

# ESASky: A new window for Solar System Data Exploration

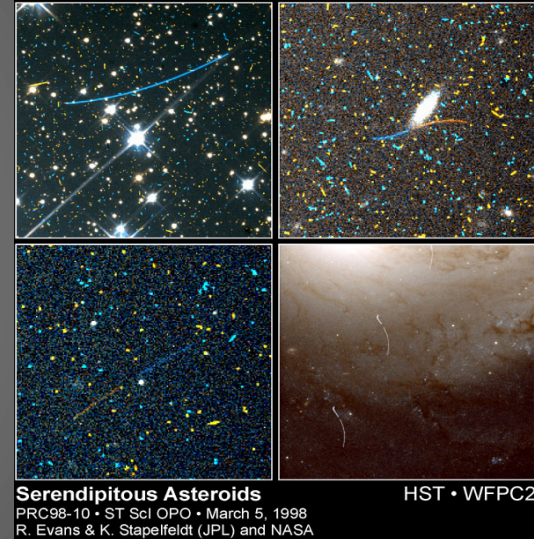
**Elena Racero, Fabrizio Giordano & Juan Gonzalez**

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

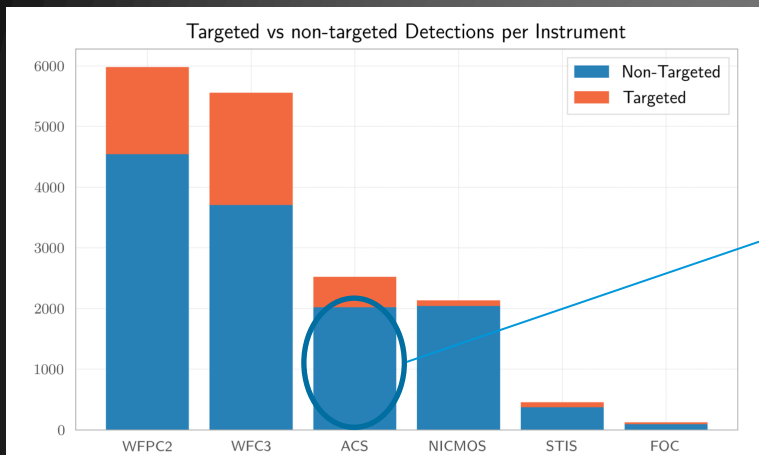
*In Collaboration with Benoit Carry, Observatoire de la Cote d'Azur (OCA) & Jerome Berthier, Institute for Celestial Mechanics and Computation of Ephemerides (IMCCE)*

21<sup>st</sup> February 2019

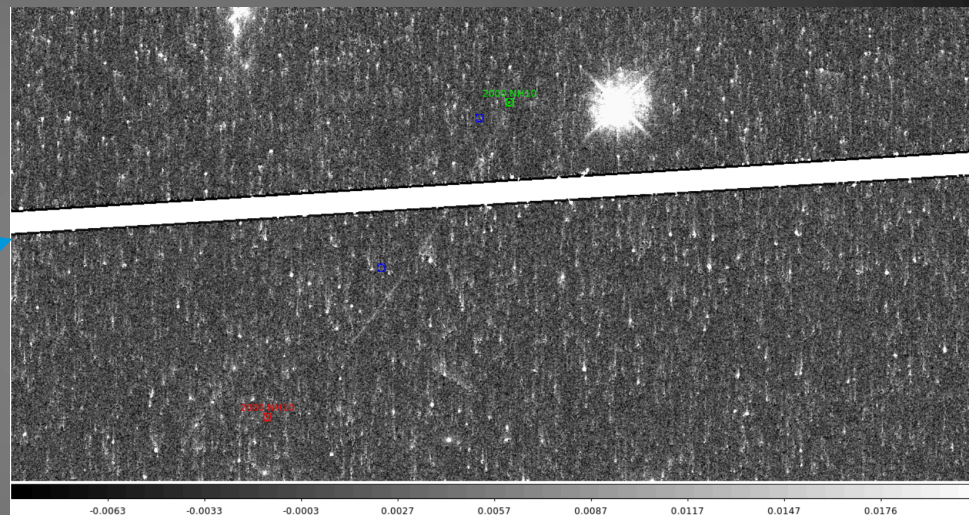
- ❑ Allow users to search through the entire astronomical archives for observations containing Solar System Objects (SSOs), targeted and **serendipitous!**
- ❑ **Scientific exploitation** of ESDC data holdings.
- ❑ HST, Herschel and XMM-Newton missions.



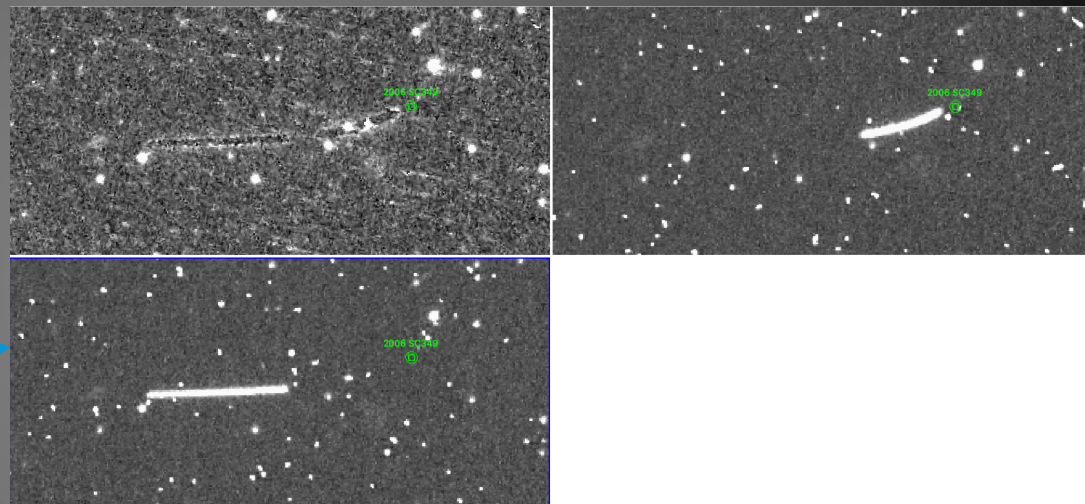
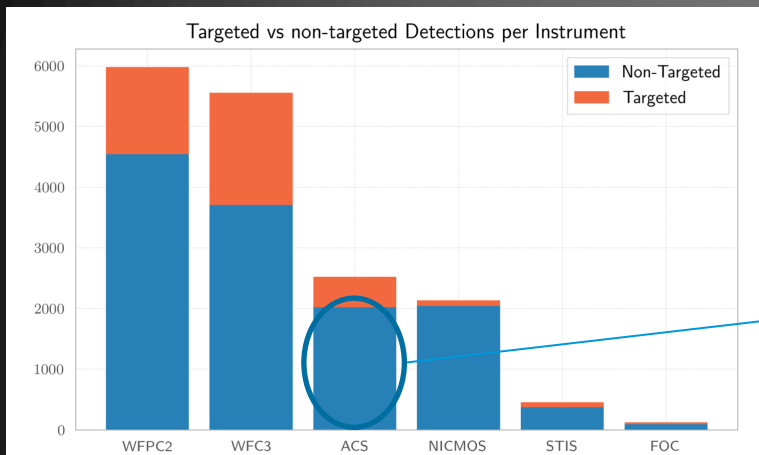
## HST Near Earth Object (NEO) population: Total #Detections



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



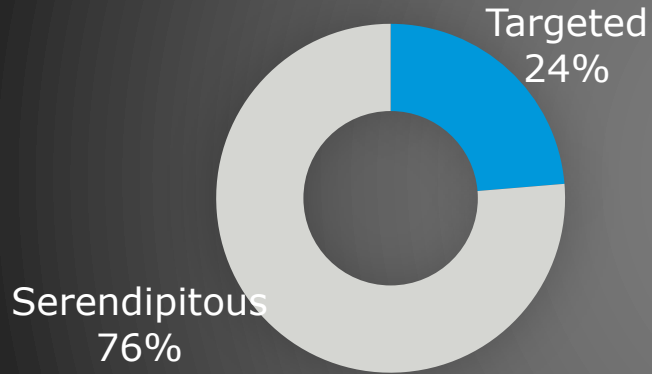
## HST Near Earth Object (NEO) population: Total #Detections



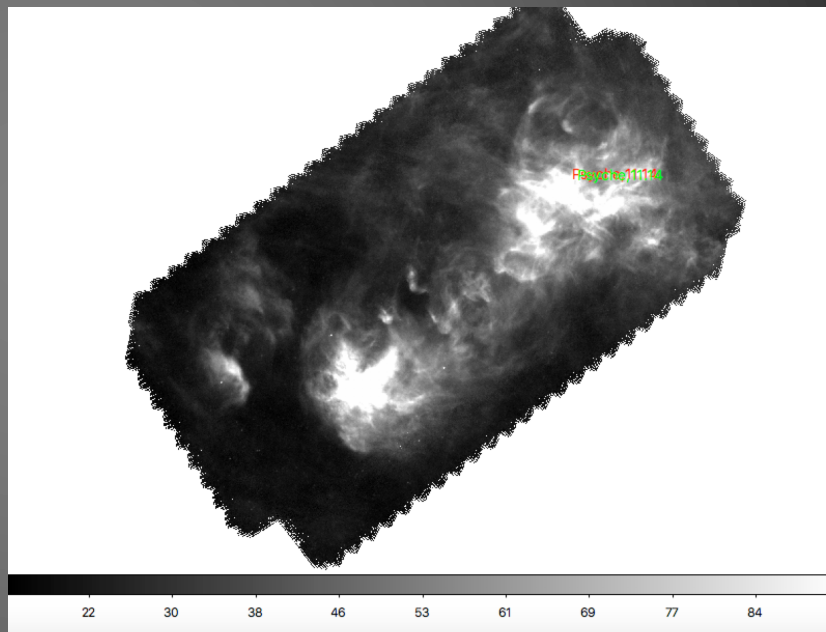
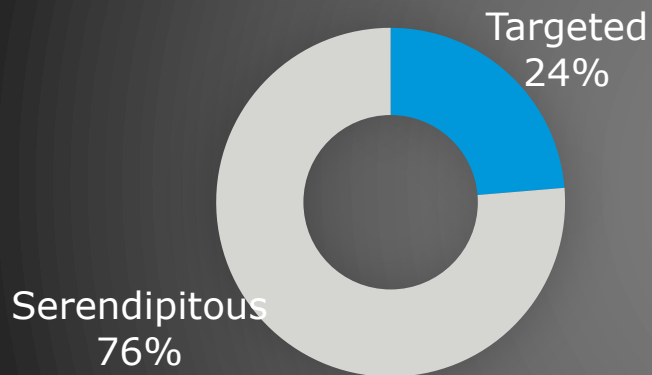
Work presented at ESA SSW11 @ESTEC.  
Credits: A.Mahlke

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

Herschel total #detections of asteroids ( $m_v < 18.0$ ): 3437

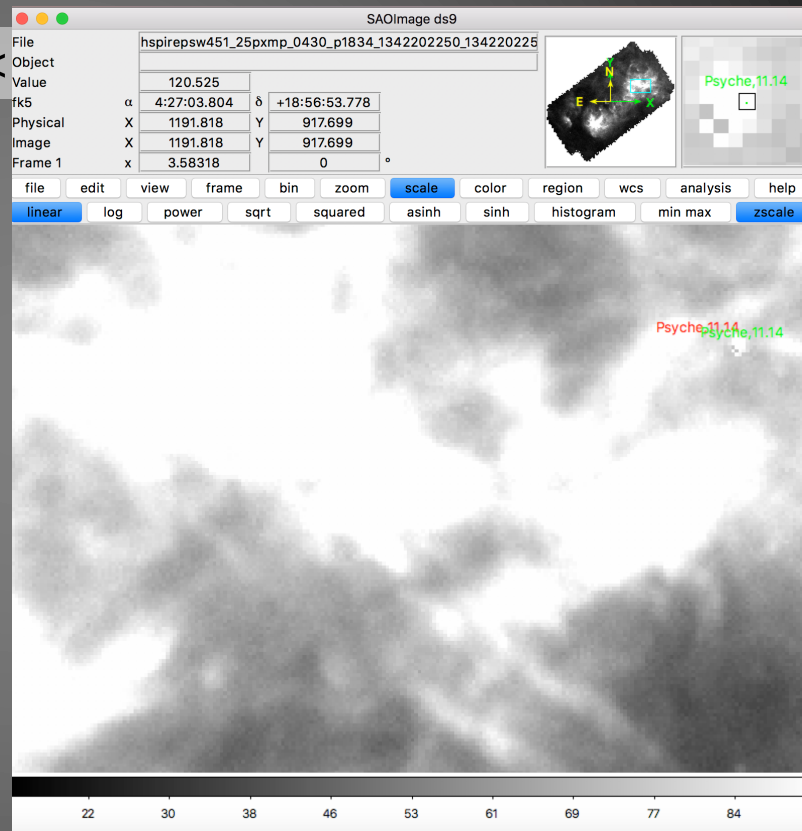
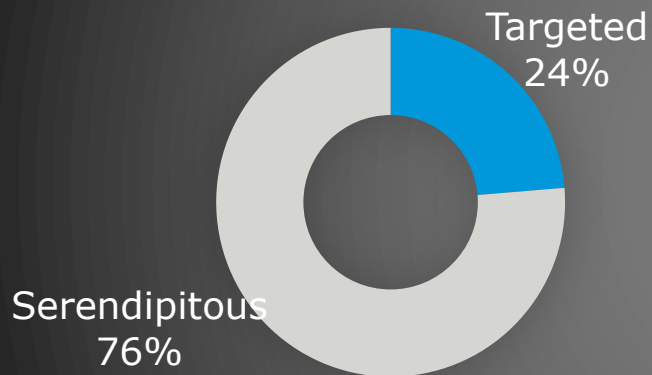


Herschel total #detections of SSOs ( $m_v < 18.0$ )



# Solar System Search Engine

Herschel total #detections of SSOs ( $m_v < 120.525$ )



SAOImage ds9

File hspirepsw451\_25pxmp\_0430\_p1834\_1342202250\_134220225

Object Value 120.525

rk5  $\alpha$  4:27:03.804  $\delta$  +18:56:53.778

Physical X 1191.818 Y 917.699

Image X 1191.818 Y 917.699

Frame 1 x 3.58318 0

file edit view frame bin zoom scale color region wcs analysis help

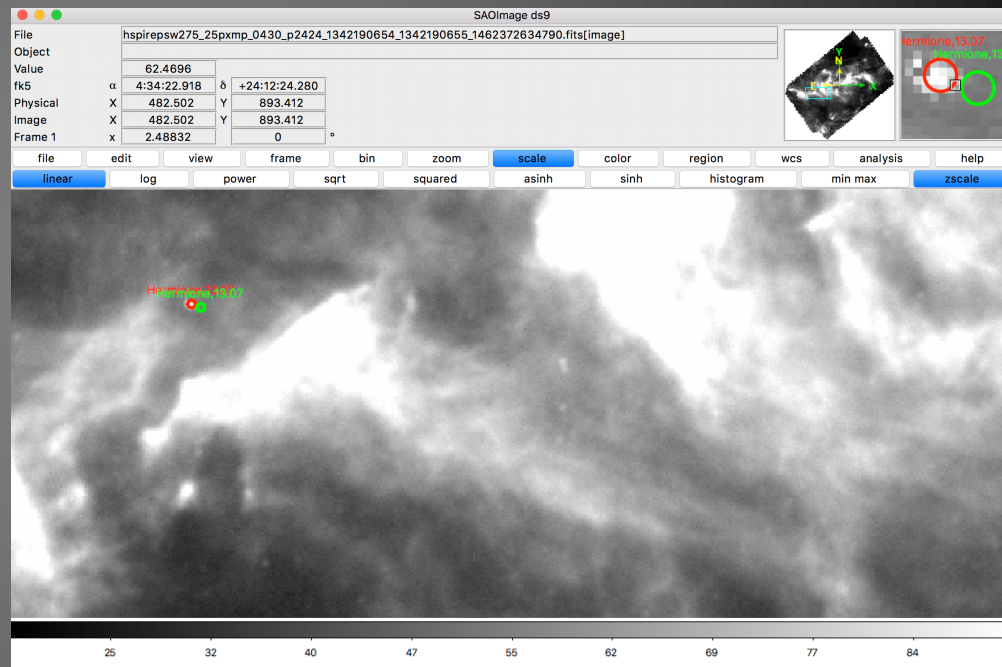
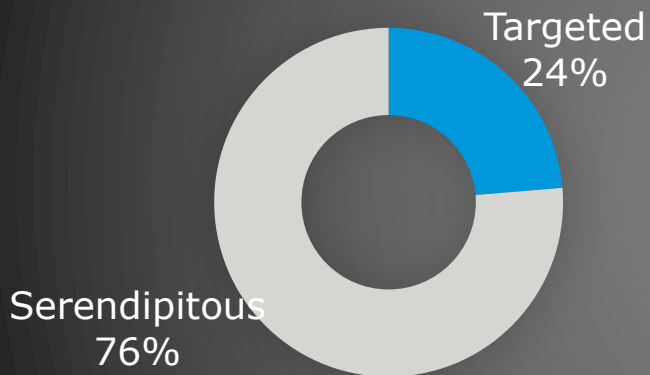
linear log power sqrt squared asinh sinh histogram min max zscale

Psyche,11.14

Psyche,11.14

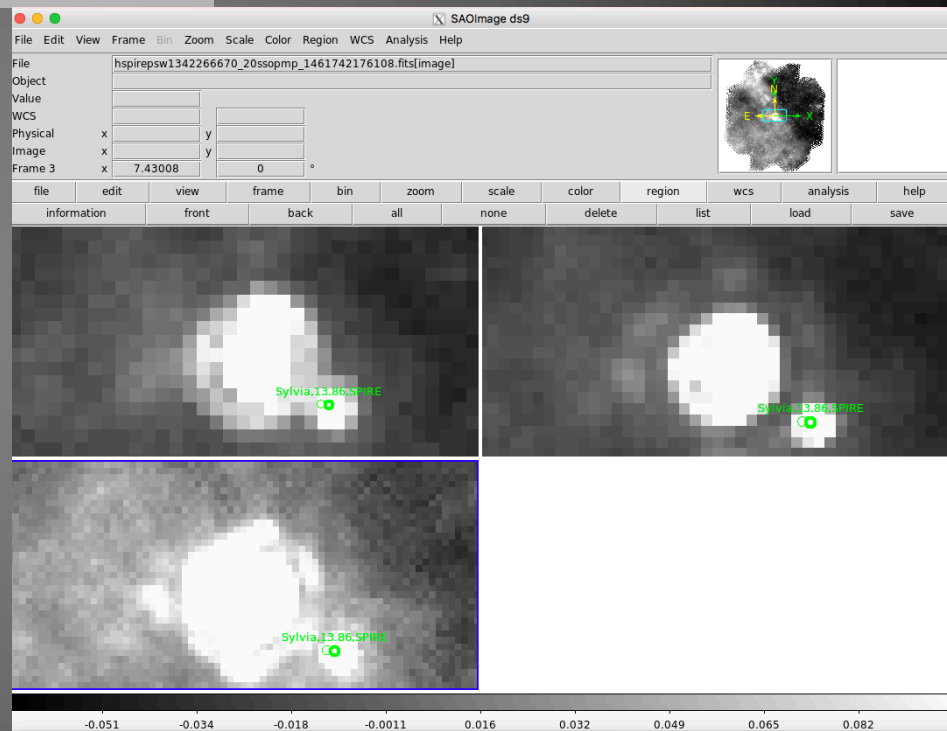
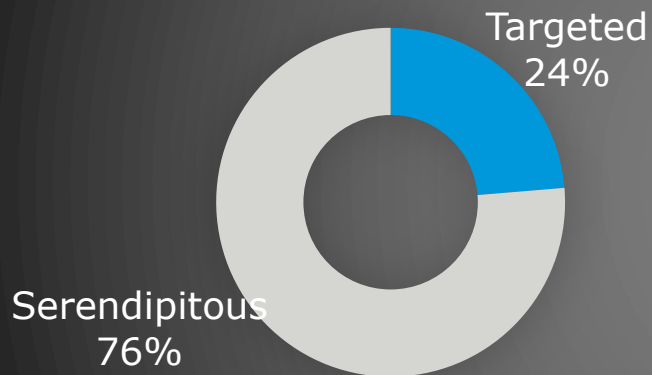
22 30 38 46 53 61 69 77 84

Herschel total #detections of SSOs ( $m_v < 18.0$ )





Herschel total #detections of SSOs ( $m_v < 18.0$ )







ASTORB

Asteroid dataset @ Lowell Observatory



COMETPRO

Comet dataset @





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



- ❑ 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)

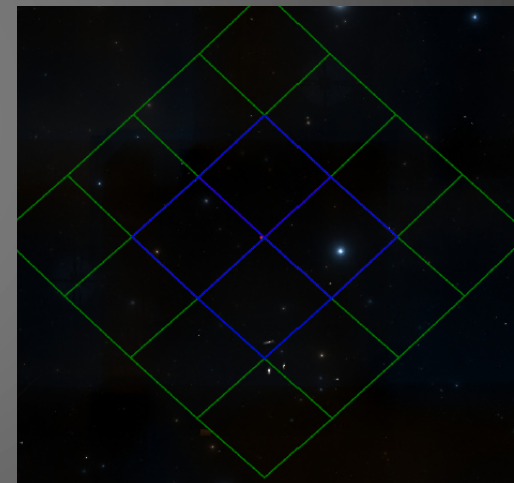
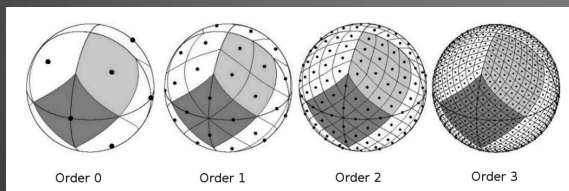
Orbital  
Parameters

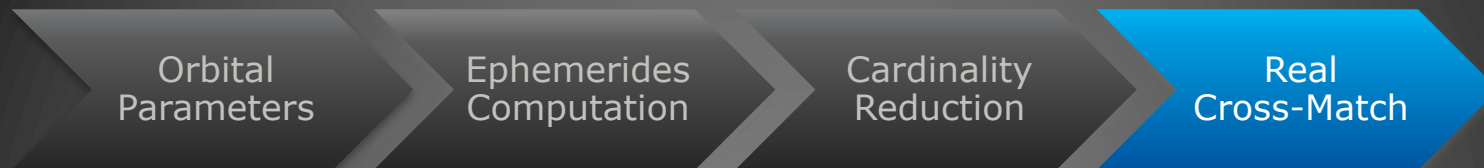
Ephemerides  
Computation

Cardinality  
Reduction

Real  
Cross-Match

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





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



**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](http://sky.esa.int)





- ❑ 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
  - Add SSO functionality on ESASky Astroquery module
  - Include observations from other missions

# Thanks!



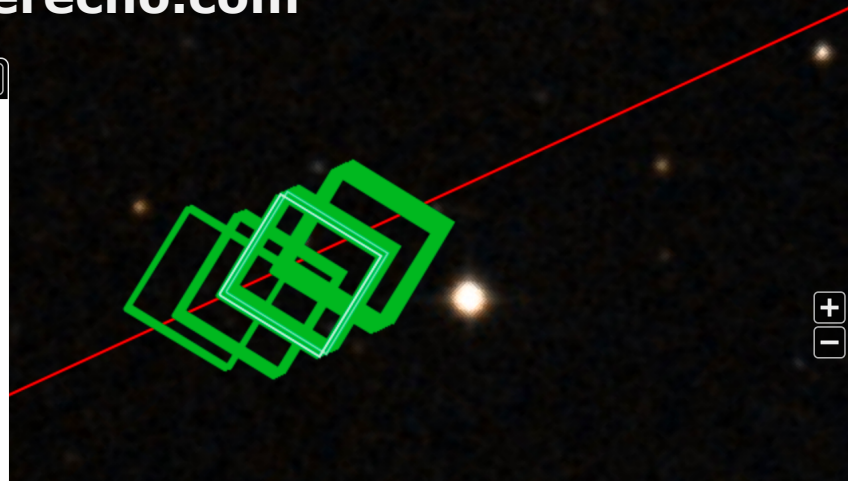
J2000 11 24 00.029 +06 19 54.85 FoV: 09.95' DSS2 color

Sci. Mode  Feedback

57 9 683 1 408 6

## Feedback: <http://esasky.userecho.com>

Saturn



HST ? X

Observation	Instrument	RA	Dec	RA	Dec	Mag. V	Distance			
<input type="checkbox"/>			ub963208m							
<input type="checkbox"/>			ub963206m							
<input type="checkbox"/>			ub963207m							
<input checked="" type="checkbox"/>			ub963203m	SATURN-TITAN	170.965636	6.341017	170.965636	6.341017	0.67	8.4174
<input type="checkbox"/>			ub963205m	SATURN-TITAN	170.965331	6.341086	170.965327	6.341087	0.67	8.4173
<input type="checkbox"/>			ub963204m	SATURN-TITAN	170.965456	6.341058	170.965453	6.341059	0.67	8.4174
<input type="checkbox"/>			ub963201m	SATURN-TITAN	170.965966	6.340929	170.965963	6.340	0.67	8.4174

Dec end	Pos.Err Start	Pos.Err End	Mag. V	Distance
341173			0.67	8.4173
341115			0.67	8.4173
341144			0.67	8.4173
Total mission coverage				
			0.67	8.4174