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The asteroid 2021 PH27 with the highest solar system precession rate

Introduction:

We computed the highest solar system precession rate of the asteroid 2021 PH27.

To compute the orbit of the asteroid 2021 PH27, we used 52 optical observations from 2021 August 13.967697 to 2021 August 18.36768.

According to the JPL Small-Body Database website (https://ssd.jpl.nasa.gov/sbdb.cgi$\ #$top), asteroid belongs to the Atira orbit group.

As of 2021, August 25, there are 26 asteroids of this type. Atira asteroids have orbit contained entirely within the orbit of the Earth (Q < 0.983 au). They are also known as Interior Earth Object.

The asteroid was first observed at Cerro Tololo Observatory, La Serena, on 2021 August 13.

To compute the orbit of 2021 PH27, we used the OrbFit 5.0.7 software with the NASA JPL DE431 ephemerides, weighting and selecting observations according to the Near-Earth Objects Dynamic Site, the error model 'fcct14' described in [1] and [2].

We used the JPL DE431 Solar System model and an additional 17 massive asteroids as described in [3, 4].

Because of the short observational arc, we did not compute non-gravitational parameters.

The initial orbit of the asteroid 2021 PH27 is presented in Table 1.

Table 1. Orbital elements of the asteroid 2021 PH27 computed with the 'fcct14' error model.

RMS= 0.1865”

Keplerian elements: a(au), e, I(deg), long. Node(deg), arg. peric.(deg), mean anomaly(deg)

4.615505068731364 2E-01,0.710007034748617

31.7503530422201,39.4547674187894,

8.48722113506, 28 197.6981371525827

RMS 8.60431E-04 4.46445E-03 4.88156E-01 1.48074E-01 2.35410E-01 1.51519E+00

Epoch: MJD 59443.000000000 TDT=2021 August 17.

Absolute magnitude, H=17.728 mag.

Next, we propagated starting orbital elements from Table 1 1 My forward.

The results are presented in Figs. 1-4, 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. Hence we computed perihelion precession rates for, v, of Mercury and 2021 PH27.

Using the Eq. (1) and Eq. (2) from [5], we got the following results:

Object, precession rate

Mercury 42.993”/century

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.

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References:

[1] Baer, J., Chesley, S.~R., Milani, A.\ 2011.\ Development of an observational error model.\ Icarus 212, 438–447.

[2] Farnocchia, D., Chesley, S.~R., Chamberlin, A.~B., Tholen, D.~J.\ 2015.\ Star catalog position and proper motion corrections in asteroid astrometry.

[3] Del Vigna, A., Faggioli, L., Milani, A., Spoto, F., Farnocchia, D., Carry, B.\ 2018.\ Detecting the Yarkovsky effect among near-Earth asteroids from astrometric data.\ Astronomy and Astrophysics 617.

[4] Del Vigna, A., Milani, A., Spoto, F., Chessa, A., Valsecchi, G.~B.\ 2019.\ Completeness of Impact Monitoring.\ Icarus 321, 647–660.

[5] Gilvarry, J.~J.\ 1953.\ Relativity Precession of the Asteroid Icarus.\ Physical Review 89, 1046–1046.

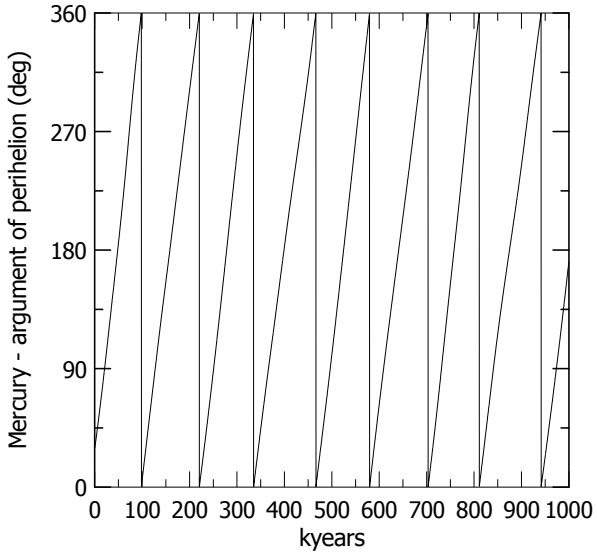

Fig.1. Time evolution of the argument perihelion of Mercury.

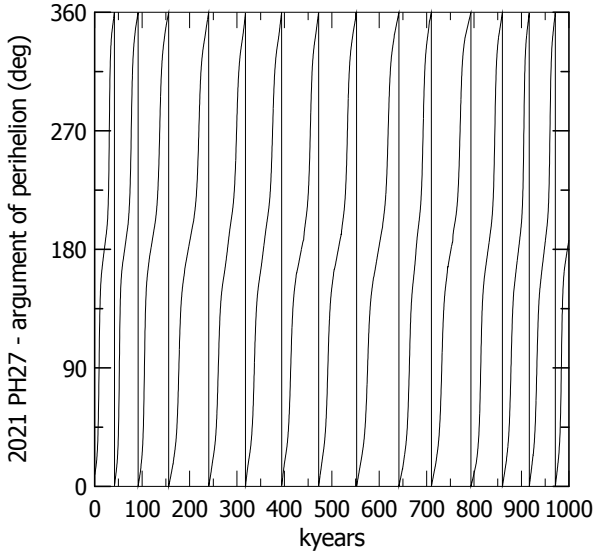

Fig.2. Time evolution of the argument perihelion of the asteroid 2021 PH27.

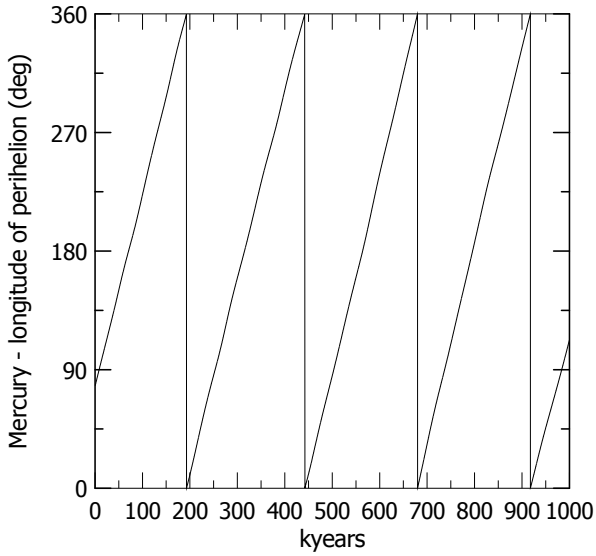

Fig.3. Time evolution of the longitude of perihelion of Mercury.

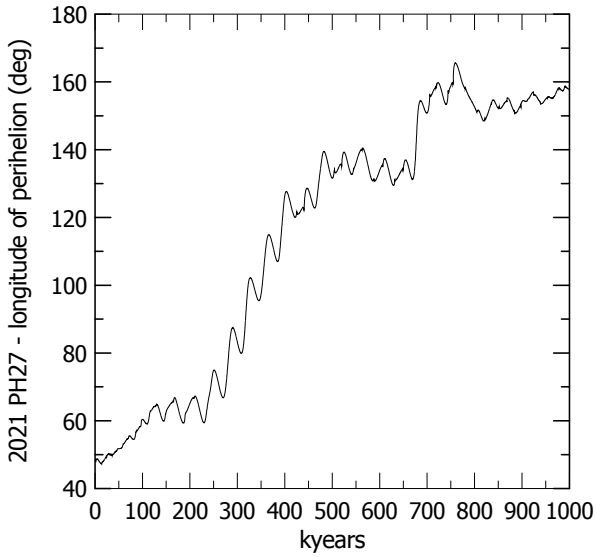

Fig.4. Time evolution of the longitude of perihelion of the asteroid 2021 PH27.