OSIRIS-REx

Asteroid Sample Return Mission

OSIRIS-REx Status Report (and What We've Learned about Bennu)

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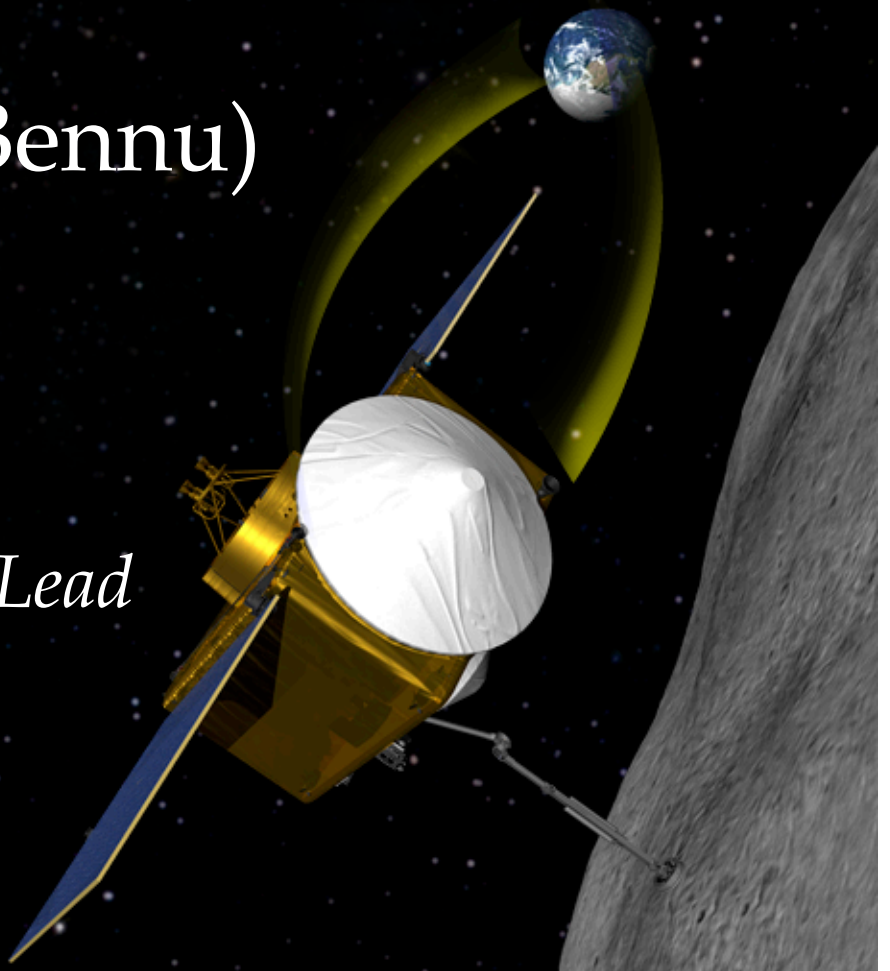
SBAG – 2013 July 11



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Recent Accomplishments

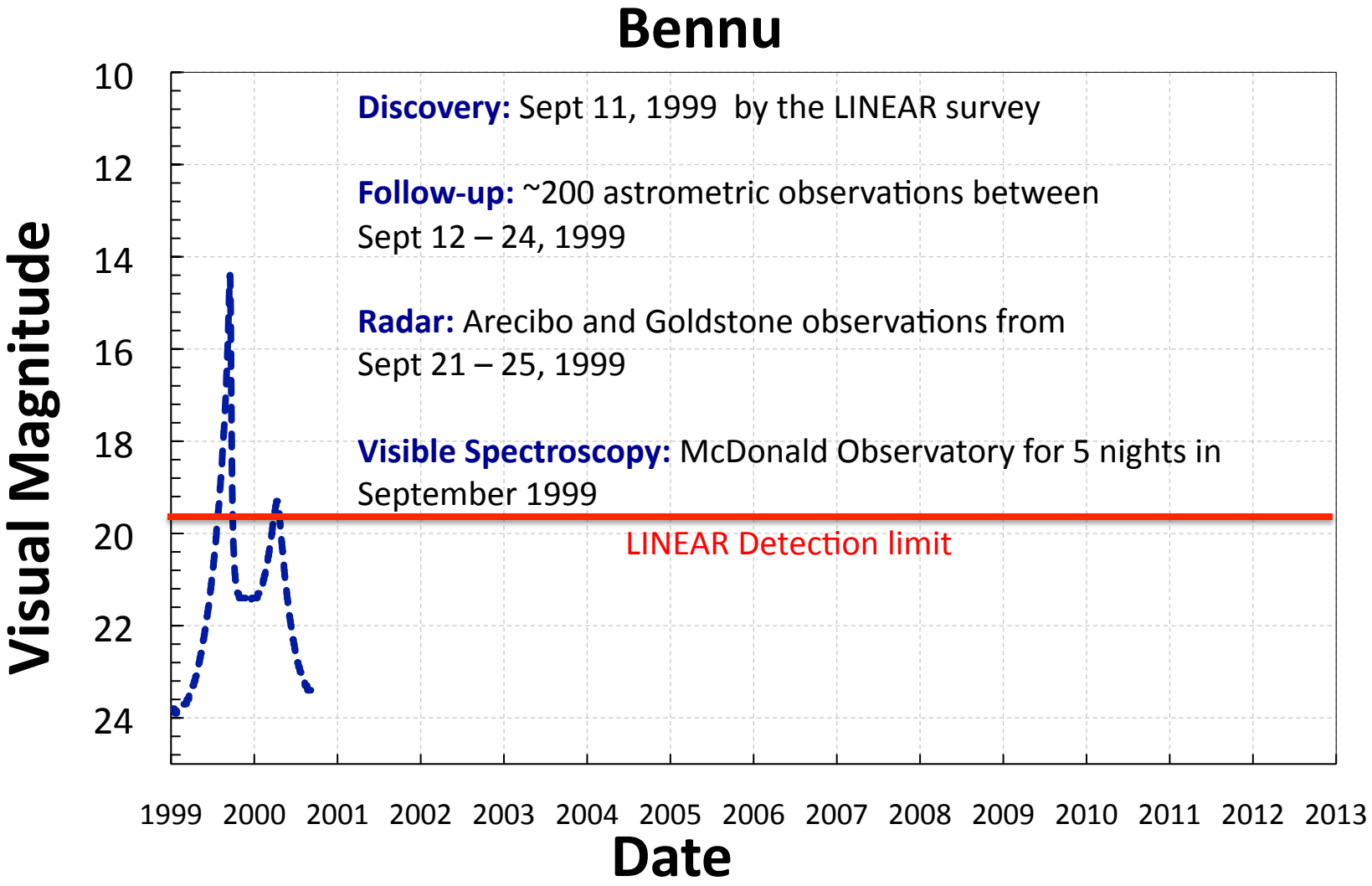
- TAGSAM microgravity testing @ JSC
- Mission “upgraded” to Category 1
- 2012 DA14 flyby and Chelyabinsk media events
- OLA authorization received for Phase B2/C
- Successful Mission Preliminary Design Review
- ‘Name That Asteroid’ winner announced – we are going to Bennu
- NFPO directed Project to remove all “STEM education” activities and eliminate E/PO element
- APMC KDP-C Confirmation Review – Confirmed!
- Start of Phase C – 6/3/2013

Asteroid (101955) 1999 RQ36 is now . . .

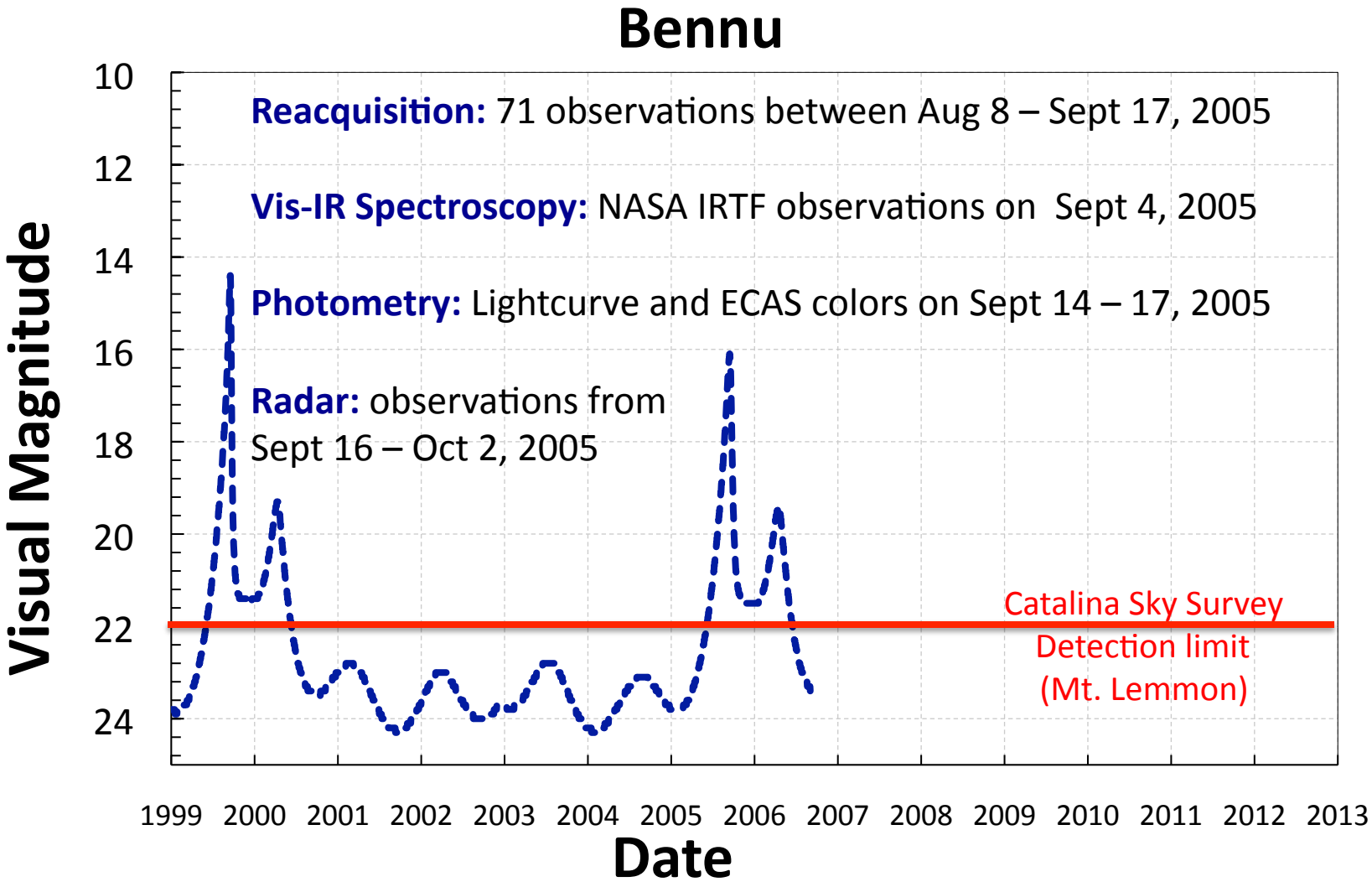
- Bennu
  - Bennu is an Egyptian mythological bird that was born from the heart of Osiris
  - It is associated with the Sun, creation, and renewal
  - The name was selected in an international contest run by the Planetary Society

Image credit:
http://www.touregypt.net

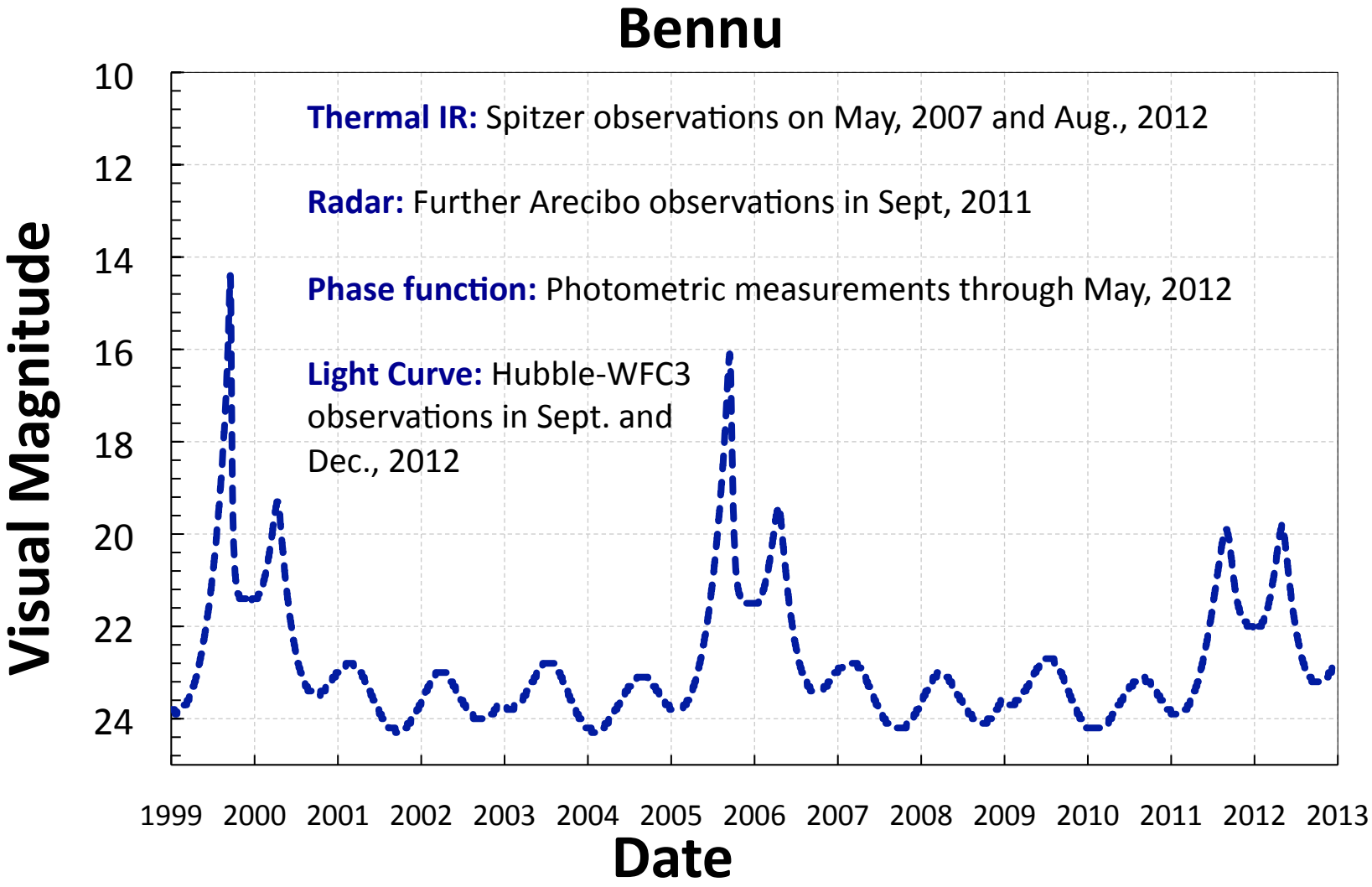
INITIAL CHARACTERIZATION: 1999



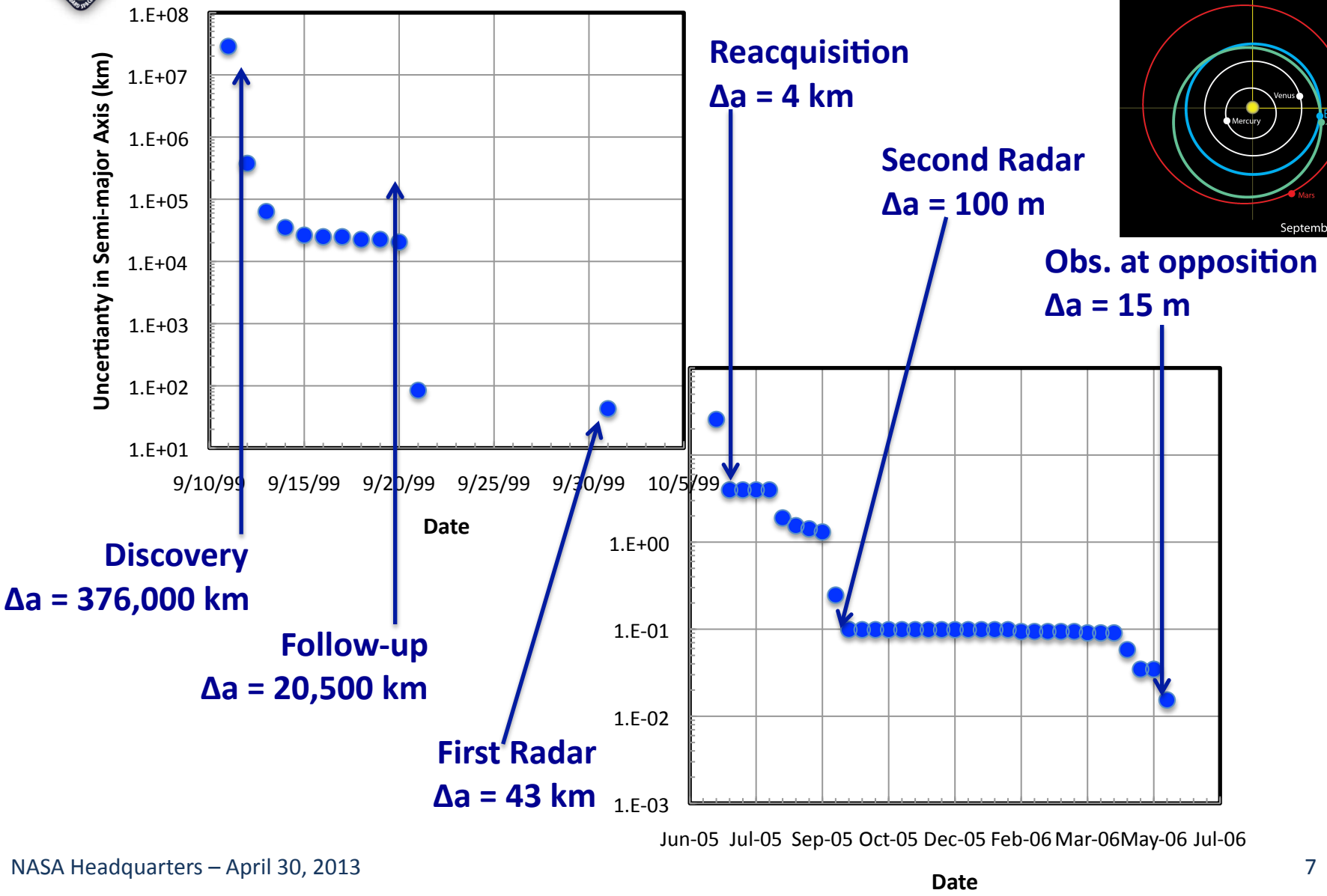
Reacquisition and Physical Characterization: 2005



FINAL CAMPAIGN: 2007 - 2012

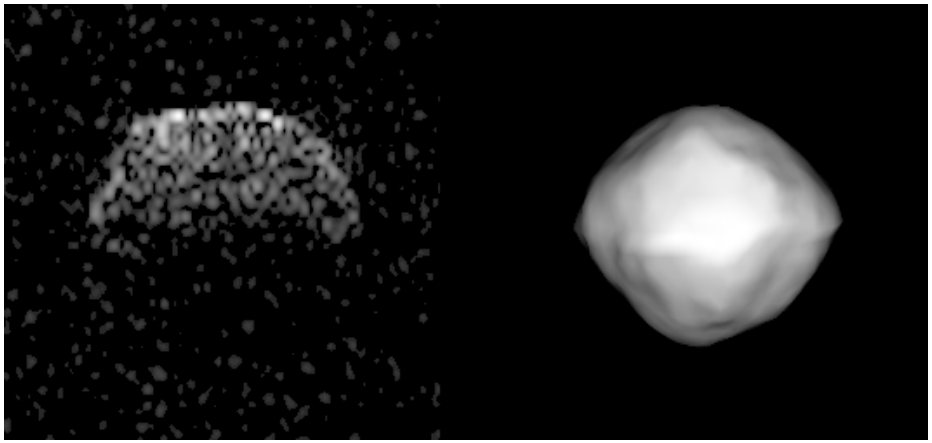


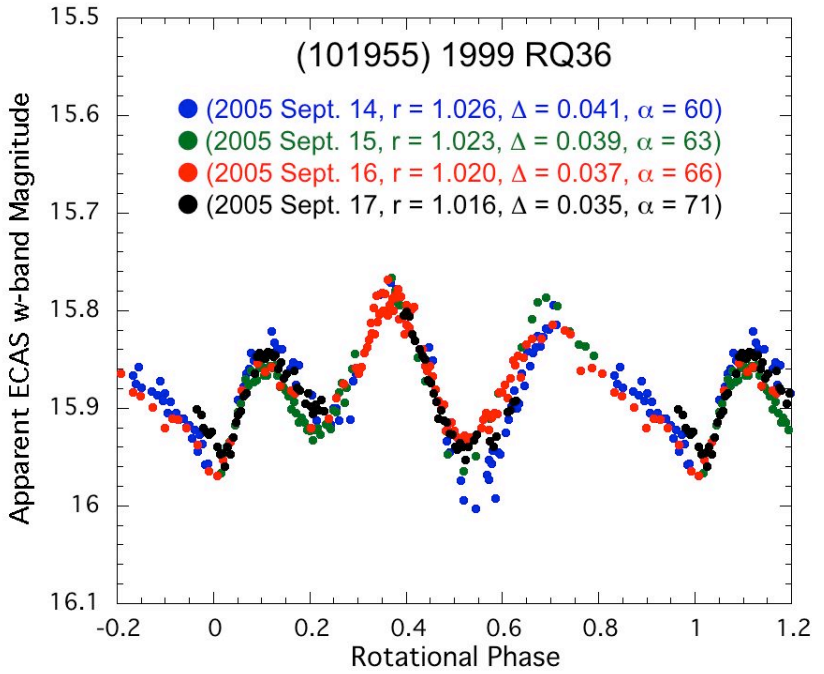
A Quality Orbit Requires Extensive Observation



Radar and Photometry Are Powerful Sources of Information about Asteroid Physical Properties

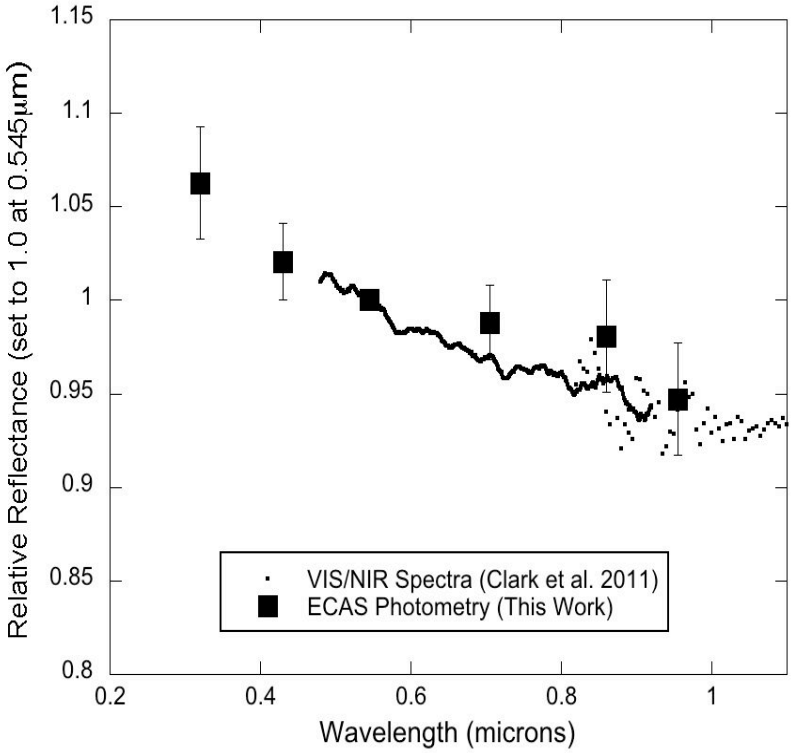
- Measurements of the distribution of range and radial velocity provided two-dimensional images with spatial resolution of 7.5 m
- Images used to construct a geologically detailed three-dimensional model and define the rotation state
  - **Size =** 492-m (±20 m, mean diameter)
  - **Shape =** spheroidal "spinning top"
  - **Rotation state =** 4.29 hr period, 180º obliquity
- Radar also probed the near-surface bulk density (1.7 g cm^{-3}) and structural scales larger than a few centimeters





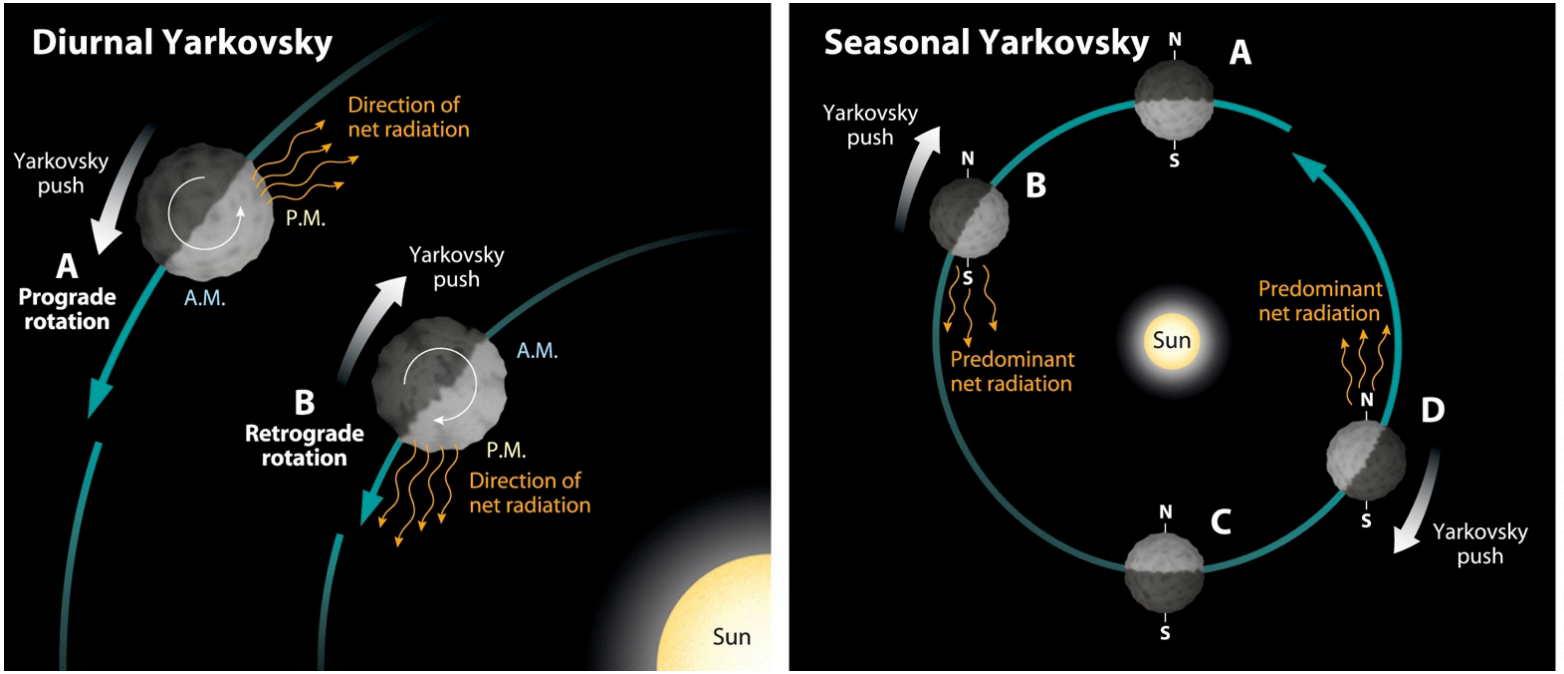
FINDING THE RIGHT ASTEROID MEANS KNOWING WHAT IT IS MADE OF

- OSIRIS-REx seeks to return samples from a Carbonaceous Asteroid
- Visible, near-infrared spectroscopy and ECAS photometry show that Bennu is a B-type asteroid
  - Linear, featureless spectrum with bluish to neutral slope
- Near-IR thermal emission starting at 2 µm suggest an albedo of 3-5%
- The hydrated CI and CM carbonaceous chondrite meteorites are the most likely analogs



An OSIRIS-REx First: Measuring a Planetary Mass Using Radar and Infrared Astronomy

- The three precise series of radar ranging position measurements over two synodic periods allows us to measure the Yarkovsky acceleration
- The asteroid has deviated from its gravity-ruled orbit by 160 kilometers in just 12 years
- This result, when combined with the thermal inertia and the shape model, constrains the mass to 6.278 (-0.942/+1.883) x 10^{10} kg
- Mass and shape constrain the bulk density to 0.980 ± 0.147 g/cm^3
- Spitzer observations yield a very low albedo – 4.5 ± 1.5%



Surface Properties are Consistent with Abundant Loose Regolith Available for Sampling

- Radar polarization shows transition to a “rough” surface at a scale smaller than the shortest (3.5-cm) wavelength
- The thermal inertia is substantially below the bedrock value – regolith grains are significantly smaller than the scale of the skin depth (~1 cm)
- The asteroid’s shape, dynamic state, and geomorphology provide additional evidence for the presence of loose particulate regolith
- There is one ~10–m boulder apparent on the surface