Surveillance and opportunities for observing Near-Earth Objects

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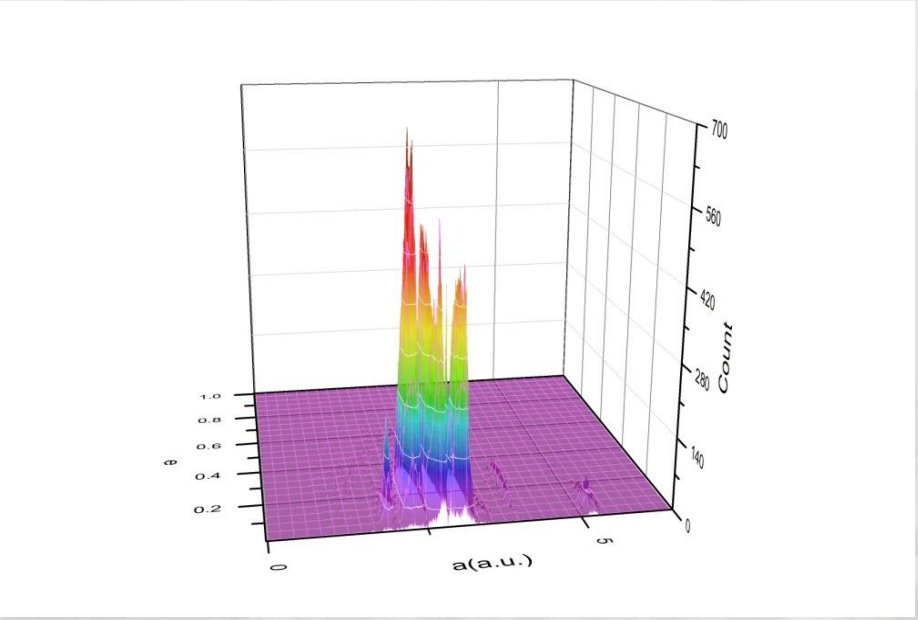
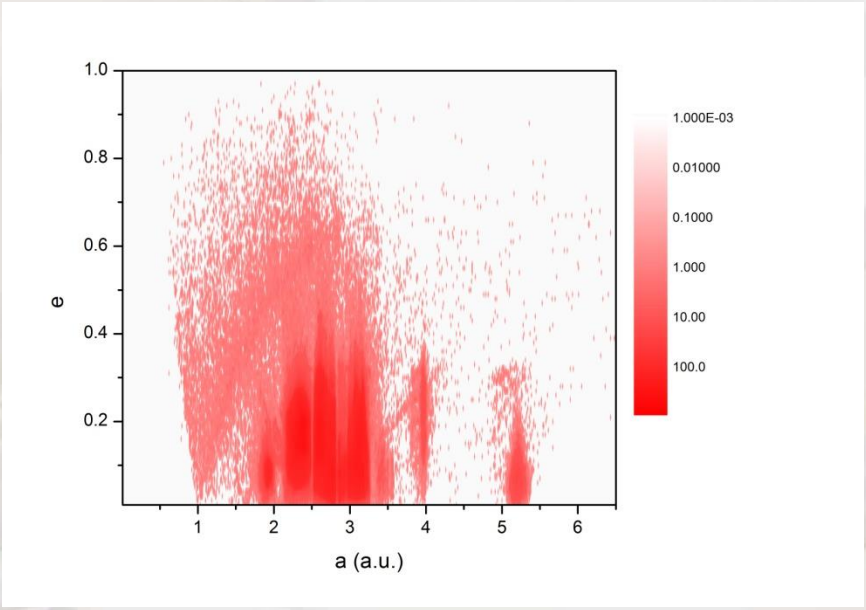
4) Laboratoire d'astrophysique de Marseille, France

Asteroid population

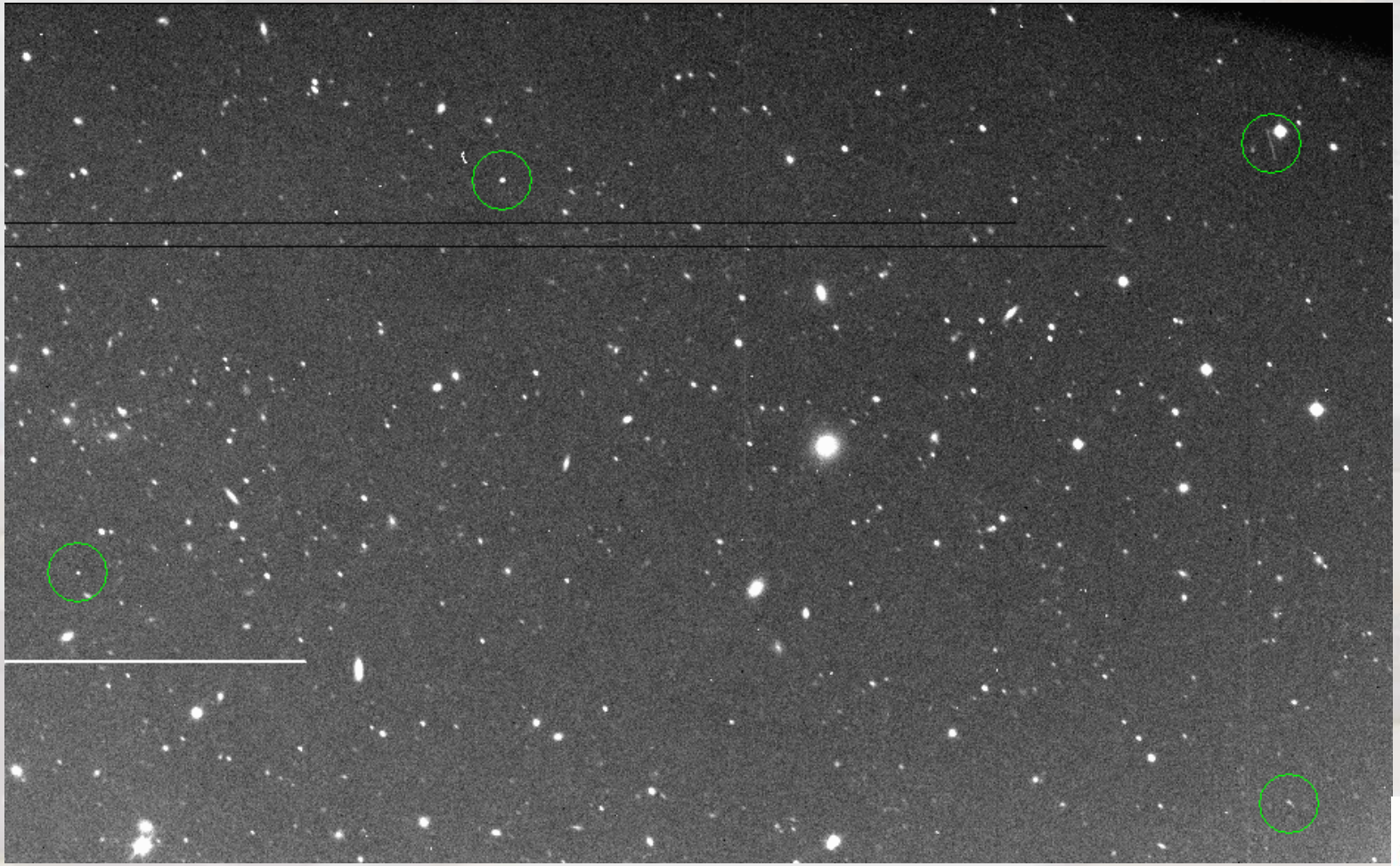
- More than 790,000 objects (779,833 MB in May 31, 2018)
- 13,800 Near-Earth Asteroids (NEA),
- ~1,200 Potential Hazardous Asteroids (PHA)





~10% of NEA population with known spectral trends (1,400 objects)

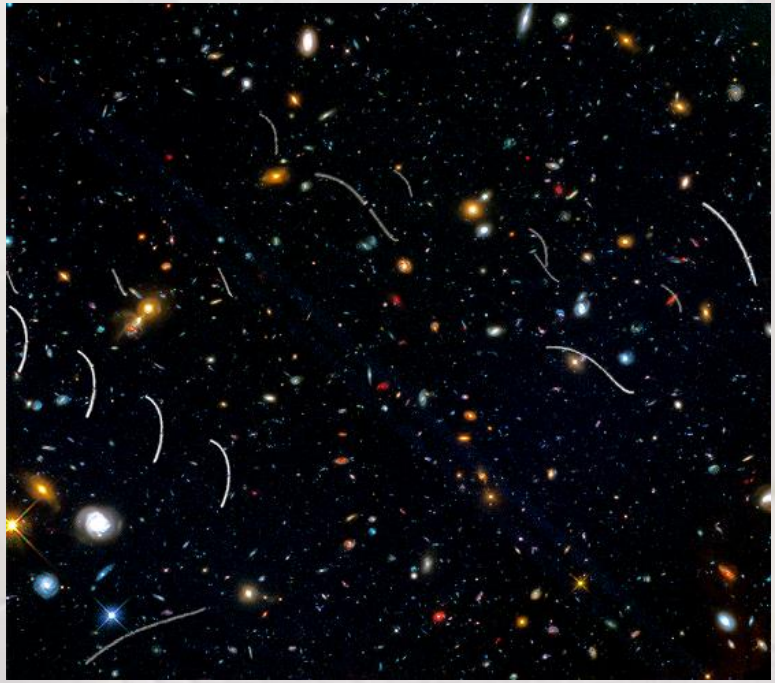
Discover an asteroid- short opportunities for NEA



Credit:

Constraints NEAs

- Geometries of observations - only few/century
- Tight windows (hours to few weeks)
- Asteroids – vermin in the sky?
- Need to secure orbit and to maximize data for physical characteristics
- Need coordinated campaigns of observation.



Copyright HST

Initiatives over Europe

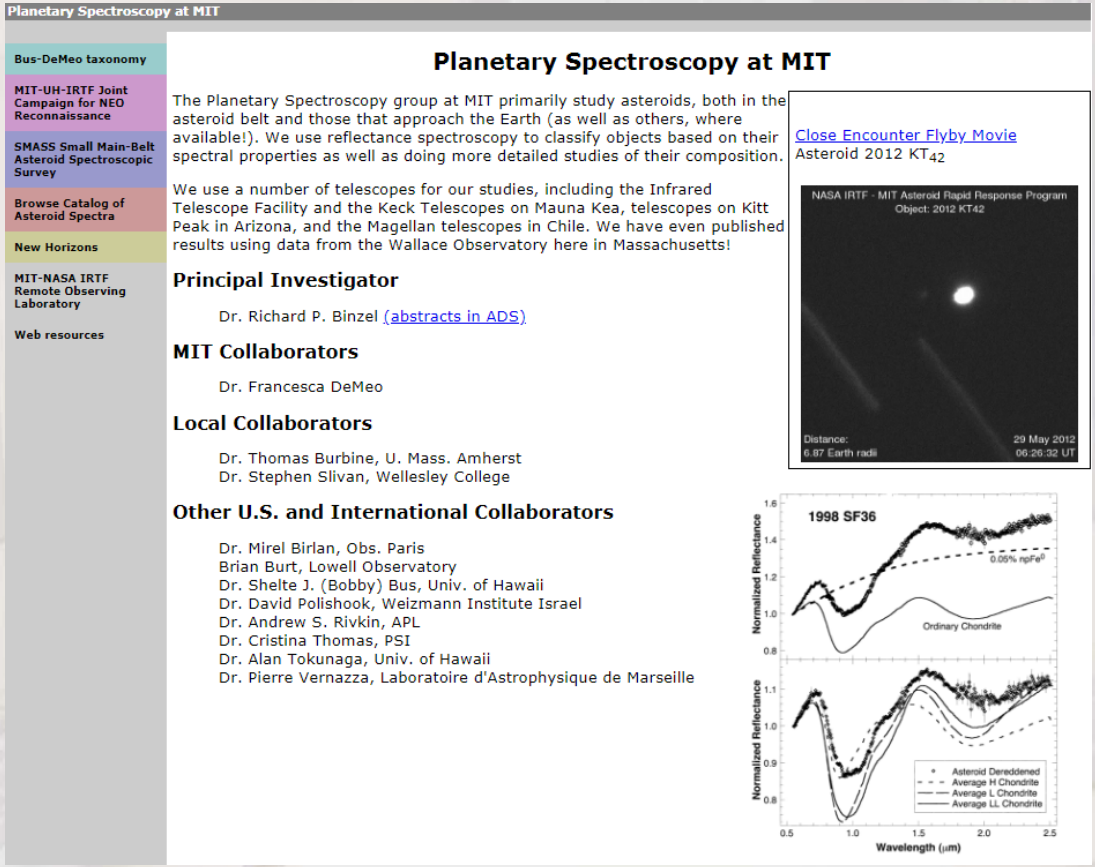
- Astrometry, photometry, spectroscopy

- Photometry, spectroscopy of a short list NEAs

- Astrometry, recovery, secure orbits, natural risk evaluation

Campaigns

- How quick is the Quick response for a medium/ large telescope?



Our campaigns for NEAs

- Pic du Midi, France

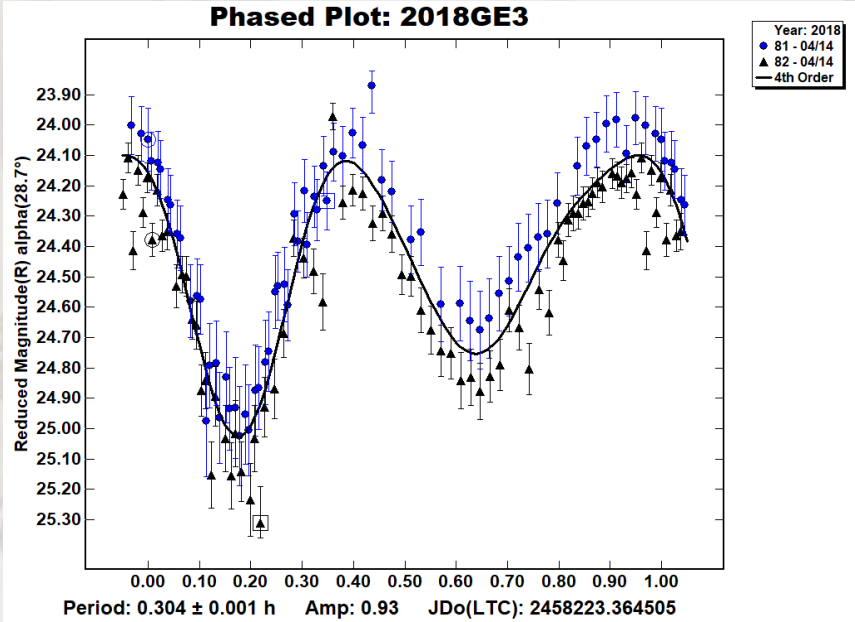
1meter telescope

- Bucharest, Romania

0.4meter telescope

2018 GE

- Observed in April 14, 2019 (0.005AU from Earth) from Bucharest (0.38 m f/8 Ritchey-Chretien, SBIG STL-11000M)
- Astrometry reported to MPC
- Psyn = 18.24 min, A=0.93 ± 0.03



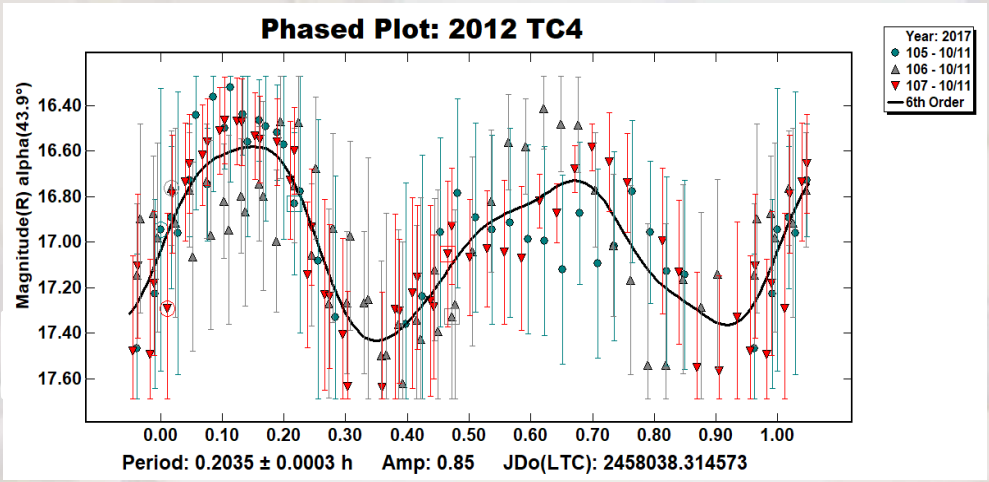
Gornea et al 2018, submitted

2012 TC4

- Graze the Earth at 50,151km in October 12, 2017
- Recovered in August 2017 by FORS2-VLT « the faintest NEA ever measured » (m_{app}=27)
- Observed in October 10 & 11, 2017 from Bucharest

2012 TC4 – Fast rotator

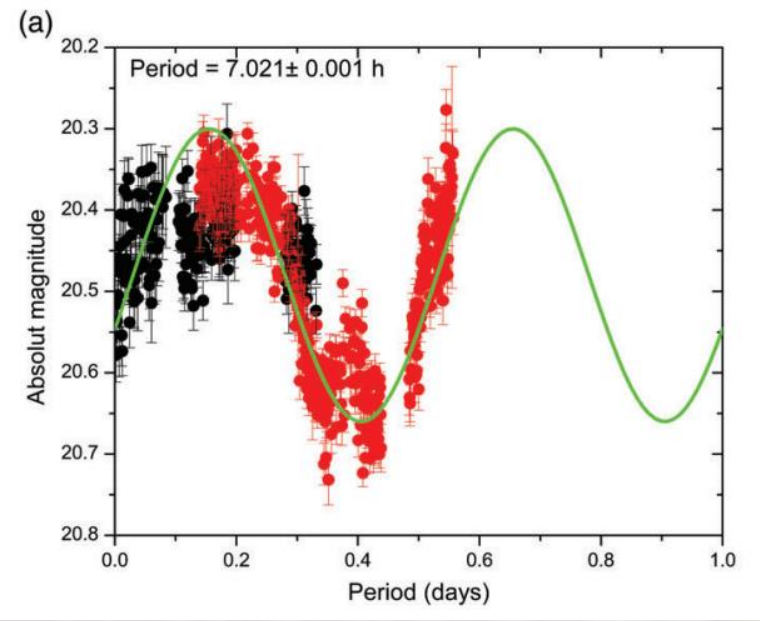
- P_{syn}=12.18min (compatible with the literature)
- D=17-26meter (albedo=0.15)

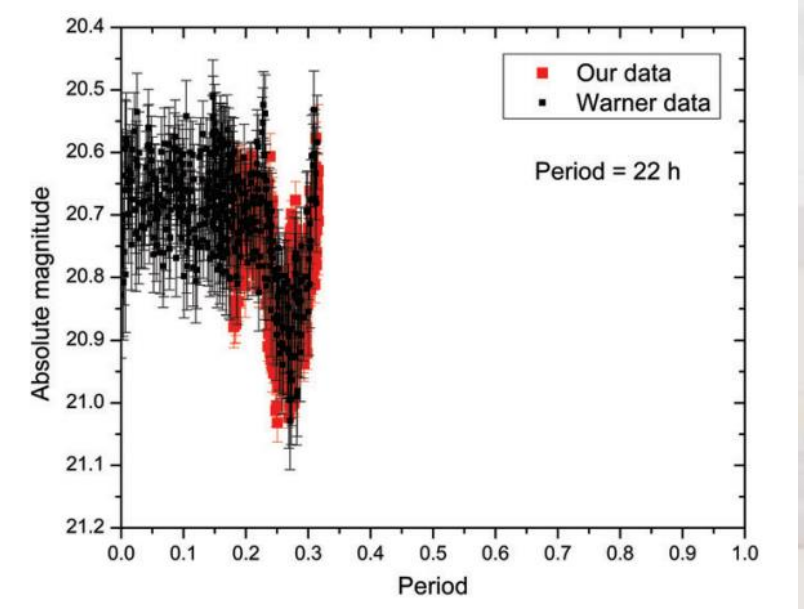


Sonka et al RoAJ, 2017

Colors and lightcurves from Pic du Midi

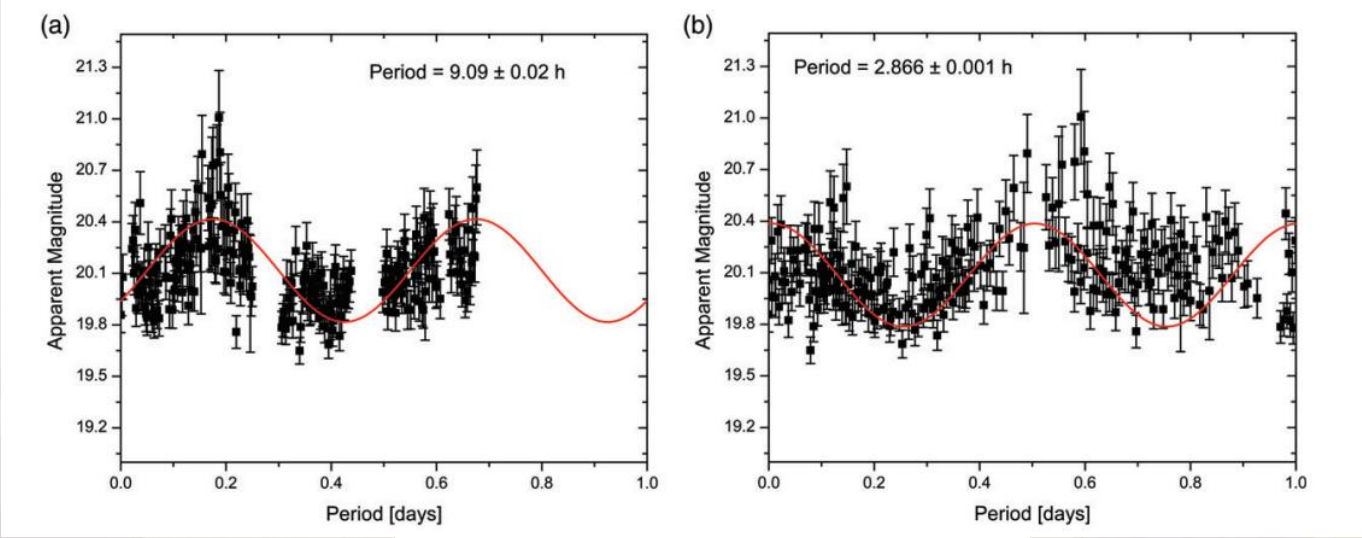
- (363599) 2004 FG_{11} and the necessity of observations in network over longitudes



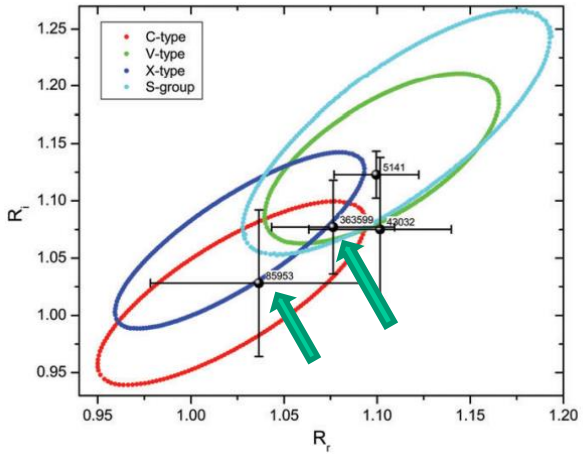


Colors and lightcurves from Pic du Midi

- (259221) 2003 BA_{21}



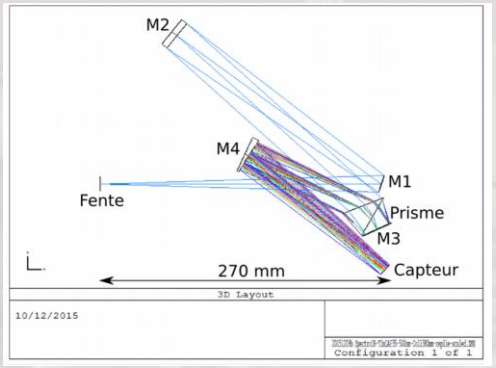
SDSS data (g-r), (g-i) plot

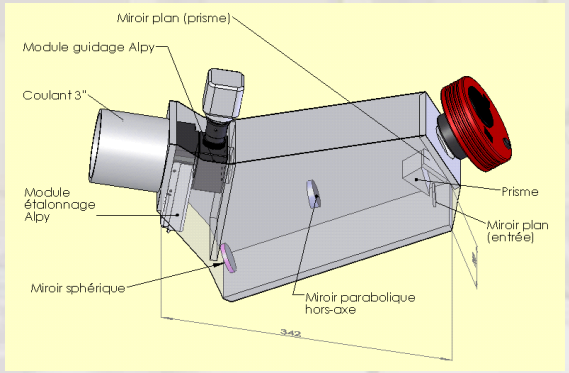


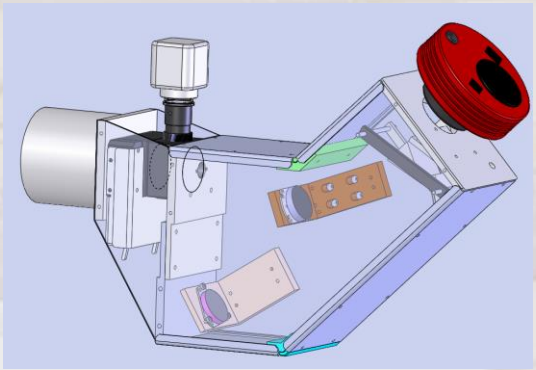
Dumitru et al, AstronNach, 2018

SOVAG- New facility for NEAs in Pic du Midi

- Spectrograph Visible + NIR (0.5-1.6 µm)
- Single order spectrum R=100-280
- Take profit of miniaturisation for hyperspectral cameras

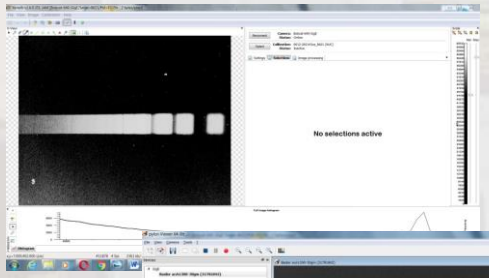


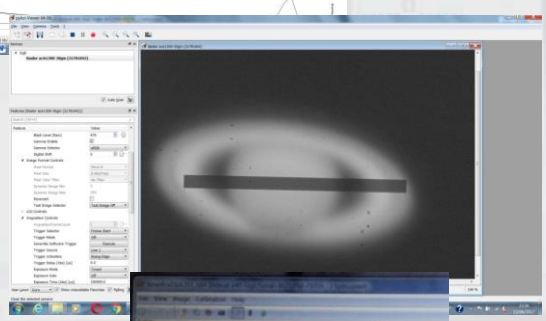


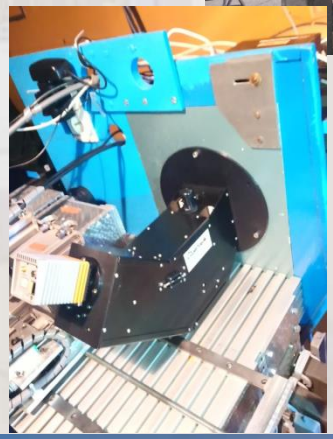


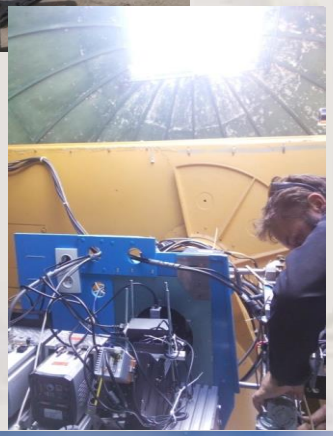
Laboratory and on-site calibration

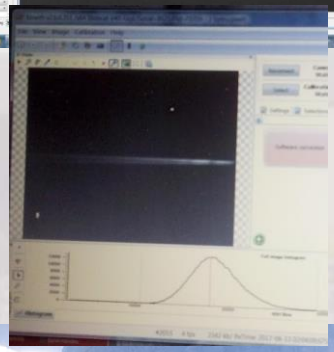
Ne lamp



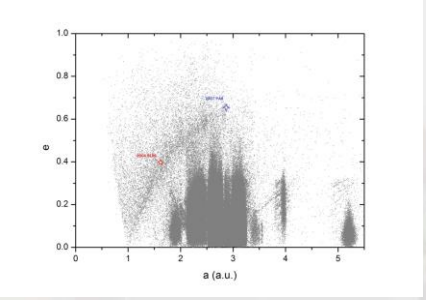








- First light - Fall 2018

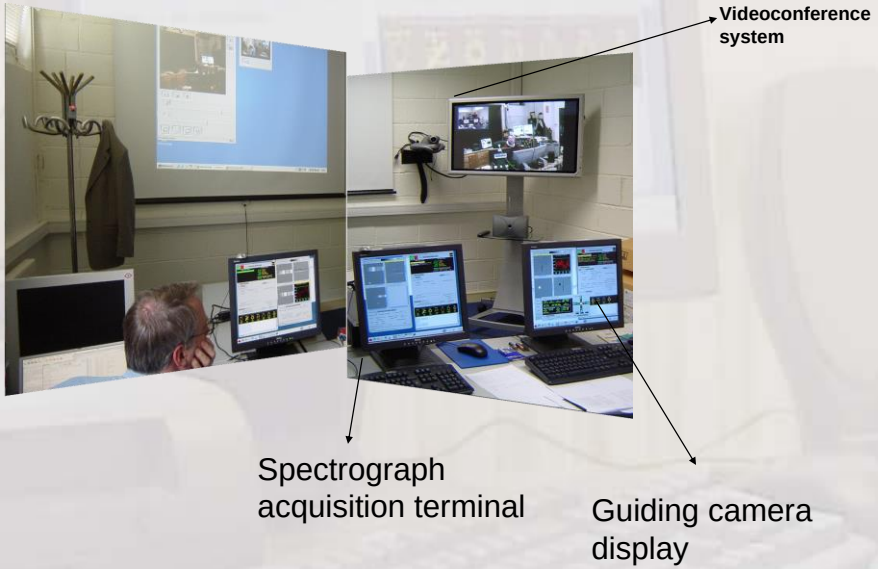


2004 BL86

- Grazed the Earth : Jan 26, 2015
- Distance: 1.2 million km.
- Discovered in 2004 (LINEAR program)
-Estimated diameter: 500m
-Arecibo radar : binary object

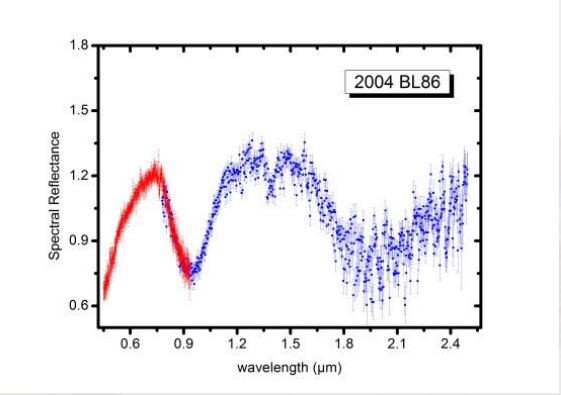
Physical properties

Usually observations using 3m diameter facilities: IRTF (Hawaii) & INT (Canarias Islands) operated remotely from Paris Observatory (CODAM) or Bucharest-Astronomical Institute (ROC).



CODAM

ROC



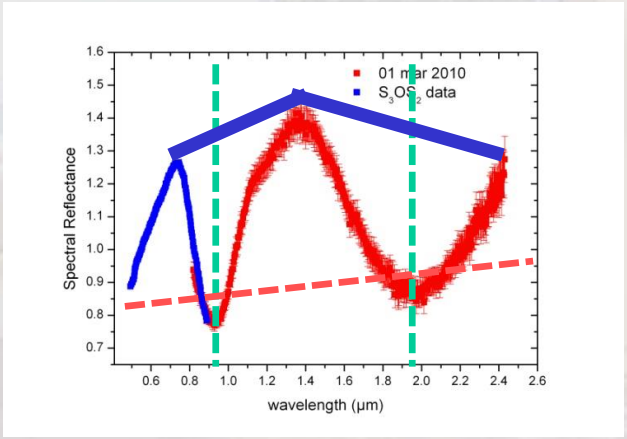
2004 BL86 Analysis

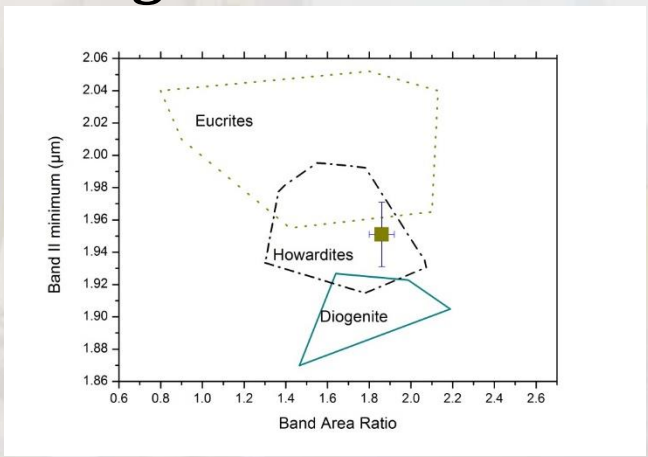
Runs in Feb 6 & 7, 2015, first spectrum of this PHA (INT/Vis + IRTF/Nir)

- BL86 is V-type asteroid

Mineralogical analysis: 2004 BL86 has a basaltic mineralogy

Thermal albedo of BL86 help in deriving a diameter of 290 ± 20 m.





Next favorable observation of 2004 BL86 in 2050!

(Birlan et al, A&A, 2015)

Asteroid Event of the Decade –

A “close shave” 5 times larger than the Tunguska body.
100 times more massive.

Slides From Richard Binzel (MIT)

Credit: M. Birlan (IMCCE, Paris)

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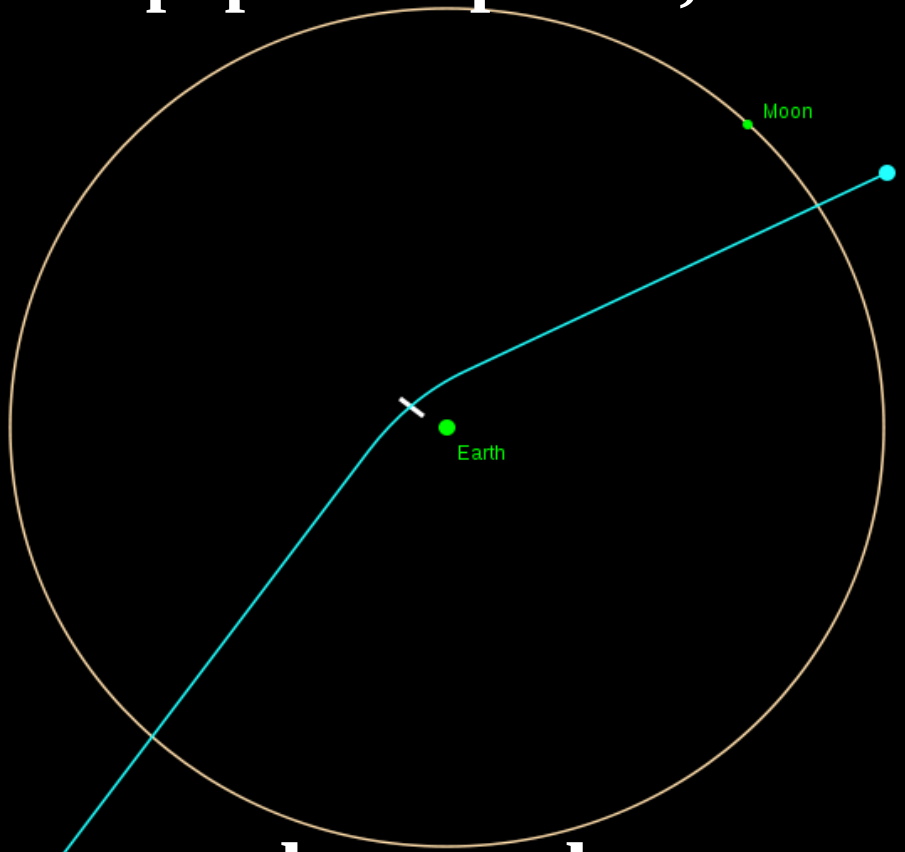
Apophis: April 13, 2029

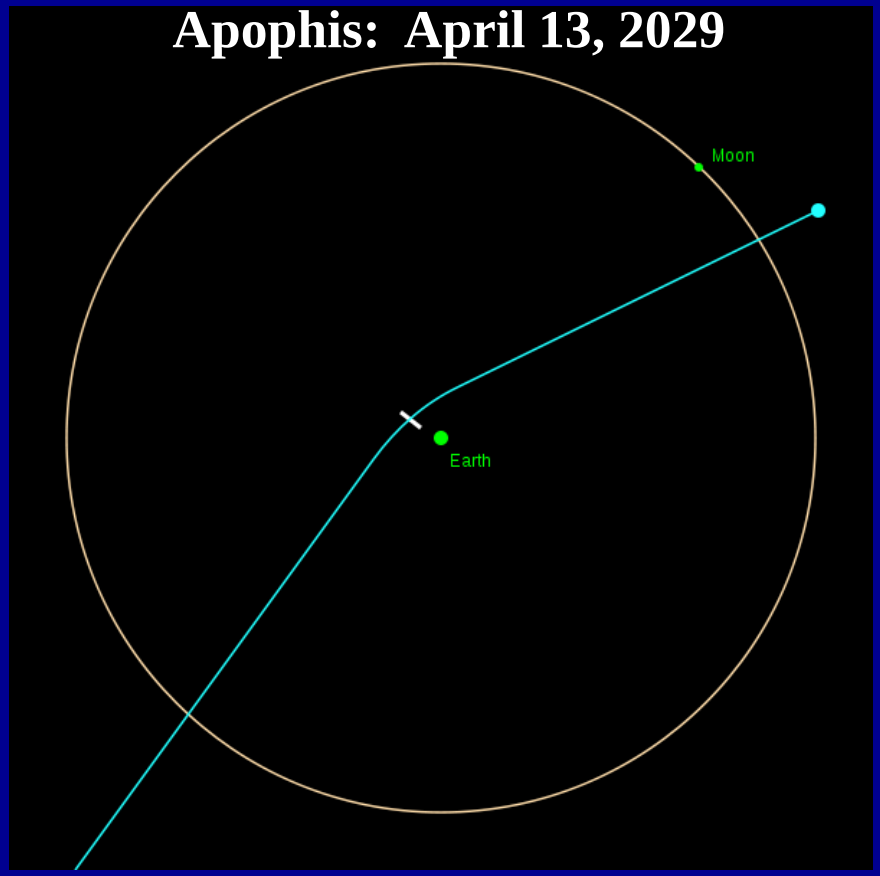


Credit: P. Chodas (JPL)

Once per thousand year event:

350m asteroid within 6 Earth-radii

Decadal opportunity for science and for informing Planetary Defense.



Encounter will alter Apophis' orbit and spin, but other physical effects are less sure.

Scheeres et al. (2005)

Itokawa landslides

Miyamoto et al. (2007)


nature International weekly journal of science

LETTERS

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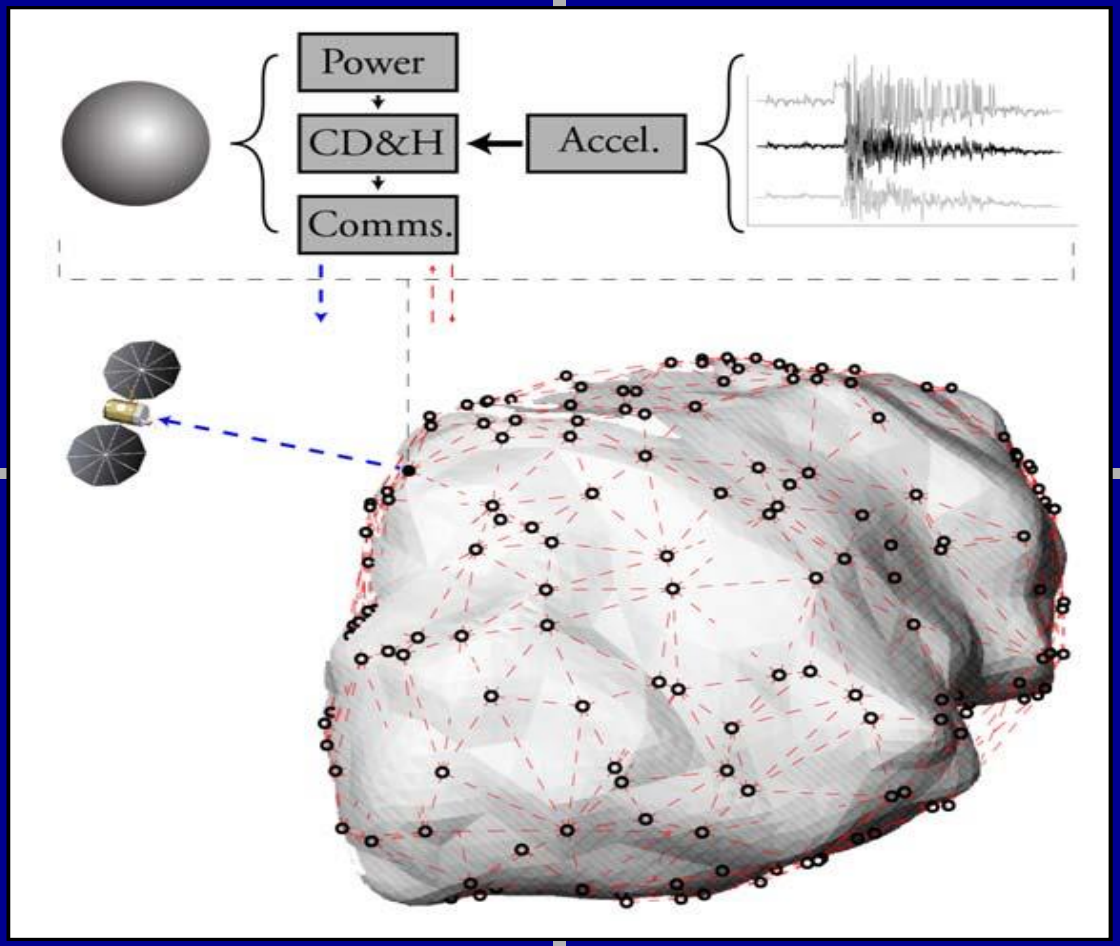
Earth encounters as the origin of fresh surfaces on near-Earth asteroids

Richard P. Binzel[1,2], Alessandro Morbidelli[3], Sihane Merouane[4], Francesca E. DeMeo[4], Mirel Birlan[2], Pierre Vernazza[5], Cristina A. Thomas[6], Andrew S. Rivkin[7], Schelte J. Bus[8] & Alan T. Tokunaga[8]

"Fresh" resurfacing?

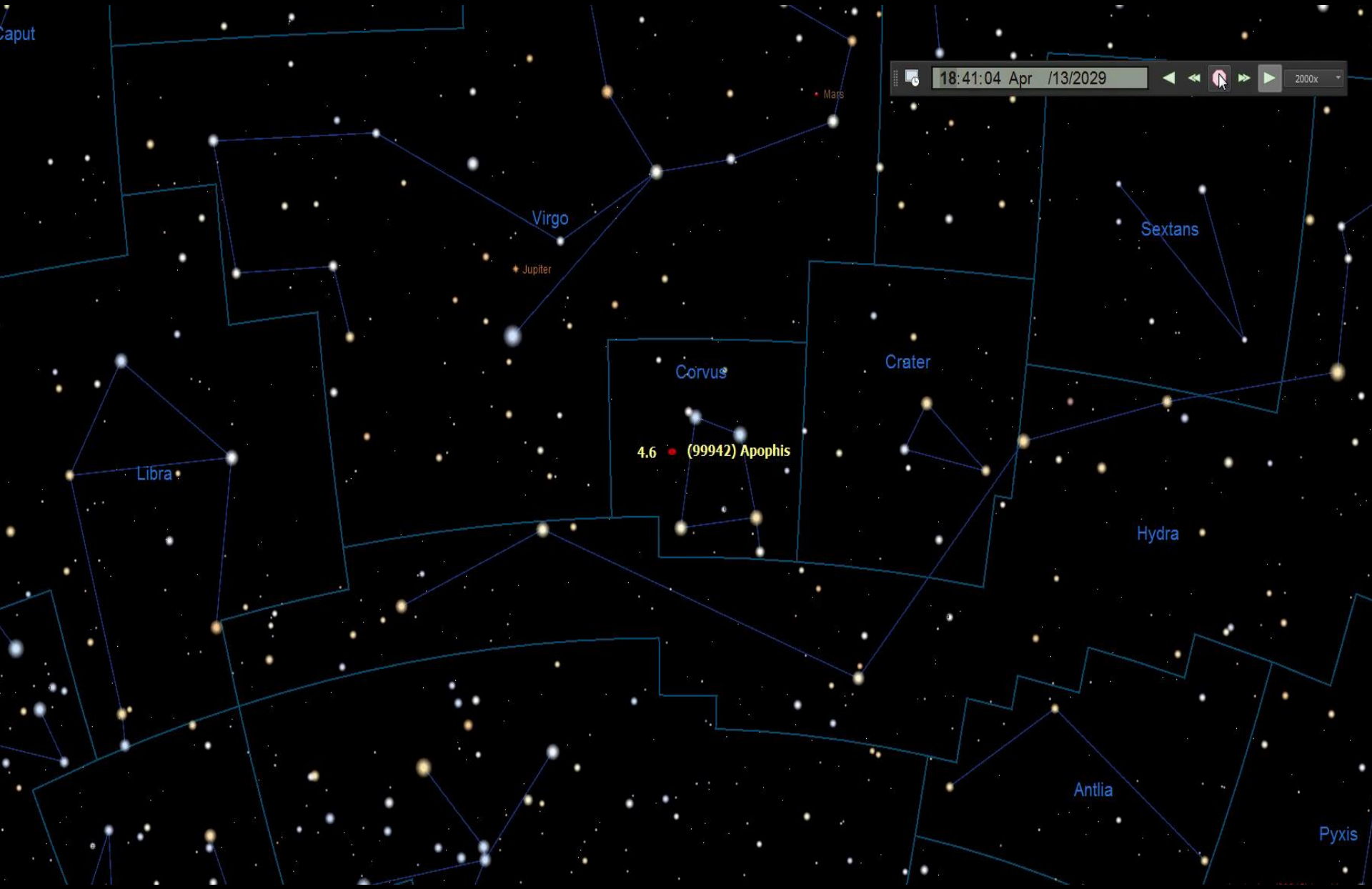
Binzel et al. (2010);
Nesvorny et al. (2005; 2010)

Decadal opportunity for mapping the *interior structure* of a Potentially Hazardous Asteroid.



MIT “Project Apophis” concept study (2017).

The World Will be Watching "What will the science community be doing?"



Apophis over Paris: April 13, 2029 Animation by Brian Warner