ESASky SSOSS: A new window for Solar System Data Exploration

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On behalf of ESAC Science Data Centre (ESDC), European Space Agency

In Collaboration with Benoit Carry, Observatoire de la Cote d'Azur (OCA) & Jerome Berthier, Institute for Celestial Mechanics and Computation of Ephemerides (IMCCE)

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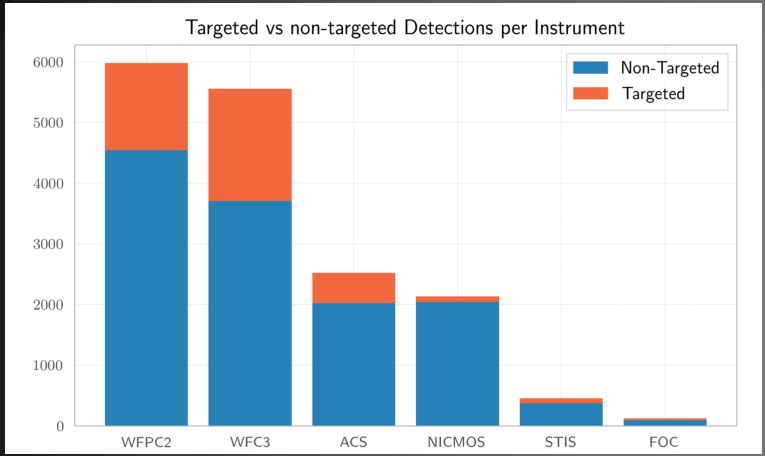
Solar System Objects Service

- Allow users to search through the entire astronomical archives for observations containing Solar System Objects (SSOs), targeted and **serendipitous**!
- **Scientific exploitation** of ESDC data holdings.
- HST, Herschel and XMM-Newton missions.

Solar System Objects Service

HST Near Earth Object (NEO) population: Total #Detections



Work presented at ESA SSW11 @ESTEC.
Credits: A.Mahlke

Solar System Objects Service

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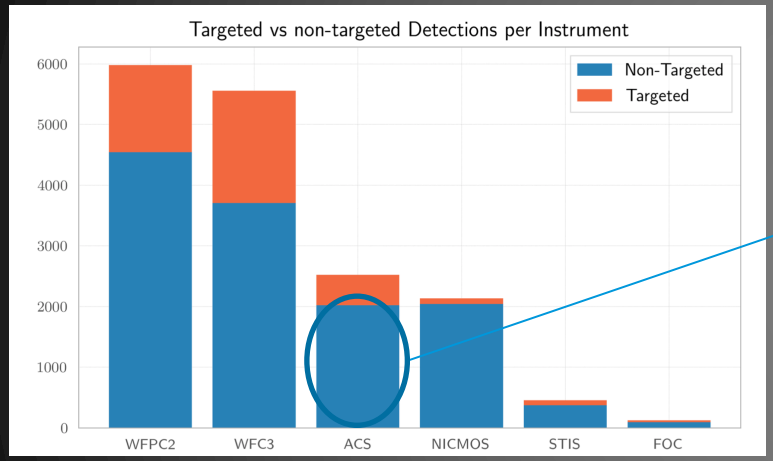

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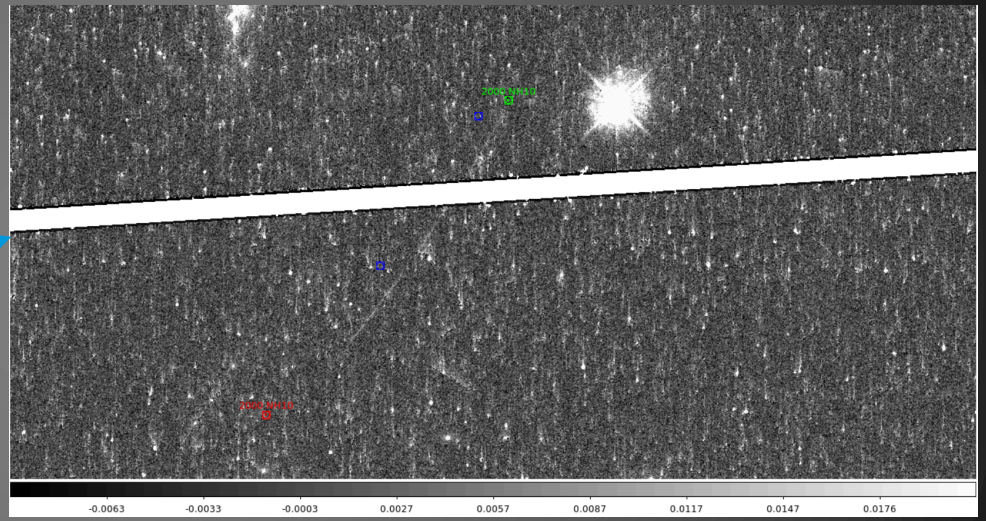

Example 1: a non-targeted observation from ACS for NEO 2000 NH10. Green and red regions mark calculated start and end of asteroid streak by the ESASky algorithm.

Solar System Objects Service

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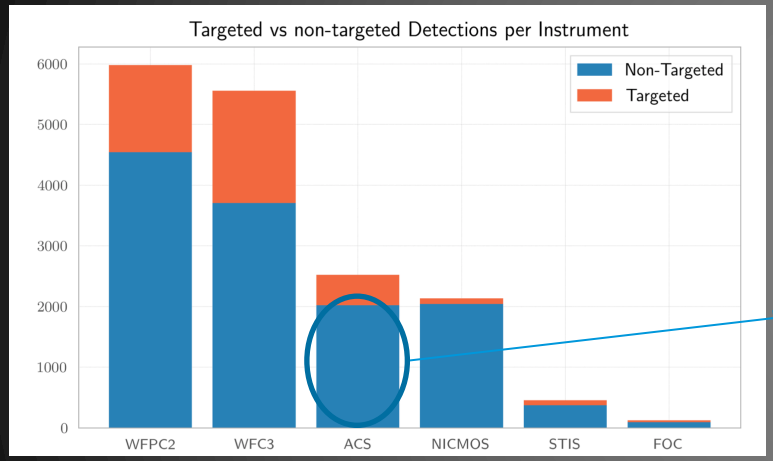

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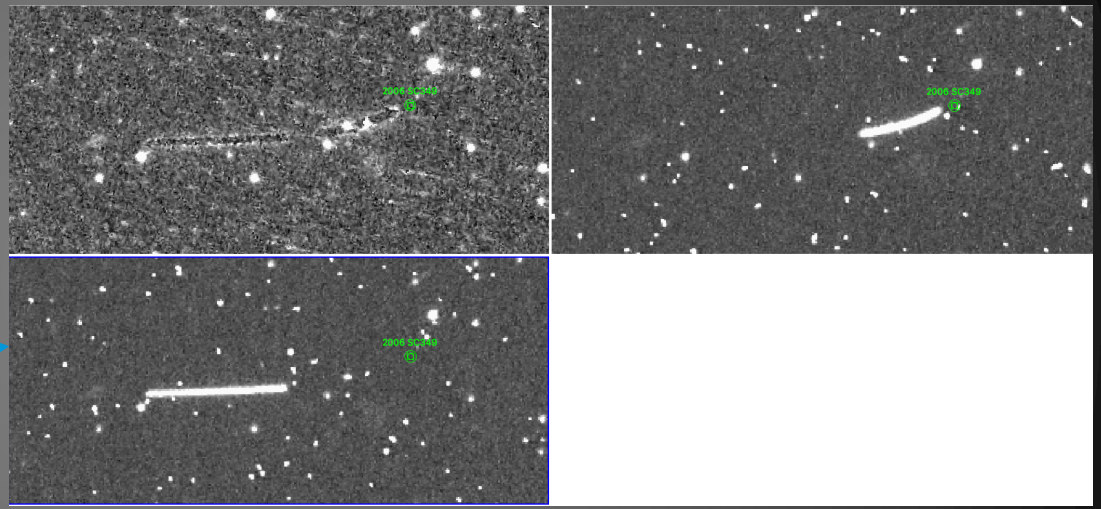
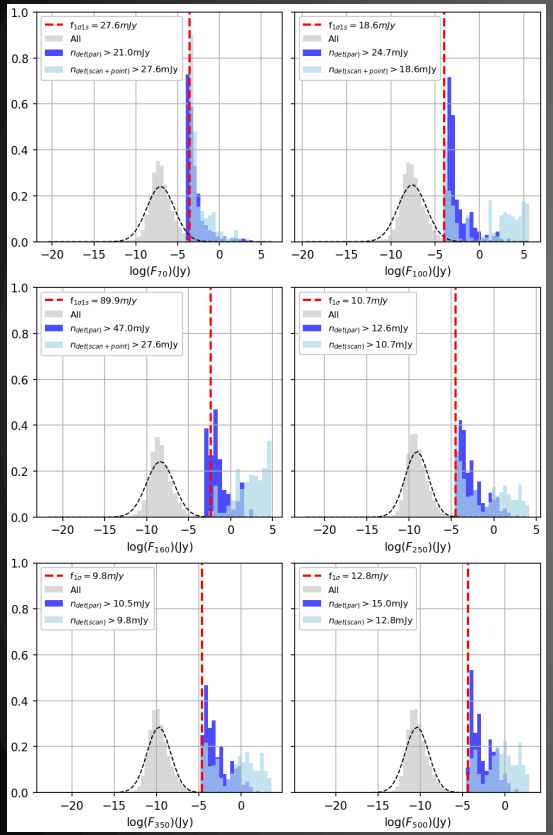
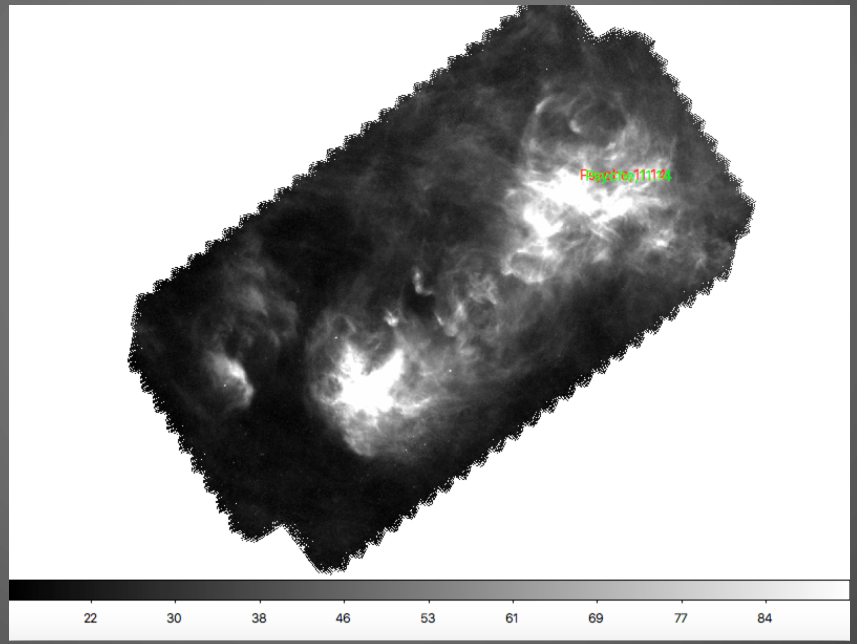


Example 2: Serendipitous observation of NEO 2006 SC349 by the ACS. The predicted position at the beginning of the observation is shown in green.

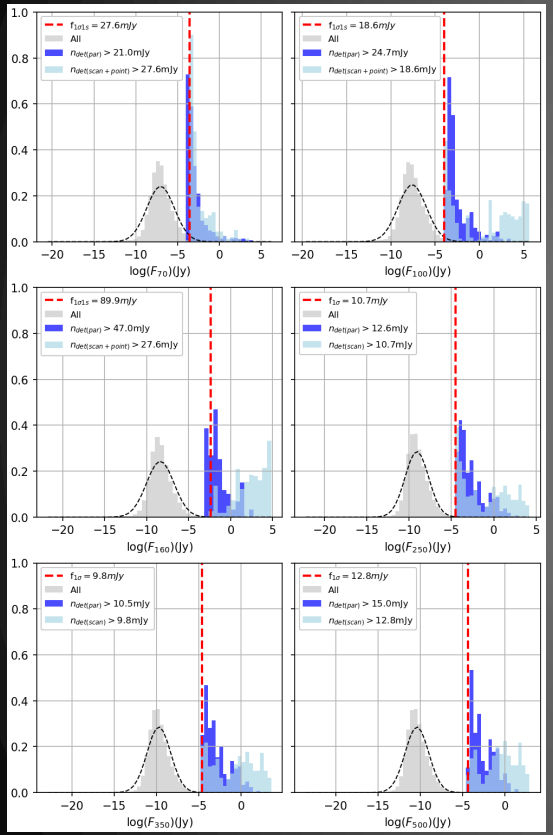
Solar System Objects Service



Herschel total #detections of SSOs above flux limit: >900



Solar System Search Engine



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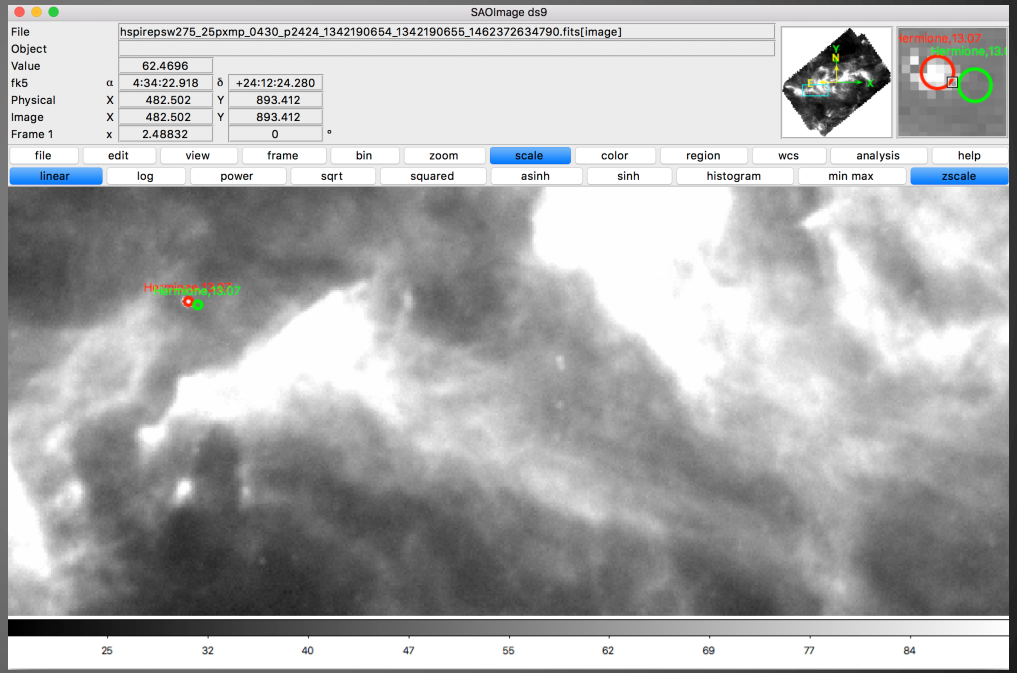

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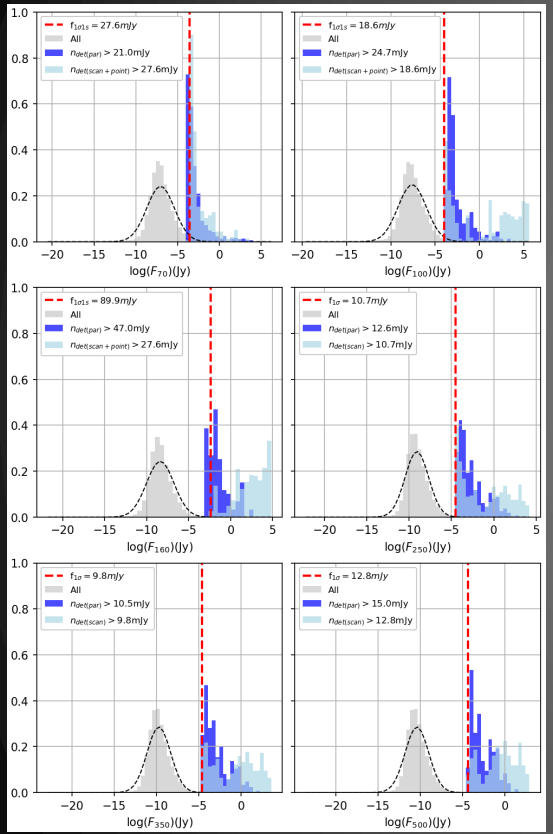

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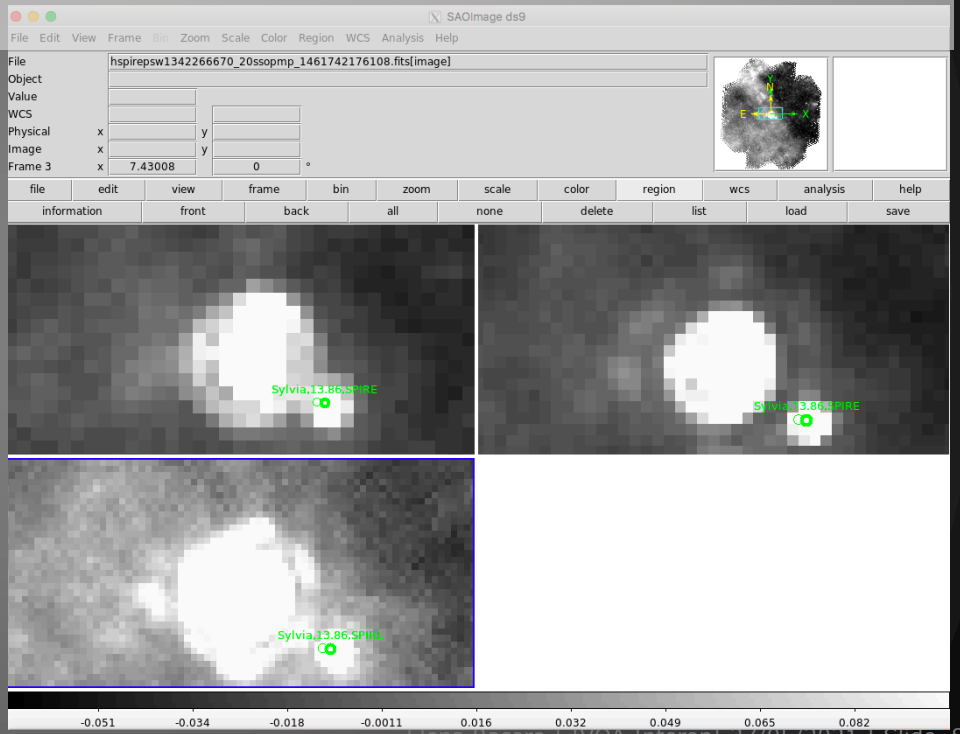

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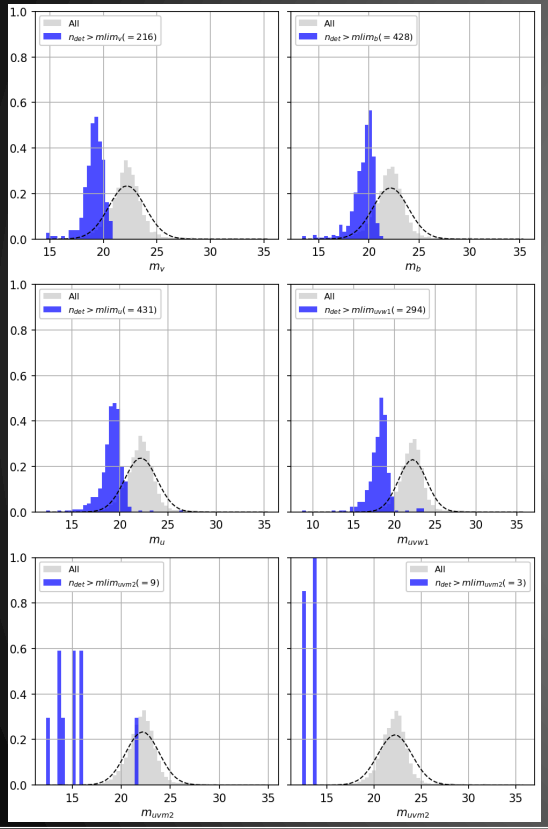
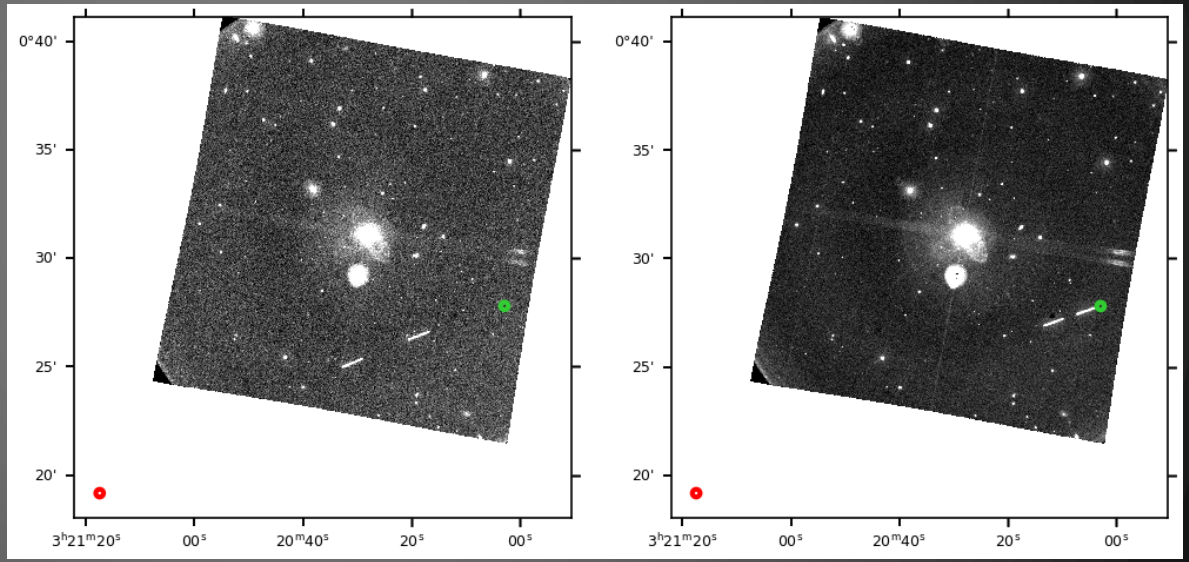


XMM-Newton OM total #detections of SSOs above limiting magnitude: > 900



SSO Pipeline

SSO Pipeline

Orbital Parameters → Ephemerides Computation → Cardinality Reduction → Real Cross-Match

ASTORB

Asteroid dataset @ Lowell Observatory

COMETPRO

Comet dataset @ IMCCE

SSO Pipeline

Orbital Parameters → **Ephemerides Computation** → Cardinality Reduction → Real Cross-Match

- Eproc v3.2
- Orbit sampled evenly every 10 days

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- Eproc v3.2 
- Orbit sampled evenly every 10 days
- Spacecraft SPICE kernels:

  HST: public @ http://naif.jpl.nasa.gov/pub/naif/HST/

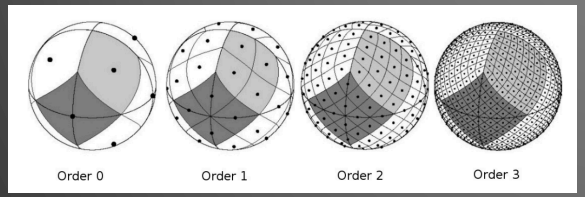
  Herschel: OEM provided by SOC and kernel produced in-house.

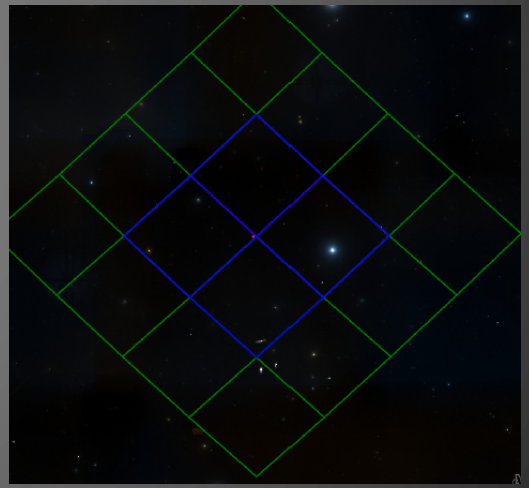
  XMM-Newton: provided by SOC (P.Rodriguez)

SSO Pipeline

Orbital Parameters → Ephemerides Computation → **Cardinality Reduction** → Real Cross-Match

- Possible candidates selection based on HEALPix sky tesselation.
- HEALPix order selected based on distance to the object and proper motion.

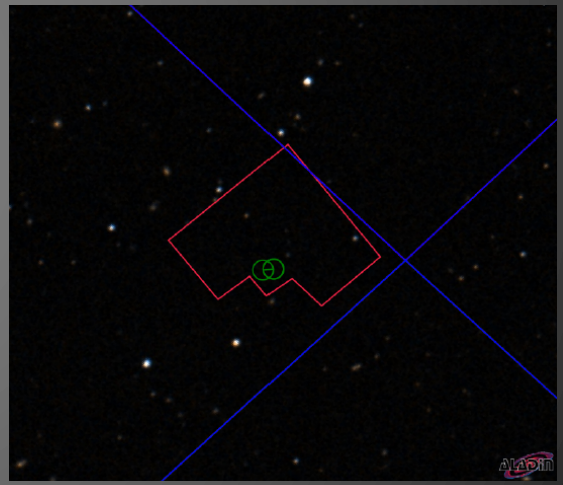




SSO Pipeline

Orbital Parameters → Ephemerides Computation → Cardinality Reduction → **Real Cross-Match**

- Precise cross-match: position of SSO re-computed using start time and duration of observation and cross-match performed against image footprint.



ESASky Concept

Goal: to facilitate data discovery and archival science for ALL users

- Multi-wavelength
- Project agnostic
- Exploration

Interface "on top of" all ESA astronomy archives

ESASky - sky.esa.int

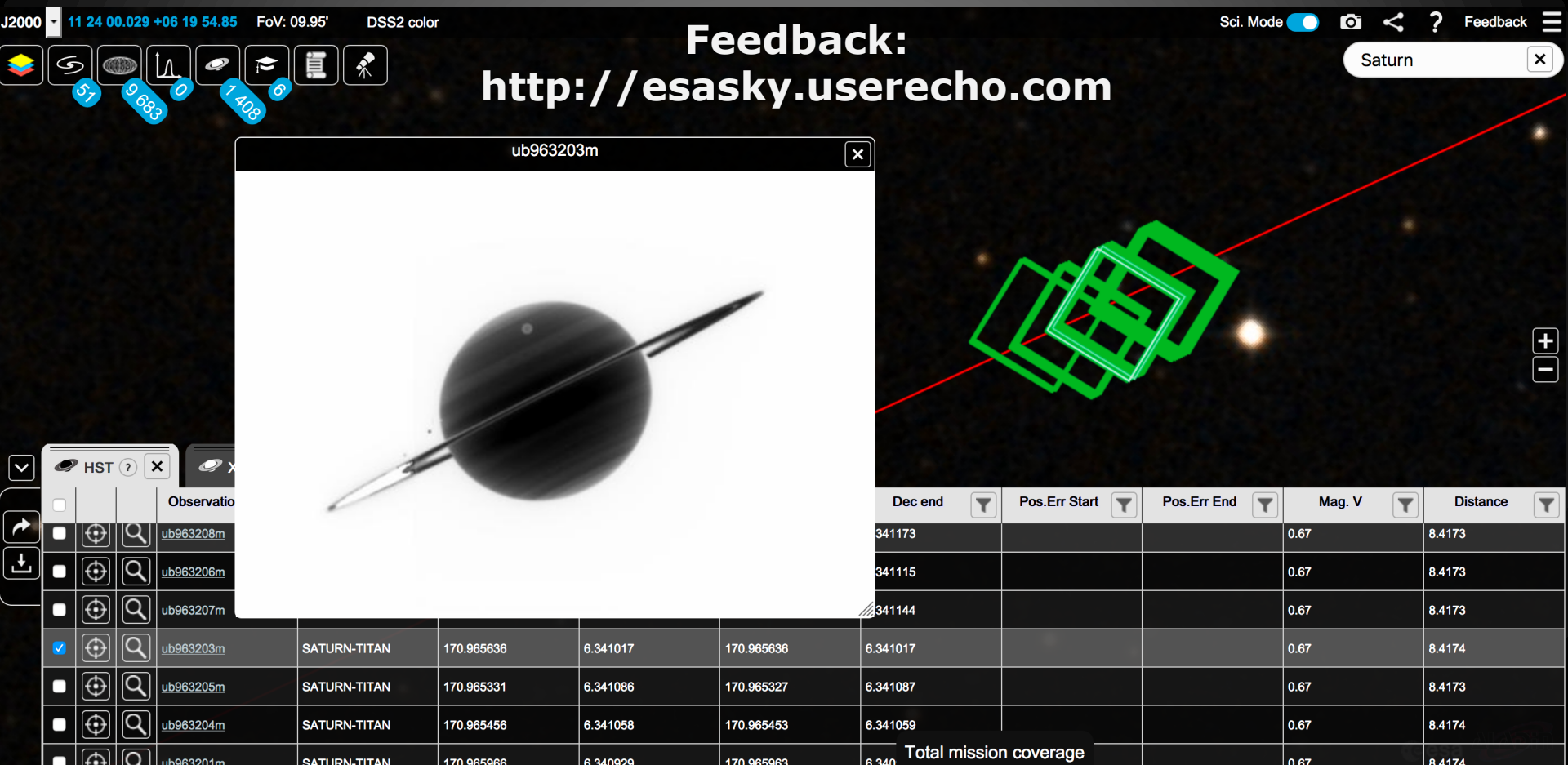
Final Remarks

- In collaboration with IMCCE, we've added functionality through ESASky that **allows fast discovery of observations from ESA missions that potentially contain SSOs within their field of view.**
- The value of this service is that it allows you **to visualize the exact predicted position of the solar system object superimposed to a satellite image.**
- Current version contains all asteroids, comets and planets observed by HST, Herschel and XMM-Newton (EPIC) missions.

- Future work:
  - Orbital parameters input interface
  - EPN-TAP integration
  - Include more missions

Thanks!

Feedback:
http://esasky.userecho.com



LINKS

http://sky.esa.int

- How to use ESASky and links to help pages:

https://www.cosmos.esa.int/web/esdc/esasky-how-to

- API: Astroquery python module information:

https://www.cosmos.esa.int/web/esdc/esasky-astroquery-module

- API: ESASky TAP:

http://sky.esa.int/esasky-tap/tap

- How to contribute data to ESASky:

https://www.cosmos.esa.int/web/esdc/esasky-contributing