Ground-based Observations of Asteroids to Support Gaia Data Exploitation

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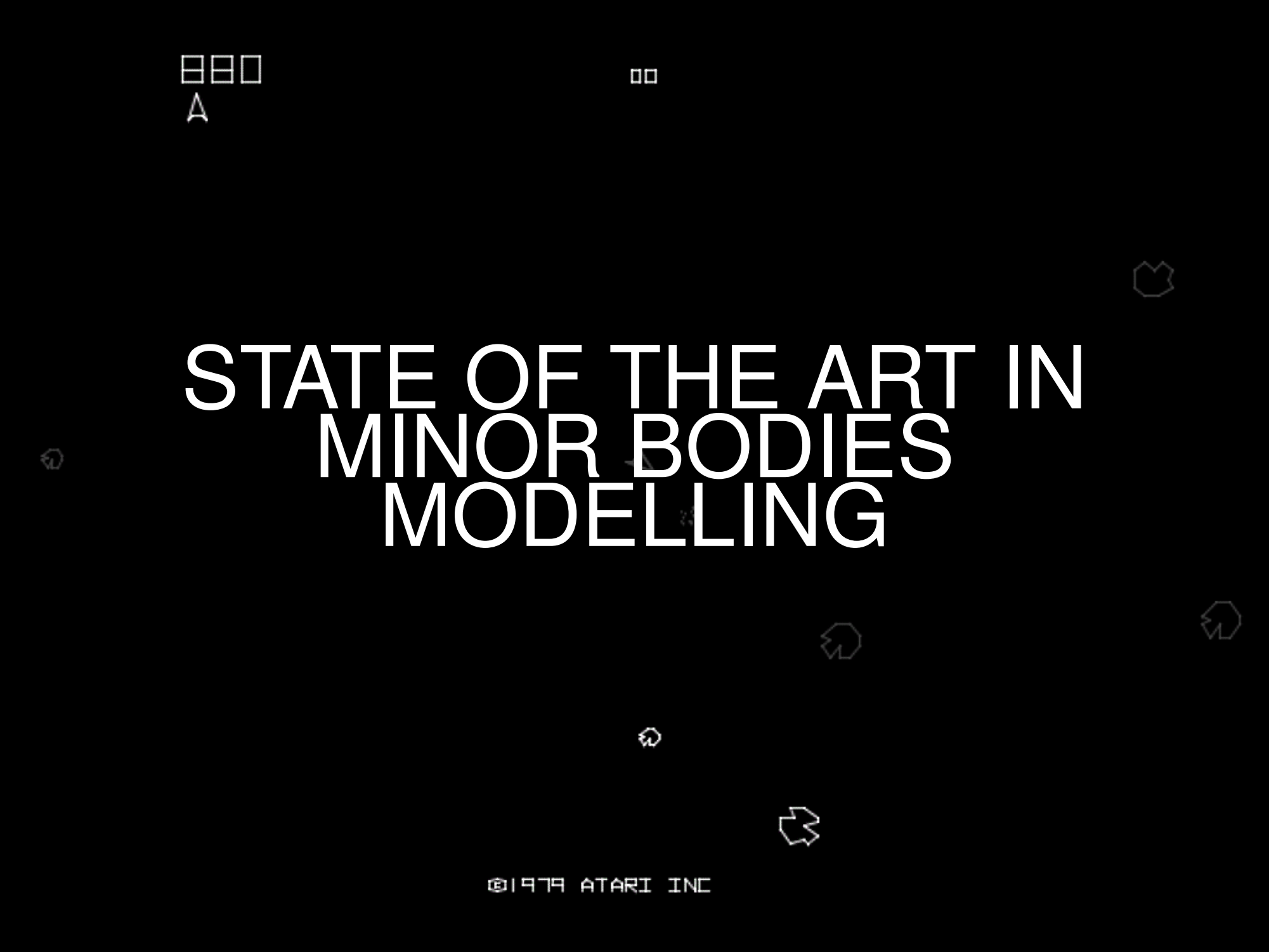
Gaia DPAC
Data Processing & Analysis Consortium


STATE OF THE ART IN
MINOR BODIES
MODELLING
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Minor bodies with ground-truth

	Visited	Targeted
Minor planets	15 (2)*	4
Comets	9	2

** Far flyby, image not resolved*

Minor planets known: >850.000
Comets discovered: ~ 4.000

Source: Minor Planet Center

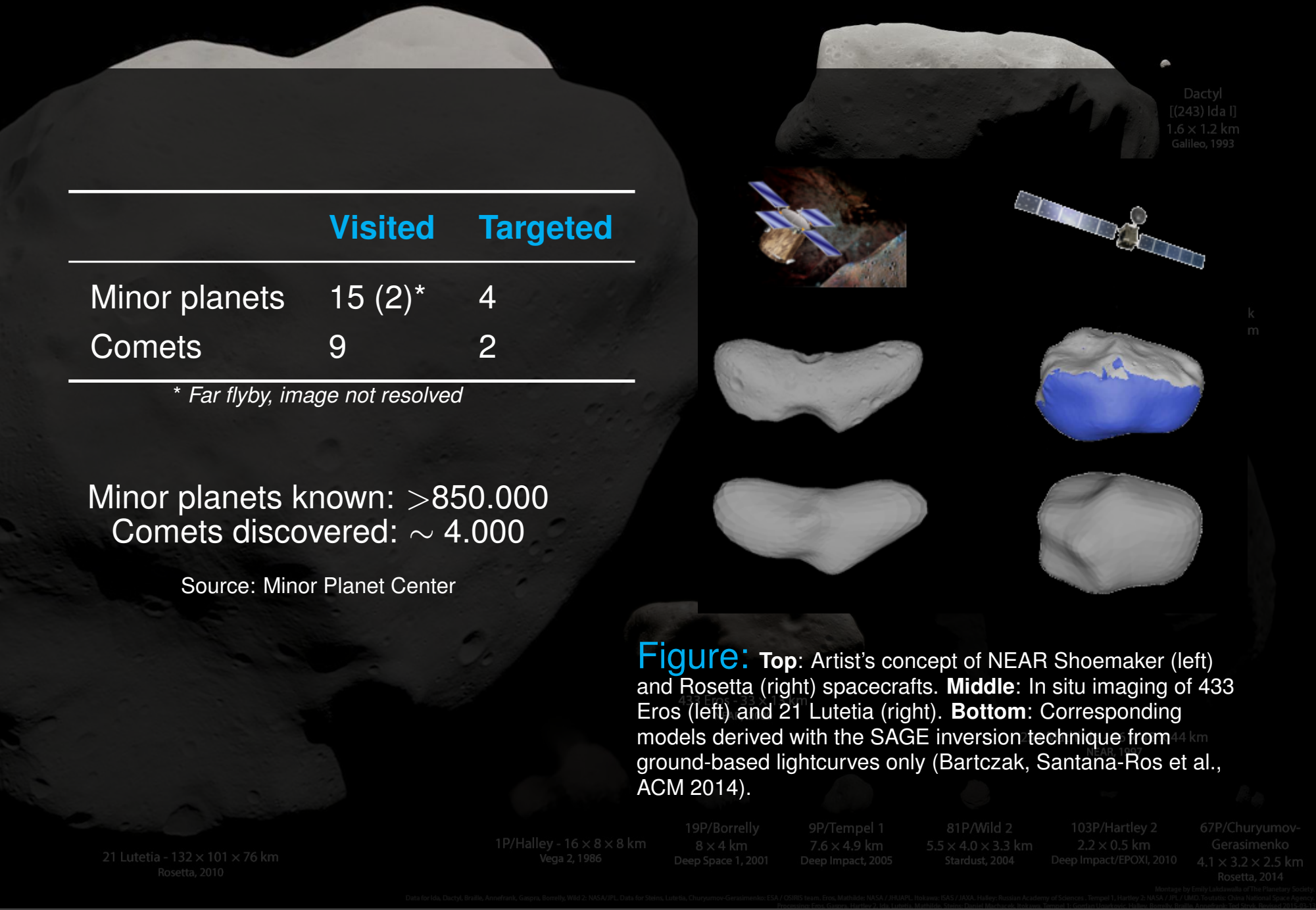


Figure: **Top**: Artist's concept of NEAR Shoemaker (left) and Rosetta (right) spacecrafts. **Middle**: In situ imaging of 433 Eros (left) and 21 Lutetia (right). **Bottom**: Corresponding models derived with the SAGE inversion technique from ground-based lightcurves only (Bartczak, Santana-Ros et al., ACM 2014).

Knowledge from remote observations

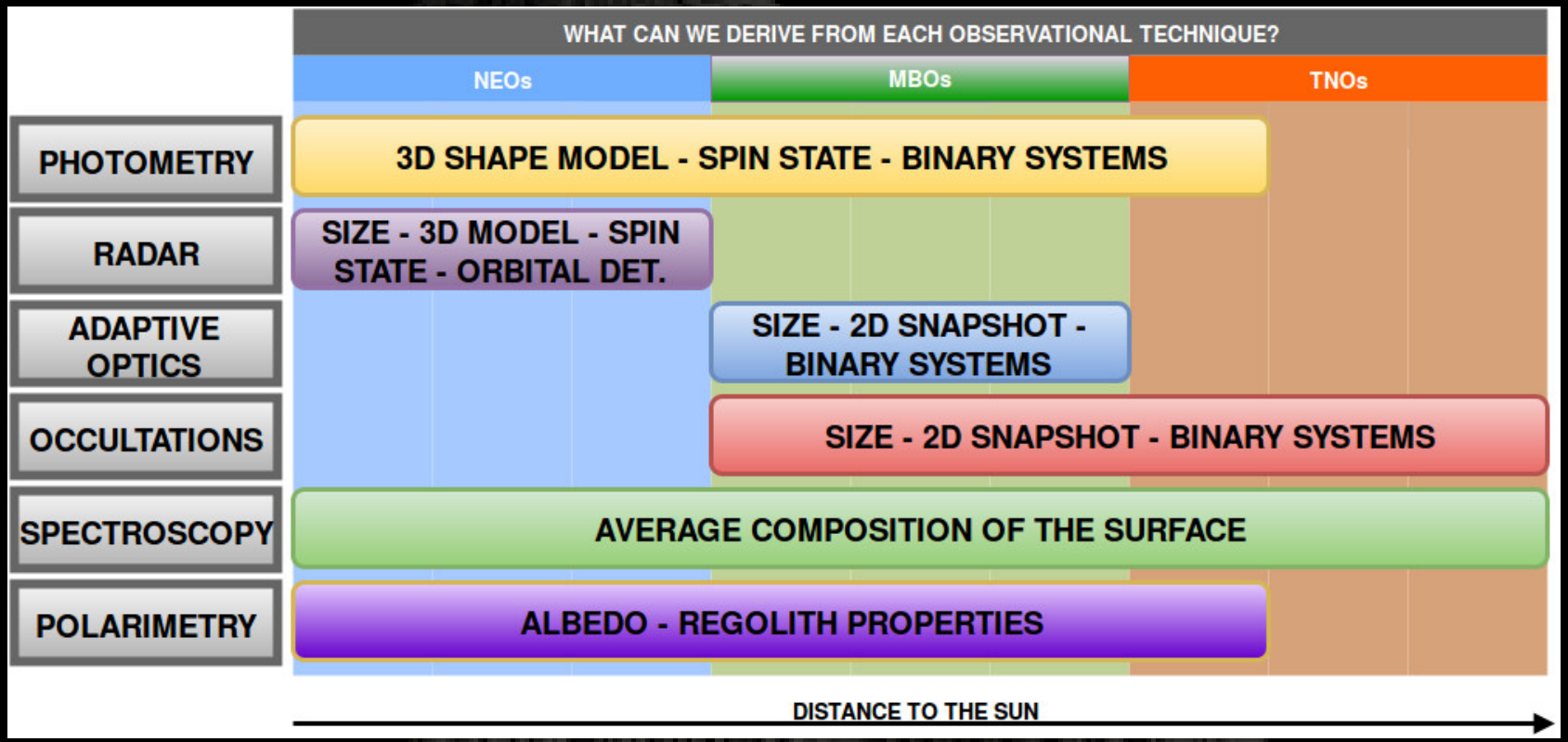


Figure: Physical properties derived from remote observations

Asteroid modeling: Lightcurves are the main source

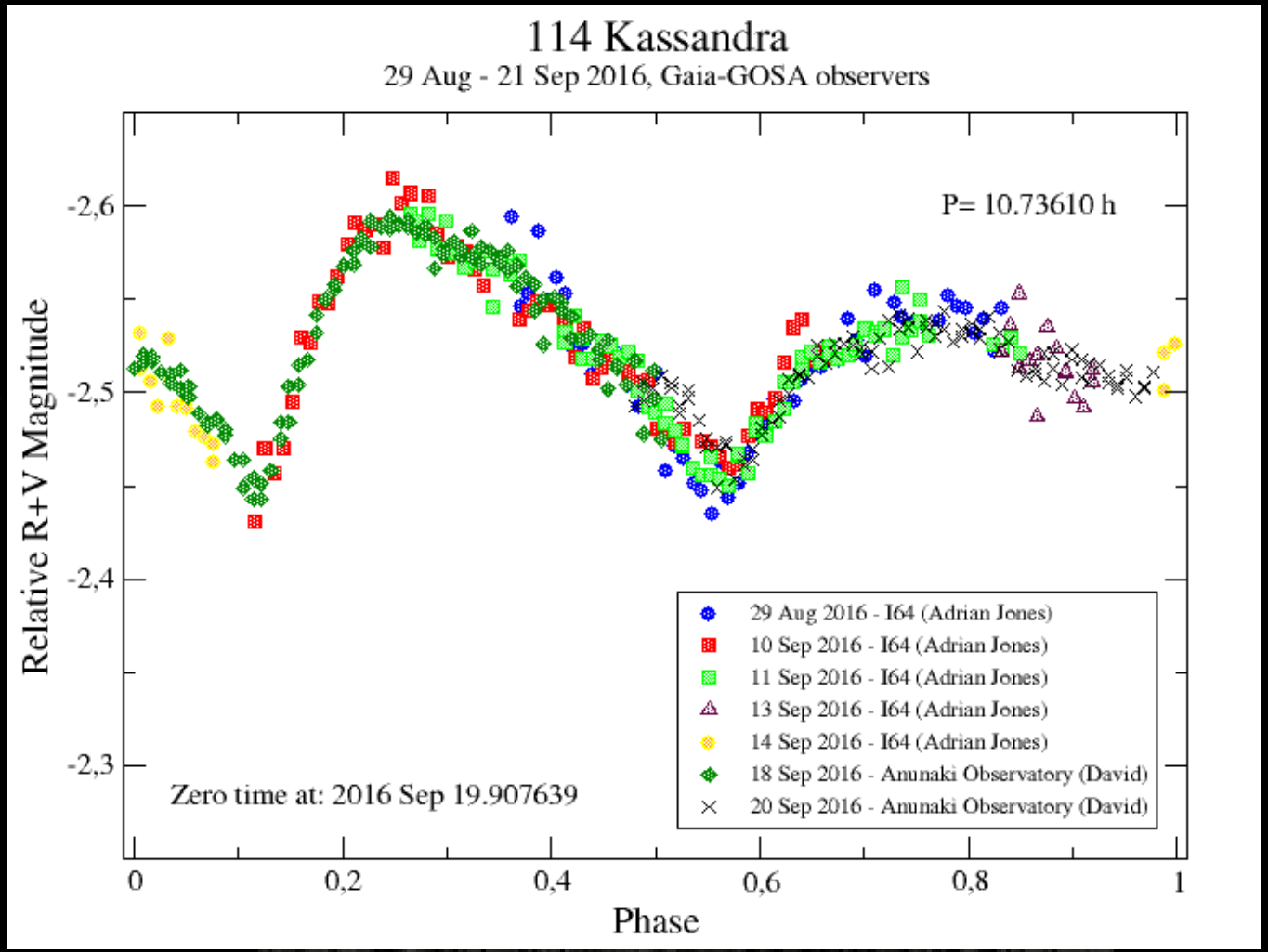


Figure: A composite lightcurve of main belt asteroid 114 Kassandra.

Asteroid modeling: Inversion technique

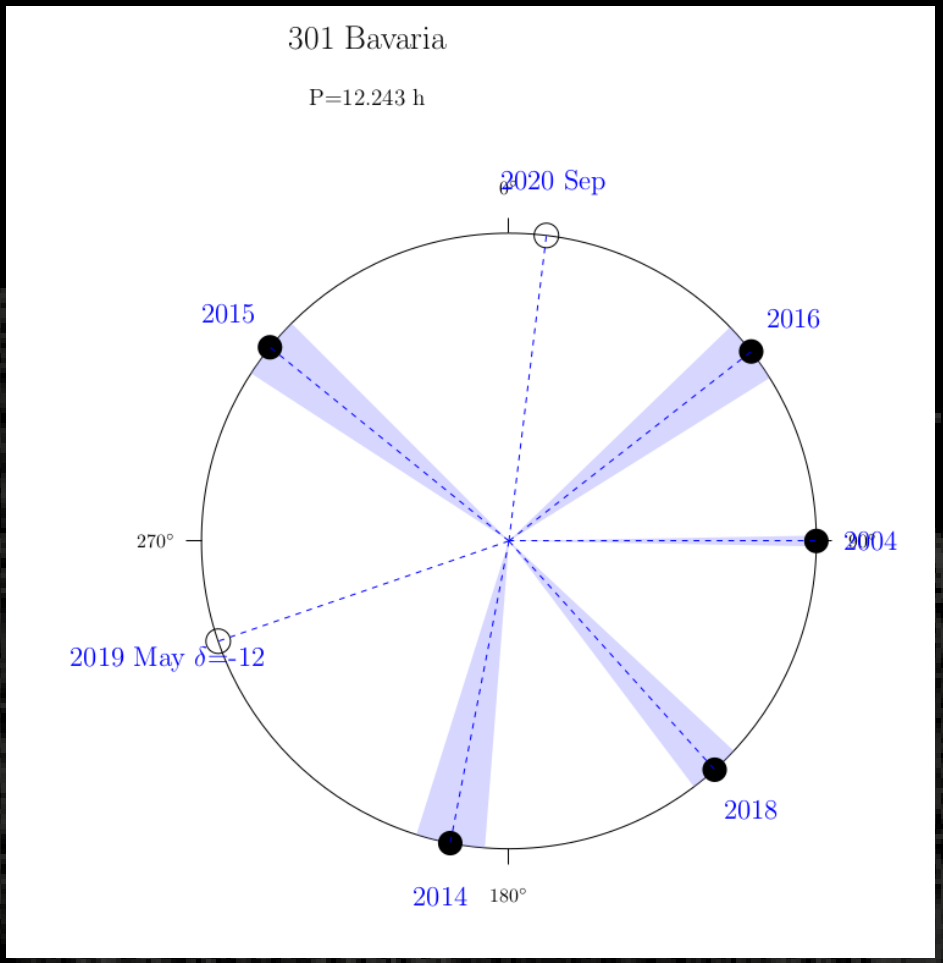


Figure: Earth-centered ecliptic longitudes of an asteroid at different apparitions.

>2400 shape models available

MINOR BODIES MEET BIG DATA

What we do have so far? Gaia DR2

Asteroid content in Gaia DR2

14 099 objects
1 977 702 observations
22 months

CLICK ME!

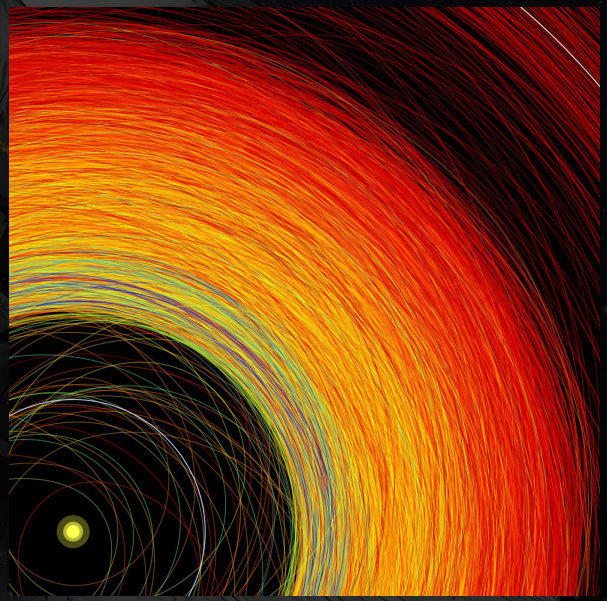


Figure: Asteroid orbits derived from DR2. Orbits are coloured following the albedo of asteroids.

Asteroid sparse data from Gaia DR2

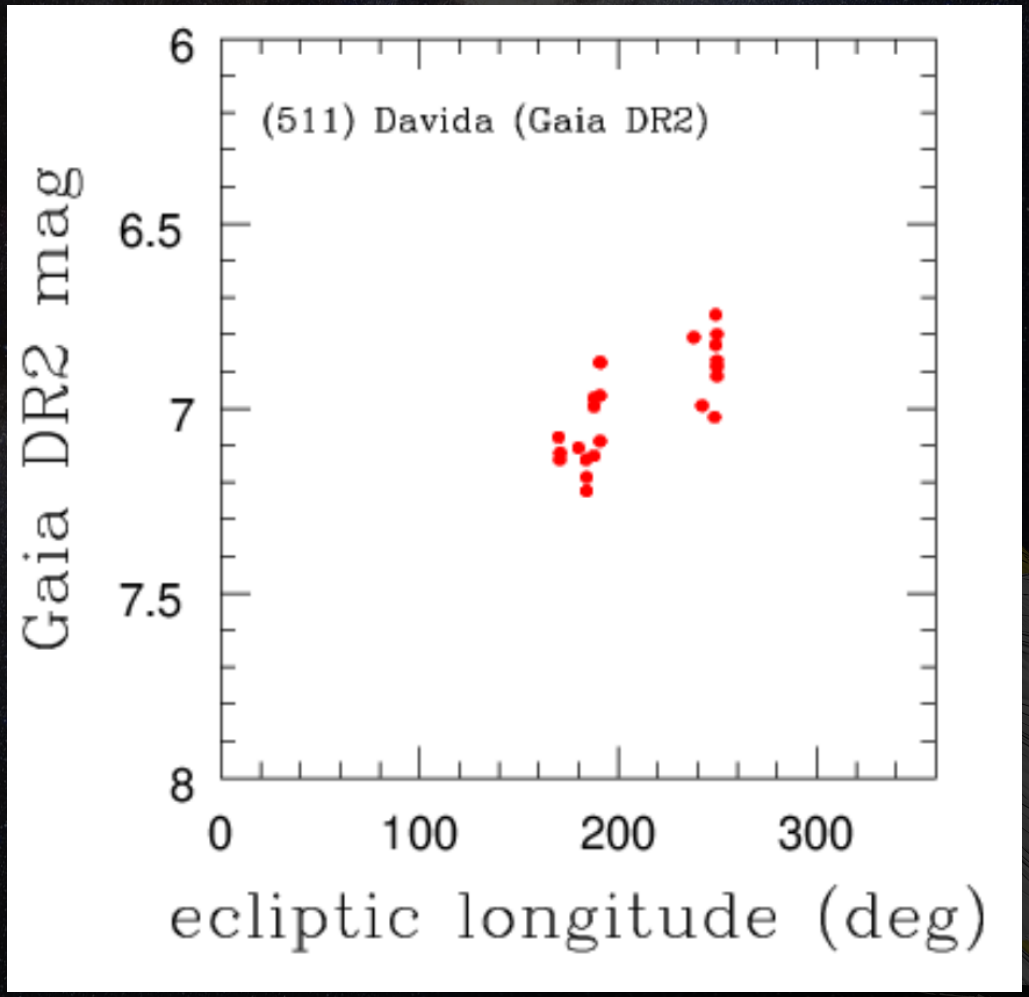
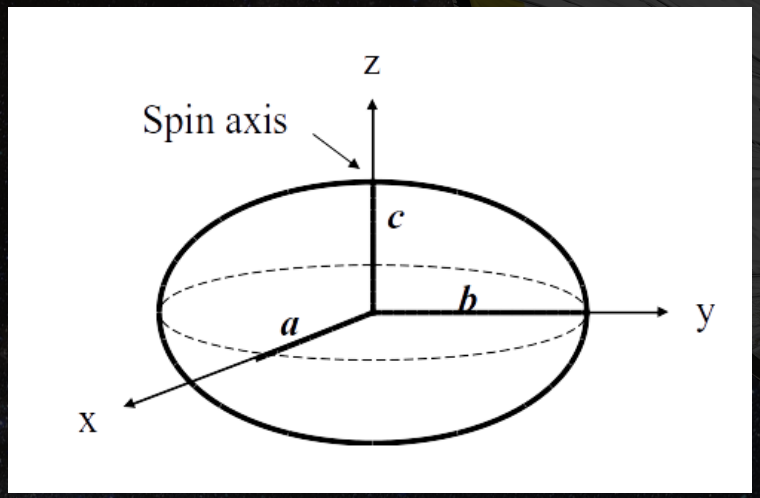


Figure: Gaia DR2 photometry of asteroid 511 Davida.

Asteroid modeling with Gaia data: Genetic algorithm

We assume that the objects can be represented by **triaxial ellipsoids** (In order to avoid highly CPU intensive calculations).



The Gaia genetic algorithm (Cellino et al. 2014) search for the best fit of:

- Pole coordinates (λ, β)
- Sidereal Rotation Period (P)
- Axial Ratios (b/a, c/a)
- Rotational phase at epoch of first observations (ϕ_0)

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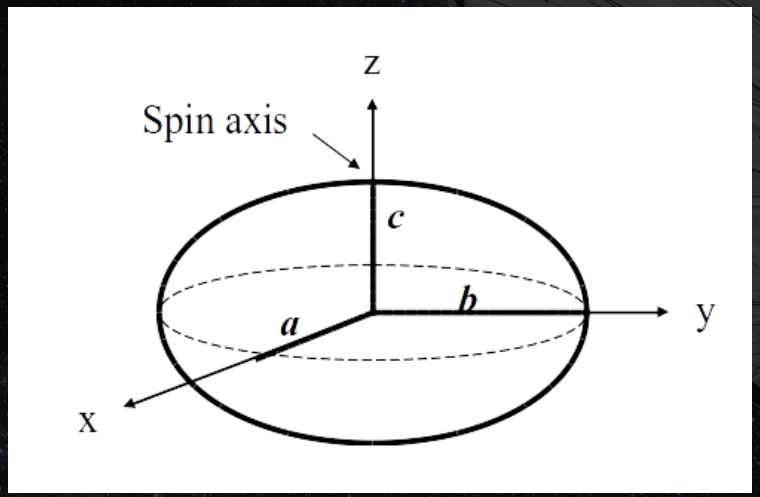

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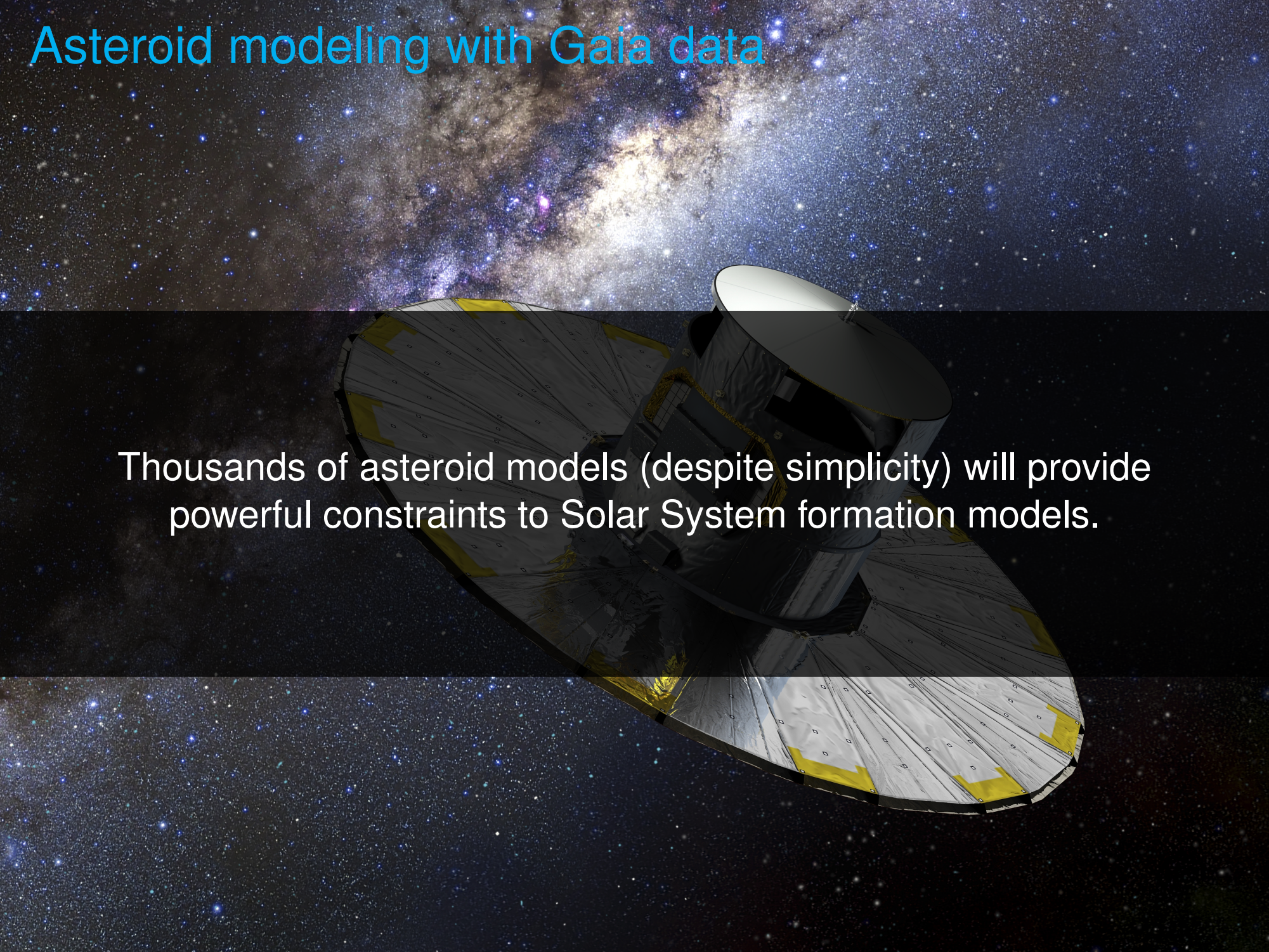
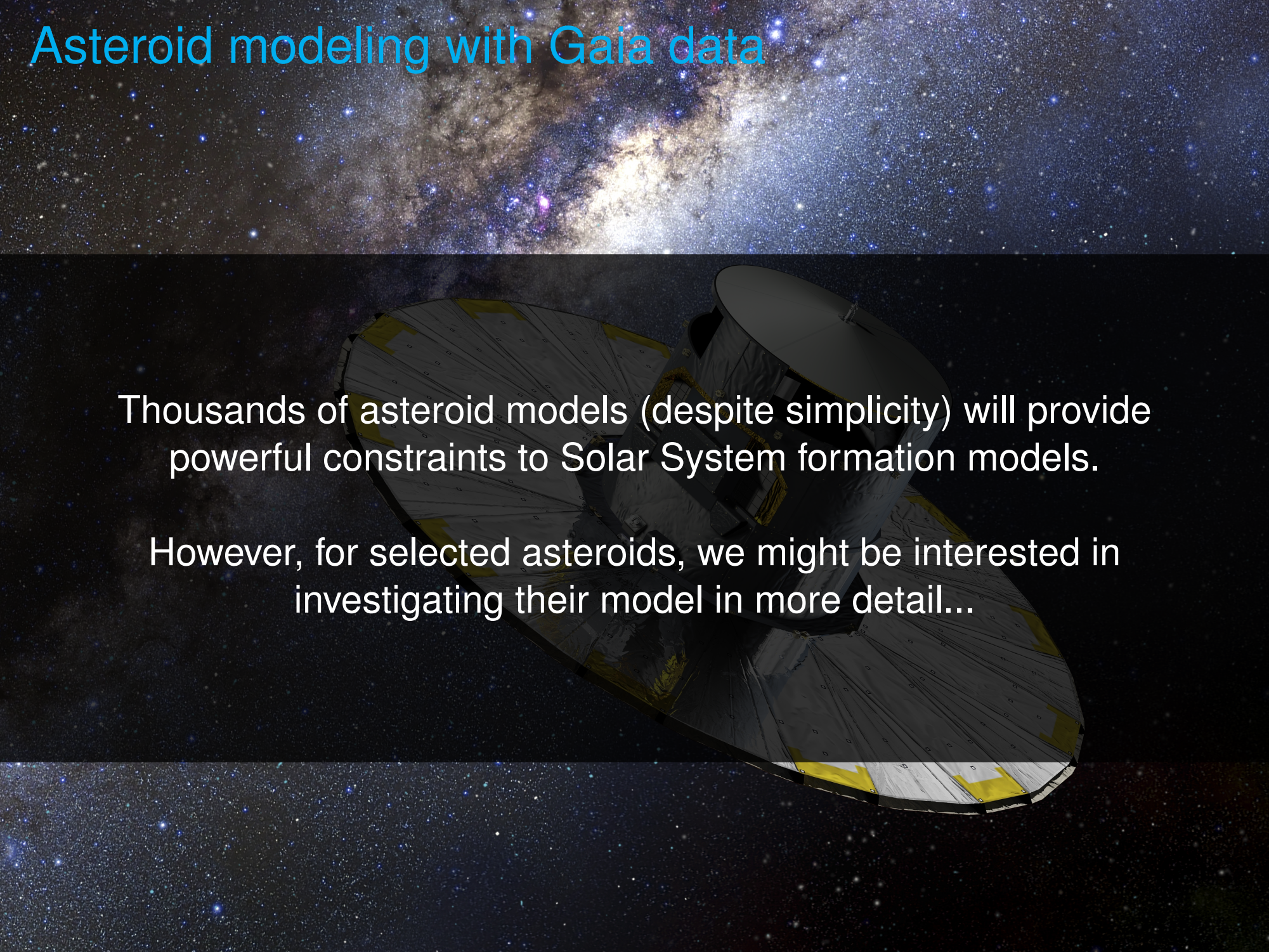
DR2 DR3

Asteroid modeling with Gaia data



Thousands of asteroid models (despite simplicity) will provide powerful constraints to Solar System formation models.

Asteroid modeling with Gaia data



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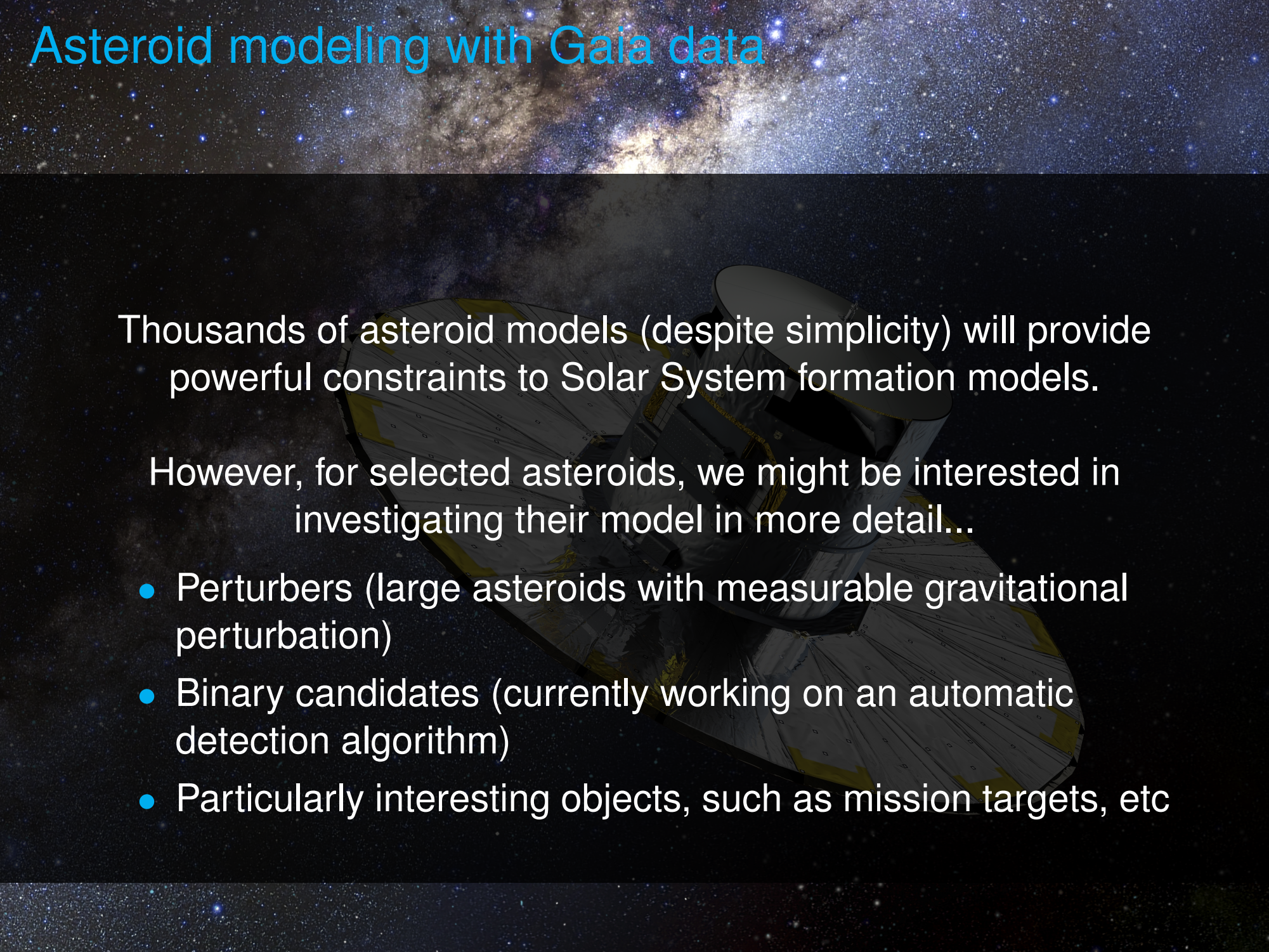
Asteroid modeling with Gaia data

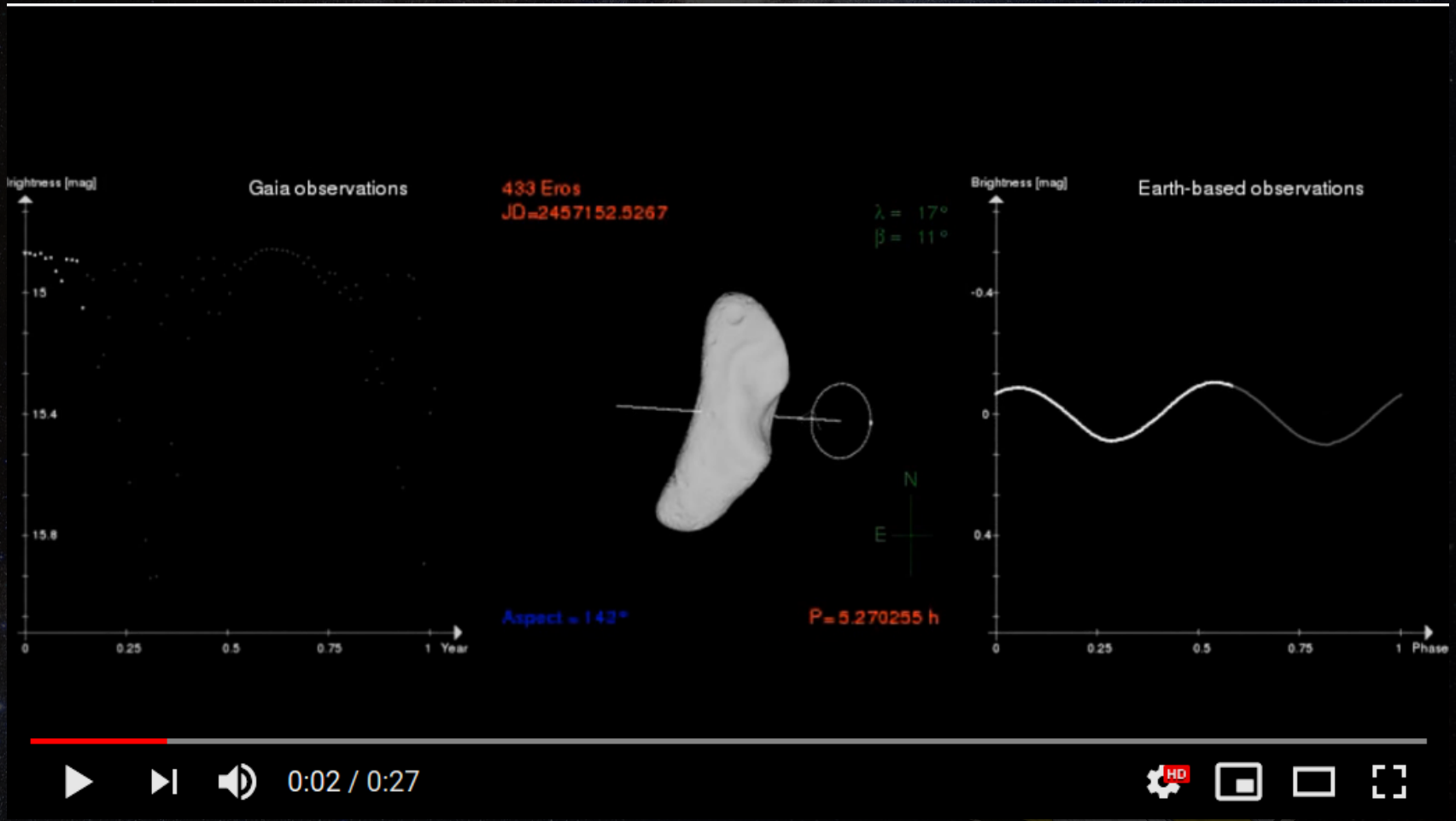


Thousands of asteroid models (despite simplicity) will provide powerful constraints to Solar System formation models.

However, for selected asteroids, we might be interested in investigating their model in more detail...

- Perturbers (large asteroids with measurable gravitational perturbation)
- Binary candidates (currently working on an automatic detection algorithm)
- Particularly interesting objects, such as mission targets, etc

Gaia vs ground-based



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GROUND-BASED PHOTOMETRIC OBSERVATIONS IN SUPPORT OF GAIA

Gaia-GOSA: A network of amateur astronomers

www.gaiagosa.eu

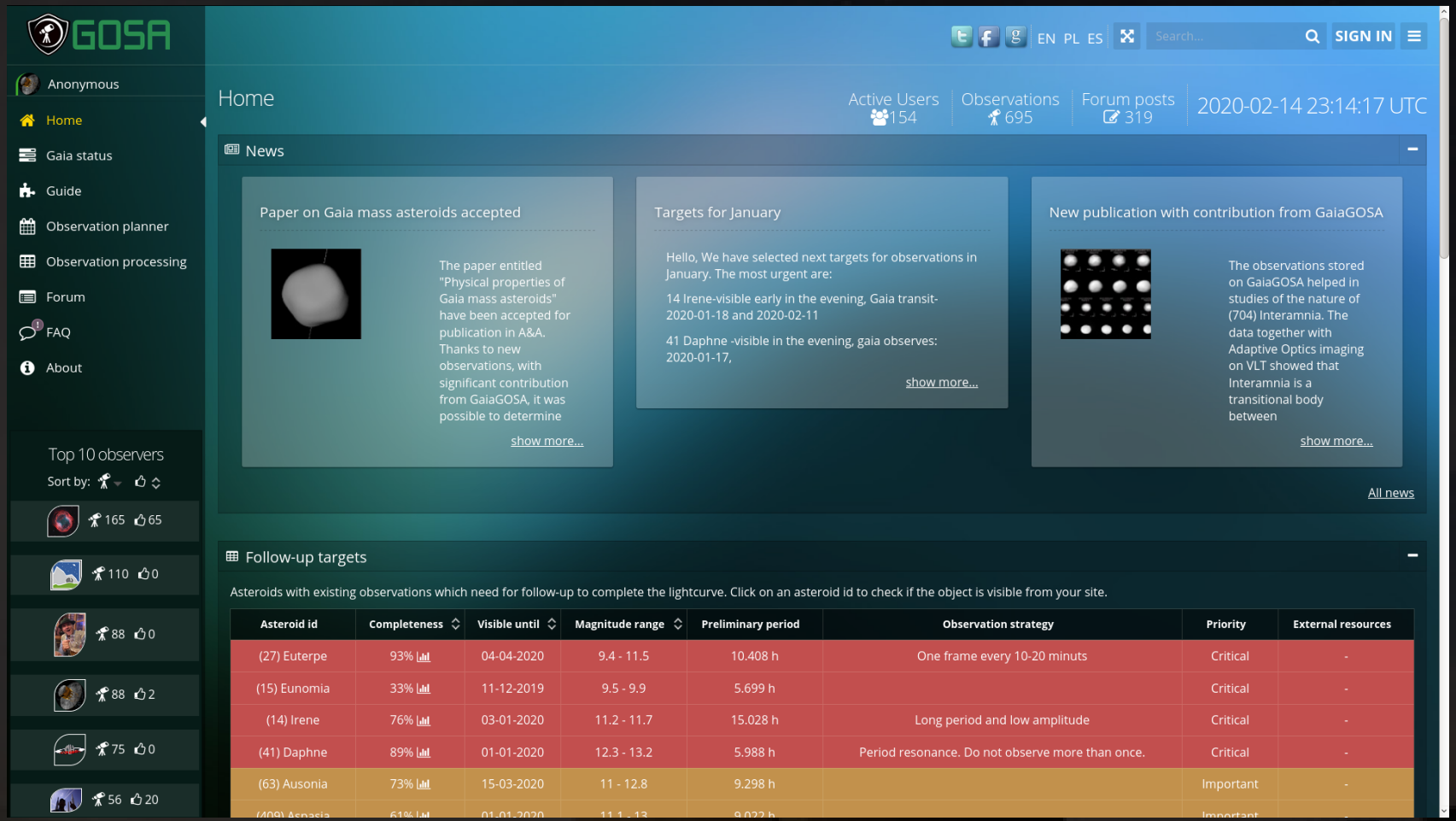

Figure: A screenshot of the Gaia-GOSA main page (Santana-Ros et al. 2014)

Gaia-GOSA: Observers ranking

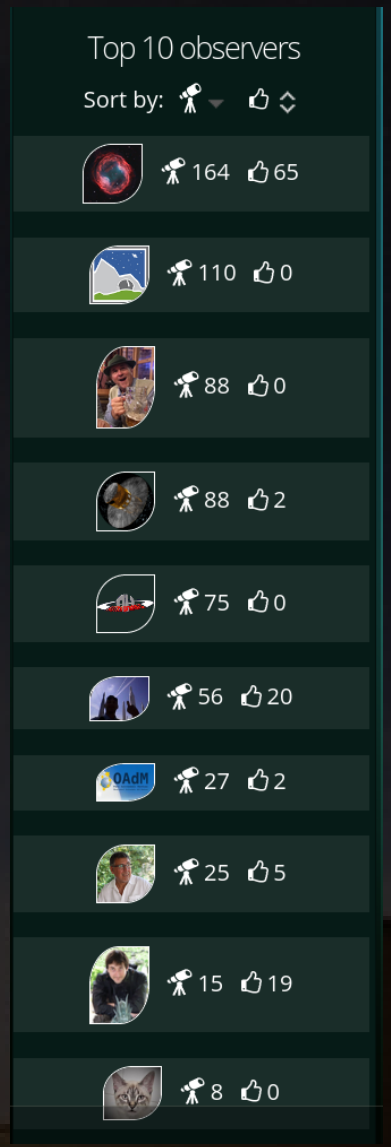

Figure: Current observers ranking.

Gaia-GOSA: Observers ranking

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Gaia-GOSA: Observers ranking

Figure: Anunaki Observatory Z51 (Manzanares el Real, Madrid).

Gaia-GOSA: Observers ranking

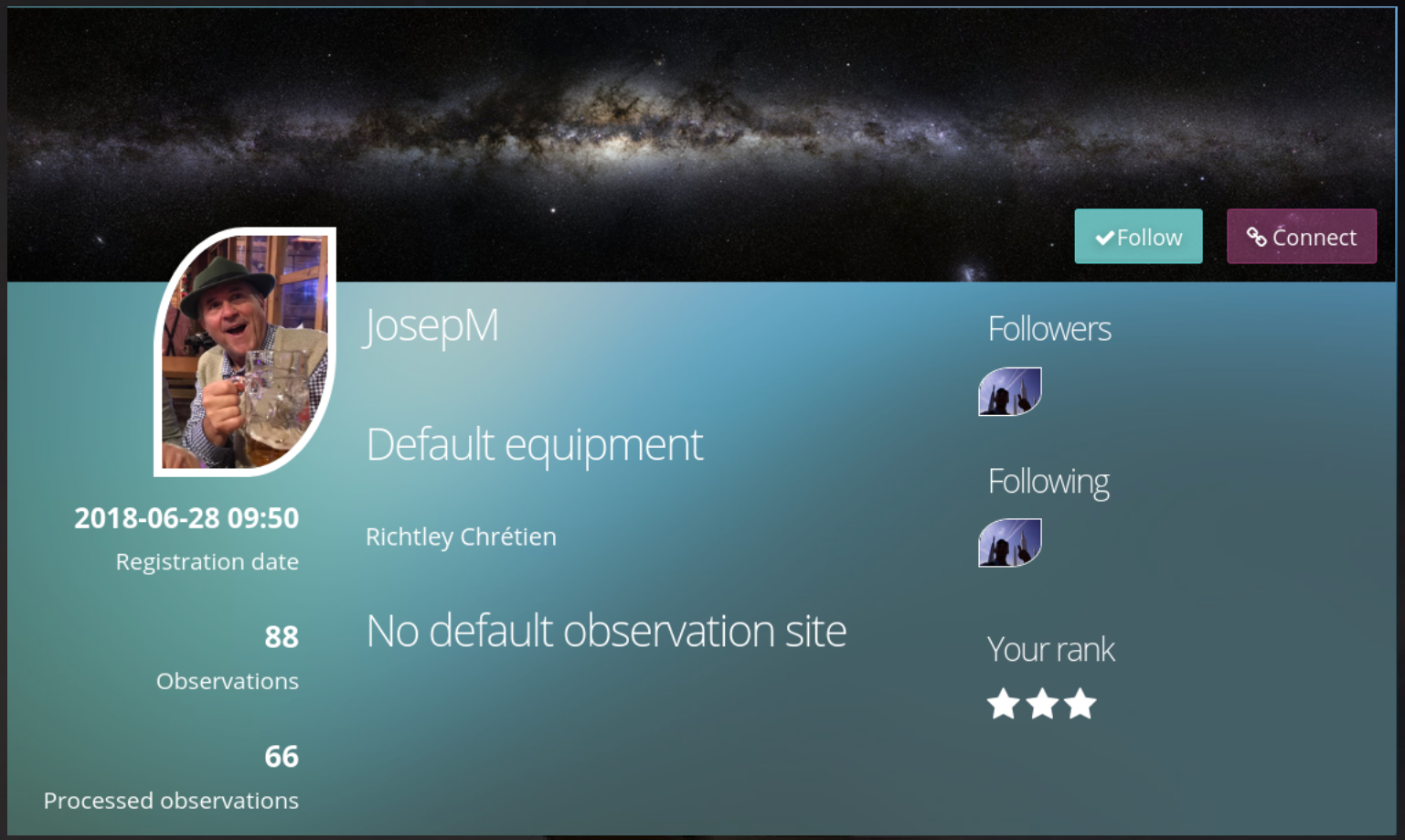

Figure: Observatori Astronómic de les Planes de Son C29 (Lleida).

Gaia-GOSA: Observers ranking

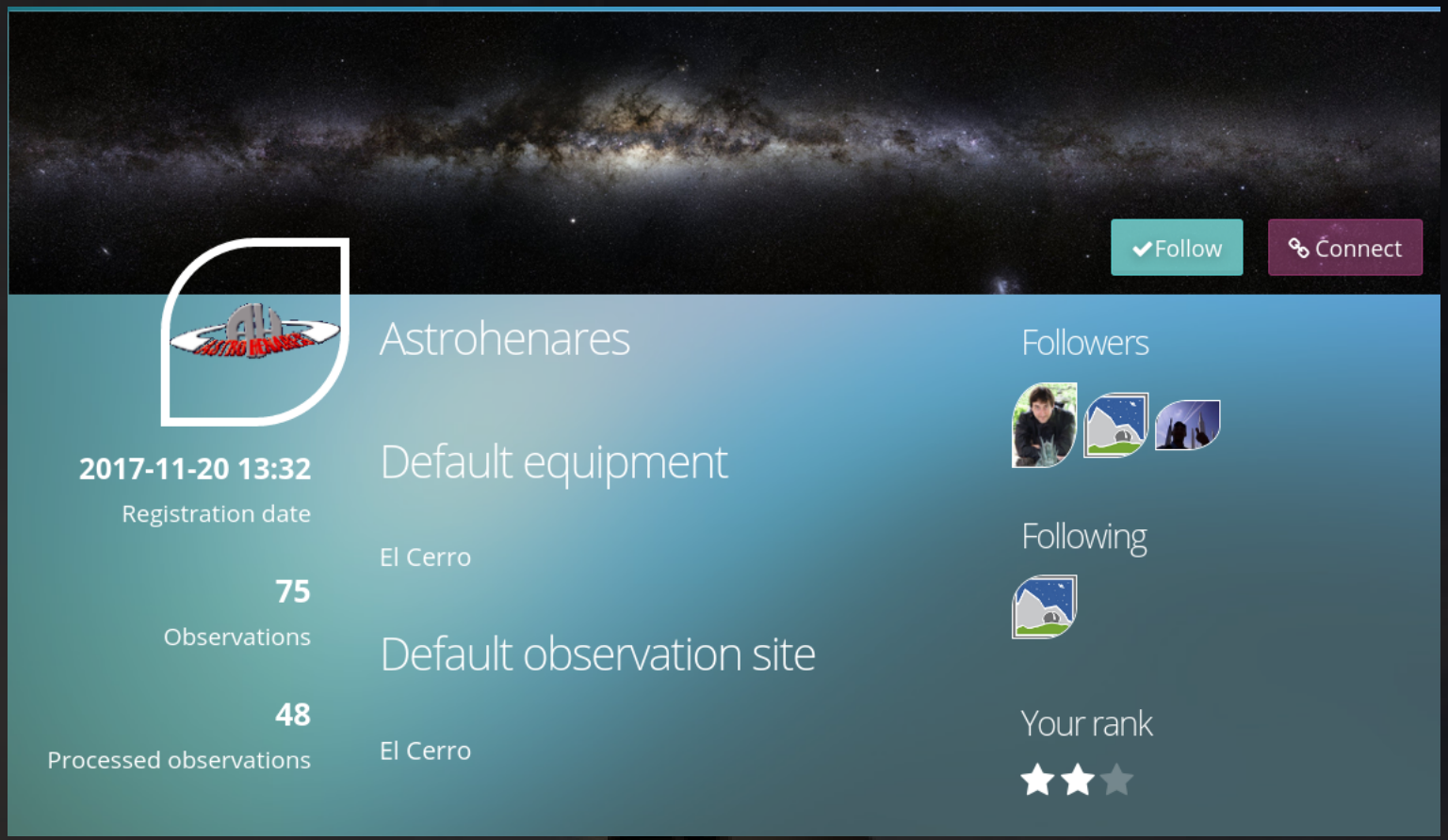

Figure: Astrohenares (Coslada, Madrid).

Gaia-GOSA: Observers ranking

Figure: Observatori Astronòmic del Montsec C65 (Lleida).

Gaia-GOSA: Observers ranking

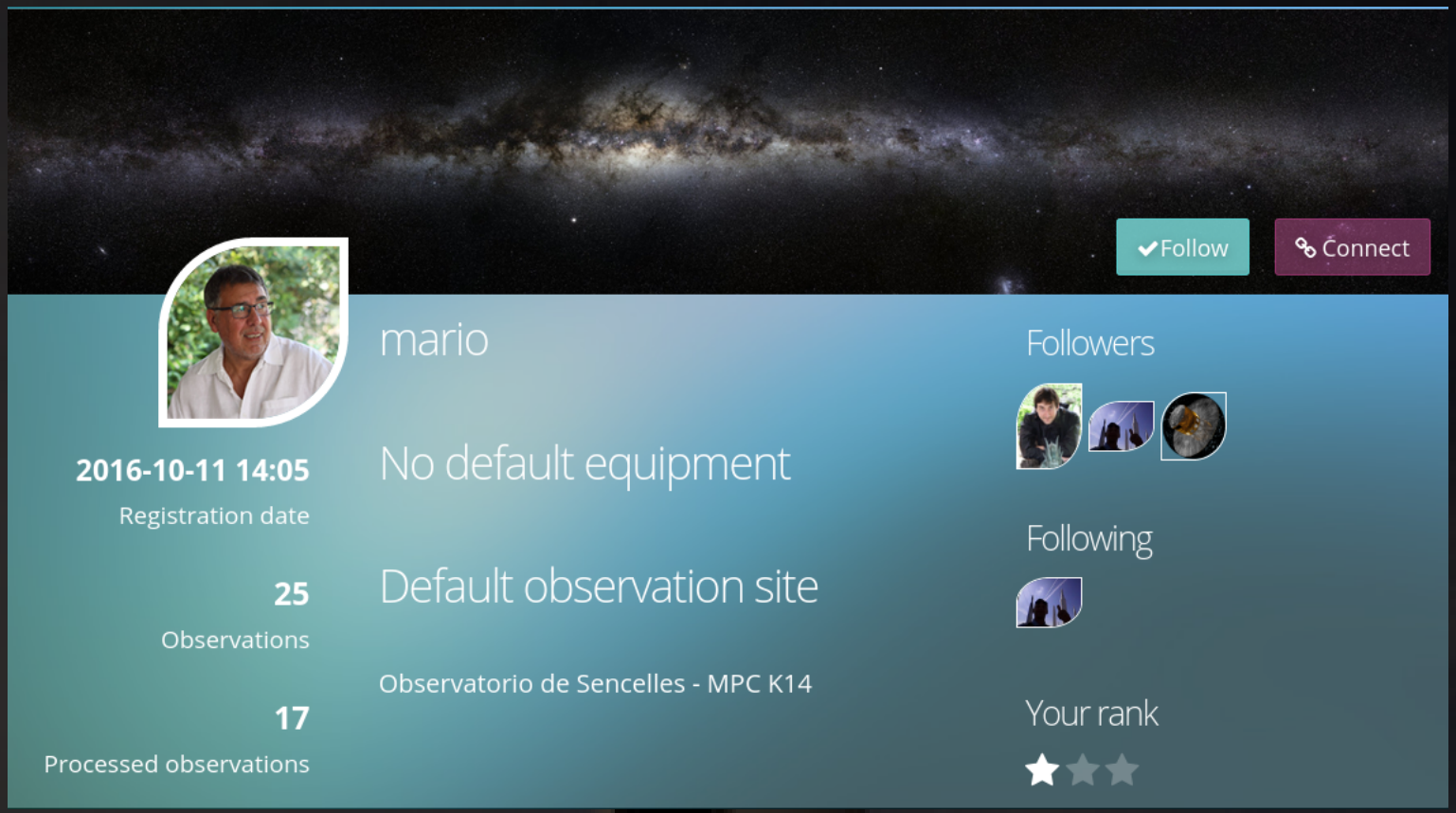

Figure: Observatori de Sencelles K14 (Mallorca).

Gaia-GOSA: Observers ranking

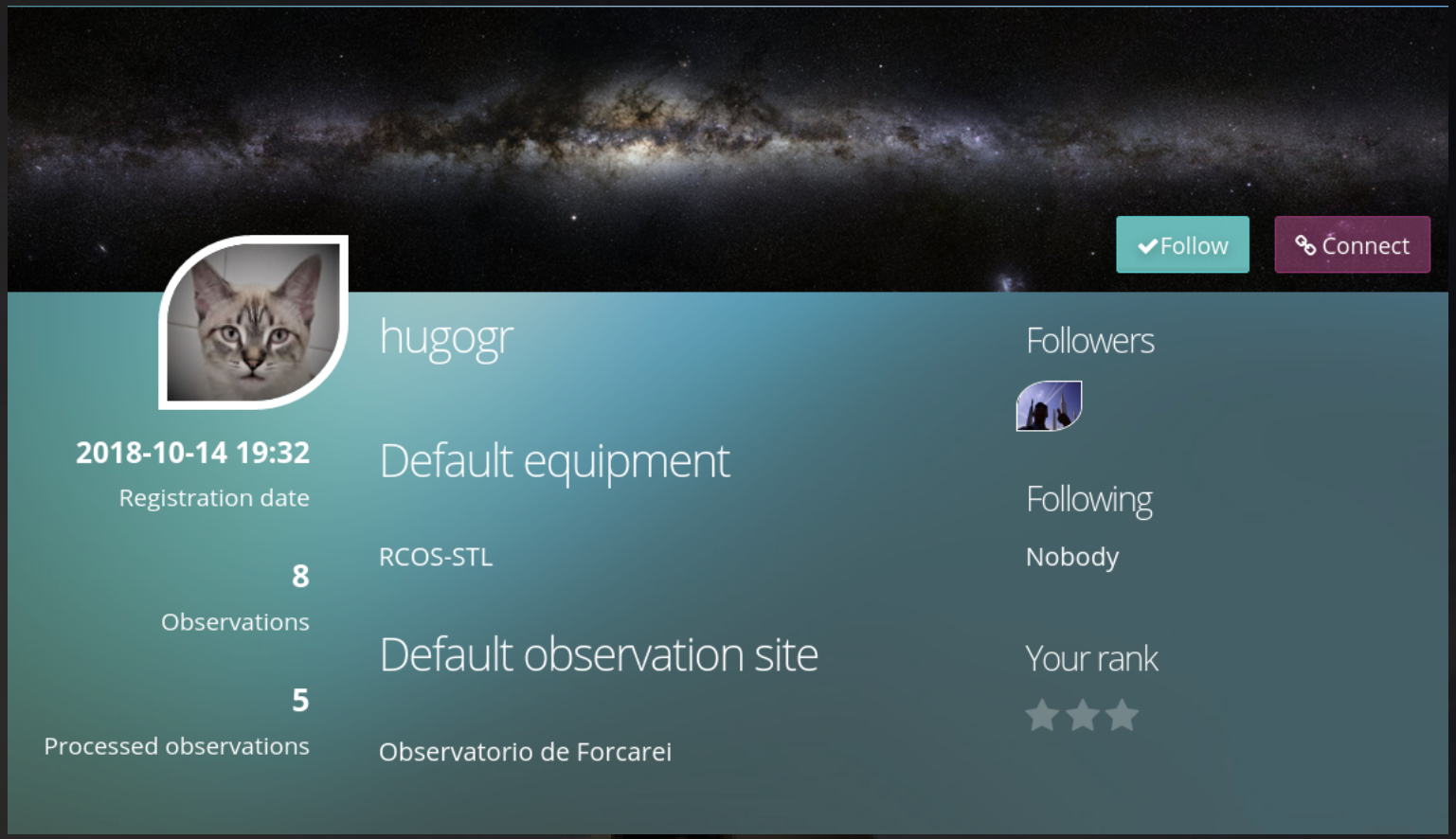

Figure: Observatorio de Forcarei Z62 (Pontevedra).

Telescopi Joan Oró

We have an active project in TJO (p249) to gather photometry of selected asteroids.

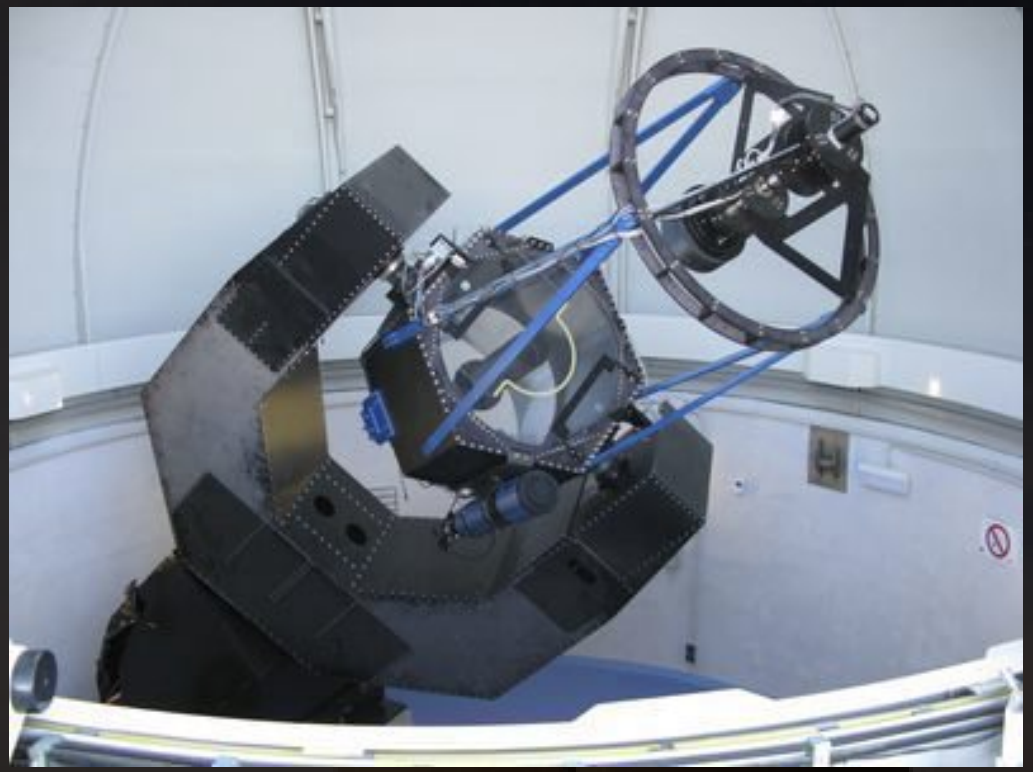

Figure: Telescopi Joan Oró (OAdM).

THANK YOU

NEW GAME

EXIT