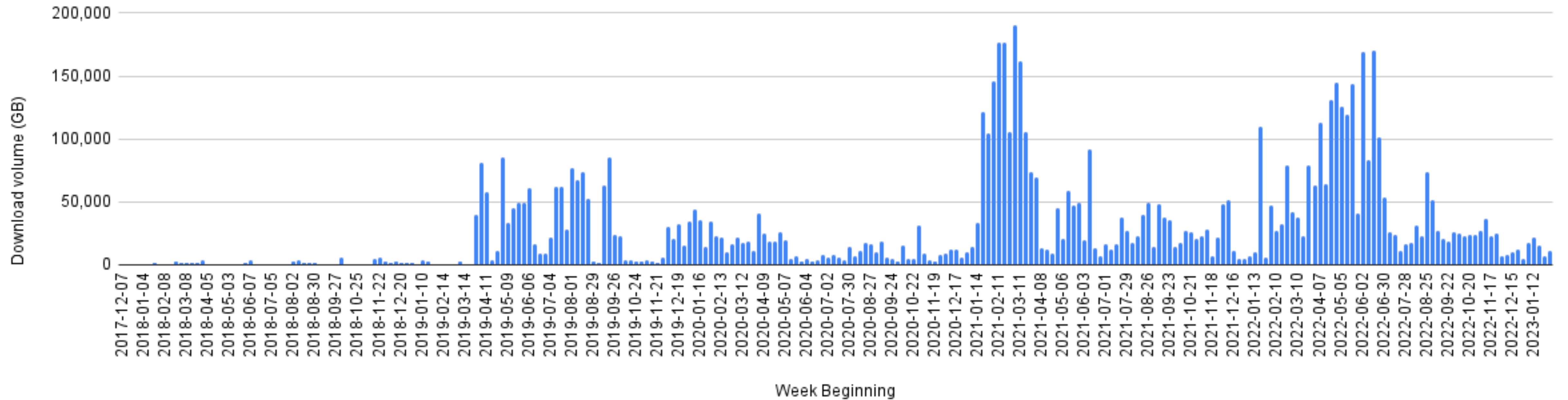
Period finding

Period finding interface. It shows a plot of mag vs phase with a period of 0.315 day, a Resonance Periodogram, and a Periodogram.

ZTF Archive Usage

Total = 7.40 PB served, Max = 189TB / week

ZTF Archive Weekly Downloads (GB)



Moving Object Search

irsa NASA/IPAC INFRARED SCIENCE ARCHIVE
 IRSA | DATA SETS | SEARCH | TOOLS | HELP Login

MOST - Moving Object Search Tool

The Moving Object Search Tool (MOST) can determine the orbit for a given solar system object then find images that match the object's predicted positions in select image datasets housed at IRSA (see [Instructions](#)). It can serve as a "precovery" tool to determine if newly discovered objects were previously observed.

Submit Reset

Image Dataset ztf

For ZTF: Time Range = 2017-10-15 to present
 For complete range, leave limits blank (but this may take a long time)
 Example: Antonia 2017-11-01 to 2017-12-31

Observation Begin (UTC) 2018-03-17 **Observation End (UTC)** 2020-10-22

Ephemeris Step Size (day) 1 **Output Mode** Regular

Create Fits and DS9 Region Files Tarballs

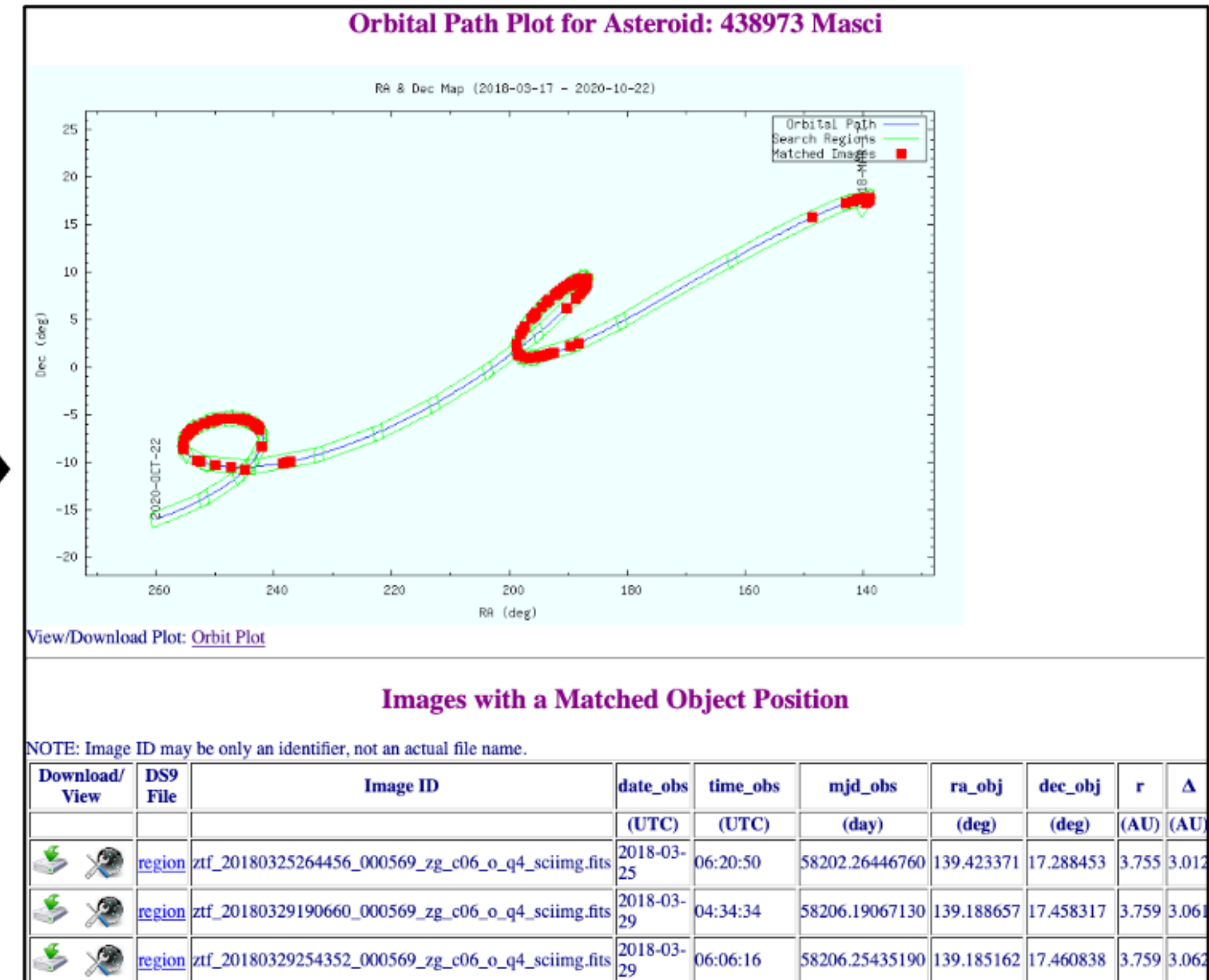
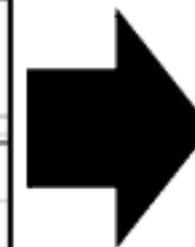
Solar System Object Name Input: Masci

Solar System Object NAIF ID Input:

MPC One-Line Element Input:

Object Type: Asteroid

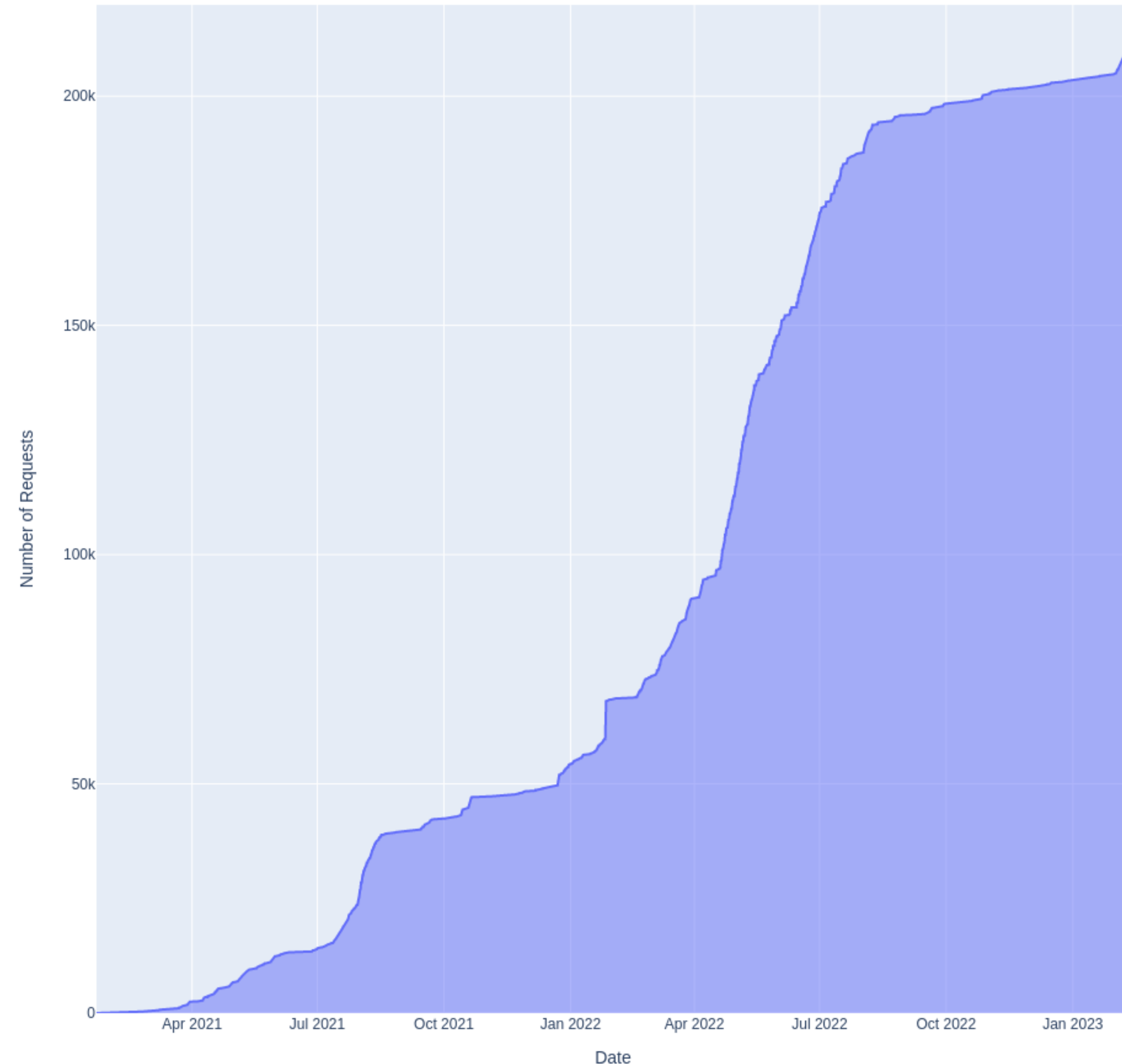
Orbital Elements Manual Input:



Forced Photometry Service

ZTF Forced Photometry Requests over Time (updated: 2023-02-11)

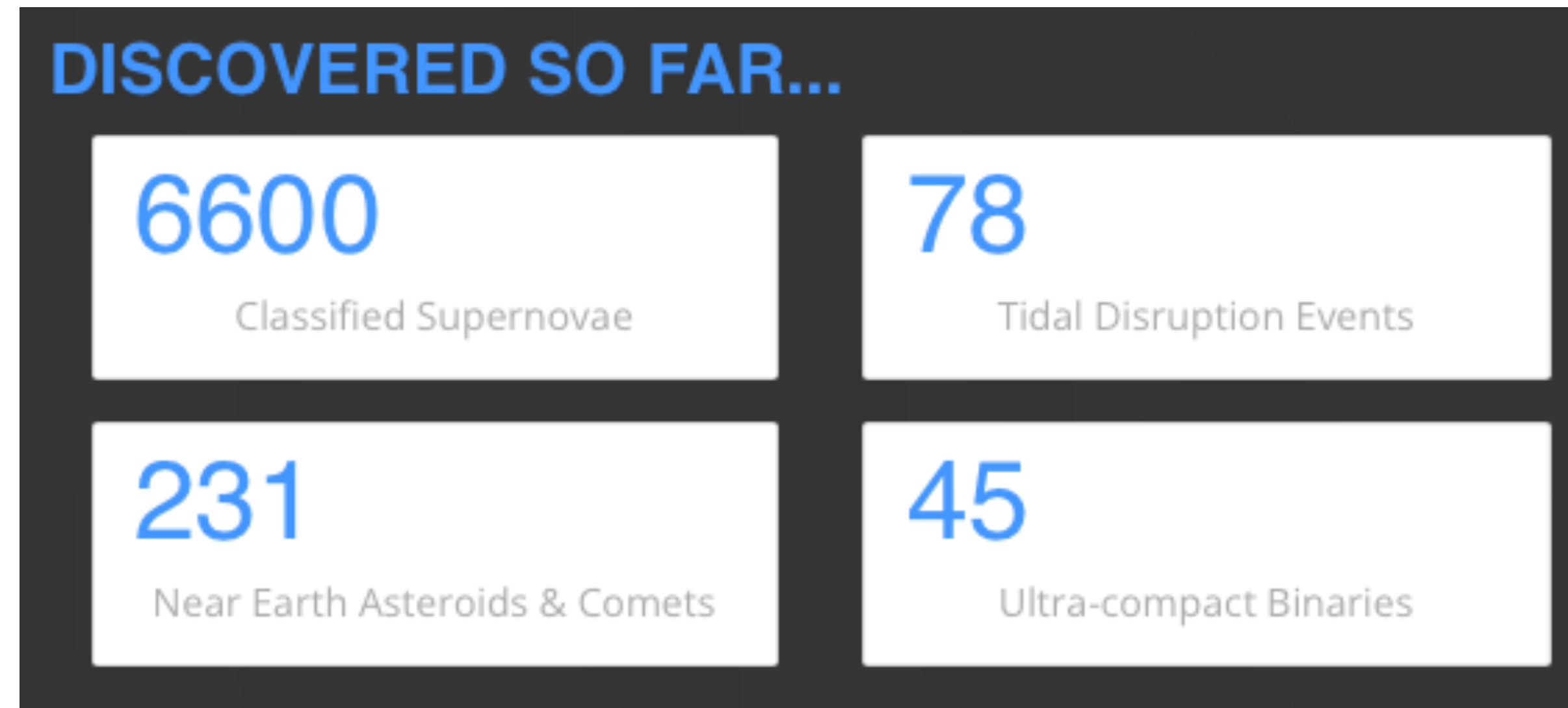
- As of 2023-02-11:
 - 209,181 requests
 - 248 registered users
- Next iteration (currently user testing):
 - 100 -> 10K limit increase
 - CGI -> REST API interface



Alerts

- ZTF publishes realtime alerts in machine-readable format for automated scanning and follow-up
- Alerts are published as Apache Avro files, containing candidate info, previous candidate position match, and FITS image cutouts
- Avro files are distributed Worldwide via Apache Kafka (within seconds)
- International broker community has grown around ZTF alerts. GCN just added Kafka stream, will be adopted by Rubin
- Soon adding realtime forced-photometry per alert (already running nightly)
- Over 500M alerts issued (both public and private)
- Caltech recently announced 1K automated/ML SNe classifications using stream

Science Enabled...



- ADS - 902 papers, 6 in Nature
- 'Ayló'chaxnim - First asteroid with the orbit of Venus
- Comet 2022 E3 (ZTF)
- 15 Data Releases
- Development of International alert-broker community

Team

Current	
Steve Groom	George Helou (Co-PI)
Russ Laher	Ben Rusholme
Avery Wold	
Emeritus	
Ron Beck	Ed Jackson
Frank Masci	David Shupe
Jason Surace	
IPAC	
ICE	IRSA
ISG	Mangement & Accounting