WHAT'S UP OR DOWN WITH APOPHIS?

AN OPEN CASE OR CASE CLOSED?

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Workshop on Communicating About Asteroid Impact Warnings and Mitigation Plans

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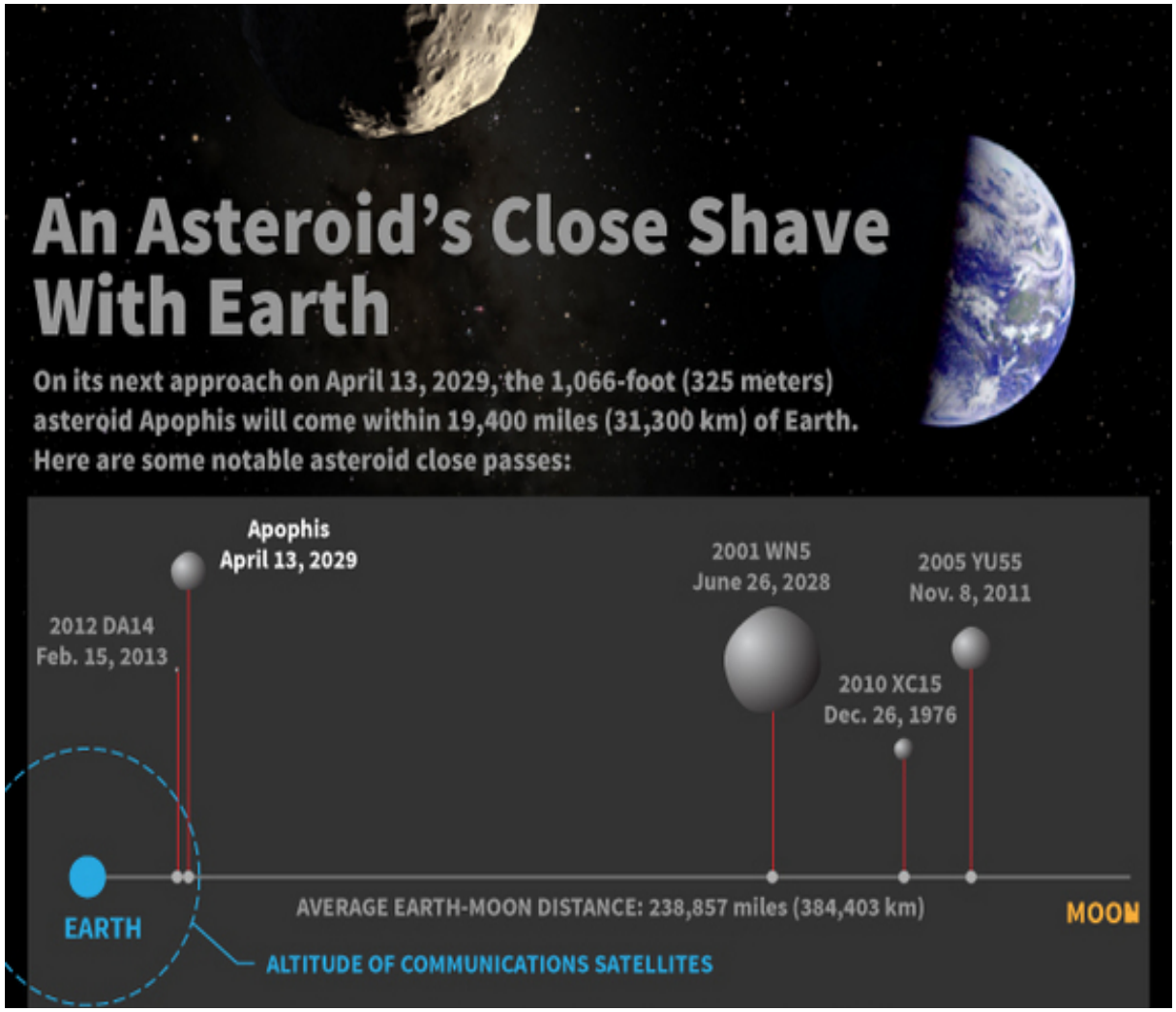
Entering the Land of the Unknown

HISTORY

Aten-type Asteroid (99942) Apophis was discovered by R.A. Tucker, D.J. Tholen and F. Bernardi at Kitt Peak, Arizona on June 19, 2004.

After rediscovery by G.J. Garradd at Siding Springs, Australia in December 2004 it was recognized as a potentially hazardous asteroid with a significant Earth impact probability in April 2029.

Arecibo radar observations in January 2005, August 2005 and May 2006 significantly reduced Apophis' orbital uncertainty and ruled out the 2029 impact (the minimum nominal distance from the geocenter in 2029 was computed to be 6 Earth radii)…But other potential impacts in following decades were revealed.


An Asteroid's Close Shave With Earth
On its next approach on April 13, 2029, the 1,066-foot (325 meters) asteroid Apophis will come within 19,400 miles (31,300 km) of Earth. Here are some notable asteroid close passes:
Apophis
April 13, 2029
2012 DA14
Feb. 15, 2013
2001 WN5
June 26, 2028
2005 YU55
Nov. 8, 2011
2010 XC15
Dec. 26, 1976
EARTH
AVERAGE EARTH-MOON DISTANCE: 238,857 miles (384,403 km)
MOON
ALTITUDE OF COMMUNICATIONS SATELLITES

Harris, et al

- New and extensive photometric observations of Apophis have allowed researchers to determine its tumbling spin state
- Yarkovsky effect contains values for the keyhole of resonant return leading to Earth impact on 2068 April 12.
- However, there are modeling uncertainties.

Harris, et al

- Further astrometric and radar observations in 2020–2021.
- Apophis impact probability still remains very small and it will likely drop to zero when the orbit determination is improved in 2021.
- The study of its spin state and of the population of slowly tumbling asteroids in general is important.

The Case of Apophis: Lessons Learned

- Asteroid astronomers and space agencies as "risk communicators" and "disaster managers": we must do better!
- Even an impact threat decades away may require near-term actions

The Case of Apophis: Lessons Learned

- There's need to institutionalize the impact hazard into the structures of national and international disaster management agencies.
- Need to further standardize our own procedures, and we must know how and when to report up the chain-of-command and to the public, if the threat warrants it.

The Case of Apophis: Lessons Learned

- December 2004: Back in its 2004 MN4 days, Apophis was a real concern, *real* concern, for a few days while the media were all off for Christmas holiday.
- Following the MN4 2029 impact probability of ~1:27, observational revisit work dropped the impact probability in 2029 to zero…but left the possibility of a keyhole passage then with subsequent impact in 2036.

The Case of Apophis: Lessons Learned

- Remaining now is a 1:256,000 chance of an impact in 2068 as a result of the 2029 close pass and potential keyhole passage.
- The media never seemed to get that while MN4 initially looked *very* threatening, the 2029 potential impact immediately disappeared back ~27 Dec 04.

The Case of Apophis: Lessons Learned

- The media never seemed to catch up with the fact that Apophis has never been a really serious concern since…while at the same time it was (has been) perhaps one of the most important NEOs in our history of study since it introduced the whole keyhole issue.

The Case of Apophis: Lessons Learned

- The media has never gotten keyholes… their significance or their physics (astrodynamics)
- And that's pretty understandable since there are many technical people, scientists, astronomers, who don't understand/get it. Let alone the public!

The Case of Apophis: Lessons Learned

- Criticism: The media tend to feed off each other rather than to go to the few people who could legitimately inform them…to help reporters understand the evolution of understanding regarding the NEO threat issue.

The Case of Apophis: Lessons Learned

- None of the NEOs on the JPL risk page simply go away… until (on rare occasion) they pass close by some other planet like Venus or Mars or Jupiter.
- Until then they will continue to circulate in an Earth crossing orbit until they hit Earth.

The Case of Apophis: Lessons Learned

- While coming close to the Earth changes their orbits, they will come right back in this new orbit, again and again.

- It takes either an impact, or an encounter with a distant planet to “eliminate” them as a NEO.

MESSAGES FOR THE MASSES

- HANDLING ASTEROIDS REFLECTS ON SPACE PROGRAMS OVERALL
- MEDIA “LIKES” APOCLAYPSE-NOW SCENARIOS
- …BUT THERE IS A DIVERSE RANGE OF “MEDIA” OUTLETS – FROM SCIENTIFIC TO BLOGMANIA

Wonder Woman –

Love those rings!

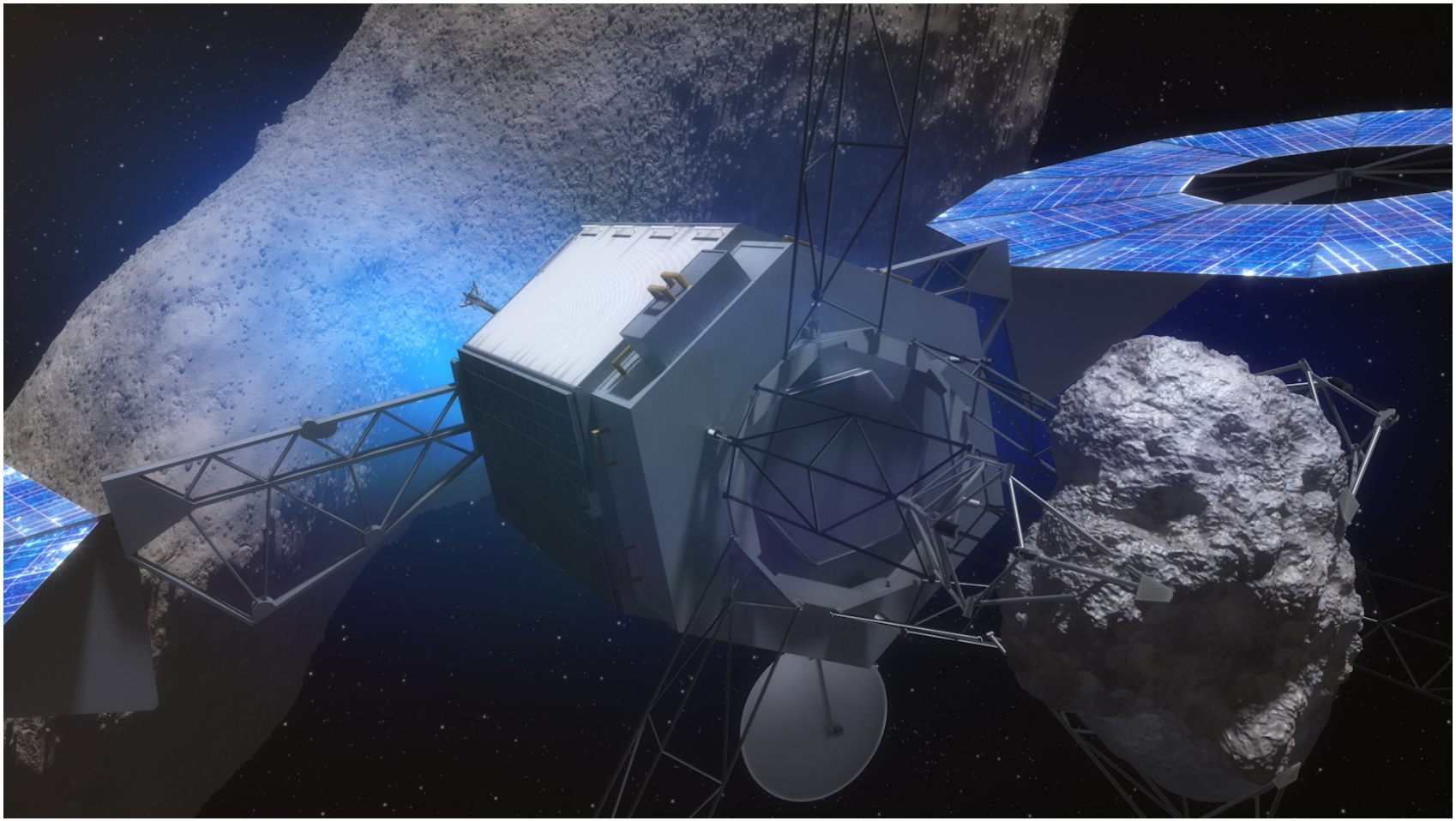
Planetary Defense

Gravity Tractor
Nuke ‘em
Laser blast
Paint them
Hit by impactor
Nudge them
Rope and pull them away
Wish them away

Or….?

Space Politics

“ARM” WAVING



New Technology

Controlling the Future

SILENCE OF THE SLAMED

- Planetary Defense is a one-to-one proposition
- There may be a reason why SETI-listeners don't hear neighbors.
- There are few and far-between civilizations that have survived the "natural" in-fall of cosmic debris.
- A sterilization factor snuffs out civilizations – as will be the case for Earth?

When the Big One Hits!

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