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Six Very Close Potentially Hazardous Asteroid Flybys in the Late 2020s

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ABSTRACT

The purpose of this presentation is to highlight six very close Potentially Hazardous Asteroid (PHA) flybys in 2027, 2028, and 2029 that will provide outstanding opportunities for high-resolution radar imaging and investigation of physical properties. Each object is at least several hundred meters in diameter, and the largest, 1990 MU, is elongated (Mottola et al. 1995) with a long axis of at least 3.4 km.

We estimate daily radar signal-to-noise ratios (SNRs) between 10^5 - 10^{11} that will permit imaging at the highest range resolutions currently available at Goldstone (1.875 m/pixel) and Arecibo (7.5 m/pixel). The radar images will place thousands to tens of thousands of pixels on these objects and reveal detail such as boulders, ridges, facets, and possible impact craters that rivals that seen in spacecraft flyby images. Two encounters will occur in each year, a cadence of very close passes that is unusual and likely to generate considerable scientific and public interest. These are the best radar imaging opportunities currently known in the next decade among PHAs at least a few hundred meters in diameter.

By far the best known is the extraordinary approach within five Earth radii by 99942 Apophis on Friday, April 13, 2029. Apophis will be the strongest near-Earth asteroid radar target since radar observations began in the 1960s. Radar opportunities to study Apophis are covered in more detail in the presentation by Brozovic et al. at this

meeting.

The table below lists the asteroids, close approach distances and dates, approximate diameters, and daily SNRs for radar observations:

Asteroid	Date	Distance	Diameter	Daily Radar SNRs at:	
				Goldstone	Arecibo
4953	1990 MU	Jun 2027 12 LD	3 km	4×10^4	3×10^5
137108	1999 AN10	Aug 2027 1.1 LD	0.9 km	2×10^7	6×10^8
153814	2001 WN5	Jun 2028 0.65 LD	0.93 km	2×10^7	7×10^6
35396	1997 XF11	Oct 2028 2.4 LD	1.3 km	3×10^6	4×10^7
292220	2006 SU49	Jan 2029 3.2 LD	0.4 km	9×10^4	4×10^5
99942	Apophis	Apr 2029 0.1 LD	0.35 km	1×10^{11}	1×10^9

In the table, "LD" is one lunar distance or 384,400 km. 2001 WN5 and Apophis will approach more closely than the Moon within one year of each other, and 1999 AN10 will approach within 1.1 lunar distances in 2027. These three objects will be visible in binoculars, and Apophis will briefly be visible to the naked eye at about 3rd magnitude.

Given that ~1/6 of NEAs >200 m in diameter have a satellite (Pravec et al. 2006), the probability is relatively high that one of these objects will also have a moon. With the exception of Apophis and 1990 MU, the physical properties of these objects are poorly known.

Apophis, 2001 WN5, and 2006 SU49 all have ΔV for a rendezvous mission less than that of the Moon, highlighting their accessibility as potential spacecraft targets. Missions to Apophis have been considered previously, but 2001 WN5 and 2006 SU49 have received much less attention and could also be exciting mission targets in the late 2020s.
