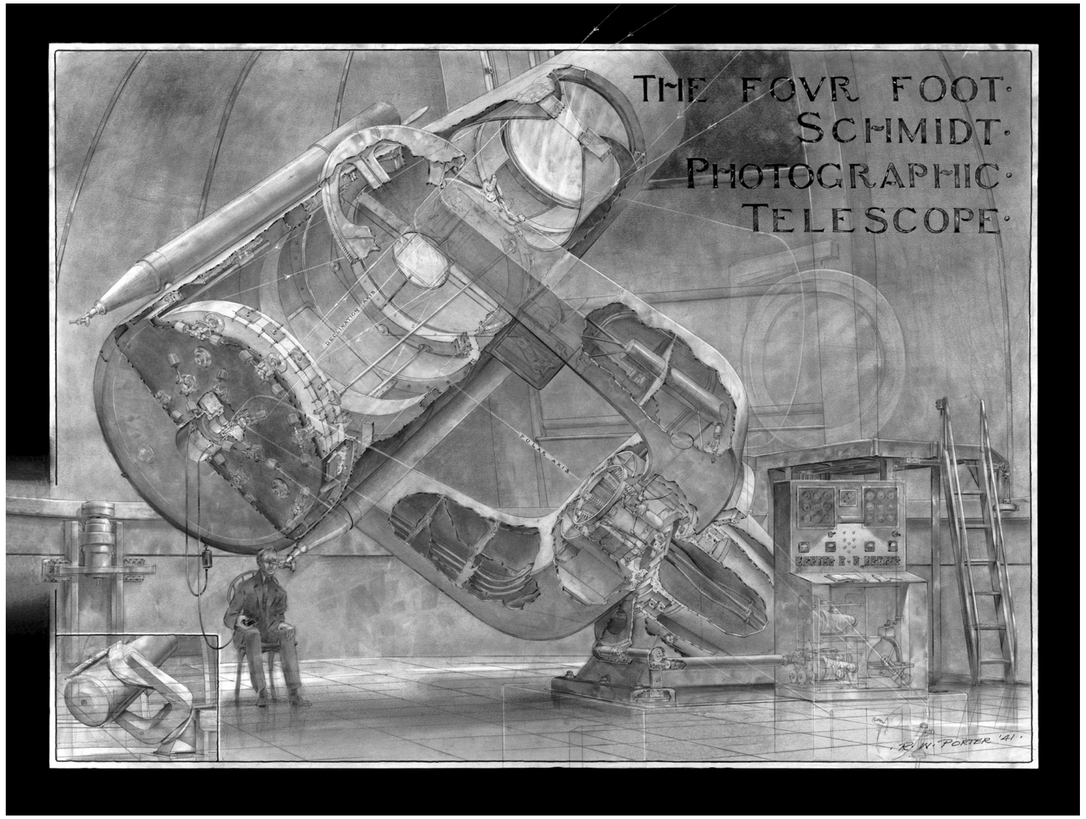
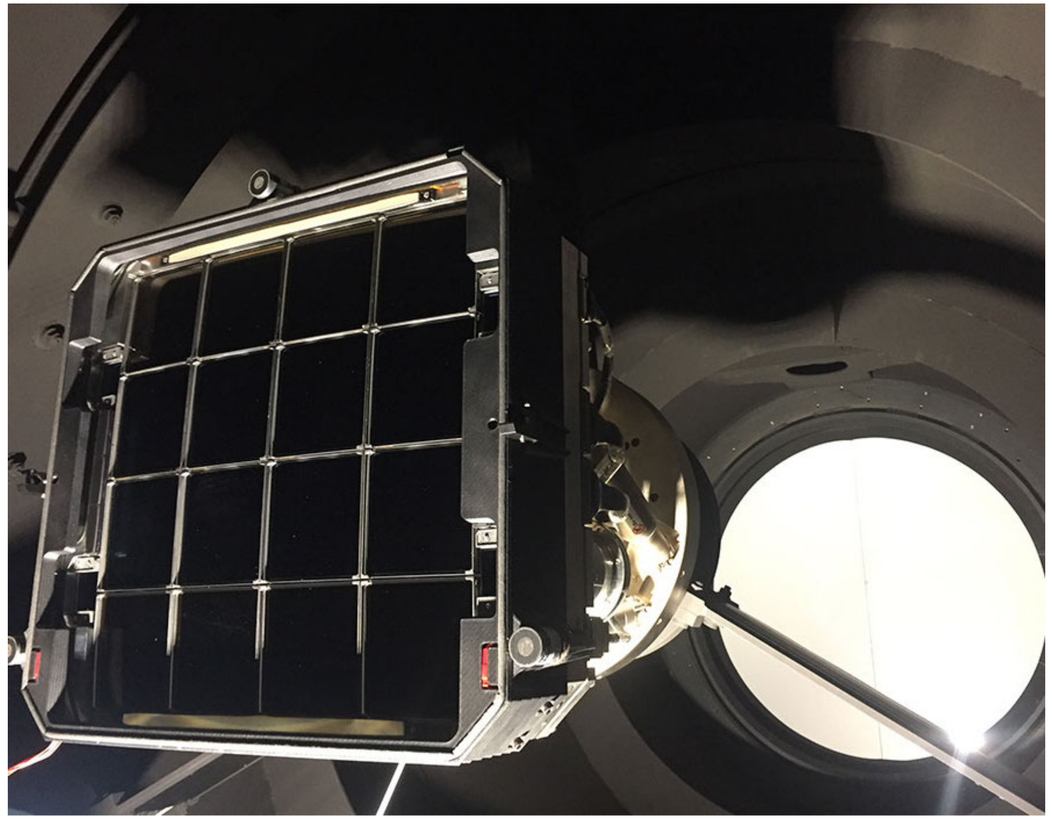
ZTF Science Data-System

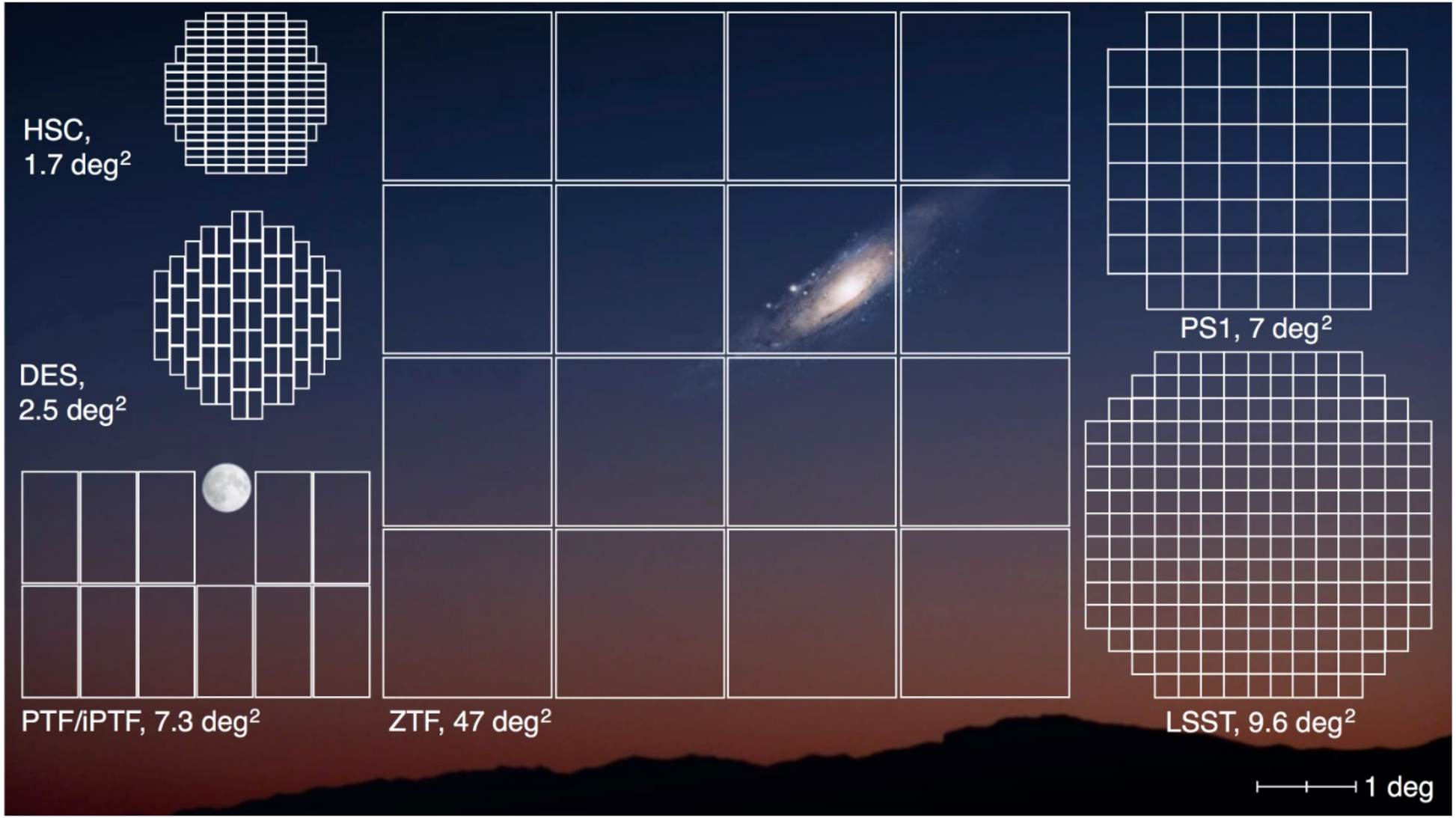
Caltech/IPAC, 2023-02–13

Zwicky Transient Facility

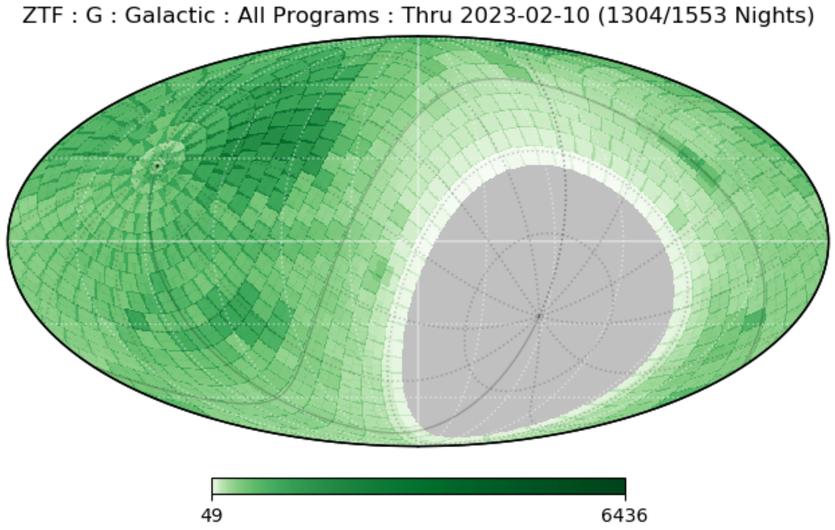


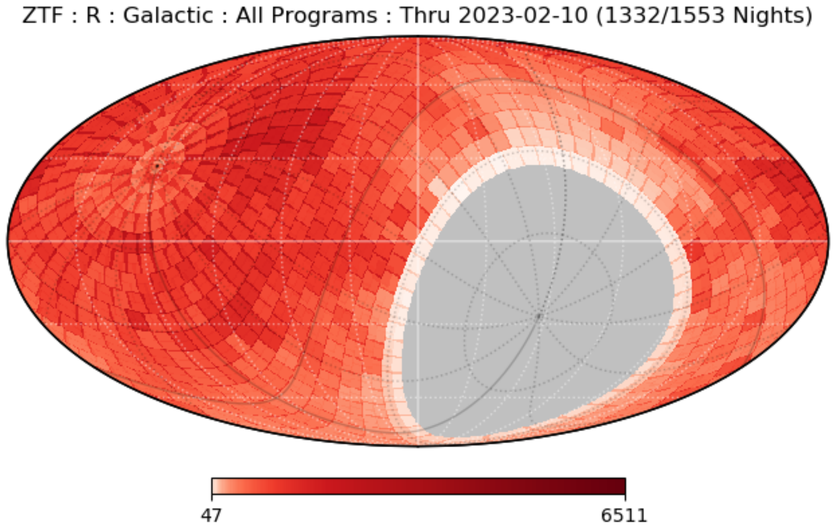


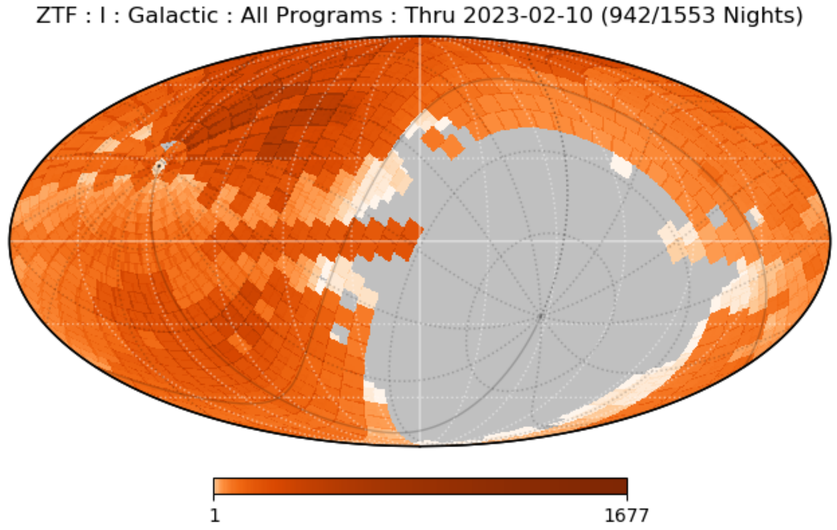
- Time-domain astronomical survey
- Wide-field Schmidt & large camera (FOV 47 deg^2, 660 MPix, sub 9s readout)
- Scans the entire Northern sky every two nights in *g*, *r*, *i* filters


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)
49
6436


ZTF : R : Galactic : All Programs : Thru 2023-02-10 (1332/1553 Nights)
47
6511

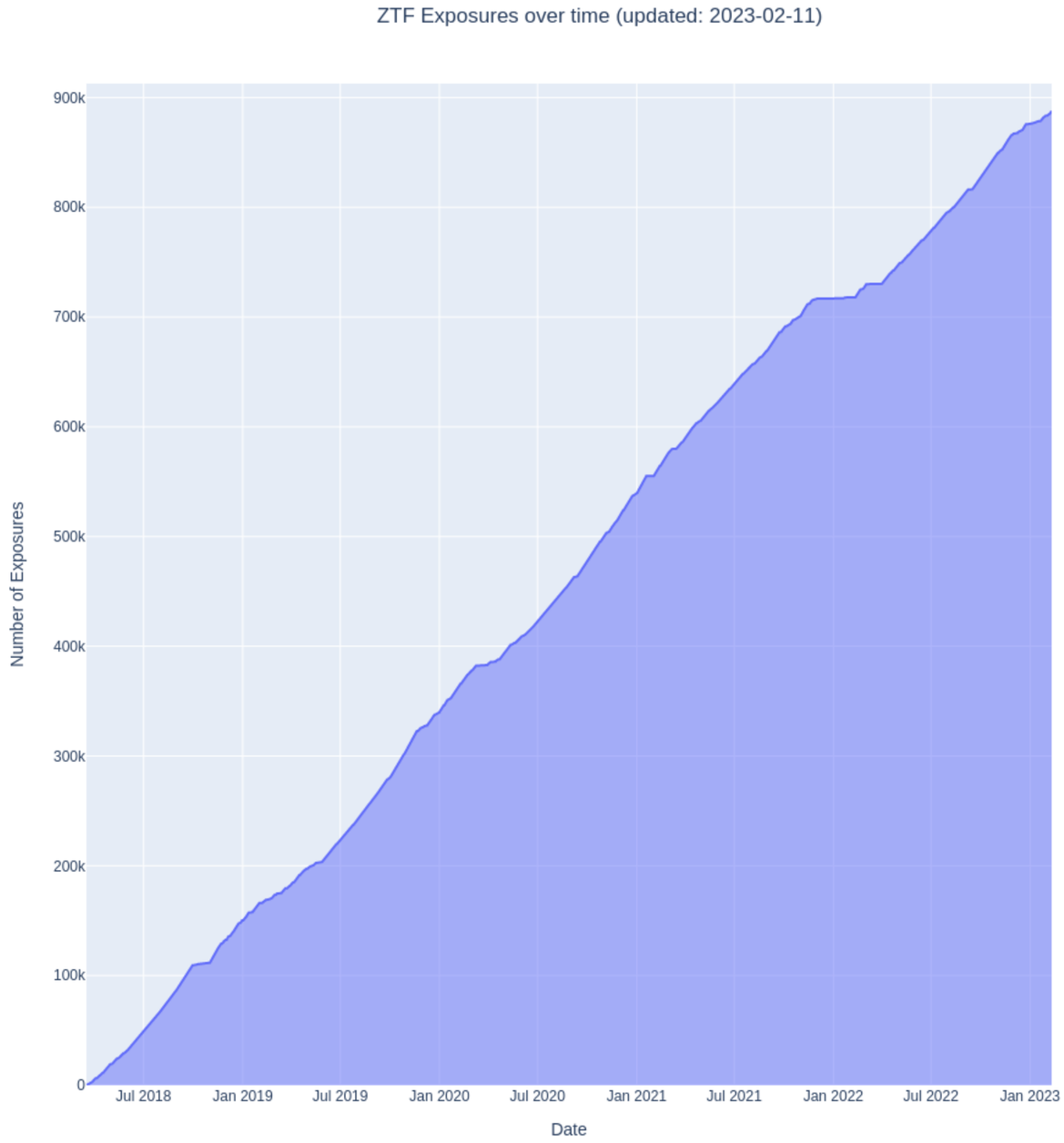

ZTF : I : Galactic : All Programs : Thru 2023-02-10 (942/1553 Nights)
1
1677

ZTF Science Data-System (ZSDS)

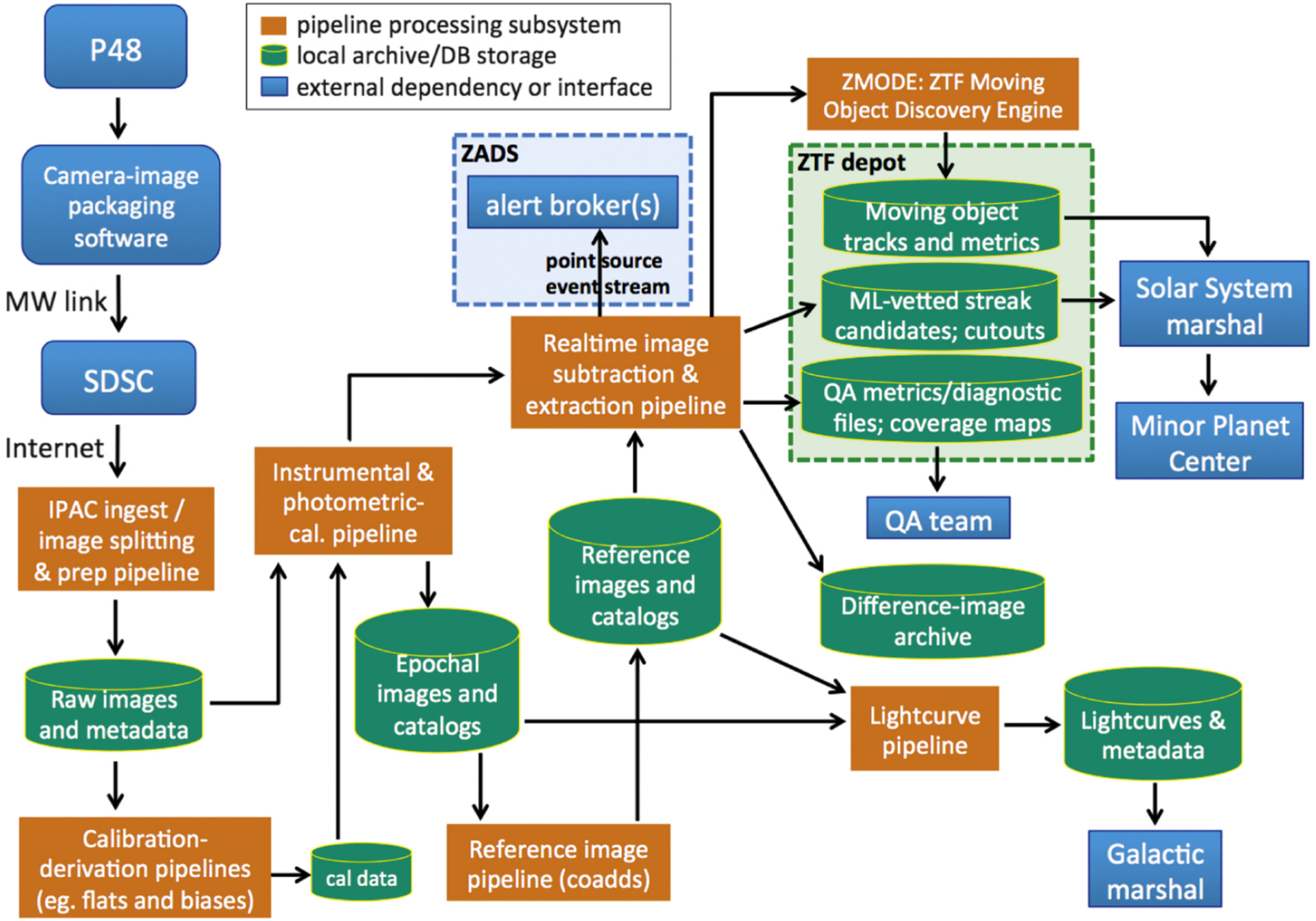
- IPAC responsibilities:
    - Realtime data processing (90% < 20 min)
        - Photometric & astrometric calibration
        - Image-differencing against reference images
        - Transient identification (including ML scoring)
        - Alert-streams for automated follow-up
    - Archiving (IRSA)
        - 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

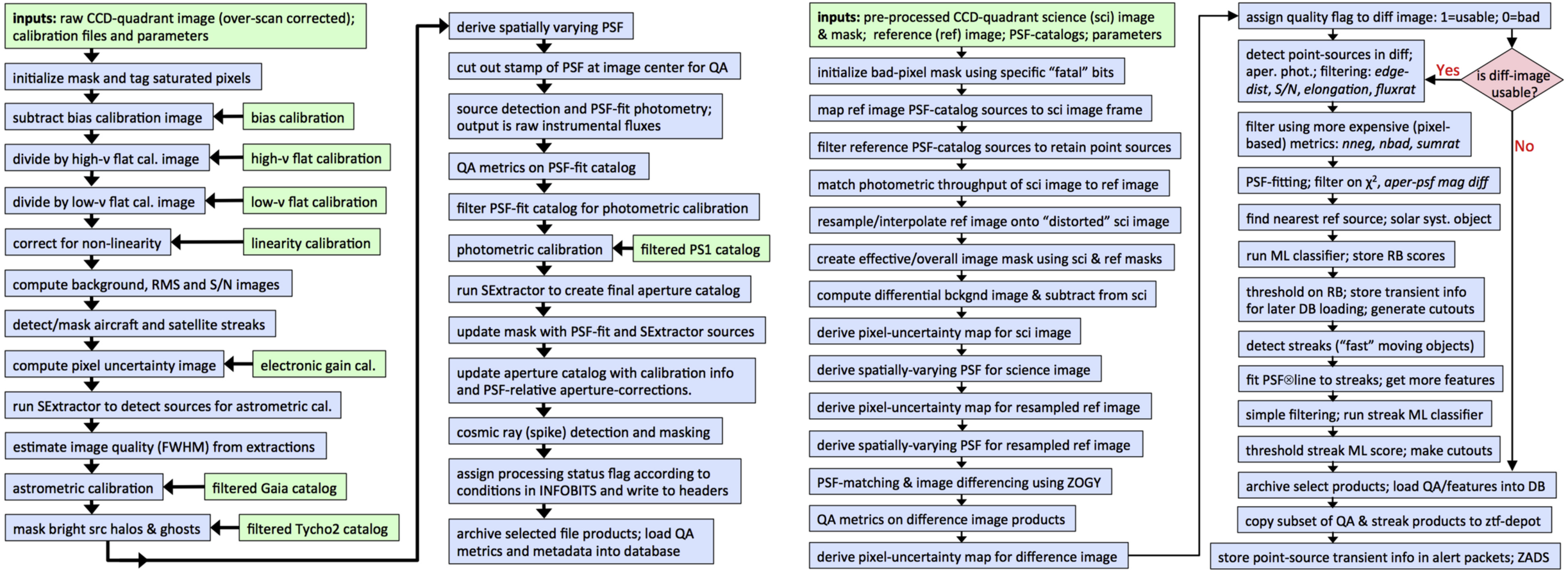
As of	2023-12-11
Nights	1,791
Observing Efficiency	77.35%
Total Exposures	1,032,647
Science Exposures	887,766
Reference Coverage	*g*=97.30, *r*=97.27, *i*=65.54
Latest Release	DR15 (2023-01-09)
Alerts	549 M (all programs)
Forced-Photometry Requests	209,181
Archive Size	4.76 PB
IRSA Data Served	7.40 PB



Processing Overview

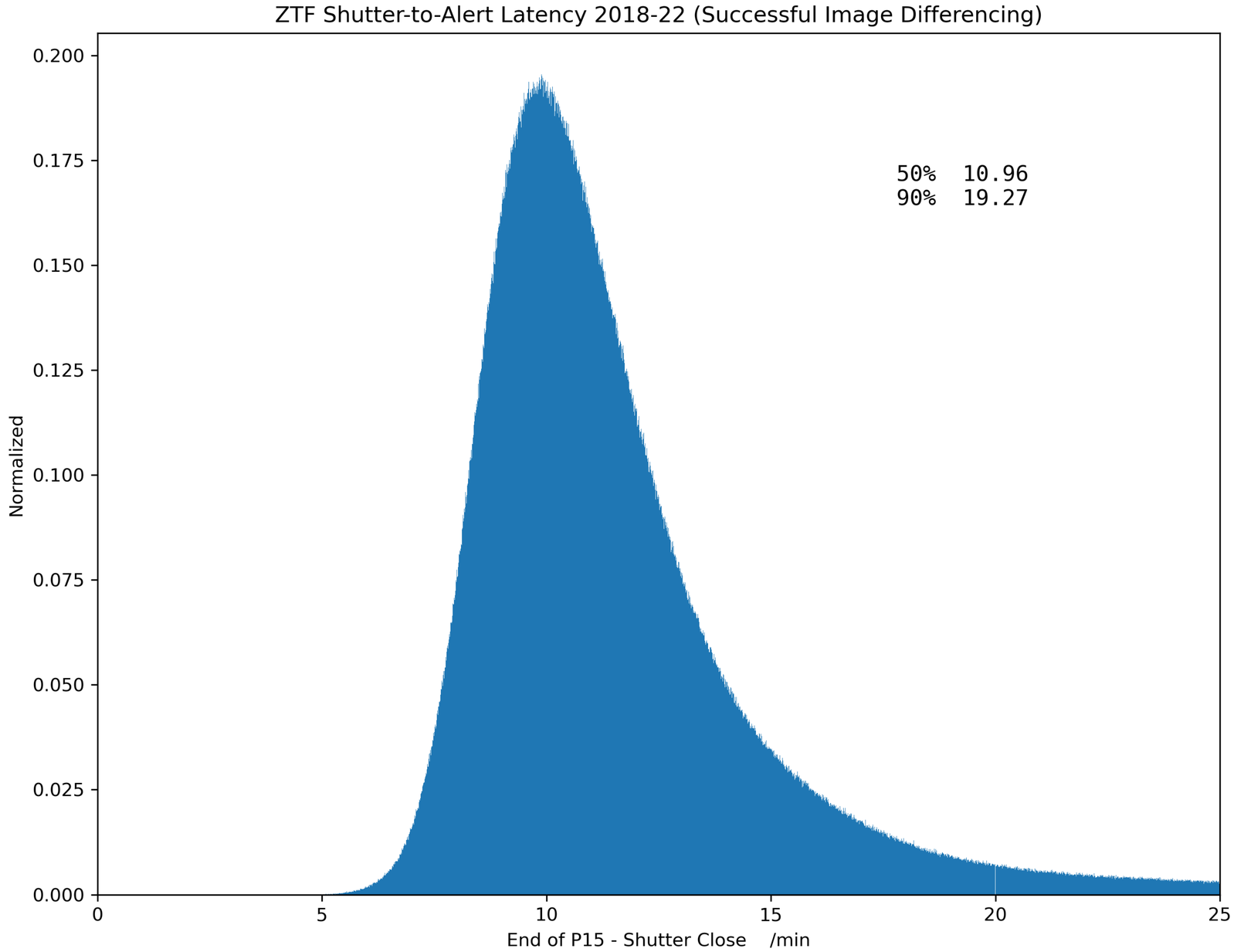


Pipeline Detail



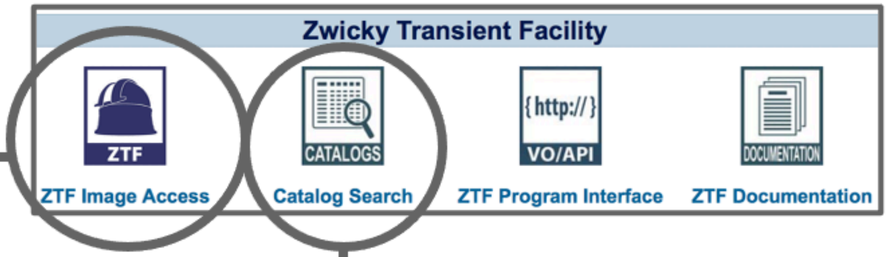
Latency

- 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

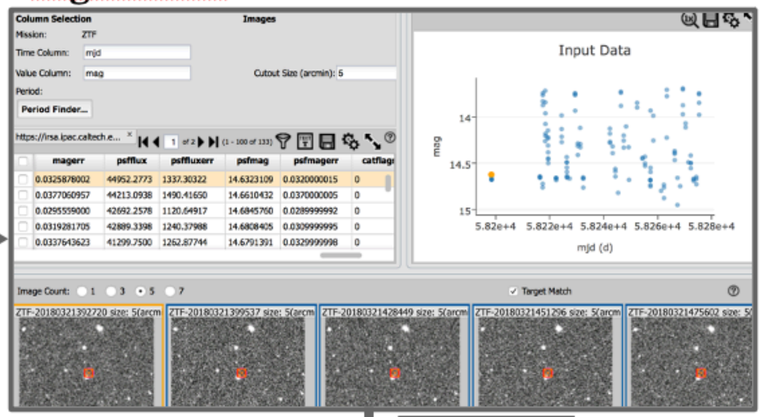
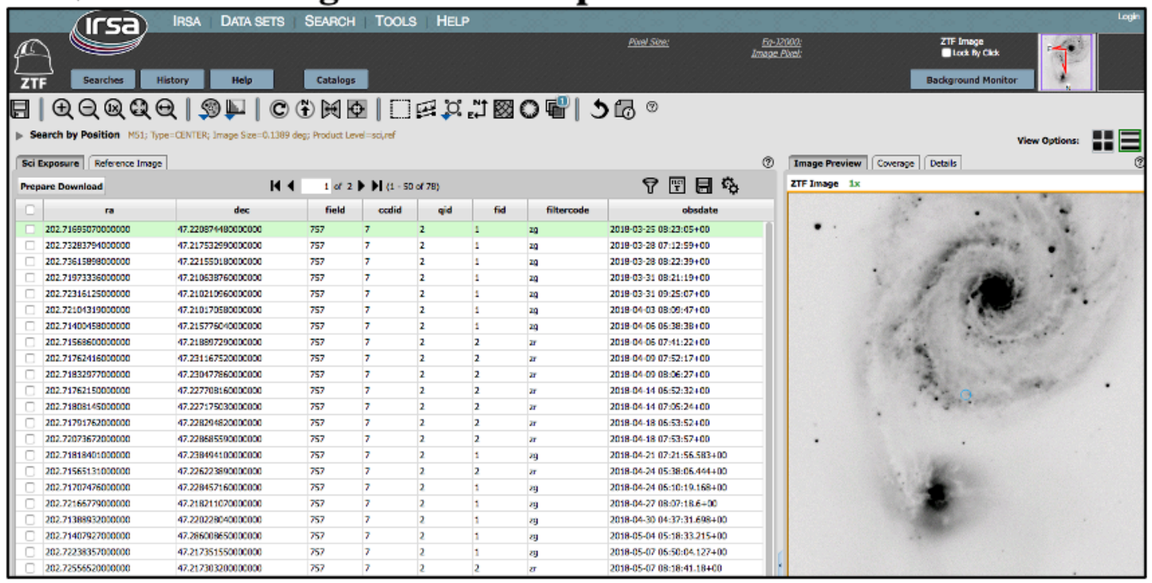
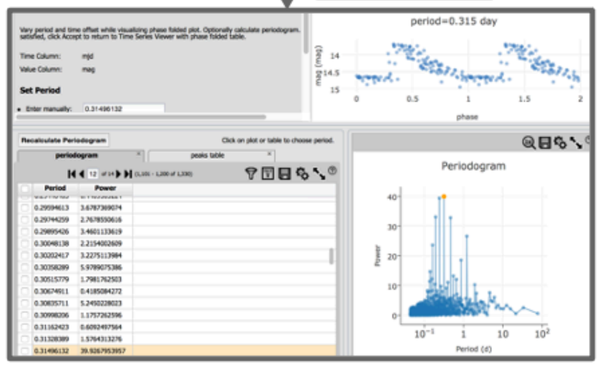


Image viewer and product retrieval

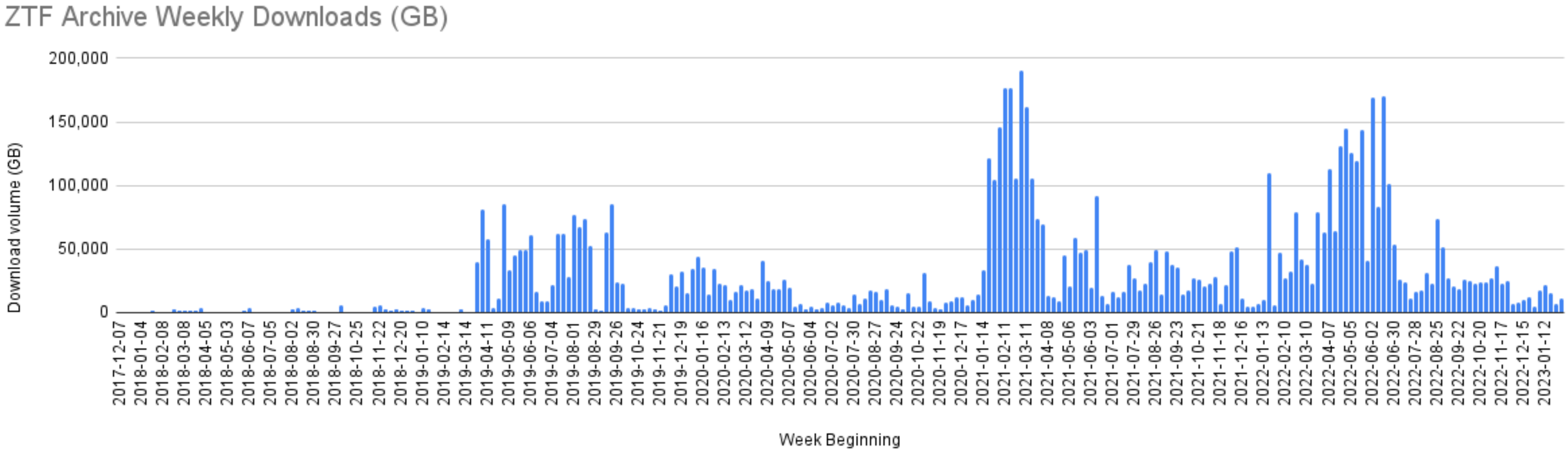


Period finding

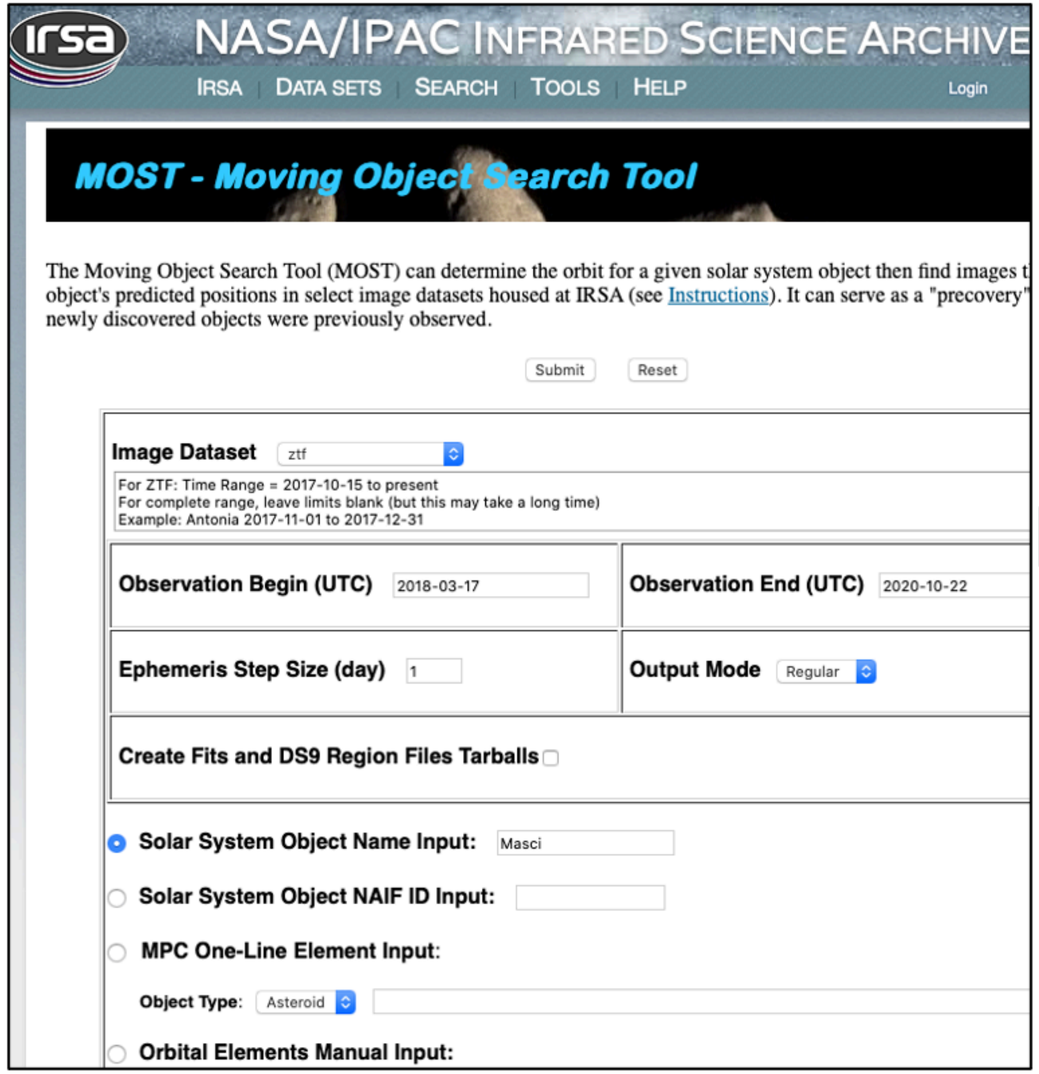


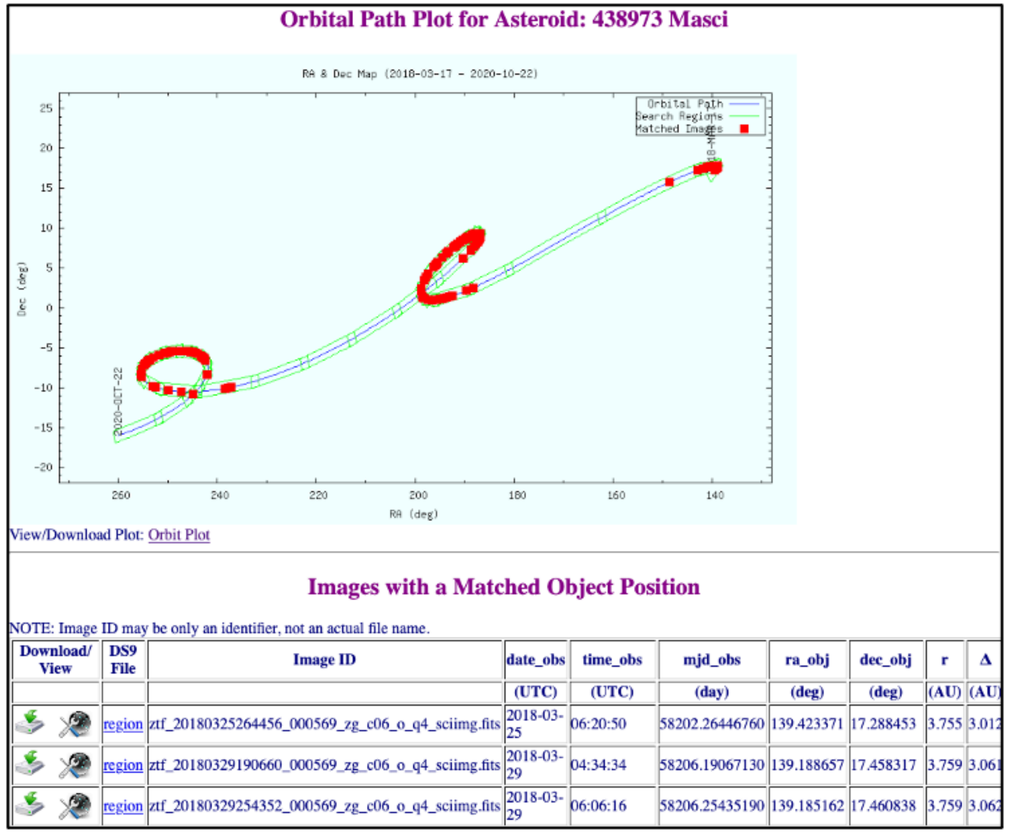
ZTF Archive Usage

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



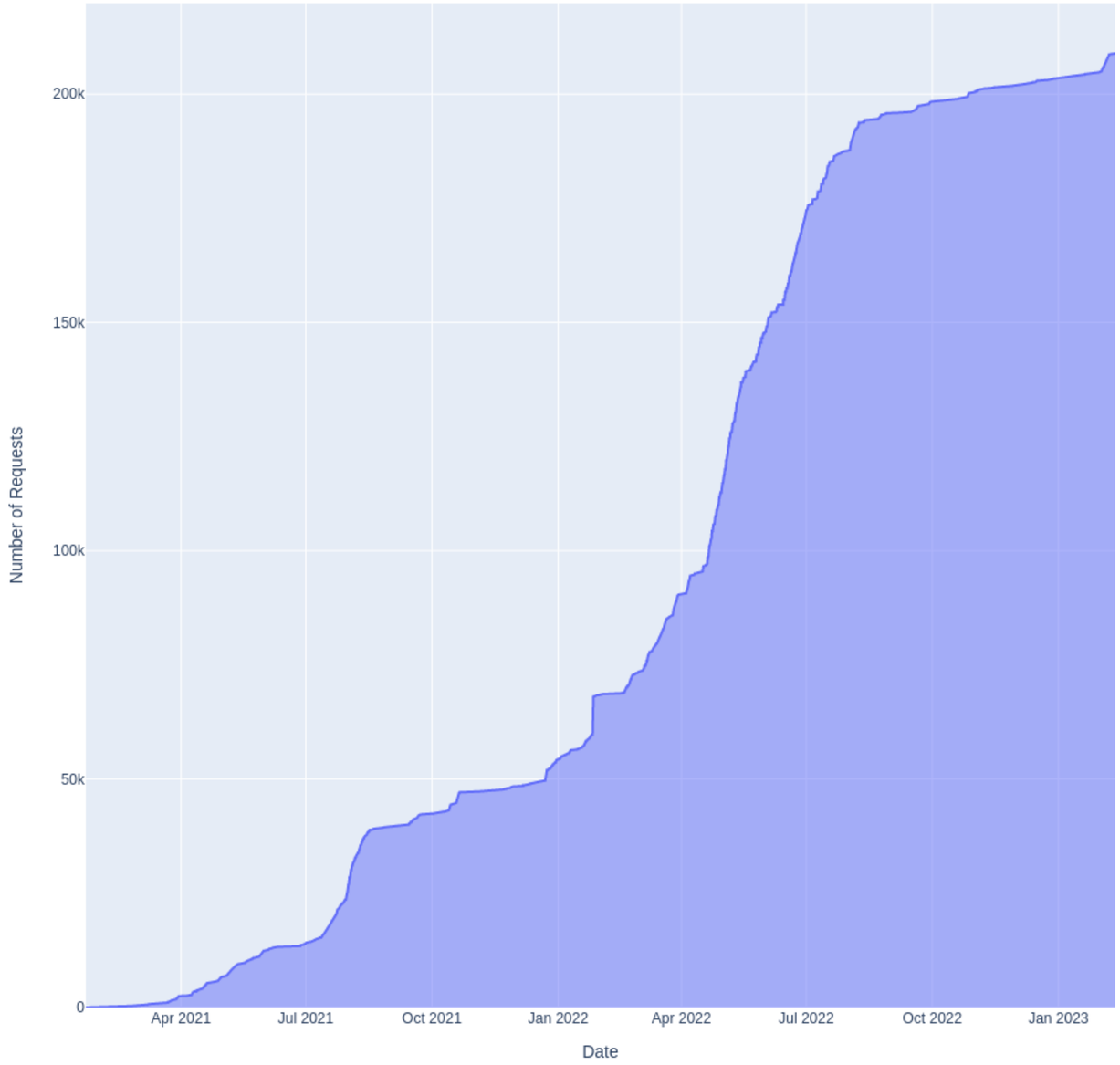
Moving Object Search





Forced Photometry Service

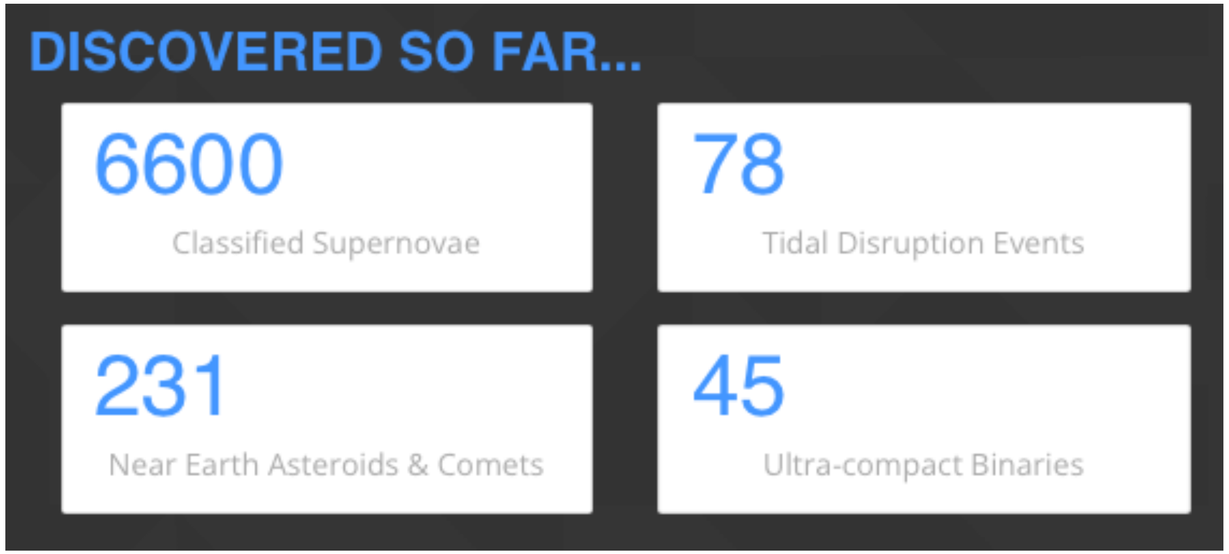
- As of 2023-02-11:
  - 209,181 requests
  - 248 registered users
- Next iteration (currently user testing):
  - 100 -> 10K limit increase
  - CGI -> REST API interface



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