Complementary observations of minor bodies for Gaia data

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Working group in Spain

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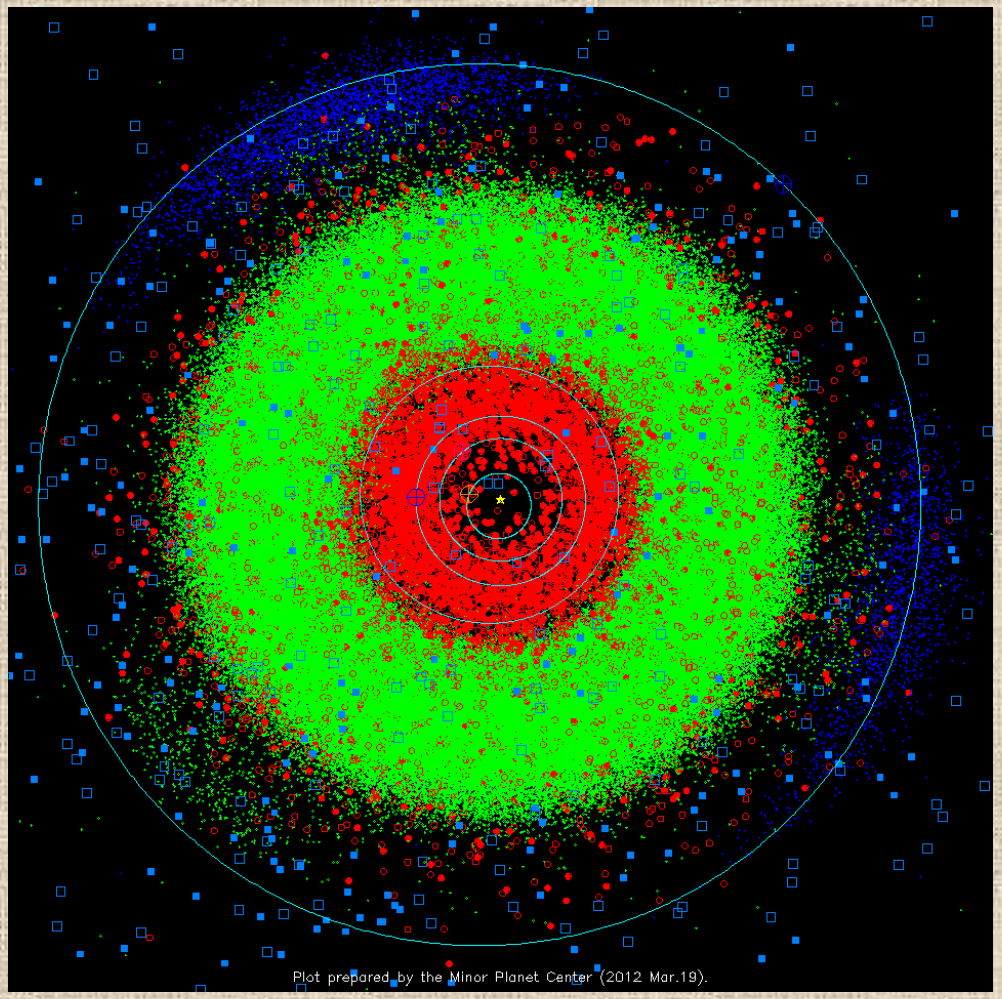
- Jose Luis Ortiz (Granada)
- Adriano Campo-Bagatin (Alicante)
- Javier Licandro (Tenerife)
- The Zaragoza Team (Geli, Javier, Eva)

- Solar System Science before and after Gaia.
- Pisa-Italy, May 2011.

Which objects will observe Gaia in the SS?

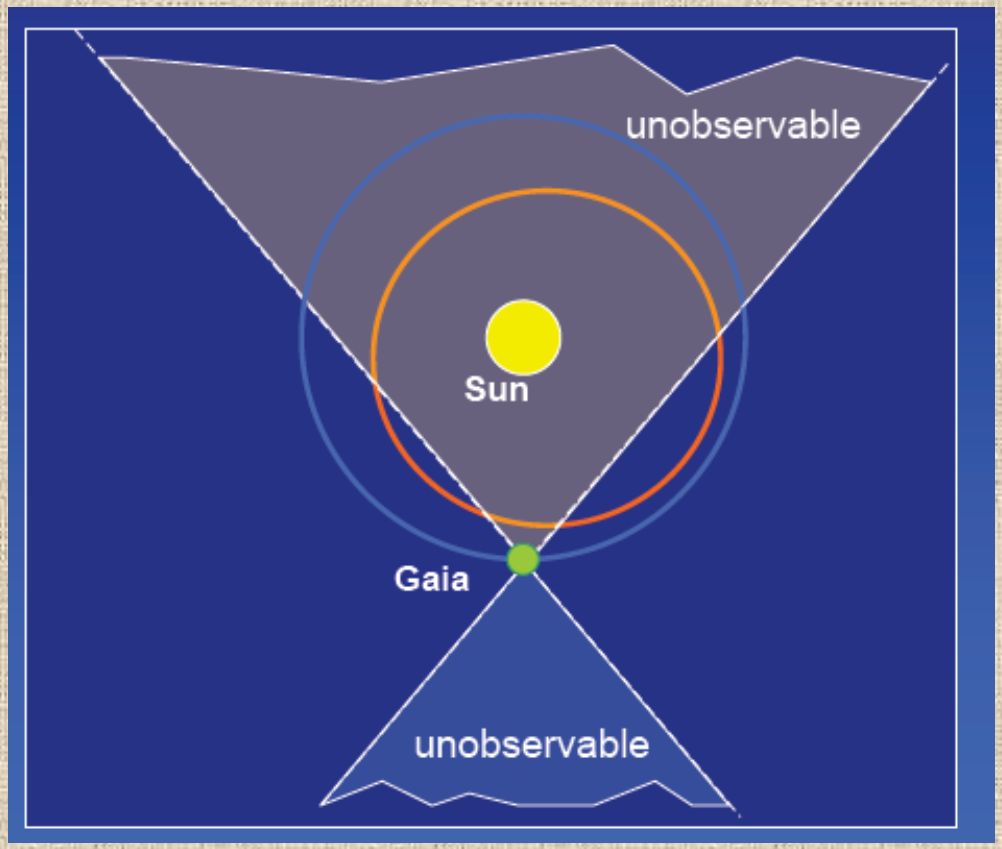


Around 400 000 asteroids
(most known and mainly from the MB)

Several NEOs

Troyans, Centaurs and some TNOs

Observable region on the ecliptic

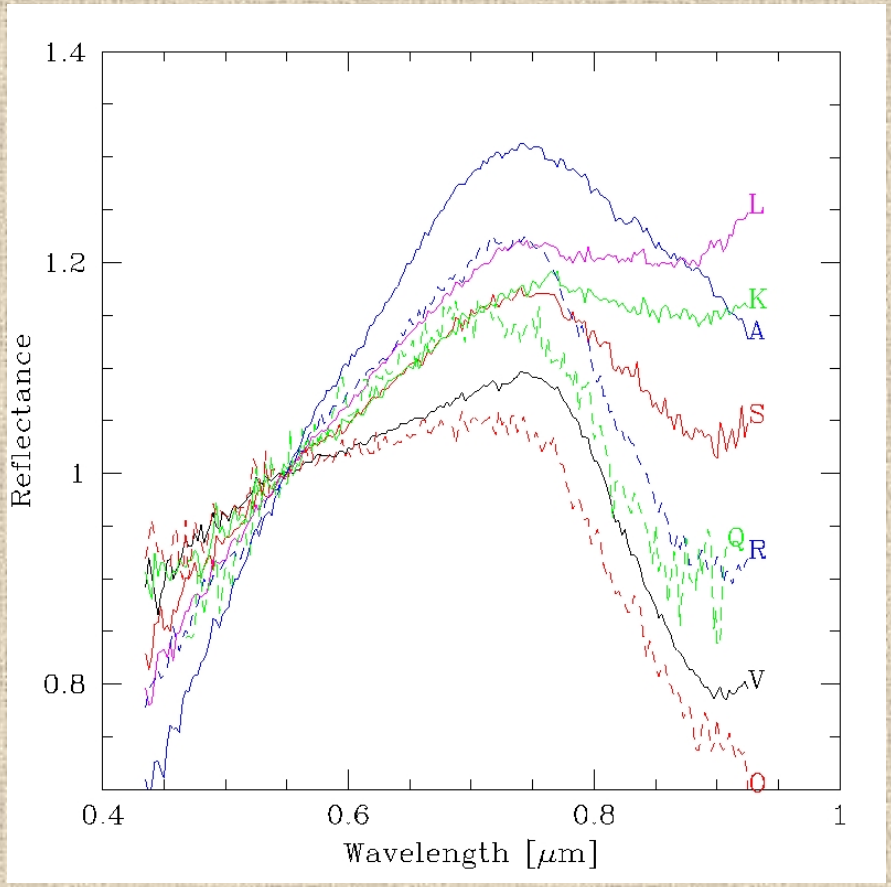


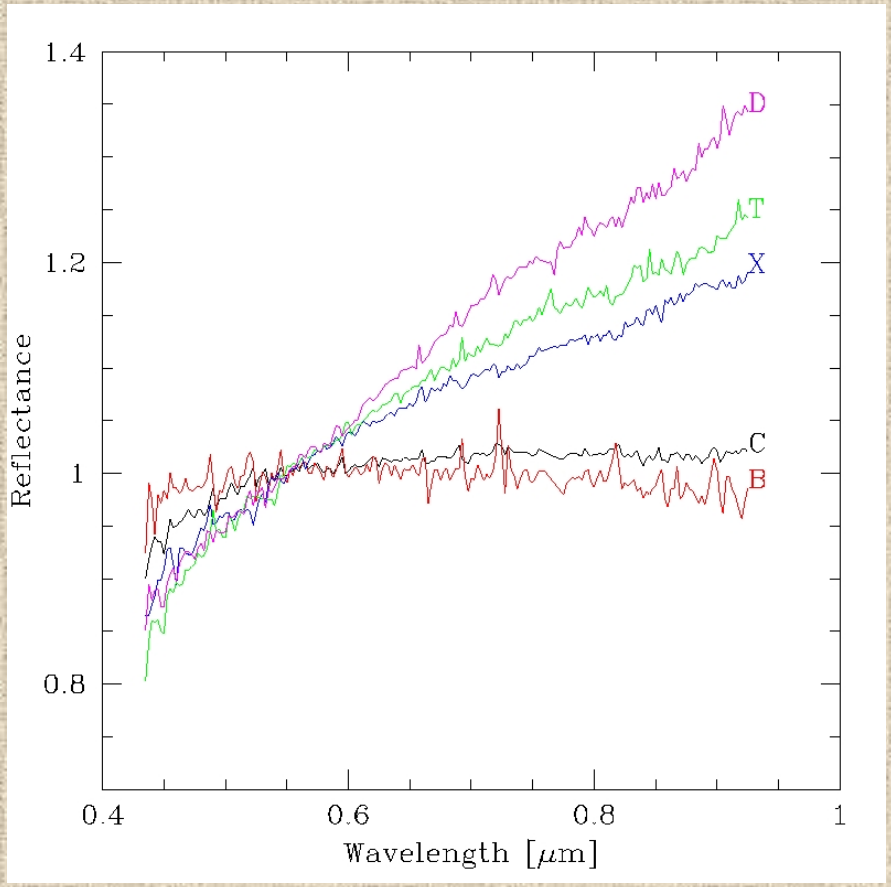
Small phase angle

~ 60 detections/asteroid in
5 years for the MB asteroids

1 SSO in the FOV each/sec

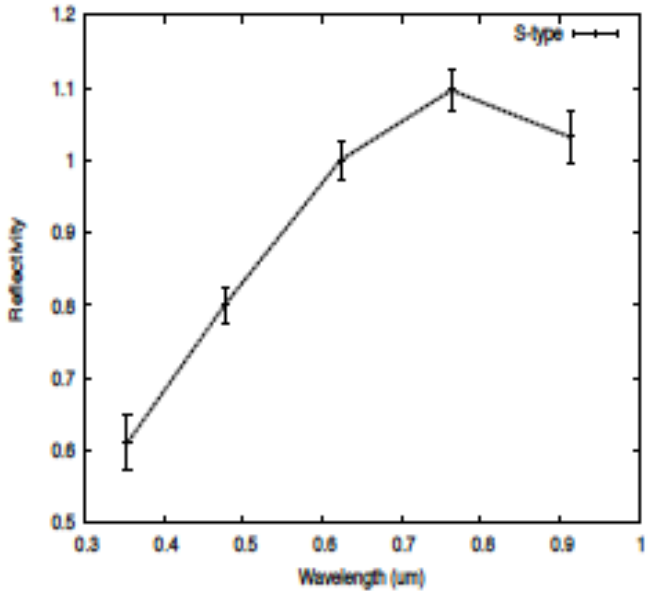
Small body spectroscopy

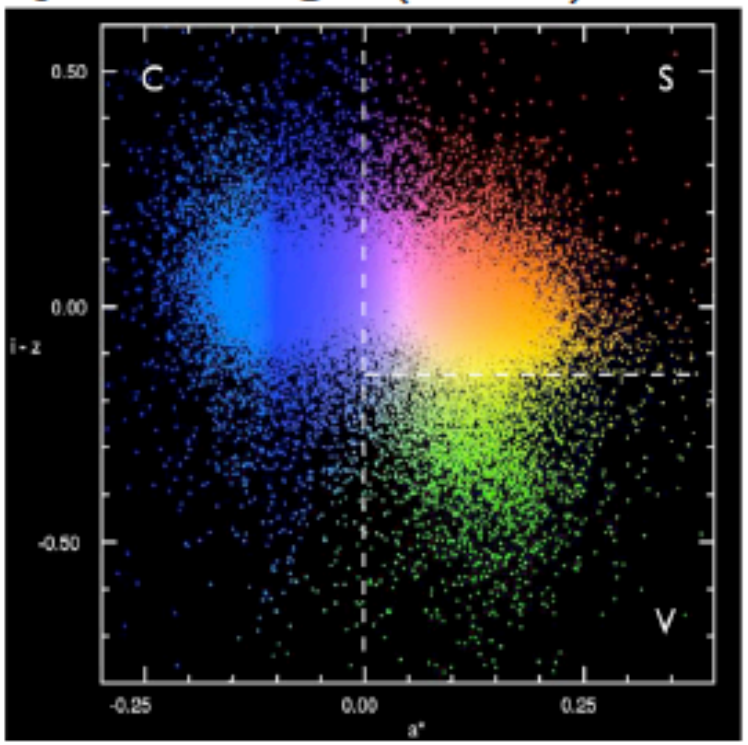




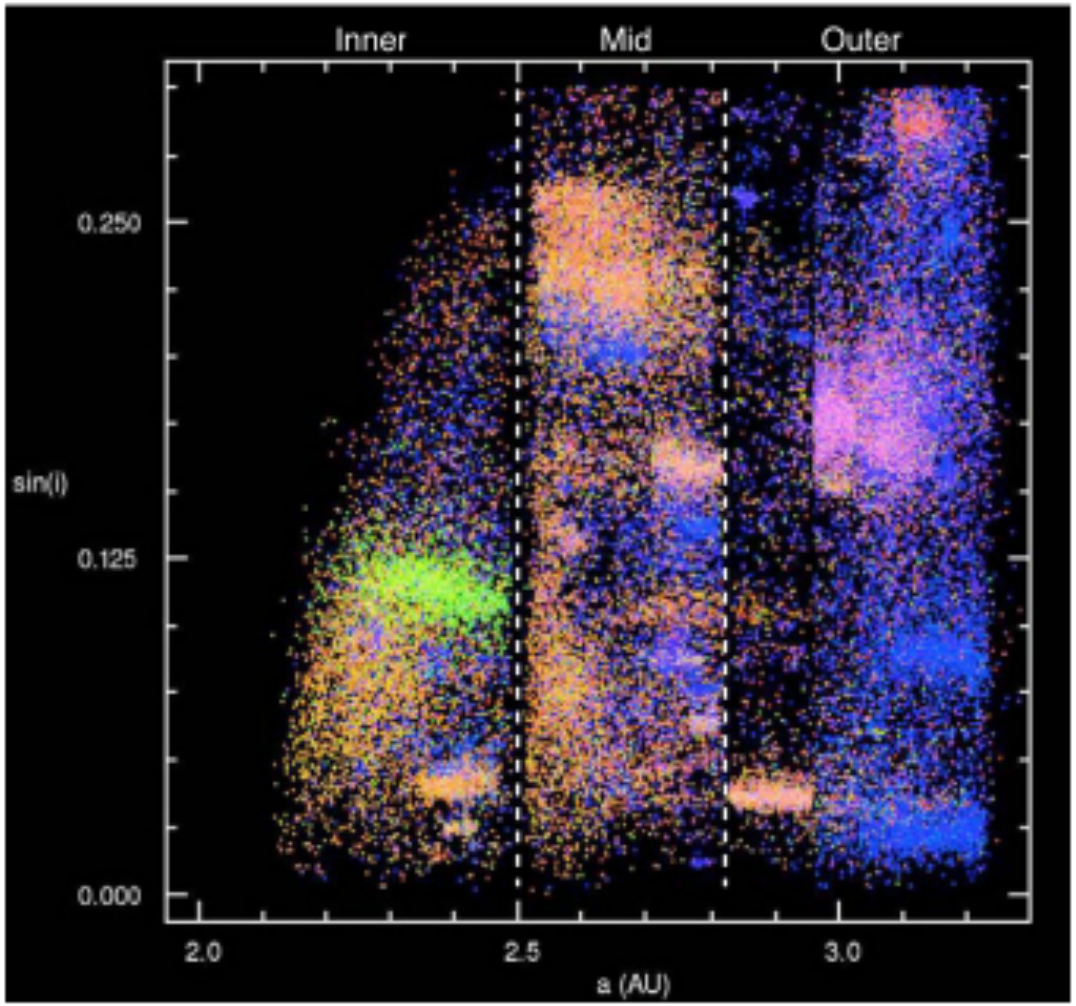
Sloan Digital Sky Survey (SDSS); Parker et al.

SDSS: color photometry of more than 100,000 asteroids.
Example from the SDSS Moving Object Catalog 4 (MOC4).

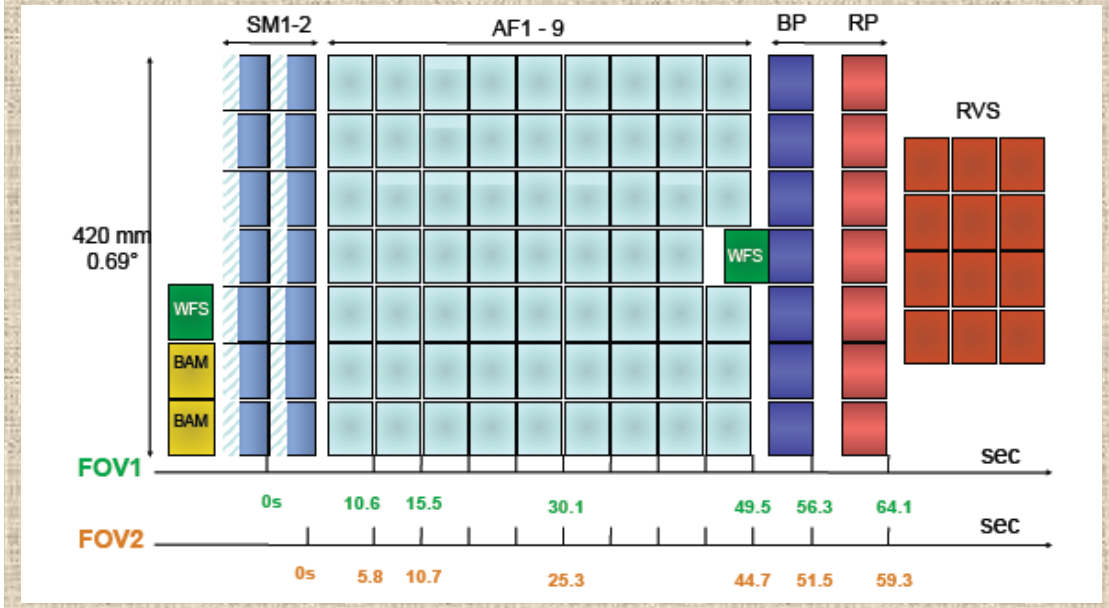


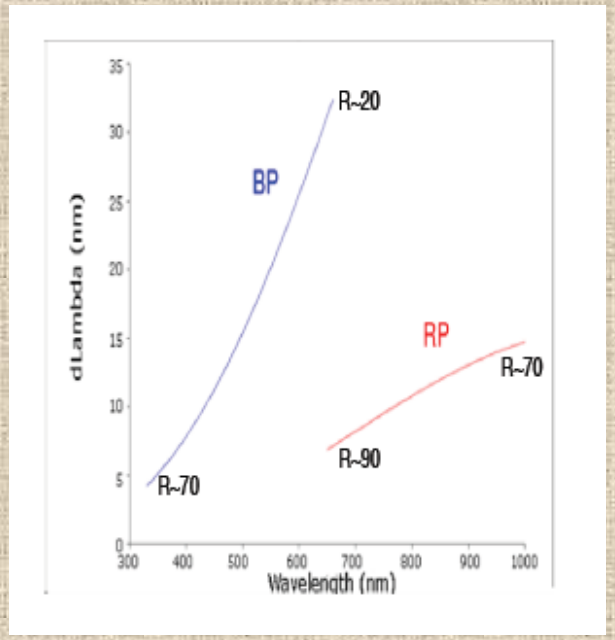


bands: u':354, g':477, r':623, i':763, z':913 (mn)
with $a^* = 0.89(g' - r') + 0.45(r' - i') - 0.57$.

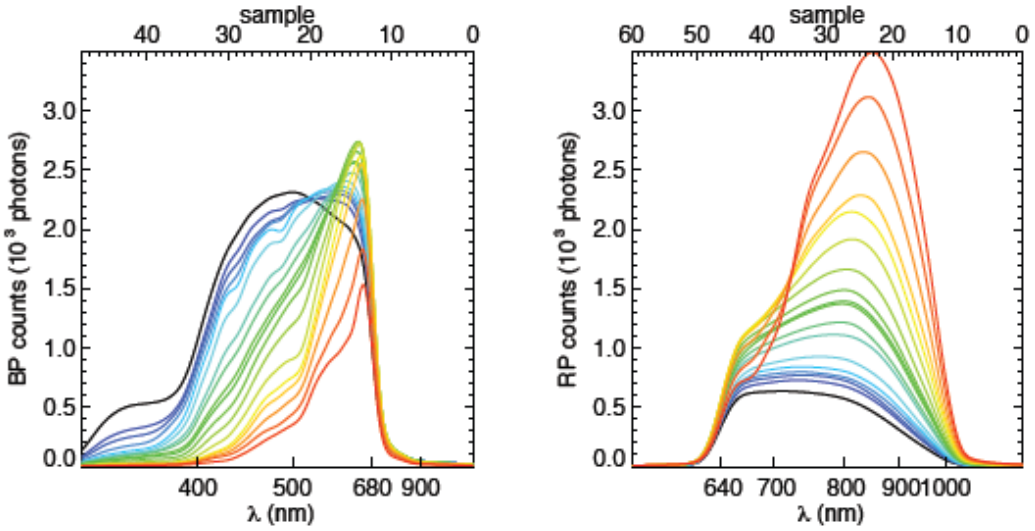


- Taxonomic classification of asteroid families
- Spectral comparition between NEOs and MB asteroids. Information on origin, families, dynamical path, etc.

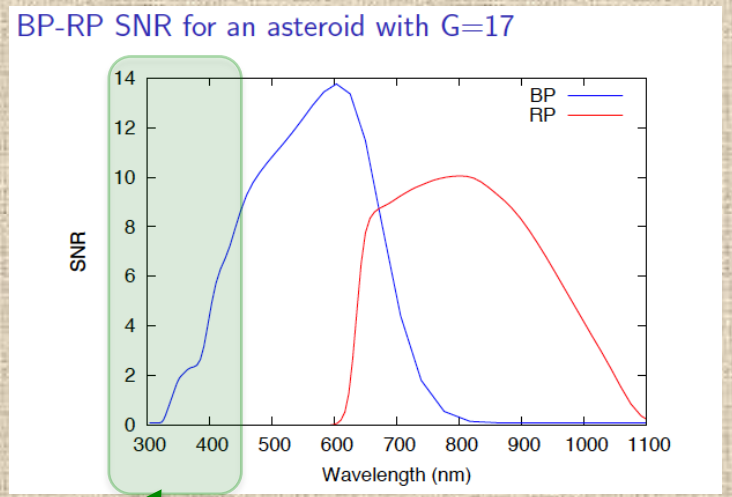




G=15 point source with different colors.

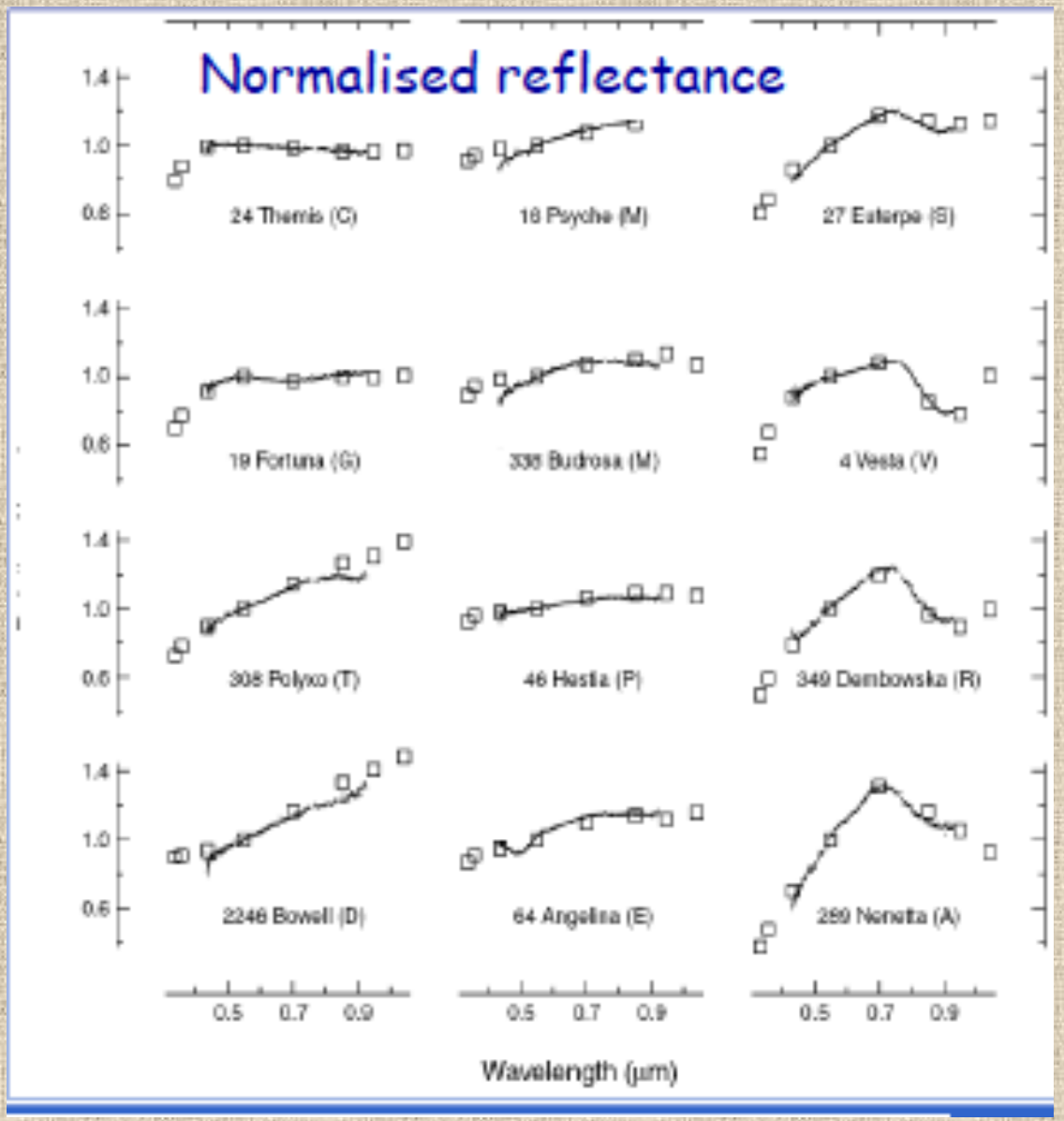


BP-RP SNR for an asteroid with G=17

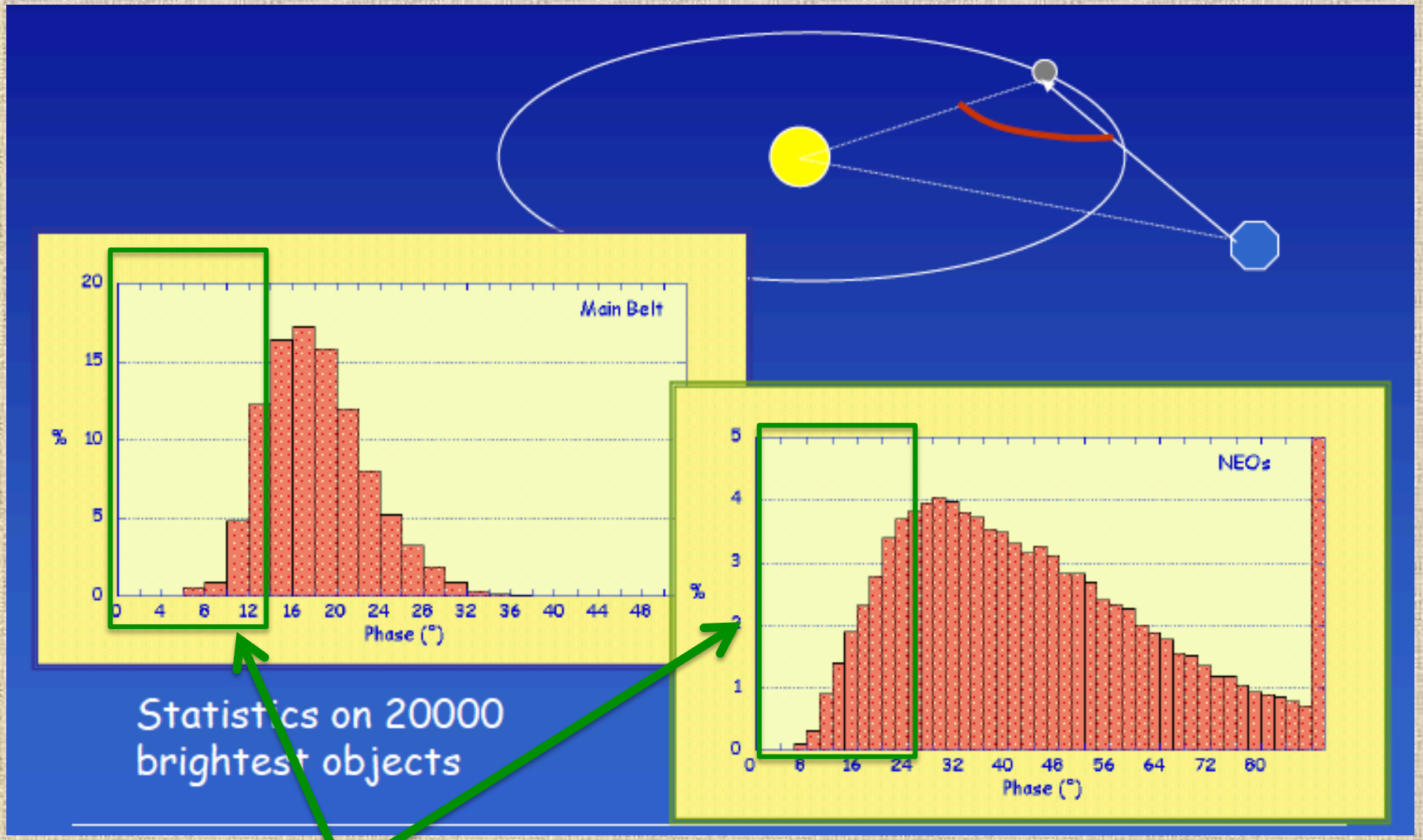


Important part – No observations from ground

- Gaia special features:
  - High solar elongation
  - Blue spectrum coverage
  - Several “bands”
  - → Preliminary investigation on earth-based observations



Small body Photometry: Phase Angle

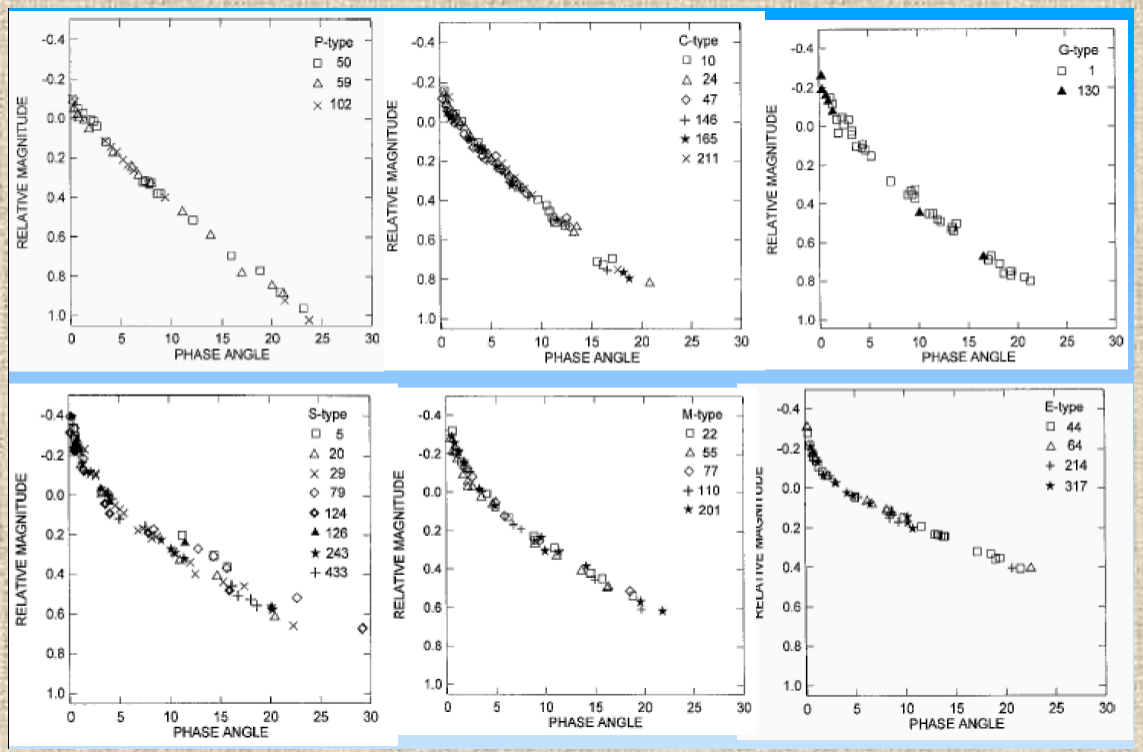


Need observations from Earth

The importance of the phase angle

$$\log(D) = 3.1236 - 0.2H - 0.5\log(albedo)$$

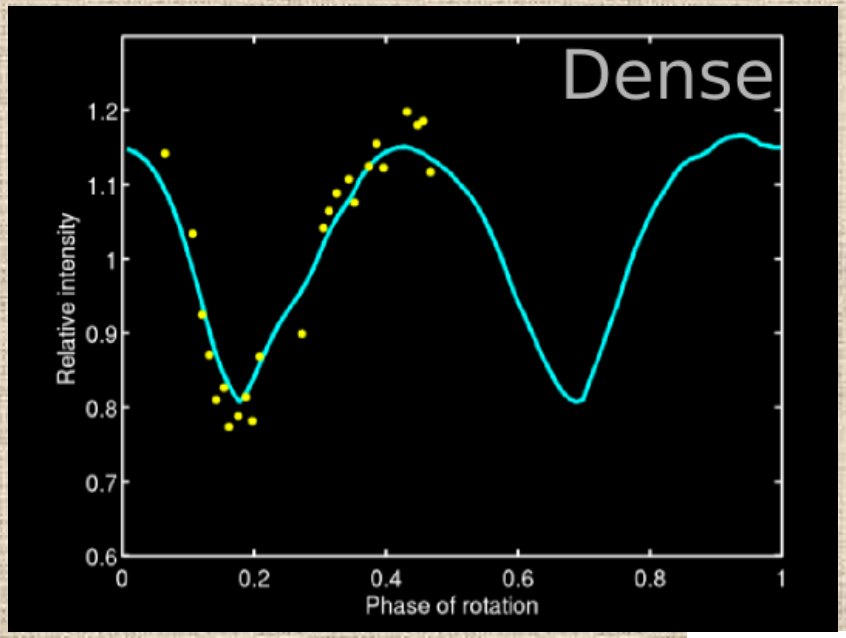
Shape information from photometric inversion

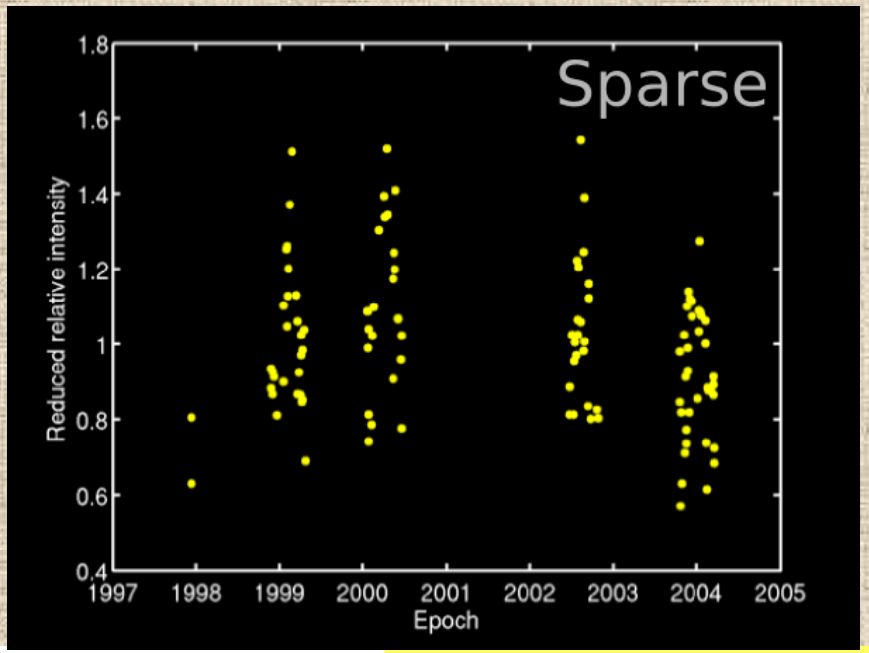


Albedo for ~1000 objects

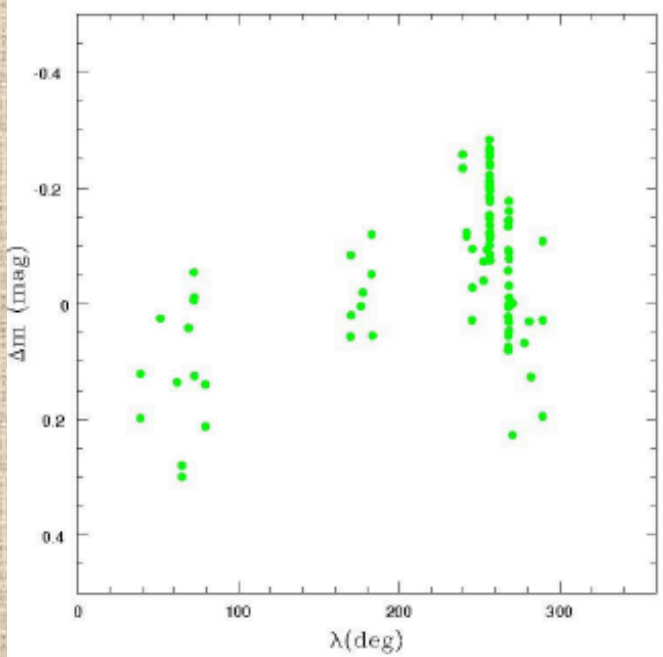
Need the Groundbased observations

Photometry II





Need GB observations
to relate
Dense → Sparse



GAIA disk-integrated photometry

Sparse photometric measurements (no light-curves)

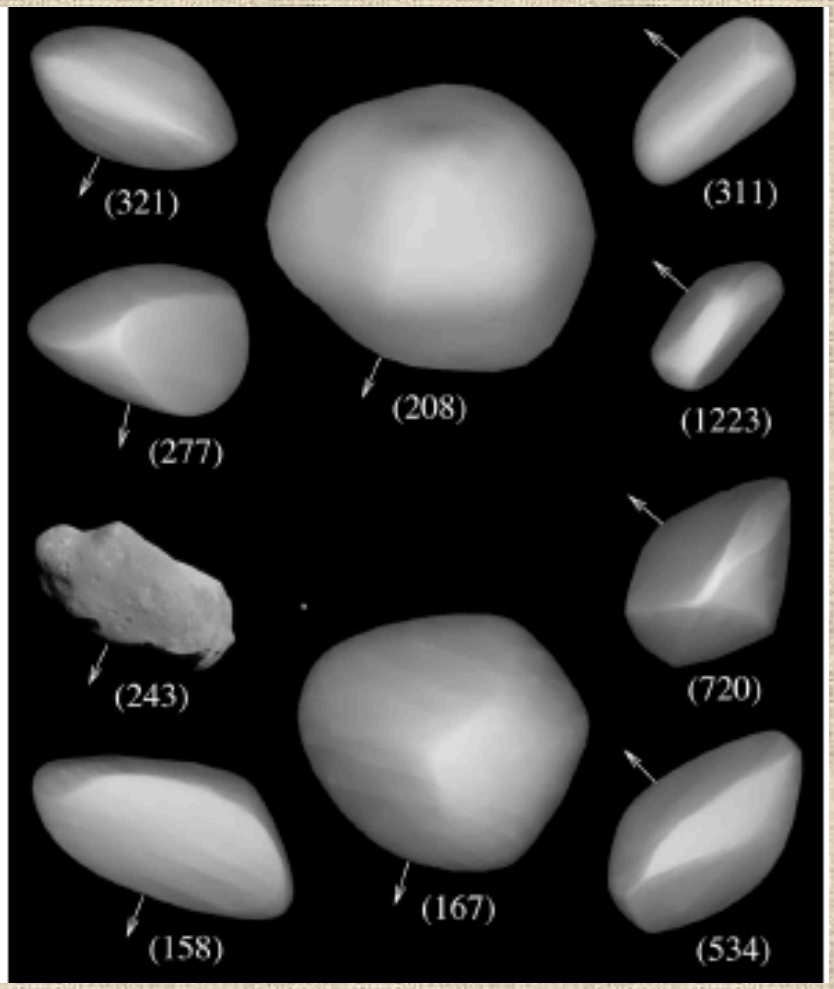
Good coverage of aspect angle variation over five years (65 observations per object, on the average).

Simulations of Gaia observations of (15) Eunomia

We expect to find solutions (poles, periods and axial ratios) for no less than 10,000 asteroids (maybe many more).

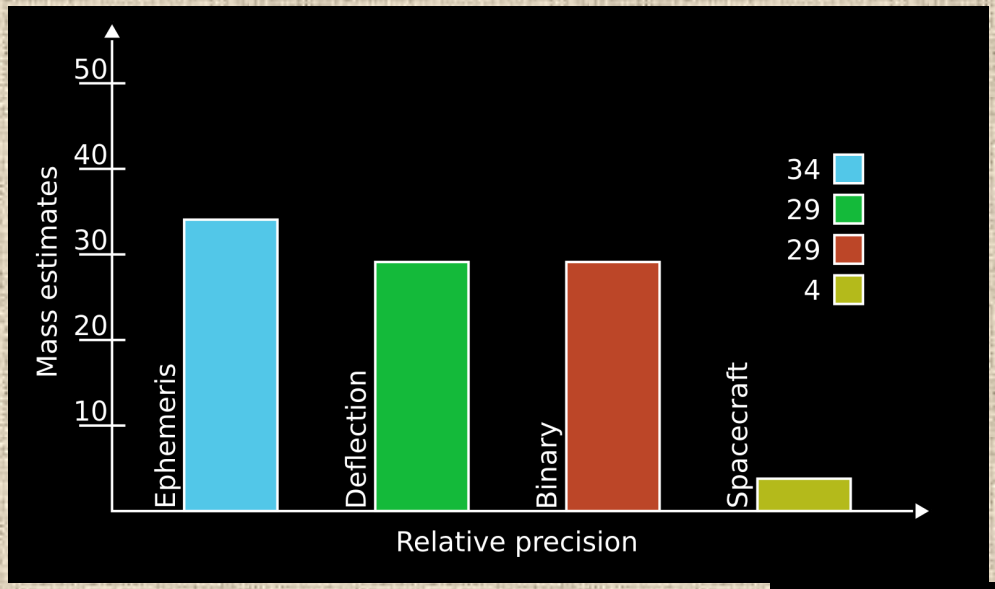
General application: Spin properties as a new, important constraint to modern models of the collisional evolution of Main Belt asteroids.

Specific applications: (1) test of the existence of possible preferential alignments of the spin axes of family members, possibly due to YORP effect.

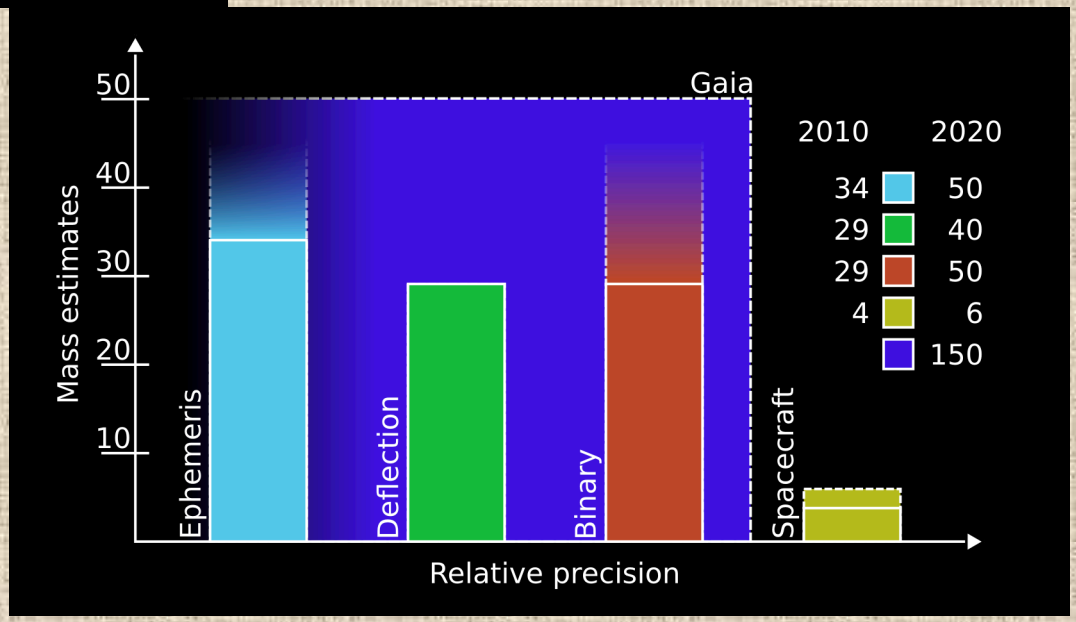


The Zaragoza team is working on this problem

Mass and densities



We need GB observations to
Determine a limit in
density (from lightcurve)



In Sumary

Before GAIA

- Phot. Obs.: small phase angles
- Phot. Obs.: Light-curve → Shape → densities
- Spec. Obs.: UV observations (previous talk)

After GAIA

- Masses and average densities measured for ~100 objects
- Sizes directly measured for ~1000 objects
- Spin properties and general shapes of thousands of objects
-New taxonomy of a large sample of the population. Implications for the original gradient in composition of the SS, for the dynamical diffusion and collisional mechanisms.

Needs BEFORE/DURING Gaia

- Telescope Time at CAHA and ORM
- Define a Guarantee time for GAIA ?
- Use the Spanish Guarantee time as in CAHA.

Needs AFTER Gaia

Telescope Time at CAHA (HEXA) and ORM Phot. Observations also to do the follow-up of the obtained GAIA data