Hugo Gylden

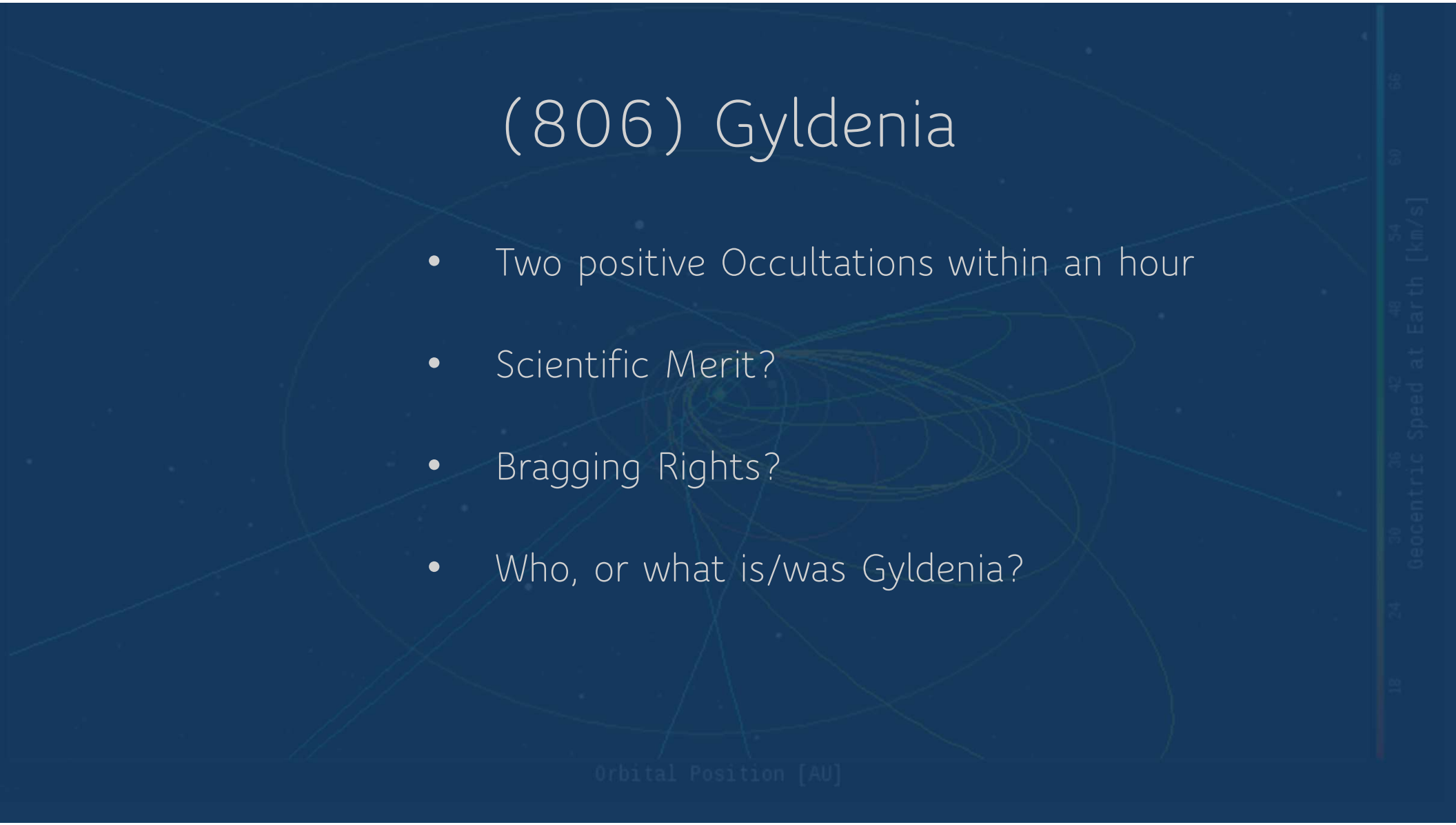
Astronomer

Dr Richard Brown

Newcastle Astronomical Society

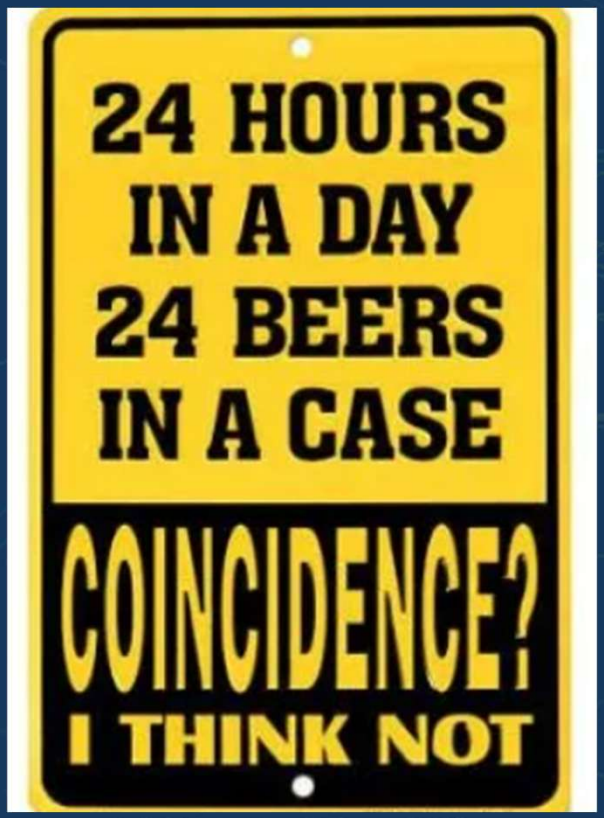
(806) Gyldenia

- Two positive Occultations within an hour
- Scientific Merit?
- Bragging Rights?
- Who, or what is/was Gyldenia?



(806) Gyldenia

(806) Gyldenia

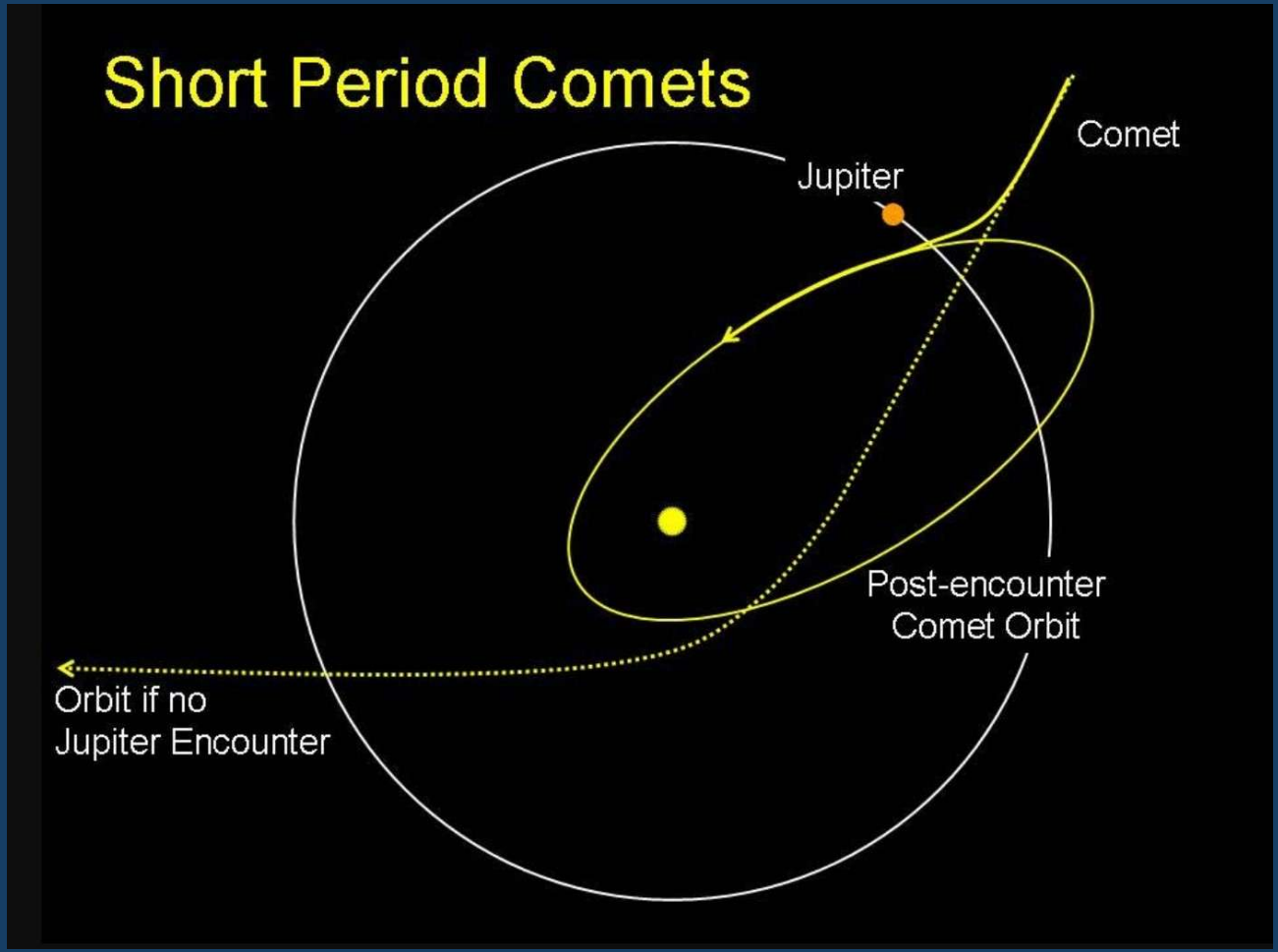


Who was Hugo Gylden?

- Johan August Hugo Gyldén
- Finnish-Swedish astronomer
- 1841 -1896.
- Father, Professor of Classical philology at the University of Helsinki
- Mother, Baroness Beata Sofia
- Home Schooled
- Celestial mechanics

Gylden's Challenge

- Gylden asked:
- "How do you predict the position of a moving body when gravity never stops *interfering*"?
- "Planets tug, resonances whisper"
- Pure "Keplerian Ellipses" don't offer "real world" predictions!
- Even the mathematics used to calculate orbits can "invent" long-term drift that isn't really there.



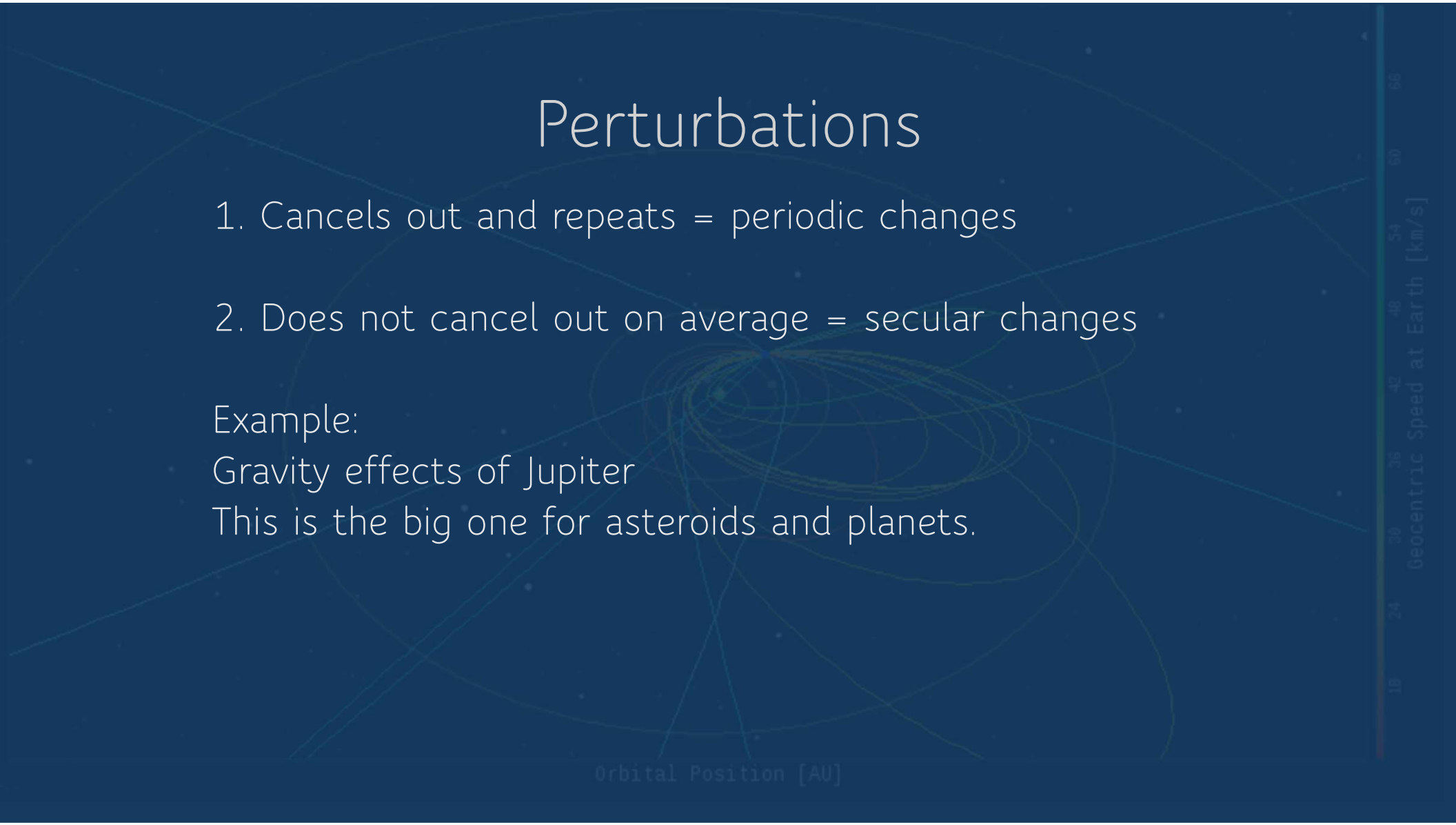
Source:
www.astronomy.ohio-state.edu/thompson.1847/161/dance.html

Perturbations

1. Cancels out and repeats = periodic changes

2. Does not cancel out on average = secular changes

Example:
Gravity effects of Jupiter
This is the big one for asteroids and planets.

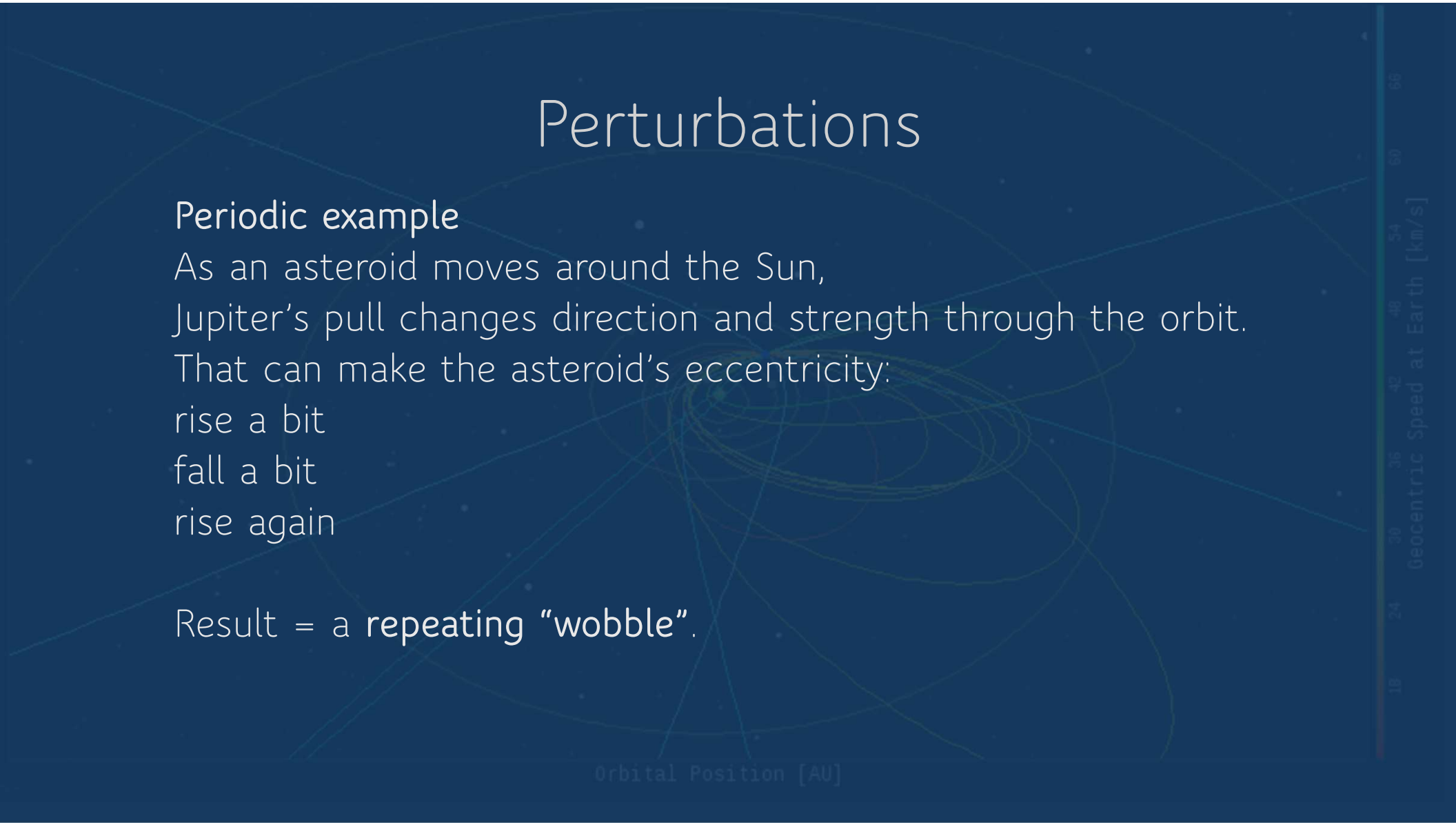


Perturbations

Periodic example

As an asteroid moves around the Sun,
Jupiter's pull changes direction and strength through the orbit.
That can make the asteroid's eccentricity:
rise a bit
fall a bit
rise again

Result = a **repeating "wobble"**.



Perturbations

Secular example

Over many orbits

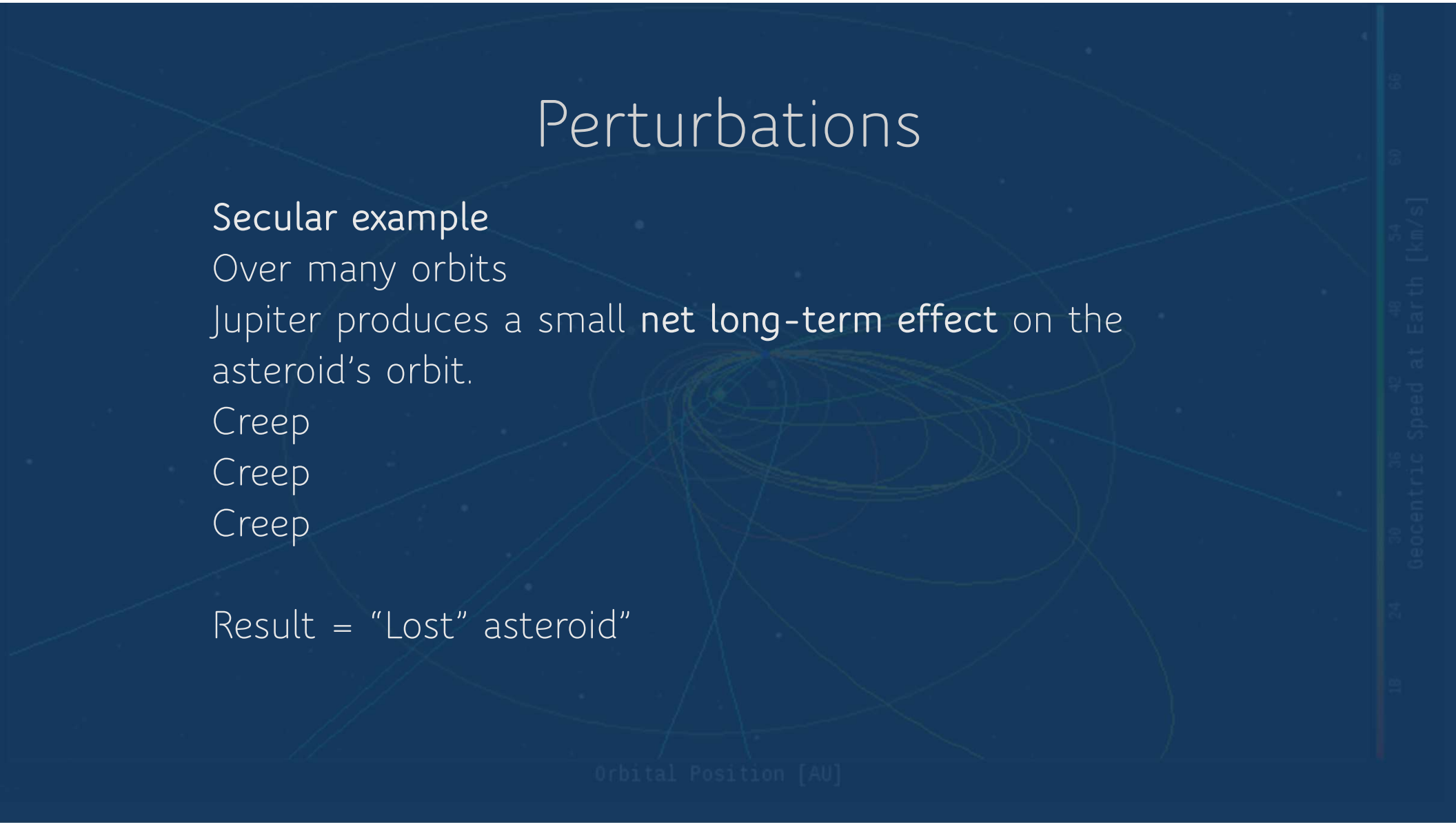
Jupiter produces a small **net long-term effect** on the asteroid's orbit.

Creep

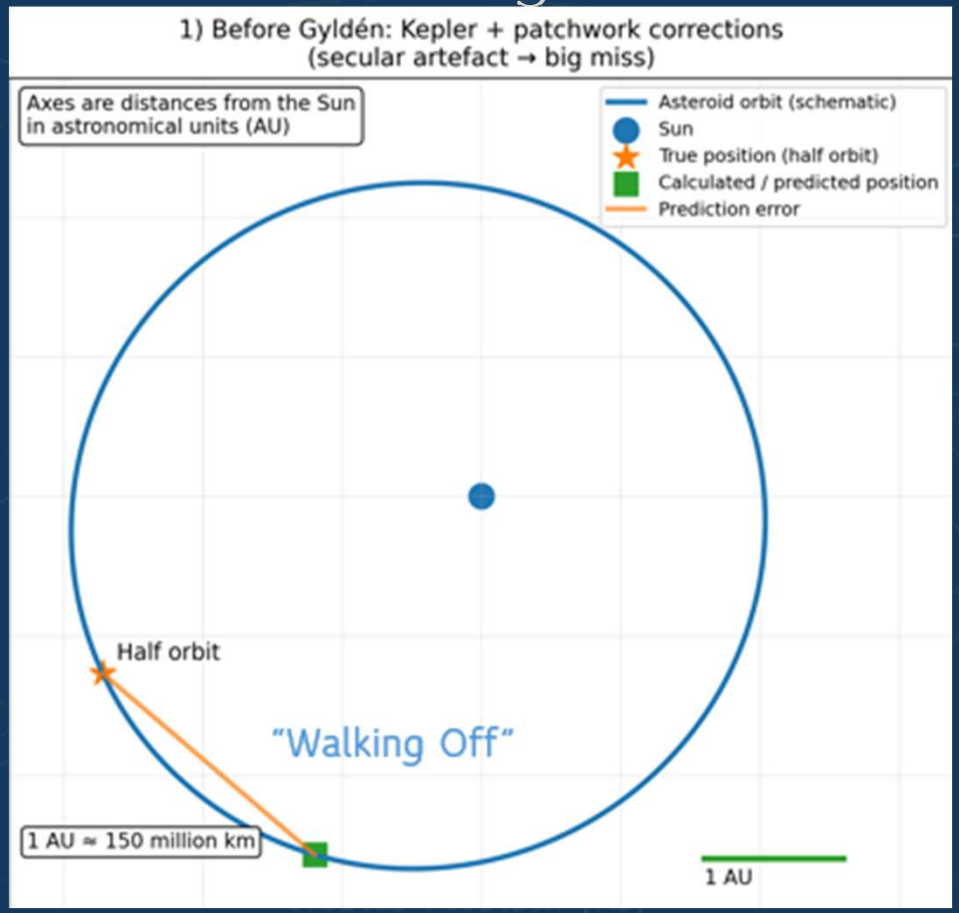
Creep

Creep

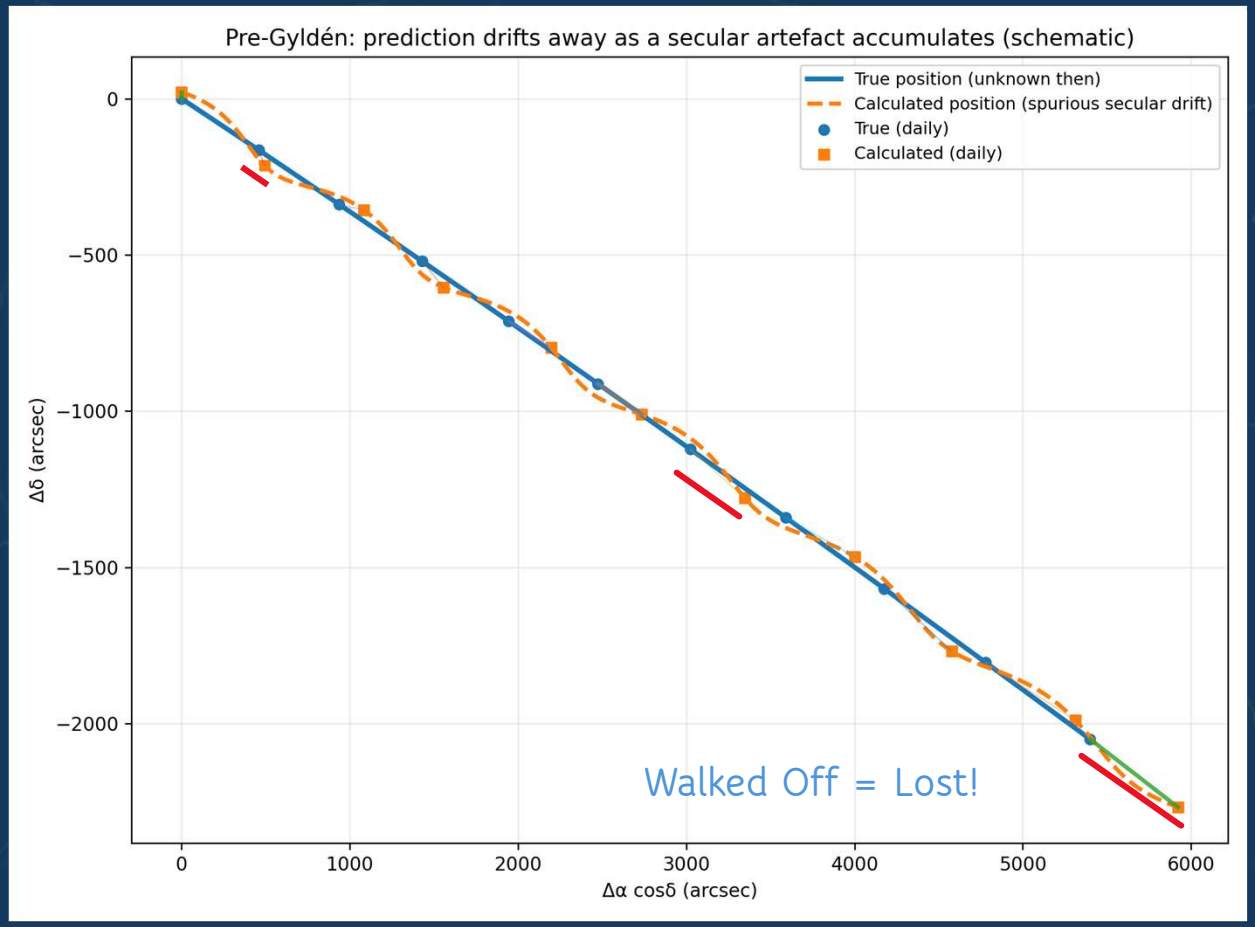
Result = "Lost" asteroid"



Pre – Gylden

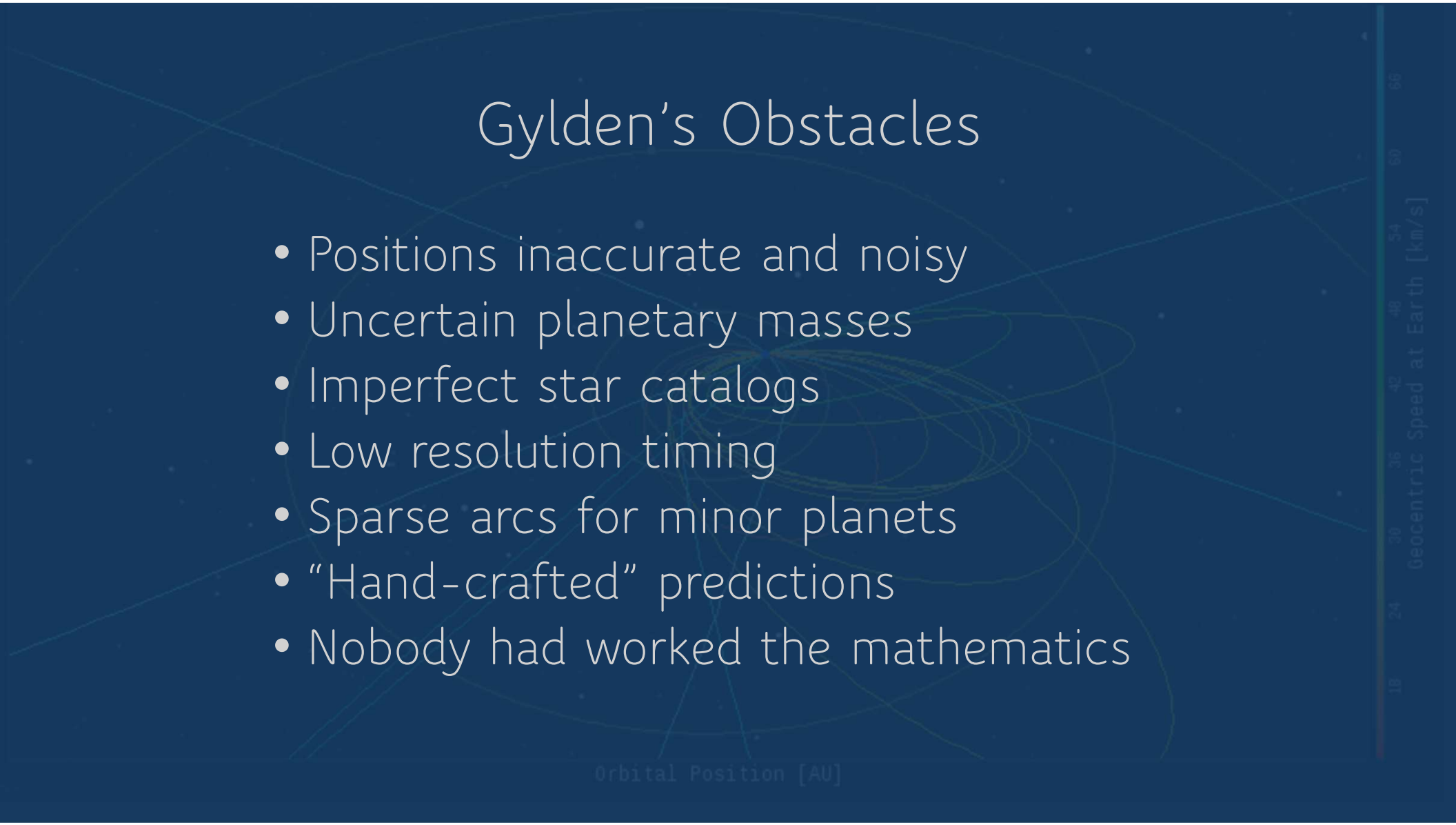

1) Before Gyldén: Kepler + patchwork corrections
(secular artefact → big miss)
Axes are distances from the Sun in astronomical units (AU)
Asteroid orbit (schematic)
Sun
True position (half orbit)
Calculated / predicted position
Prediction error
Half orbit
"Walking Off"
1 AU ≈ 150 million km
1 AU

Pre – Gylden


Pre-Gyldén: prediction drifts away as a secular artefact accumulates (schematic)
True position (unknown then)
Calculated position (spurious secular drift)
True (daily)
Calculated (daily)
Walked Off = Lost!
Δδ (arcsec)
Δα cosδ (arcsec)
0
−500
−1000
−1500
−2000
0
1000
2000
3000
4000
5000
6000

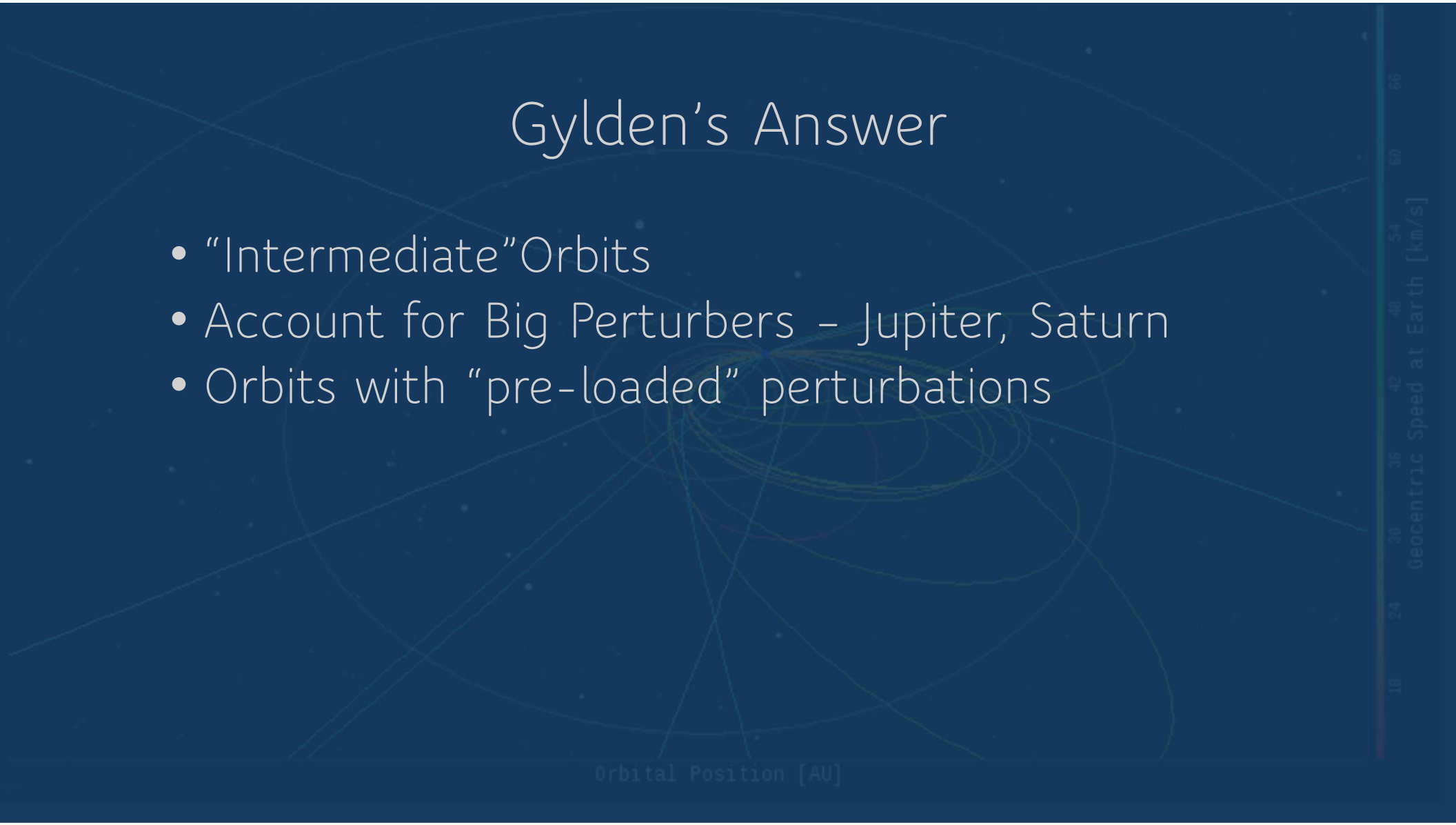
Gylden's Obstacles

- Positions inaccurate and noisy
- Uncertain planetary masses
- Imperfect star catalogs
- Low resolution timing
- Sparse arcs for minor planets
- "Hand-crafted" predictions
- Nobody had worked the mathematics

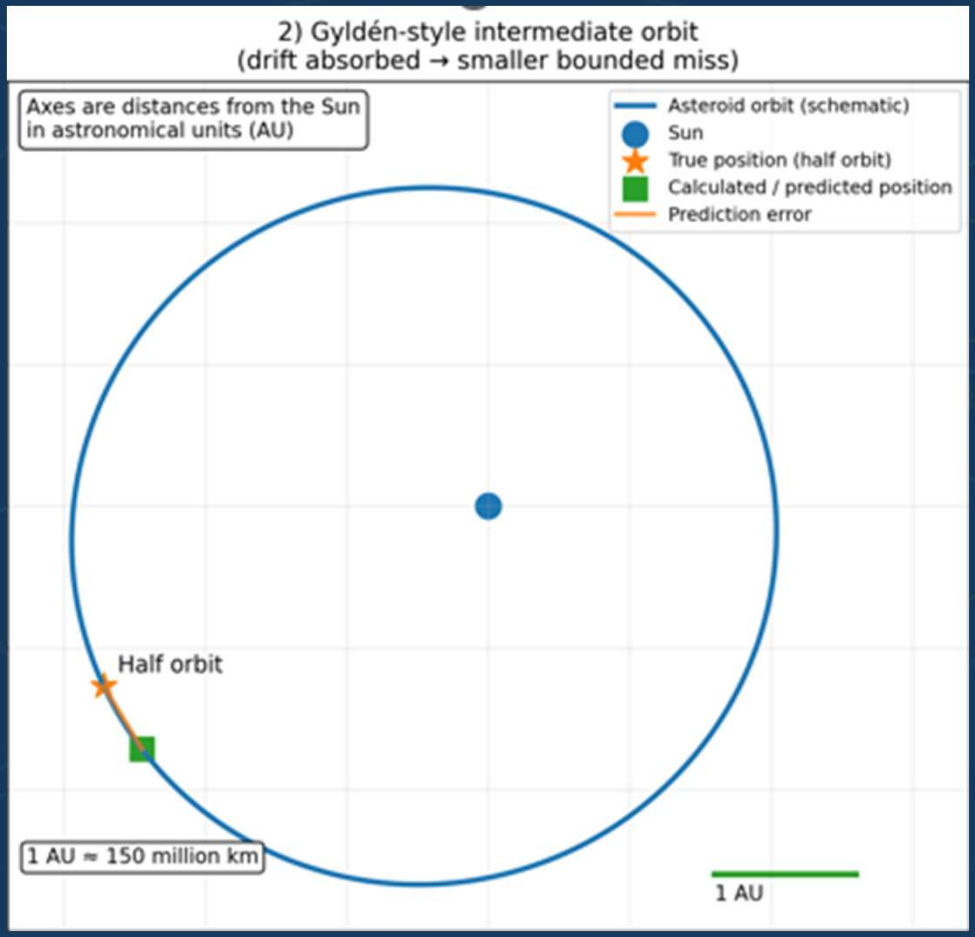


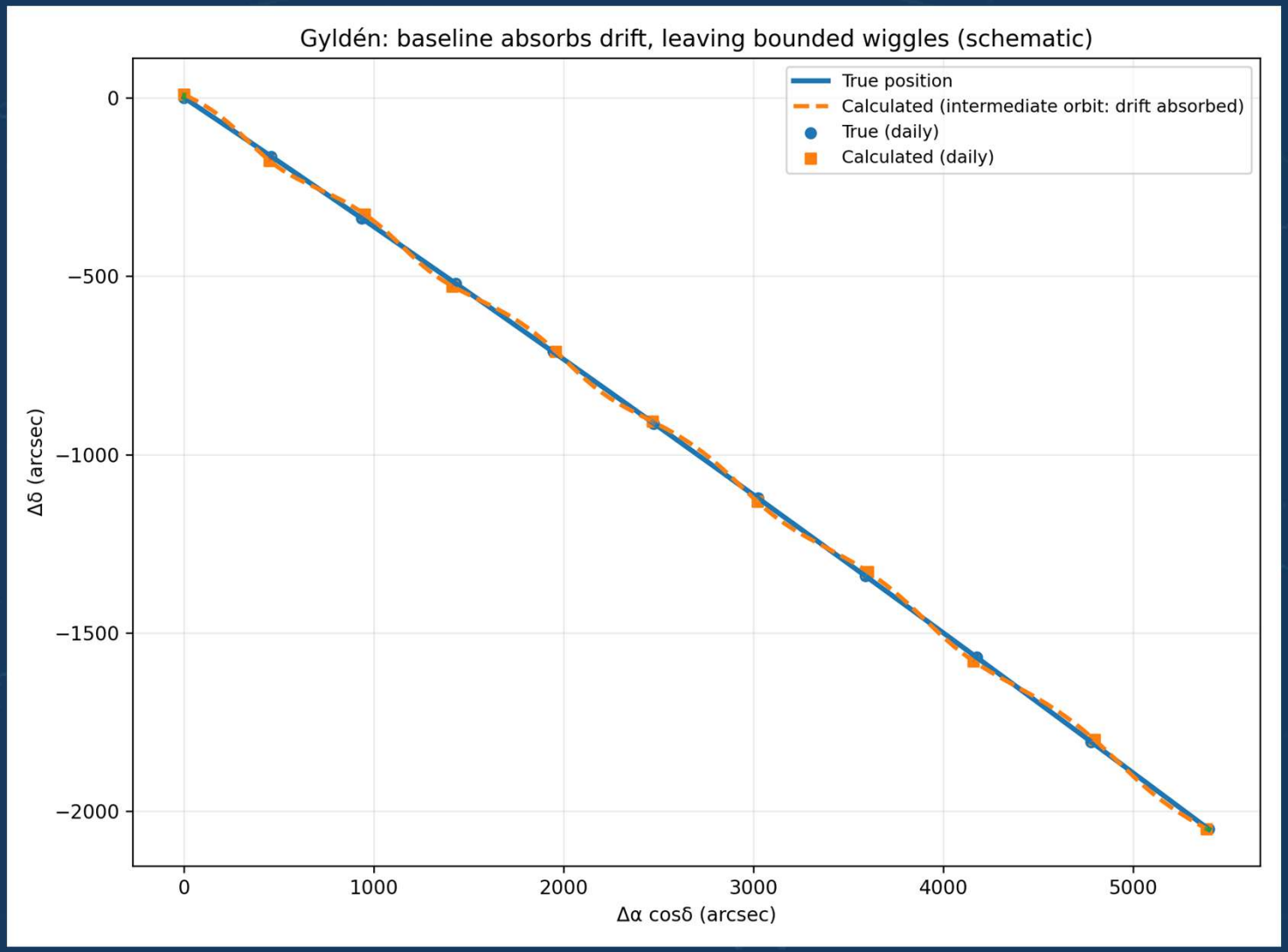
Gylden's Answer

- "Intermediate"Orbits
- Account for Big Perturbers – Jupiter, Saturn
- Orbits with "pre-loaded" perturbations

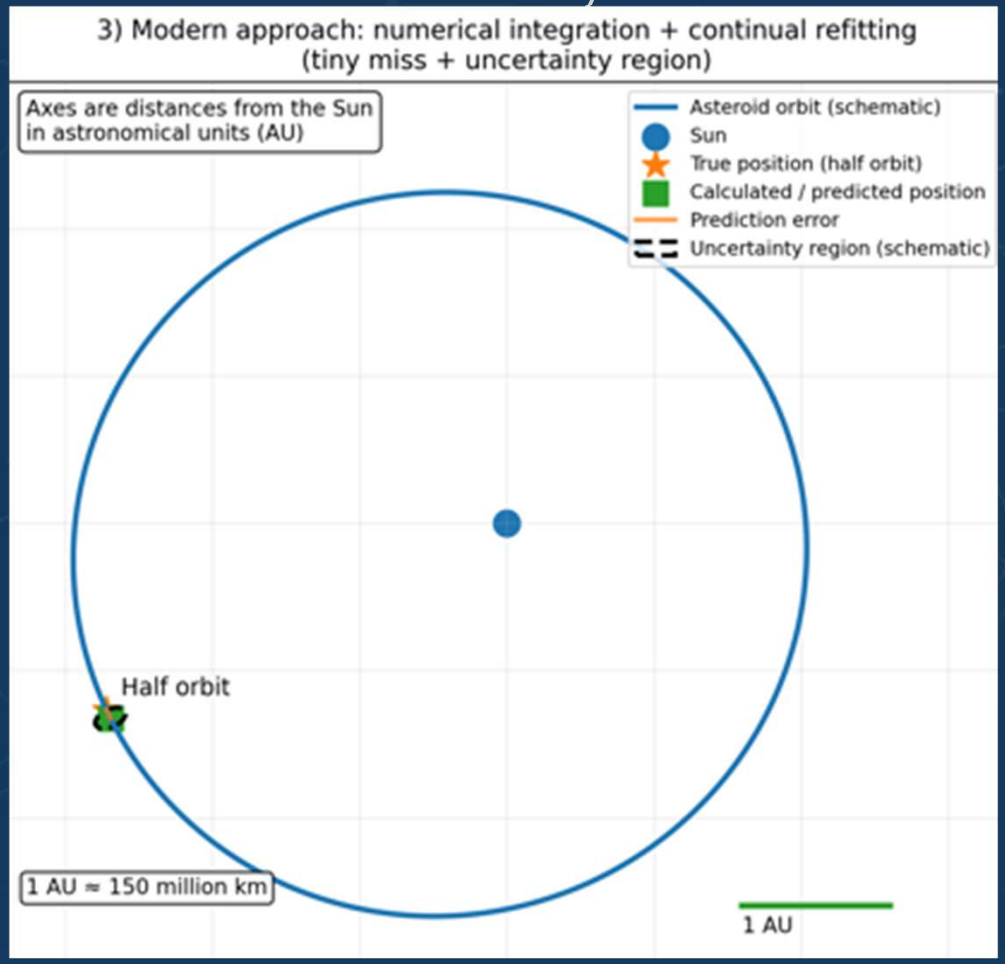


Gylden's Answer

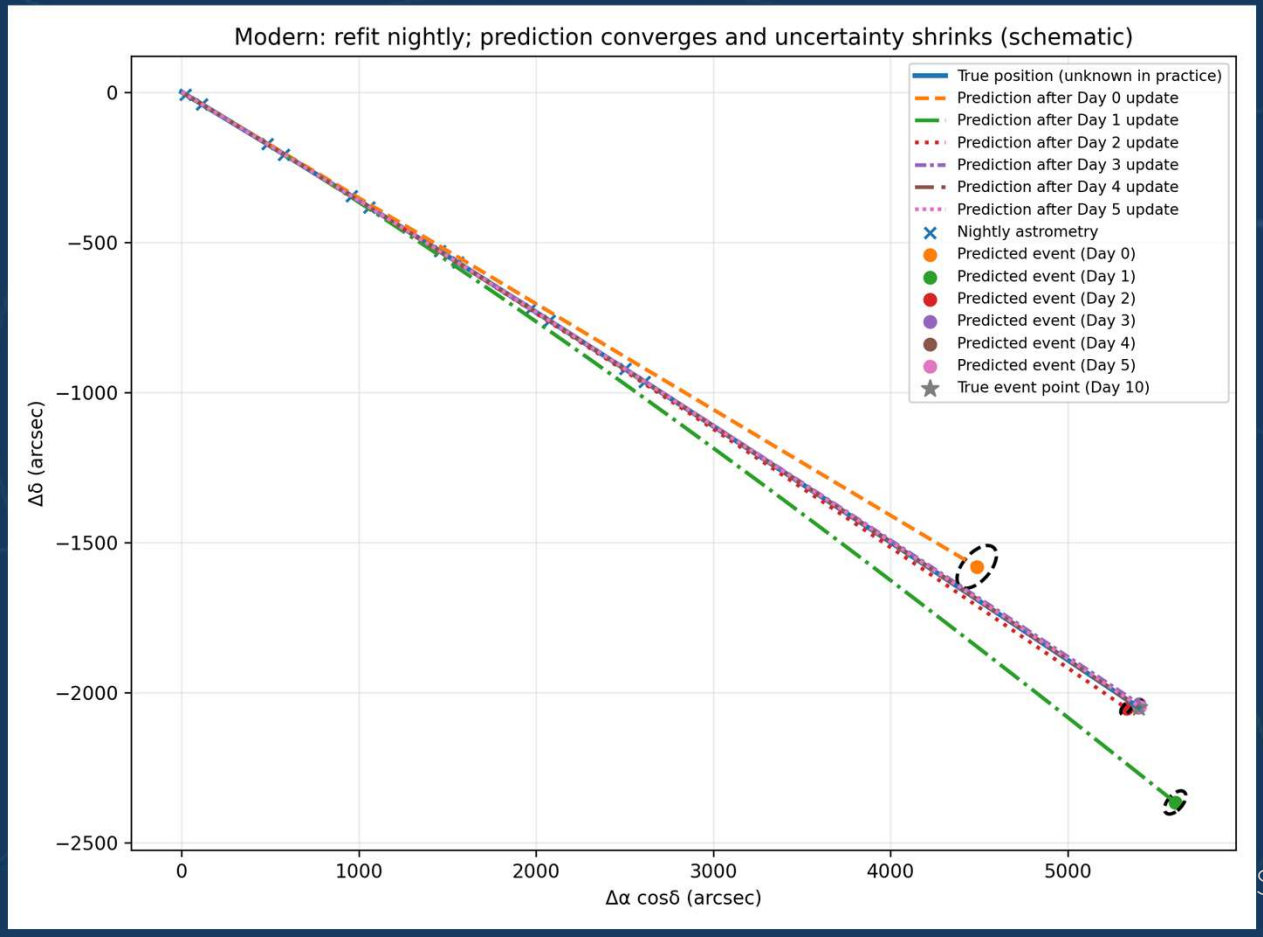



Gyldén: baseline absorbs drift, leaving bounded wiggles (schematic)
True position
Calculated (intermediate orbit: drift absorbed)
True (daily)
Calculated (daily)
0
−500
−1000
−1500
−2000
Δδ (arcsec)
0
1000
2000
3000
4000
5000
Δα cosδ (arcsec)

Today


3) Modern approach: numerical integration + continual refitting
(tiny miss + uncertainty region)
Axes are distances from the Sun
in astronomical units (AU)
Asteroid orbit (schematic)
Sun
True position (half orbit)
Calculated / predicted position
Prediction error
Uncertainty region (schematic)
Half orbit
1 AU ≈ 150 million km
1 AU

Today



Source: R Brown

Gylden's Obstacles - Today

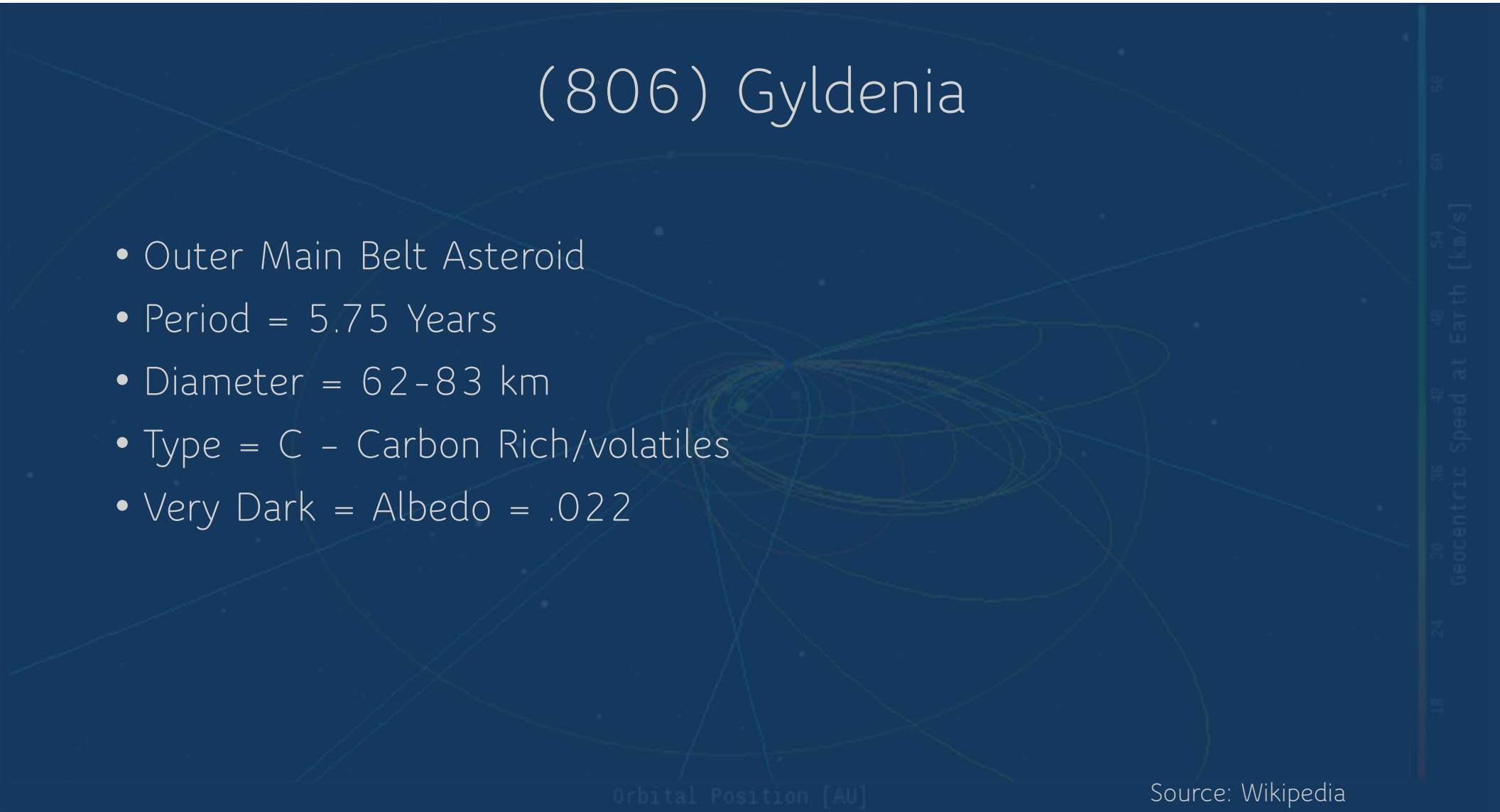
- Positions accurate
- Certain planetary masses
- Near-perfect star catalogs (Gaia)
- Very high resolution timing
- Huge arcs for minor planets
- "Computing power"
- Predictions (daily)
- Highly worked mathematics

Gylden's Legacy

- Gyldén mattered:
- He realised the problem
- Improved the craft of perturbation theory.
- Whether objects could be predicted and recovered.
- Later mathematicians &computers surpassed him.
- But his contribution wasn't pointless.
- The way you set up the problem can be as important as the physics.

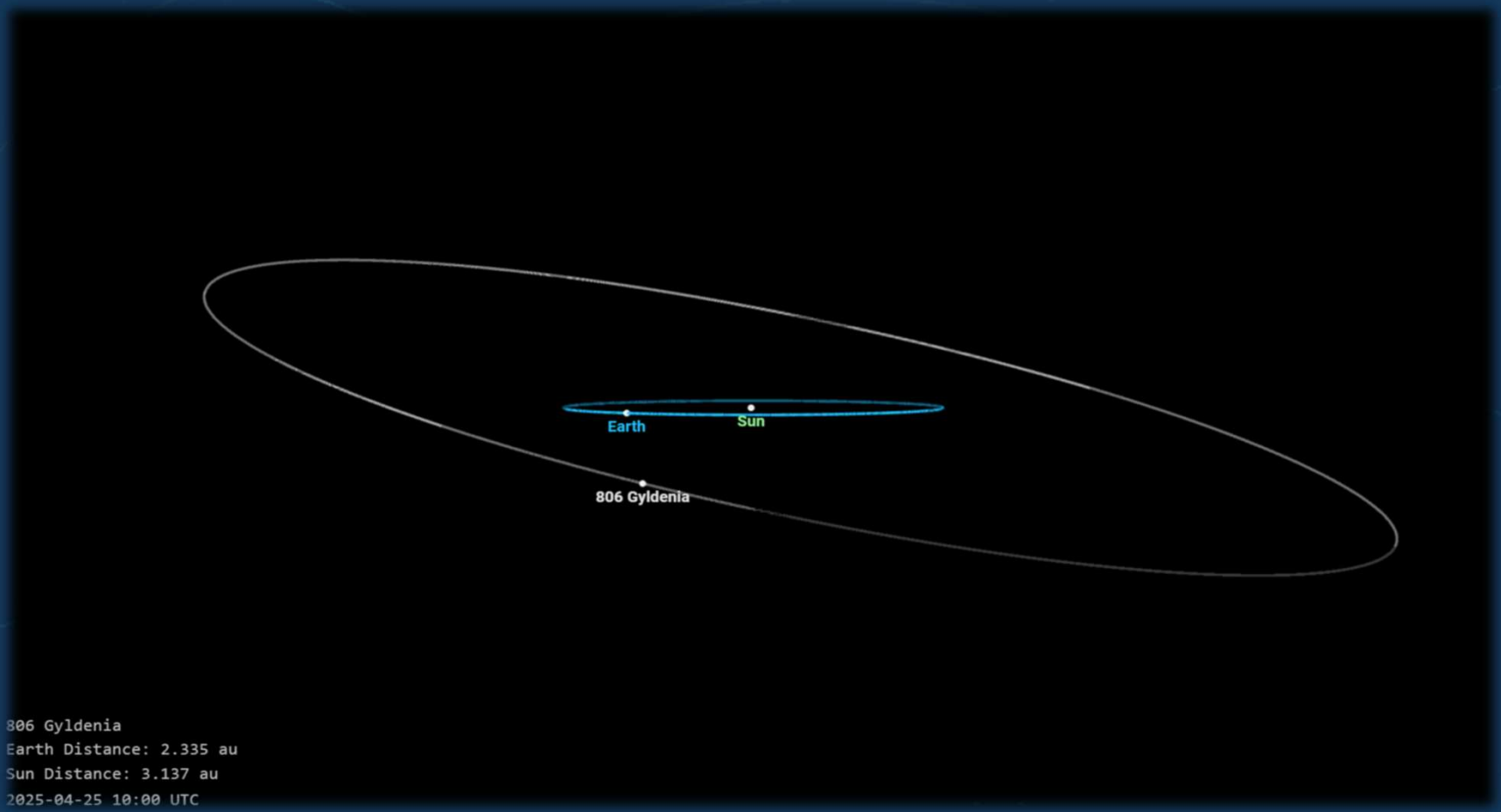
(806) Gyldenia

- Outer Main Belt Asteroid
- Period = 5.75 Years
- Diameter = 62-83 km
- Type = C – Carbon Rich/volatiles
- Very Dark = Albedo = .022



Source: Wikipedia

(806) Gyldenia



Source: NASA, JPL,CALTECH Small Body Data Base Lookup

(806) Gyldenia

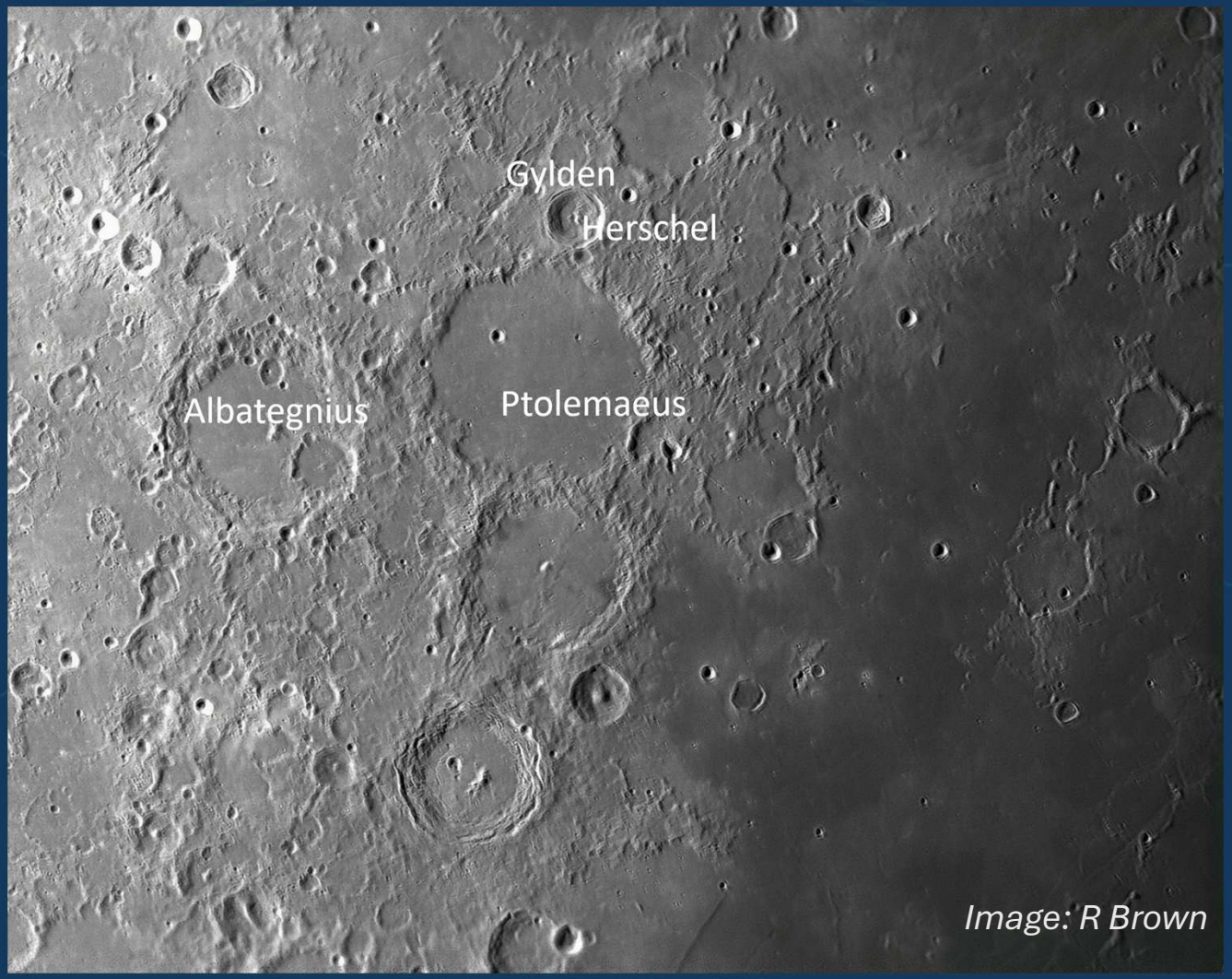
(806) Gyldénia

Discovered 1915 Apr. 18 by M. F. Wolf at Heidelberg.

Named in honor of the Swedish astronomer Johan August Hugo Gyldén (1841-1896), director of the Stockholm Observatory and author of a new method for computing perturbations of planets and comets. (H 80)

Gyldén is also honored by a lunar crater.

Schmadel, LD. (2012). Dictionary Of Minor Planet Names (6th ed). Springer, Berlin.

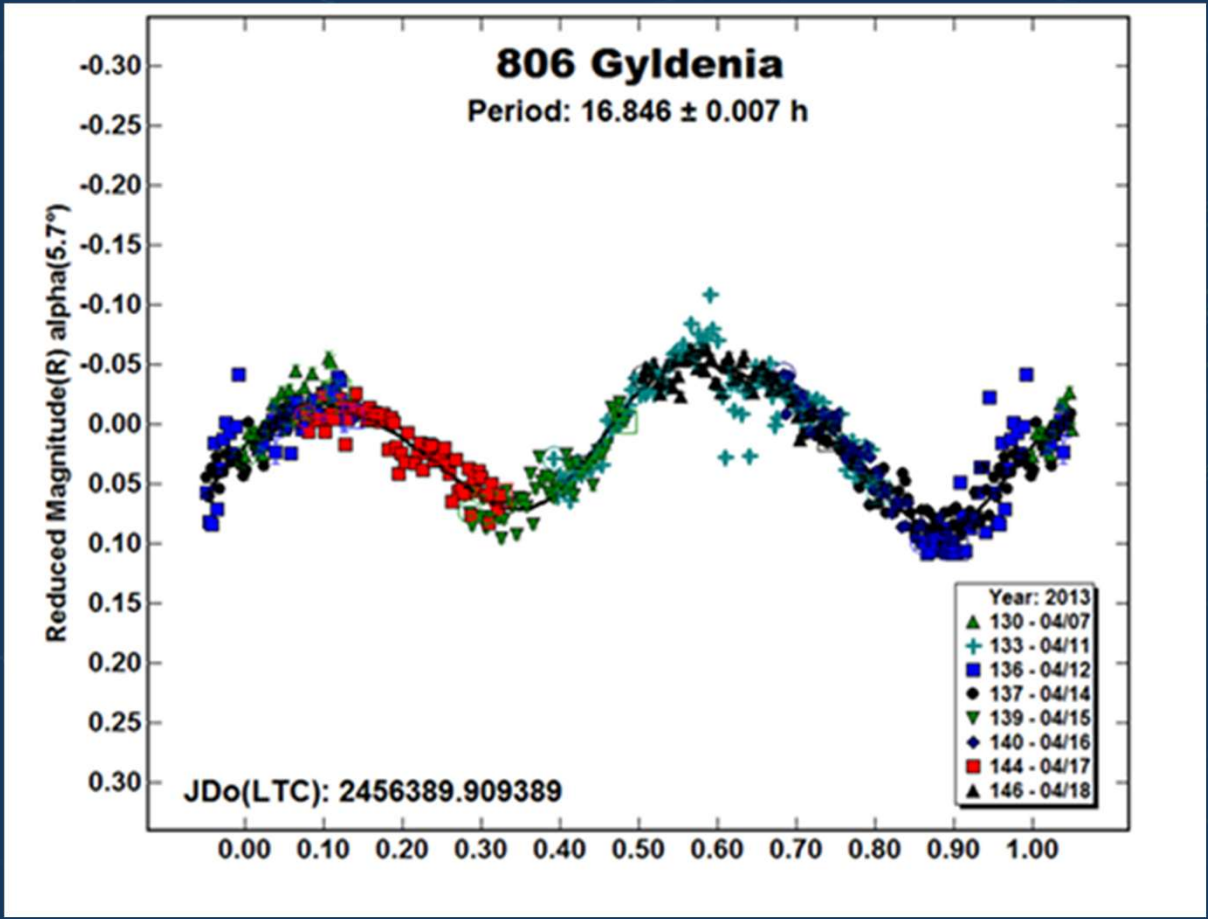

Gylden
Herschel
Albategnius
Ptolemaeus
Image: R Brown

(806) Gyldenia

(796) Sarita	1914 VH	1914 10 15	Heidelberg	Reinmuth, K.
(797) Montana	1914 VR	1914 11 17	Bergedorf	Thiele, H.
(798) Ruth	1914 VT	1914 11 21	Heidelberg	Wolf, M. F.
(799) Gudula	1915 WO	1915 03 09	Heidelberg	Reinmuth, K.
(800) Kressmannia	1915 WP	1915 03 20	Heidelberg	Wolf, M. F.
(801) Helwerthia	1915 WQ	1915 03 20	Heidelberg	Wolf, M. F.
(802) Epyaxa	1915 WR	1915 03 20	Heidelberg	Wolf, M. F.
(803) Picka	1915 WS	1915 03 21	Vienna	Palisa, J.
(804) Hispania	1915 WT	1915 03 20	Barcelona	Comas Sola, J.
(805) Hormuthia	1915 WW	1915 04 17	Heidelberg	Wolf, M. F.
(806) Gyldénia	1915 WX	1915 04 18	Heidelberg	Wolf, M. F.
(807) Ceraskia	1915 WY	1915 04 18	Heidelberg	Wolf, M. F.
(808) Merxia	1901 GY	1901 10 11	Heidelberg	Carnera, L.
(809) Lundia	1915 XP	1915 08 11	Heidelberg	Wolf, M. F.
(810) Atossa	1915 XQ	1915 09 08	Heidelberg	Wolf, M. F.
(811) Nauheima	1915 XR	1915 09 08	Heidelberg	Wolf, M. F.
(812) Adele	1915 XV	1915 09 08	Simeïs	Beljavskij, S.
(813) Baumeia	1915 YR	1915 11 28	Heidelberg	Wolf, M. F.
(814) Tauris	1916 YT	1916 01 02	Simeïs	Neujmin, G. N.
(815) Coppelia	1916 YU	1916 02 02	Heidelberg	Wolf, M. F.
(816) Juliana	1916 YV	1916 02 08	Heidelberg	Wolf, M. F.
(817) Annika	1916 YW	1916 02 06	Heidelberg	Wolf, M. F.
(818) Kapteynia	1916 YZ	1916 02 21	Heidelberg	Wolf, M. F.
(819) Barnardiana	1916 ZA	1916 03 03	Heidelberg	Wolf, M. F.
(820) Adriana	1916 ZB	1916 03 30	Heidelberg	Wolf, M. F.
(821) Fanny	1916 ZC	1916 03 31	Heidelberg	Wolf, M. F.
(822) Lalage	1916 ZD	1916 03 31	Heidelberg	Wolf, M. F.
(823) Sisigambis	1916 ZG	1916 03 31	Heidelberg	Wolf, M. F.
(824) Anastasia	1916 ZH	1916 03 25	Simeïs	Neujmin, G. N.
(825) Tanina	1916 ZL	1916 03 27	Simeïs	Neujmin, G. N.
(826) Henrika	1916 ZO	1916 04 28	Heidelberg	Wolf, M. F.
(827) Wolfiana	1916 ZW	1916 08 29	Vienna	Palisa, J.
(828) Lindemannia	1916 ZX	1916 08 29	Vienna	Palisa, J.
(829) Academia	1916 ZY	1916 08 25	Simeïs	Neujmin, G. N.
(830) Petropolitana	1916 ZZ	1916 08 25	Simeïs	Neujmin, G. N.
(831) Stateira	1916 AA	1916 09 20	Heidelberg	Wolf, M. F.
(832) Karin	1916 AB	1916 09 20	Heidelberg	Wolf, M. F.
(833) Monica	1916 AC	1916 09 20	Heidelberg	Wolf, M. F.
(834) Burnhamia	1916 AD	1916 09 20	Heidelberg	Wolf, M. F.
(835) Olivia	1916 AE	1916 09 23	Heidelberg	Wolf, M. F.
(836) Jole	1916 AF	1916 09 23	Heidelberg	Wolf, M. F.
(837) Schwarzschilda	1916 AG	1916 09 23	Heidelberg	Wolf, M. F.
(838) Seraphina	1916 AH	1916 09 24	Heidelberg	Wolf, M. F.
(839) Valborg	1916 AJ	1916 09 24	Heidelberg	Wolf, M. F.
(840) Zenobia	1916 AK	1916 09 25	Heidelberg	Wolf, M. F.

Source: Discovery Circumstances: Numbered Minor Planets (1)-(5000). Minor Planet Center.

(806) Gyldenia



ASTEROID LIGHTCURVE ANALYSIS AT ELEPHANT HEAD OBSERVATORY: 2013 APRIL –JULY

Michael S. Alkema
Elephant Head Observatory (G35)
17070 S Kolb Rd., Sahuarita, AZ 85629
msalkema@gmail.com

(Received: 12 July)

Minor Planet Bulletin **40** (2013)

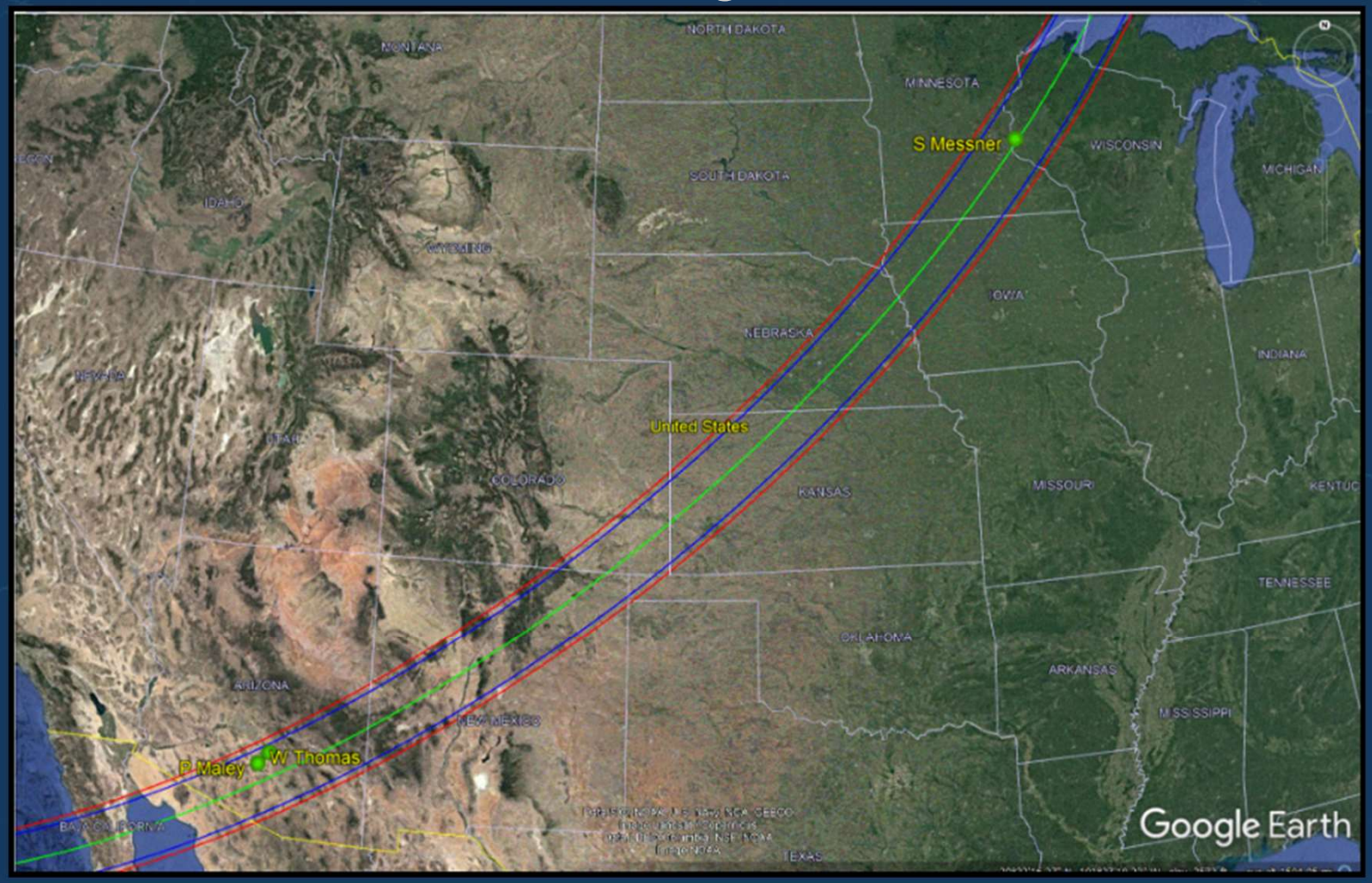
(806) Gyldenia

```
Observed chord lengths

Length      # Observer

806 Gyldenia          2012 Apr  1      UCAC4 636-043115
  11.0 km   1 H Takashima

806 Gyldenia          2014 Sep  7      UCAC4 254-171184
  36.0 km   1 B Loader

806 Gyldenia          2021 Aug 20      UCAC4 429-001516
  12.2 km   1 W Thomas
  34.2 km   2 P Maley
  68.2 km   3 S Messner

806 Gyldenia          2022 Jan  6      UCAC4 444-000743
  33.6 km   1 Hideki Yoshihara

806 Gyldenia          2025 Apr 25      UCAC4 300-114512
  33.5 km   1 R Brown

806 Gyldenia          2025 Apr 25      J-coords 170441.54-300
  50.6 km   1 R Brown
```

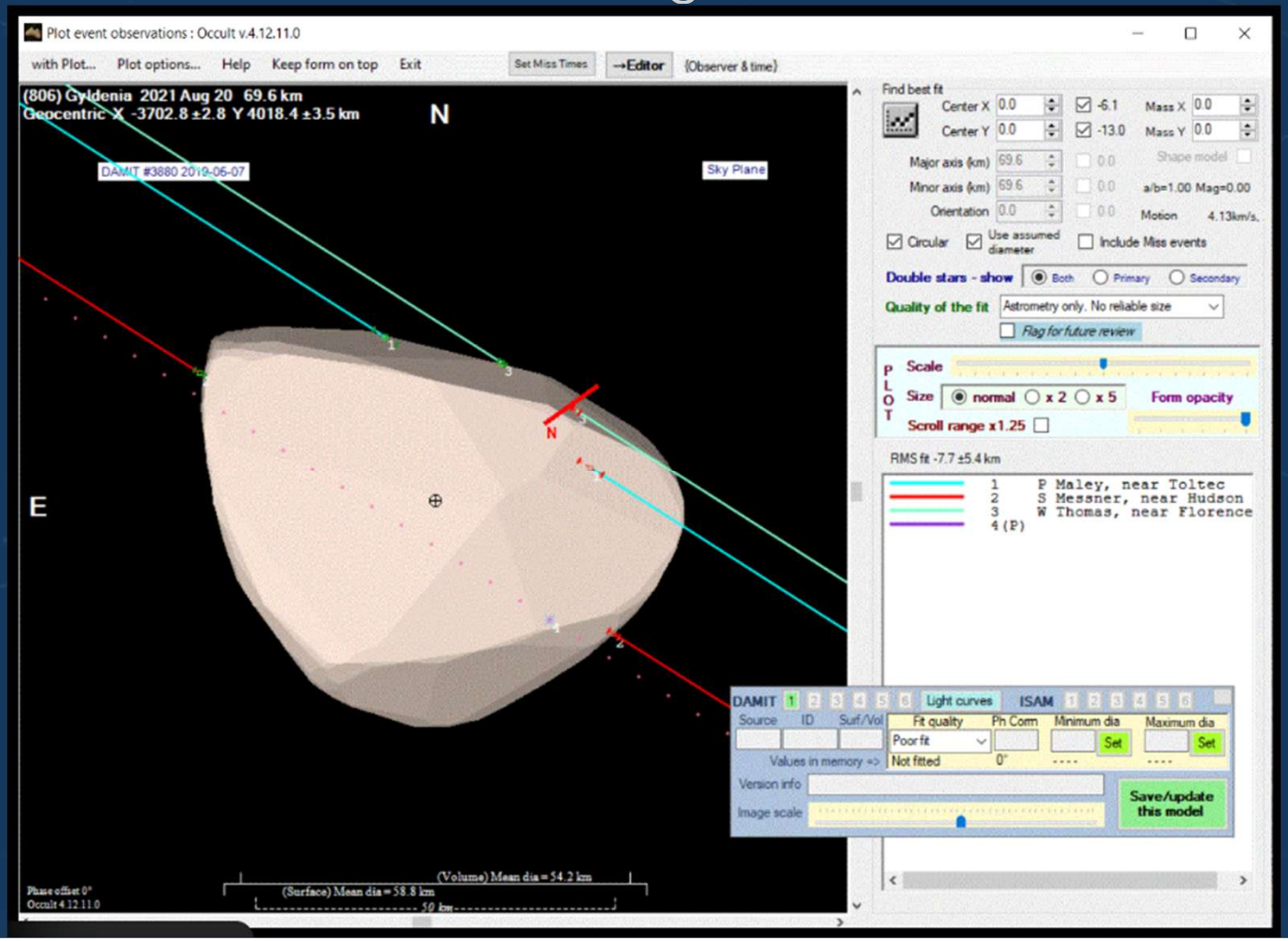
```
Approximate asteroid diameter : 54km
(Derived using John Broughton's basic method)

---------------------------------------

Satellite IR diameters for asteroid (806)

  NEOWISE:  83.1 ± 8.0km:  albedo 0.022
     AcuA:  69.0 ± 4.8km:  albedo 0.034
     IRAS:  62.6 ± 6.4km:  albedo 0.026

Weighted diameter:  69.6 ±  3.4 km
[including recommended increase in uncertainty]

Individual diameter and albedo measurements
   62.7 ± 26.4km:  albedo 0.032:  NEOWISE
   68.1 ± 29.2km:  albedo 0.030:  NEOWISE
   83.1 ±  8.0km:  albedo 0.022:  NEOWISE
   69.7 ±  9.6km:  albedo 0.034:  AcuA
   68.2 ±  9.6km:  albedo 0.036:  AcuA
```

Source: Occult – AOTA (D Herald) (Jan 2026)

(806) Gyldenia

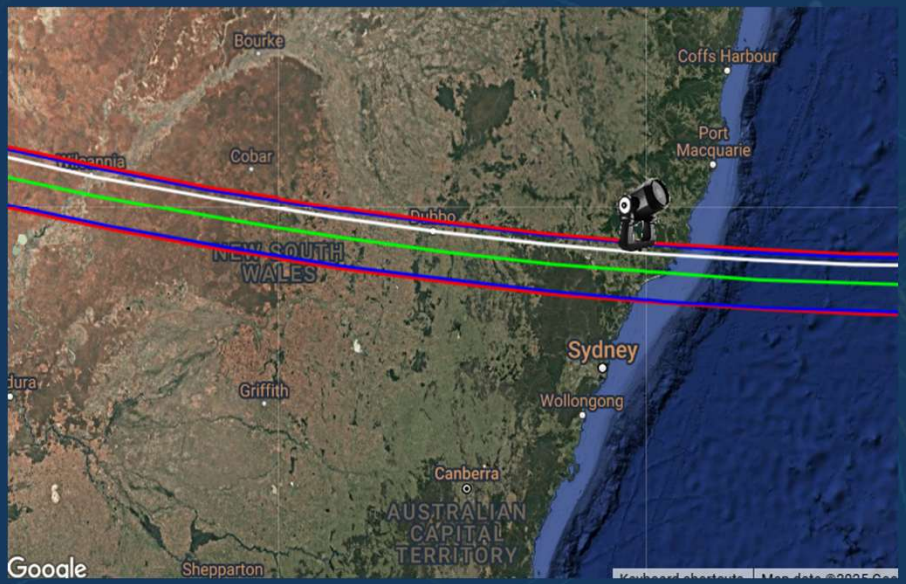


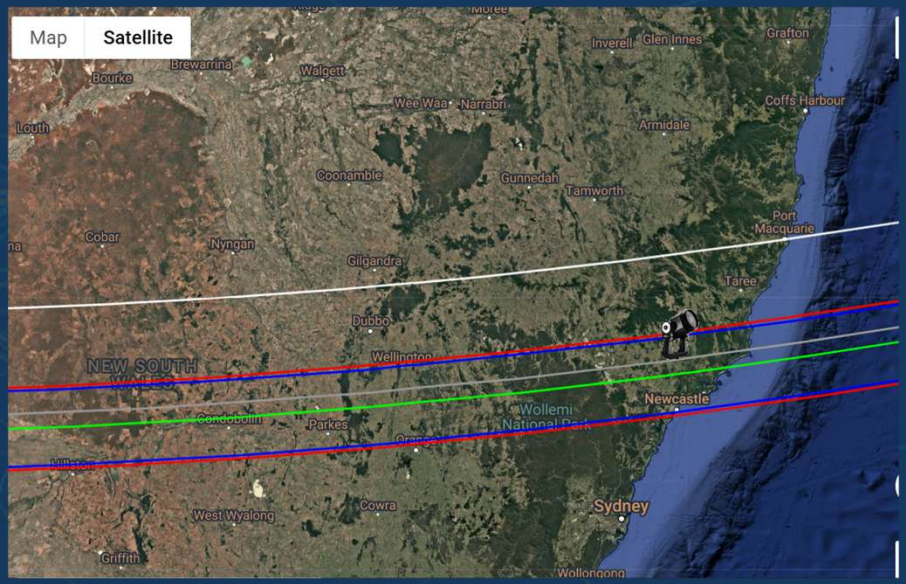
(806) Gyldenia



Source: Occult, v4.12.11.0

(806) Gyldenia



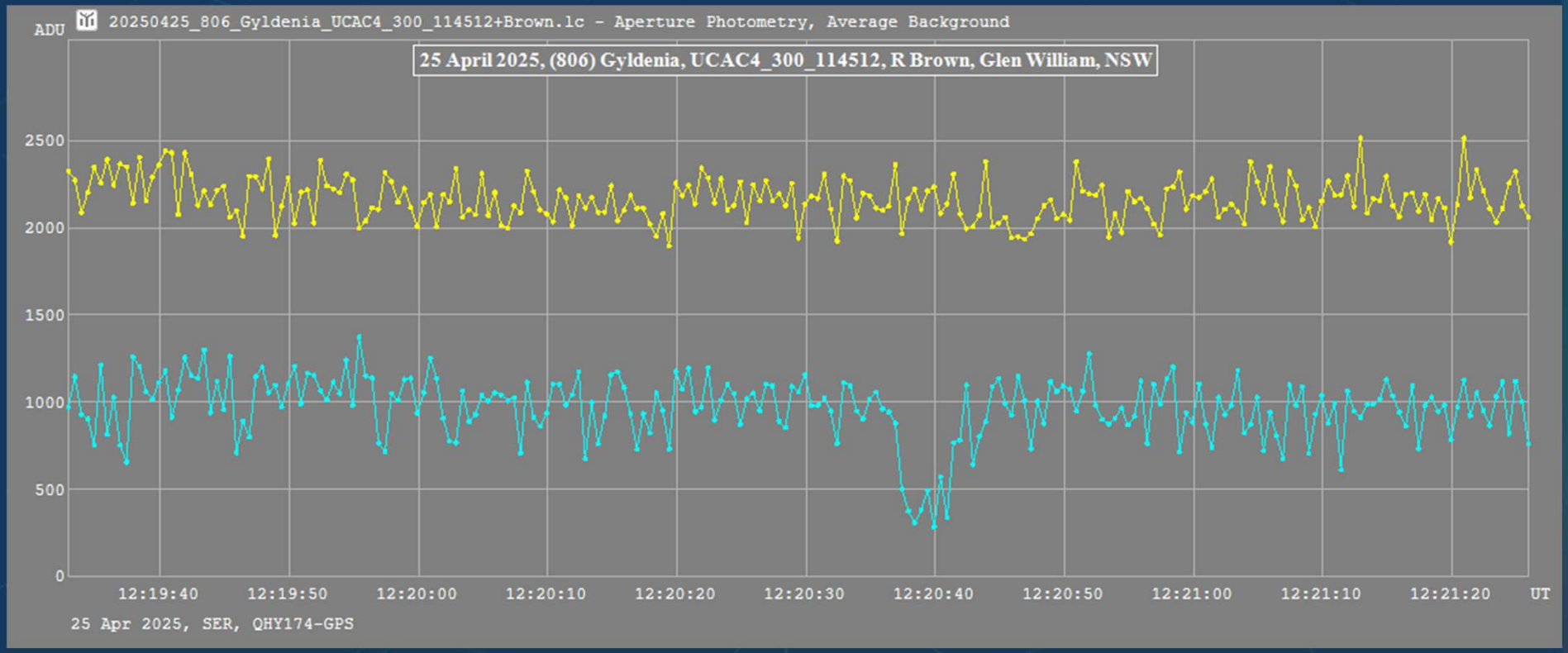


Source: OW Cloud

(806) Gyldenia

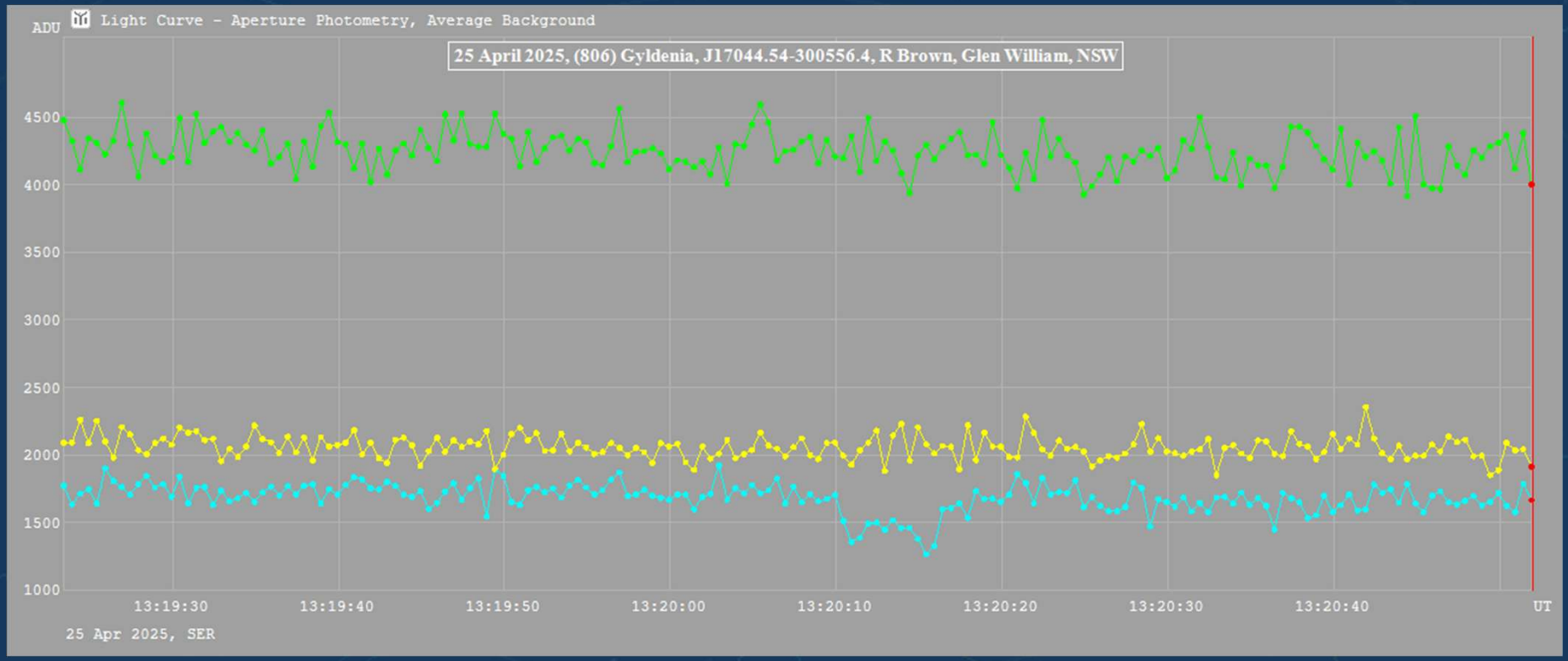
Source: R Brown

(806) Gyldenia



Source: R Brown, Tangra

(806) Gyldenia



Source: R Brown, Tangra