Asteroid 2021 PH27 with the Highest Solar System Precession Rate

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We presented the orbit of the asteroid 2021 PH27. According to the JPL NASA classification[1], 2021 PH27 belongs to the Atira group asteroid. Their orbits are contained entirely within the orbit of the Earth (Q < 0.983 au). Also known as an Interior Earth Object. Asteroid 2021 PH27 has the highest Solar System precession rate, as far. It is greater than the observed precession rate of Mercury and is about 53.418"/century.

1 The orbit of the asteroid 2021 PH27

As of 2021 August, 21 JPL NASA shows 26 Atira objects. The most recently discovered object, as of 2021 August 21, is 2021 PH27. We used 52 optical observations from 2021 August 13.967697 to 2021 August 18.36768. The asteroid was first observed at Cerro Tololo Observatory, La Serena, on 2021 August 13. To compute the orbit of 2021 PH27, we used theOrbFit 5.0.7[2] software with the JPL DE431 ephemerides, and additional 17 massive asteroids as described in Del Vigna et al. (2018, 2019). We used weighting and selecting observations according to the Near Earth Objects Dynamic Site[3], the error model *fcct14* described in Baer et al. (2011) and Farnocchia et al. (2015).

Because observations cover too short time range, we did not compute non-gravitational parameters. The initial orbit of the asteroid 2021 PH27 is presented in Tab. 1. Orbital elements of the asteroid 2021 PH27 are computed with the *fcct14* error model. We computed RMS= 0.1865" and absolute magnitude, H=17.728 mag.

2 Orbital precession rate

Next, we propagated initial orbital elements from Table 1 1.8 My forward. We used the Orbit9 implemented in the OrbFit software. The results are presented in Fig. 1, where we added the time orbital evolution of Mercury for comparison. We can see that time evolutions of the argument perihelion of Mercury and studied asteroid 2021 PH27 are qualitatively similar. Next, we used Eq. (1) and Eq. (2) from Gilvarry (1953). These equations give the general relativity corrections. Hence, we got the precession rate of Mercury equals 42.993"/century and of 2021PH27 53.418"/century. Hence, the asteroid 2021 PH 27 has a greater perihelion precession rate than Mercury and probably, as far, the greatest perihelion precession rate among all discovered asteroids.

[1] `https://ssd.jpl.nasa.gov/sbdb.cgi#top`
[2] `http://adams.dm.unipi.it/~orbmaint/orbfit/`
[3] `https://newton.spacedys.com/neodys/index.php?pc=4.1`

Tab. 1: Initial nominal orbital elements of 2021 PH27, computed without non-gravitational parameters, are given in the first row, while their errors - in the second row. Angles ω, Ω, and i refer to Equinox J2000.0. Epoch: 2021-Aug-17=JD2459443.5 TDB.

a (au)	e	i (deg)	Ω (deg)	ω (deg)	M (deg)
0.461550507	0.71000703	31.750353	39.454767	8.487221	197.69814
8.60431×10^{-4}	4.46445×10^{-3}	4.88156×10^{-1}	1.48074×10^{-1}	2.35410×10^{-1}	1.51519

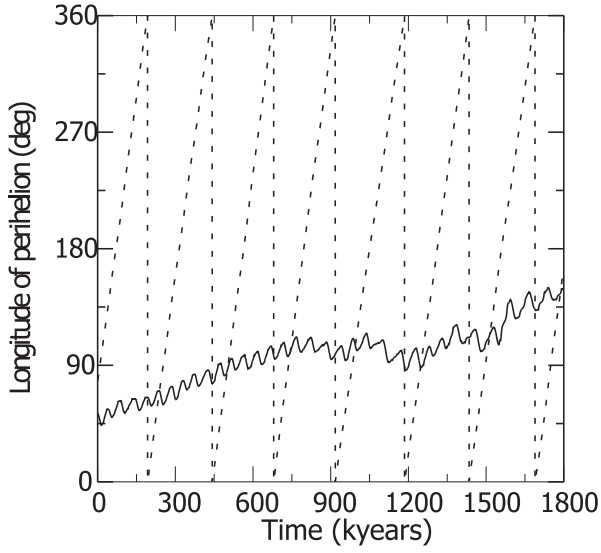

Fig. 1: Time evolution of the longitude of perihelion of Mercury (dotted line) and the asteroid 2021 PH27 (solid line).

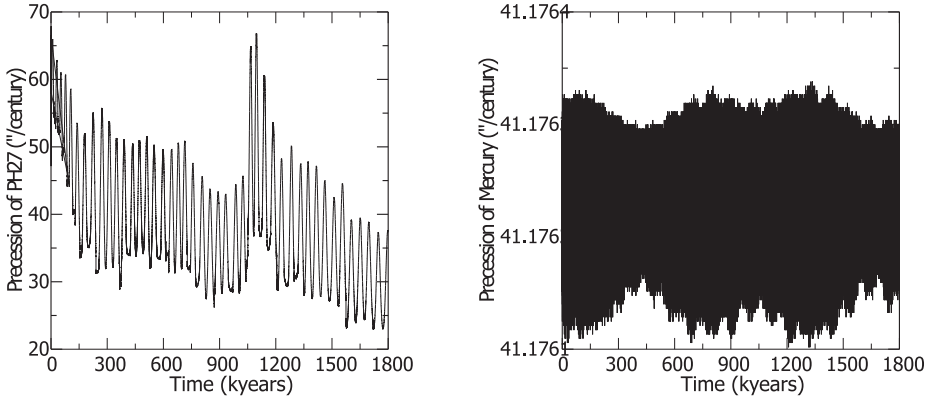

Fig. 2: Time evolution of the relativistic perihelion precession rate of the asteroid 2021 PH27 (*left*) and Mercury (*right*).

Figure 1 presents the time evolution of the longitude of perihelion of Mercury regular changes, and the asteroid 2021 PH27. Whereas Fig. 2 presents the time evolution of the relativistic perihelion precession rate of Mercury and the asteroid 2021 PH27. In both cases orbital elements of Mercury and 2021 PH27 are from Orbit9 integration.

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