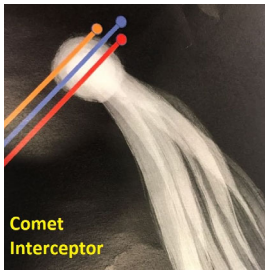


Photometric Evolution of C/2020 E3

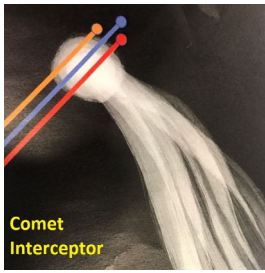
Mark Kidger

SOC

ESAC

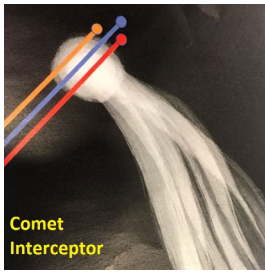
With the collaboration of the Observadores-cometas Group

& Joan Pau Sánchez Cuartielle



C/2022 E3 (ZTF)

- Discovery:
  - 2022 March 02 at the Zwicky Transient Facility.
  - Magnitude 17.2.
  - Distance r=4.28AU.
  - Initial orbital elements suggested that it was not a DNC.
  - But, reachable by Comet Interceptor.



Read More | View

Re: [CI-target-team] another new target to check

22 March, 2022 14:34

From: Joan Pau Sánchez Cuartielles

To: Colin Snodgrass | Mark Kidger

Cc: Matthew Knight | ci-target-team

C2022E3_Synodic.tif (601.5 KB) Download | Briefcase | Remove
C2022E3_inertial.tif (635.2 KB) Download | Briefcase | Remove
View all images
Download all attachments
Remove all attachments

Hi all,
Definitively, a very interesting target.

The launch date to reach C/2022 E3 would be **24/08/2022**, and the flyby would be **12/02/2023**. Time of flight of 171 days.

Given the small angular distance between the Earth and the comet at flyby date, most of the DV cost goes to increase the apoapsis to intersect the comet at 1.216 au.

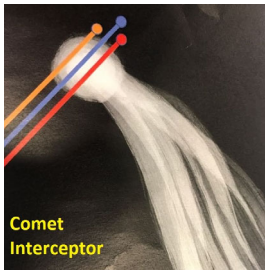
The DV is still considerable, but relatively manageable. The transfer requires a vinf to escape the Earth of 1.671 km/s. This is marginally compatible with a simple direct escape transfer from the Halo orbit, but it is a very accessible DV if a single moon fly by or an Earth periapsis DV burn is considered.

The departure date does not include these extra manoeuvres in the cis-lunar space, yet it is cool to see the first object with departure orbit not in the past.

Cheers
Pau

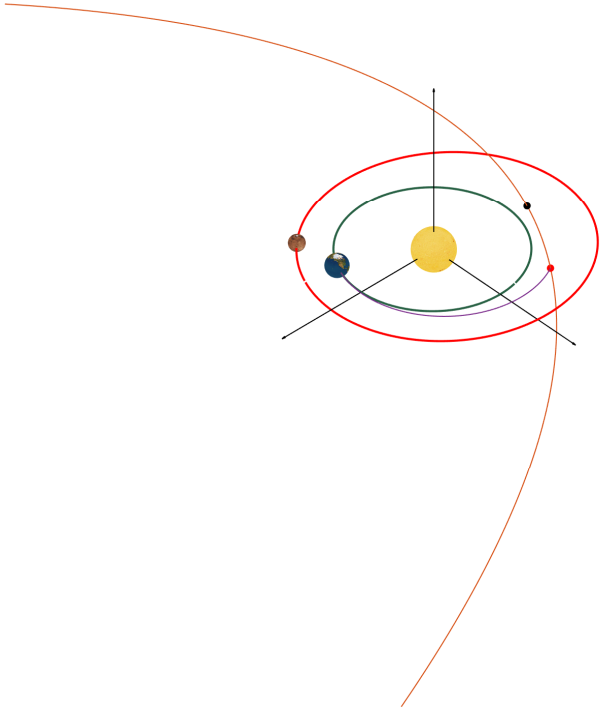
Le 22/03/2022 à 10:22, Colin Snodgrass a écrit :

> Hi Mark, all,
>
> According to the amateur mailing list this thing is brightening fast so possibly in outburst. I would treat the Horizons magnitudes with even more scepticism than normal on that basis.
>
> Does look like a nice target in terms of orbit though, finally one that we would be encountering the right side of the Sun from an Earth point of view, and not far away. So I hope that it would actually have been reachable. Whether or not we would have detected it early enough if it has only just brightened following an outburst is another question, of course.
>
> Cheers,
>
> Colin
>
> On 22 Mar 2022, at 08:08, Mark Kidger via ci-target-team <ci-target-team@lists.roe.ac.uk<mailto:ci-target-team@lists.roe.ac.uk>>

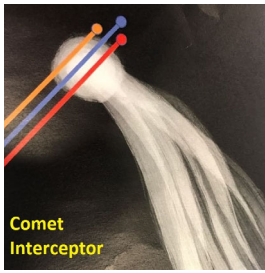


Virtual Encounter Circumstances

- Joan Pau Sánchez Cuartielle comments:
  - Trajectory similar to original despite the change in orbital elements.
    - 4 m/s more expensive.
  - Departure 24/08/2022
  - Arrival 12/02/2023
  - Time of flight 171 days
- Total escape velocity required 1.675 km/s
  - 0.5-1 km/s Delta-V required from L2.
  - "*Cost of reaching the comet is theoretically possible, albeit probably marginal*".
  - Probably needs gravity assist.
- Encounter velocity 52 km/s.



C/2022 E3 (ZTF)



Initial orbit solution

C/2022 E3 (ZTF)
Epoch 2023 Jan. 16.0 TT = JDT 2459960.5
T 2023 Jan. 13.18676 TT

				Rudenko
q	1.1142870	(2000.0)	P	Q
z	+0.0000075	Peri.	145.77014	-0.59957589	-0.07436053
+/-	0.0017500	Node	302.51706	+0.33745805	+0.87934395
e	0.9999916	Incl.	109.09060	+0.72569333	-0.47034533

From 62 observations 2022 Mar. 2-21, mean residual 0".3.

MPEC K22-F13

Current orbit solution

C/2022 E3 (ZTF)
Epoch 2022 Aug. 9.0 TT = JDT 2459800.5
T 2023 Jan. 12.78819 TT

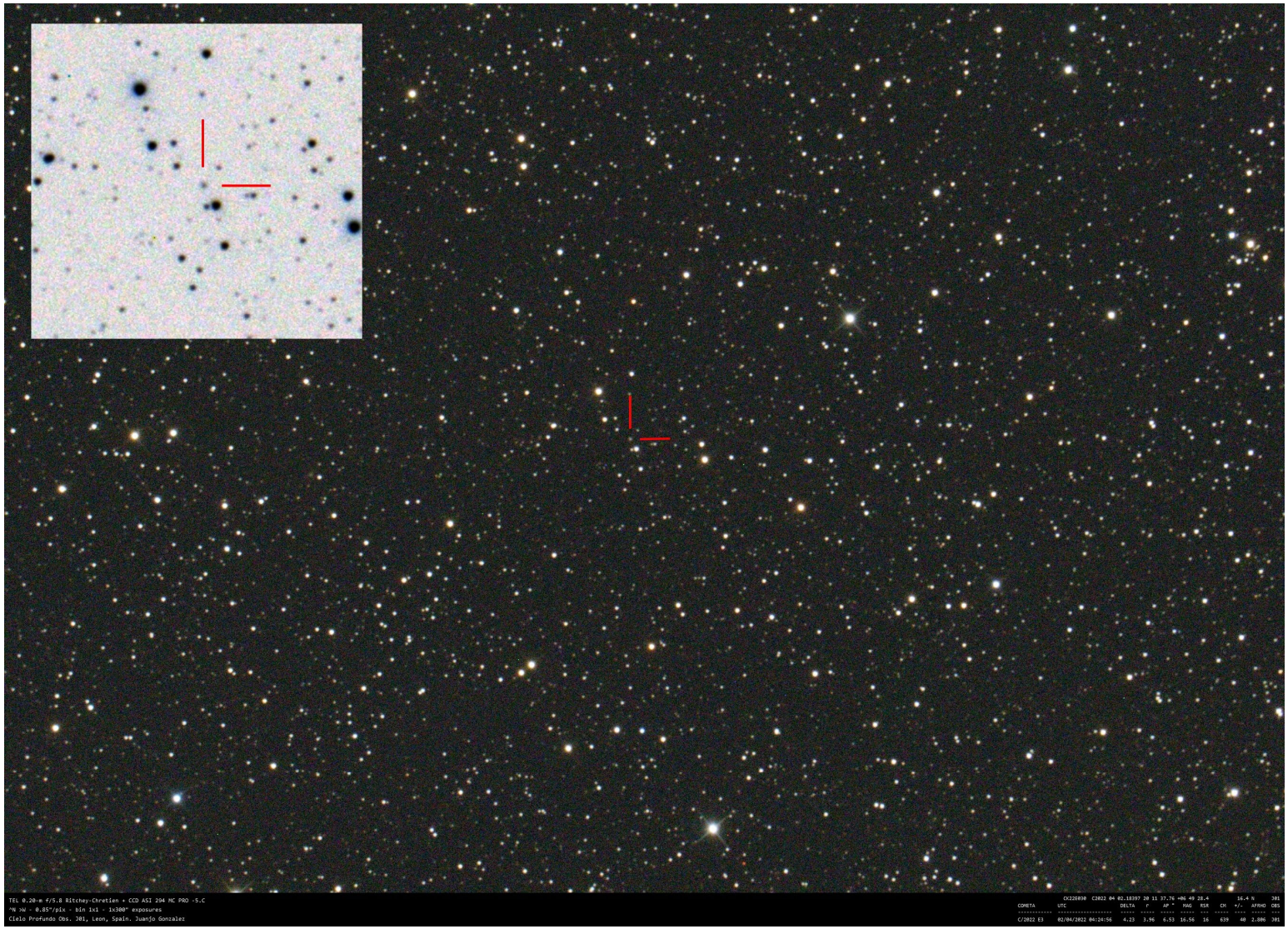
				Rudenko
q	1.1122649	(2000.0)	P	Q
z	-0.0002468	Peri.	145.81445	-0.60062558	-0.07339913
+/-	0.0000056	Node	302.55385	+0.33752809	+0.87941685
e	1.0002746	Incl.	109.16846	+0.72479218	-0.47036005

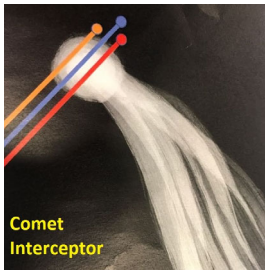
From 1098 observations 2021 Oct. 25-2022 June 27, mean residual 0".4.
1/a(orig) = +0.000760 AU**-1, 1/a(fut) = -0.000029 AU**-1.

MPEC 2022-M88

Pre-discovery images at r=5.51 AU have considerably increased the orbital arc.

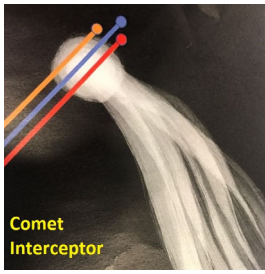
Original aphelion distance **≈5300 AU**
Original orbital period **≈130 000 years**



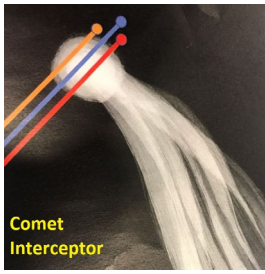


Juanjo Gonzalez: MOC J01 (Leon, Spain), April 5th
300s, 20cm Ritchey-Chretien

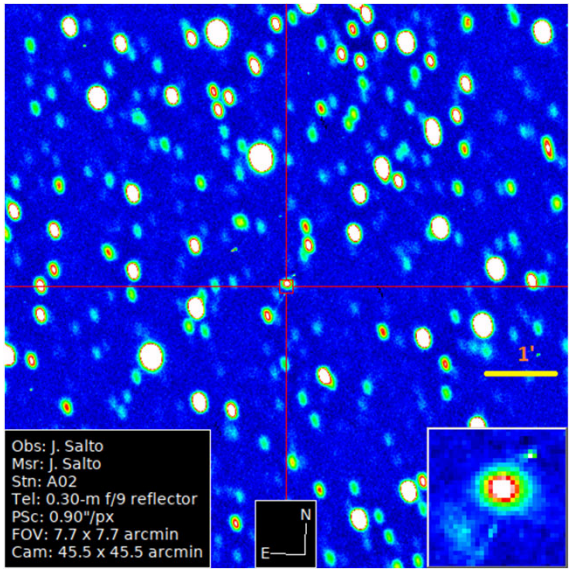
Photometry



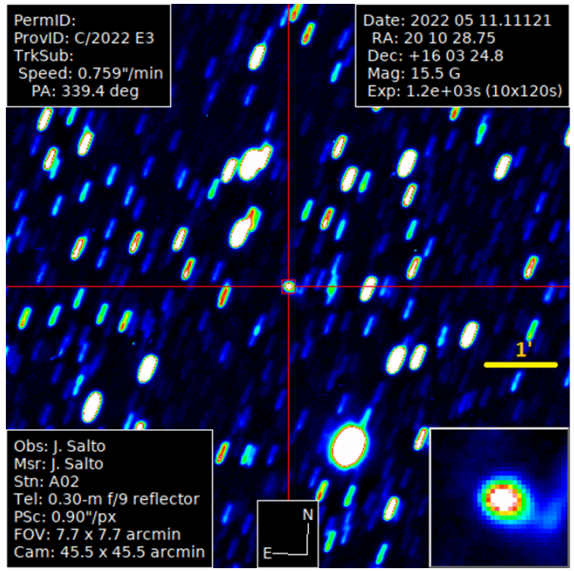
- Multiaperture
  - 10-60 arcseconds circular apertures.
  - Multiple sky apertures across the field.
  - Unfiltered R, with Gaia DR2 reference stars.
    - Good approximation to R when there is no strong emission from the Swann Bands (most comets beyond ≈1.5 AU).
  - Fit a photometric profile of the coma
    - Interpolate to 10 000, 25 000, 50 000 and 100 000 km physical diameter.
    - Usually, 100 000 km is a good reference physical aperture for most non-short period comets.
    - When total visual magnitude estimates are available, this reference aperture may need to be adjusted to fit the CCD photometry to the total visual magnitudes.



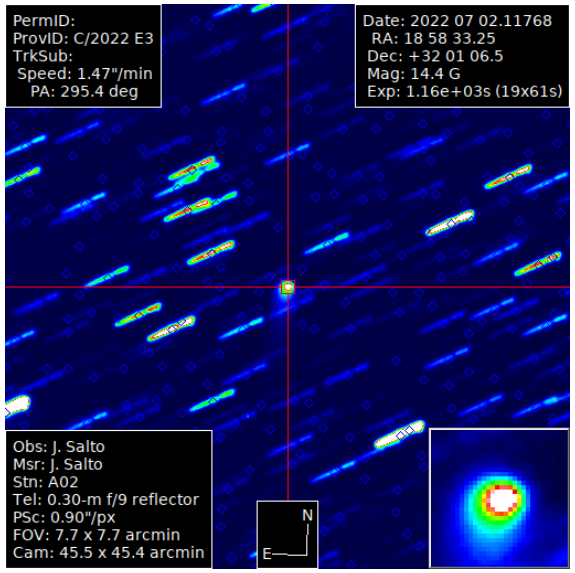
April 06
R=16.35



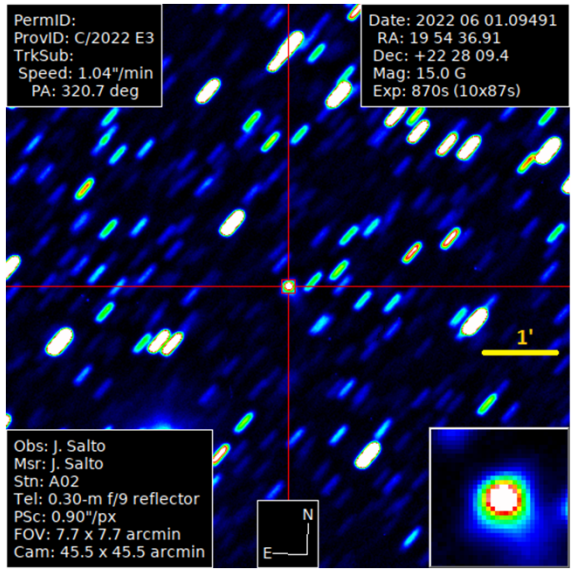
May 11
R=15.32

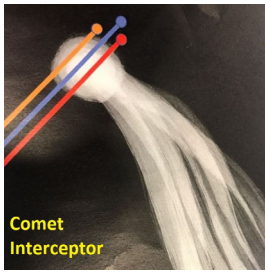


July 02
R=14.50

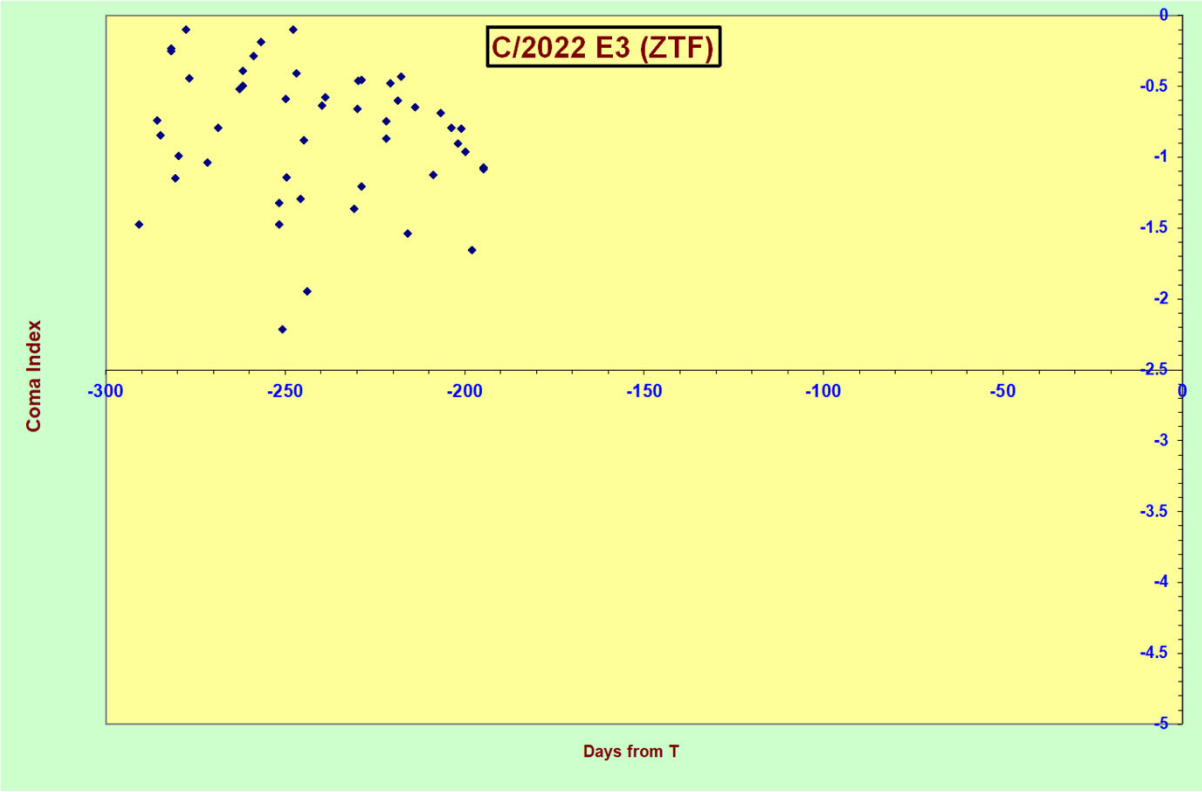


June 01
R=14.69

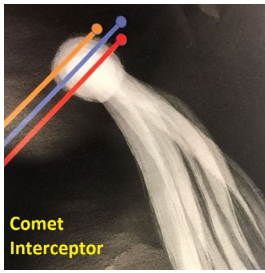




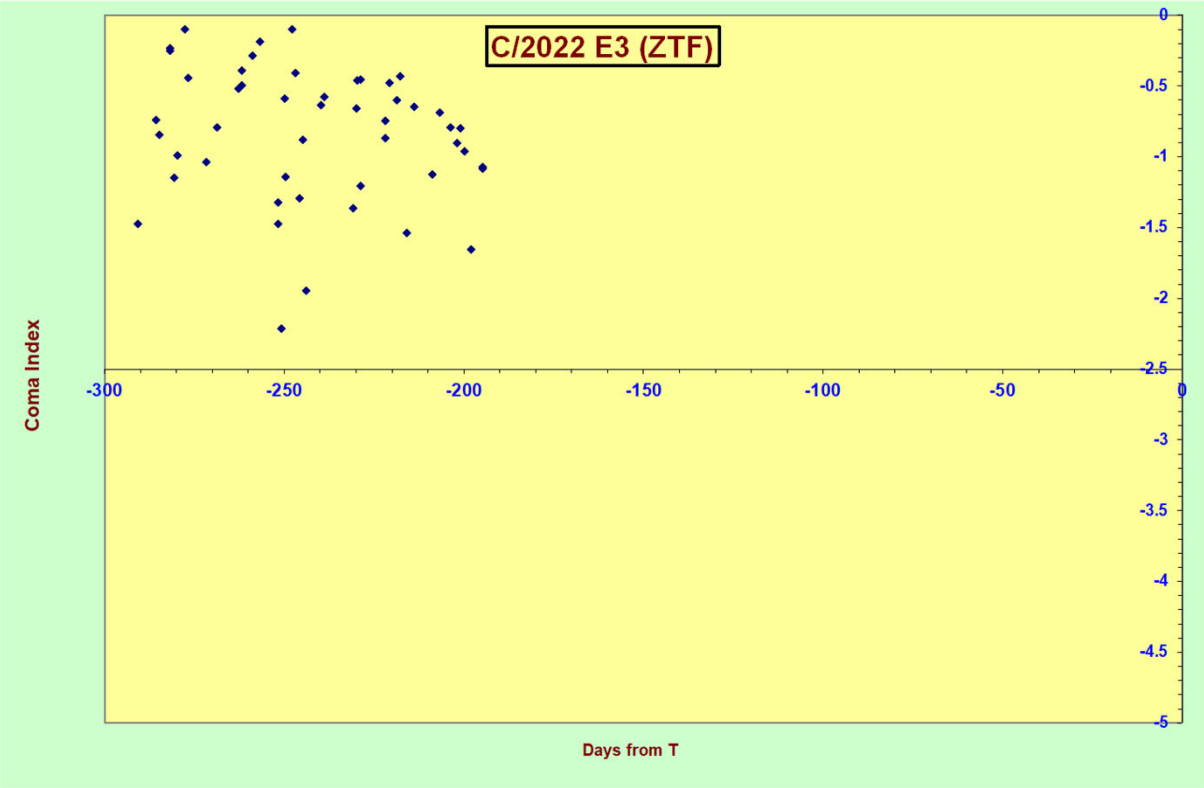
Coma Profile



If C/2022 E3 had an ideal 1/r coma profile, we would see a coma index (slope) of -2.5. It is small, highly condensed and much steeper than 1/r, but this is normal in comets at this heliocentric distance.



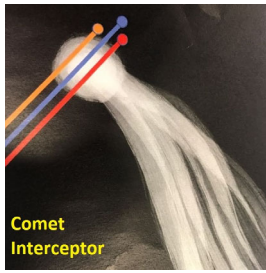
Coma Profile

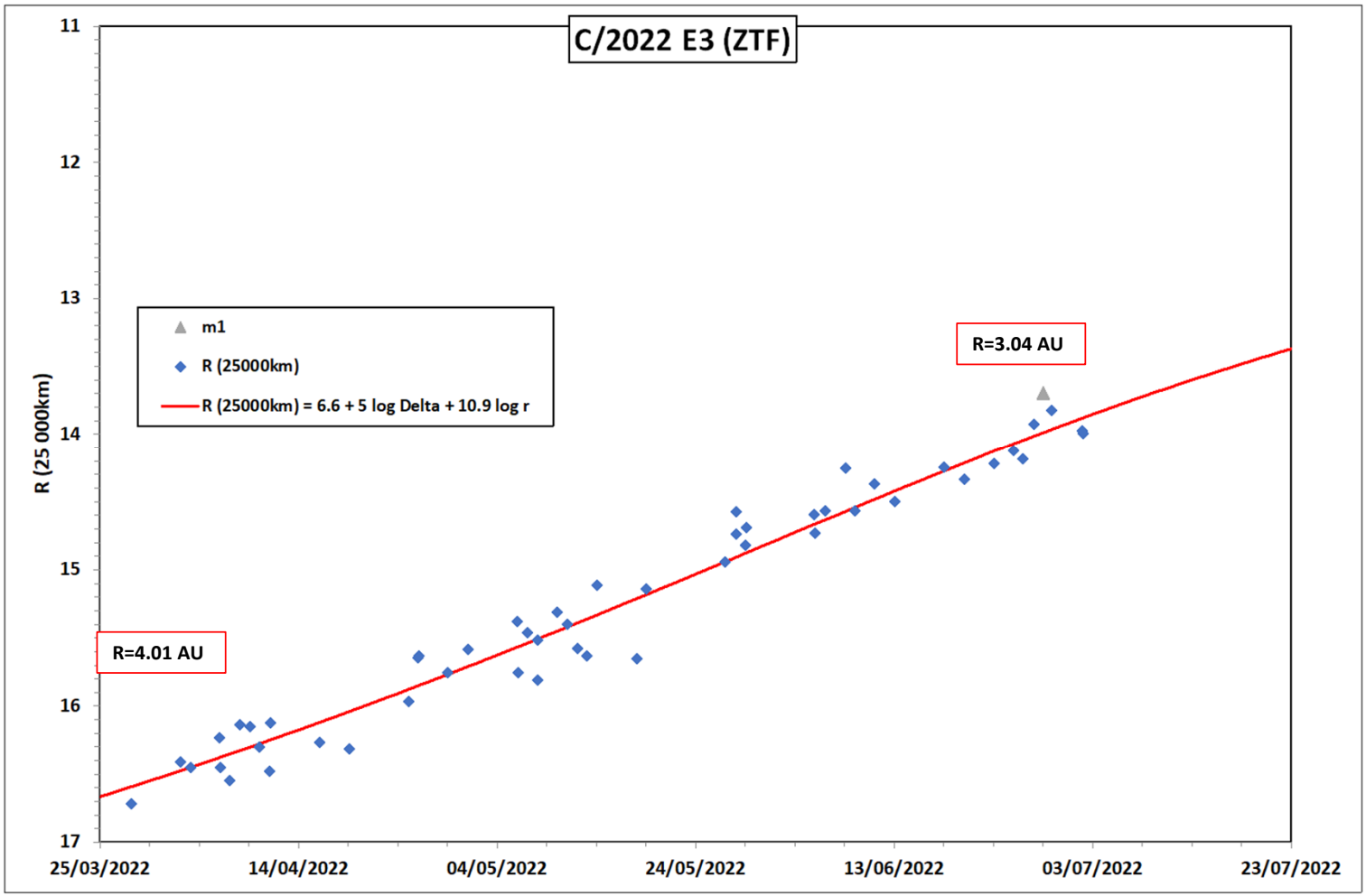


→ Any photometric aperture larger than 25 000 km is dominated by noise!

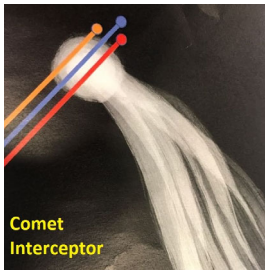
C/2022 E3 has the smallest physical coma diameter for a non-JF comet that we have measured in more than 15 years of comet photometry!

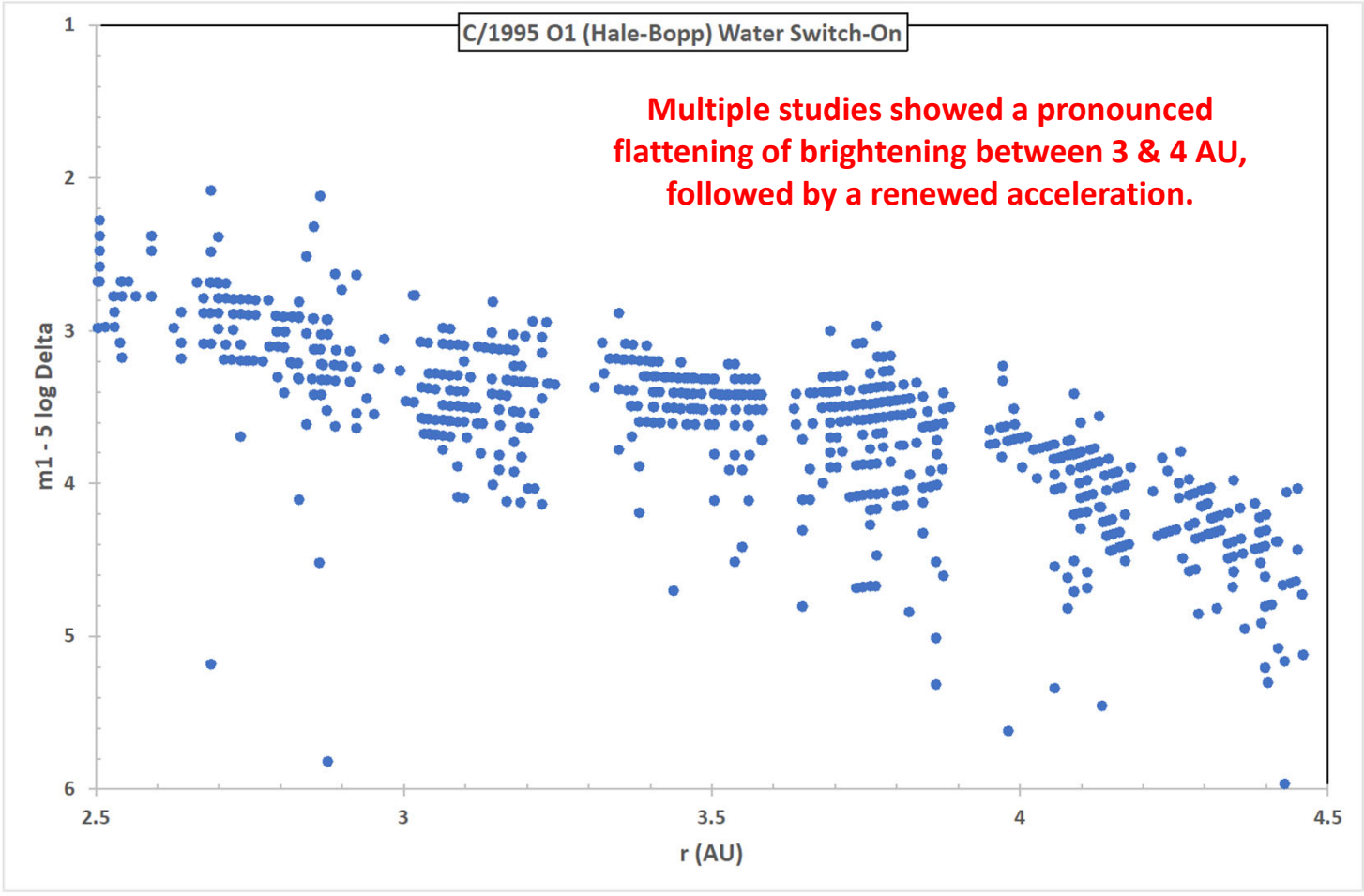
No Lightcurve Breakpoint at ≈3.5 AU



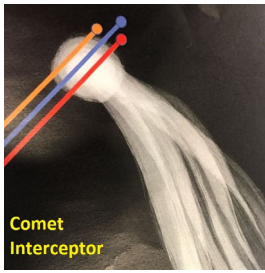


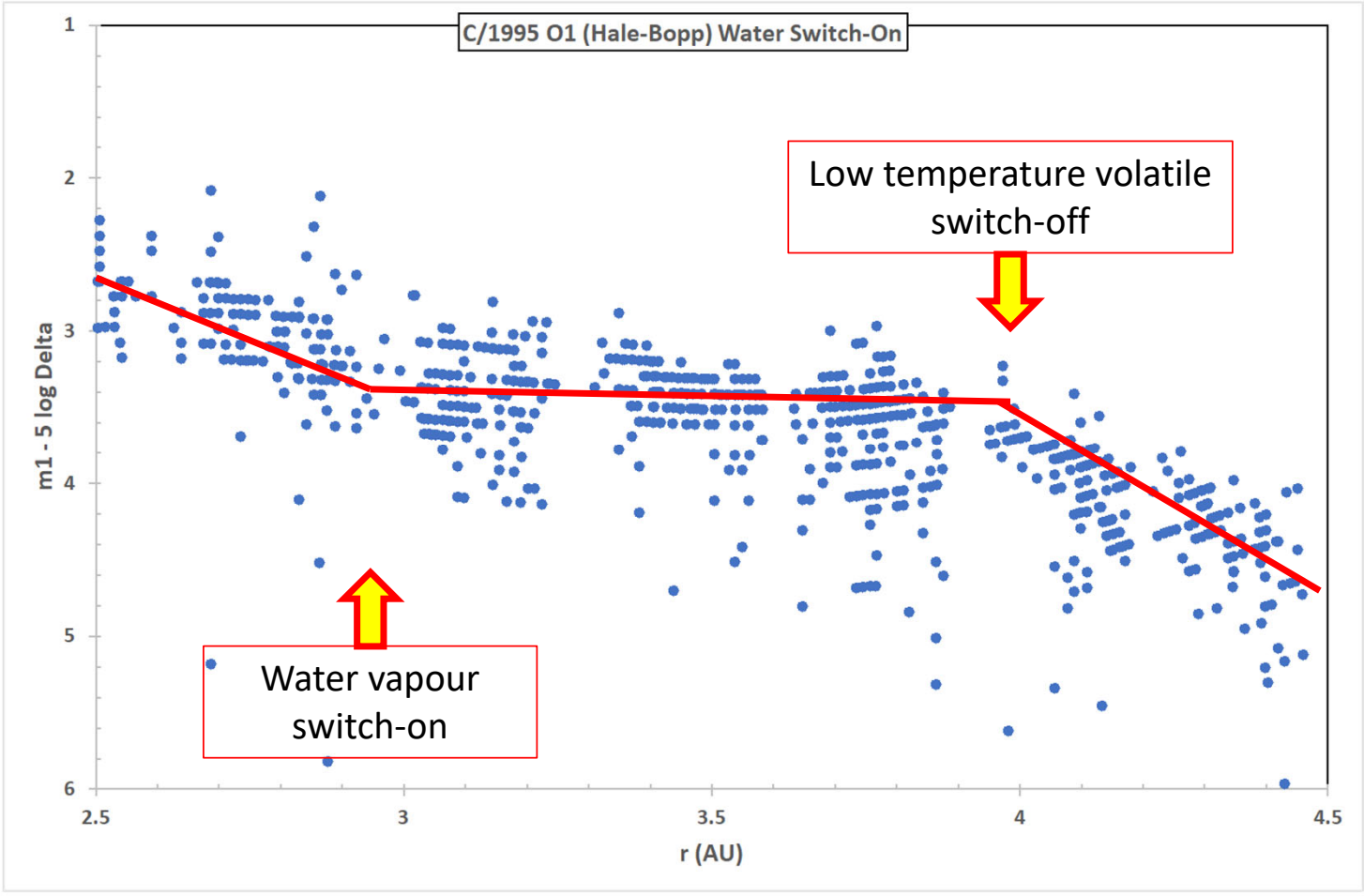
Comparison with C/1995 O1 (Hale-Bopp)



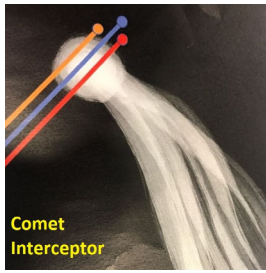


Comparison with C/1995 O1 (Hale-Bopp)

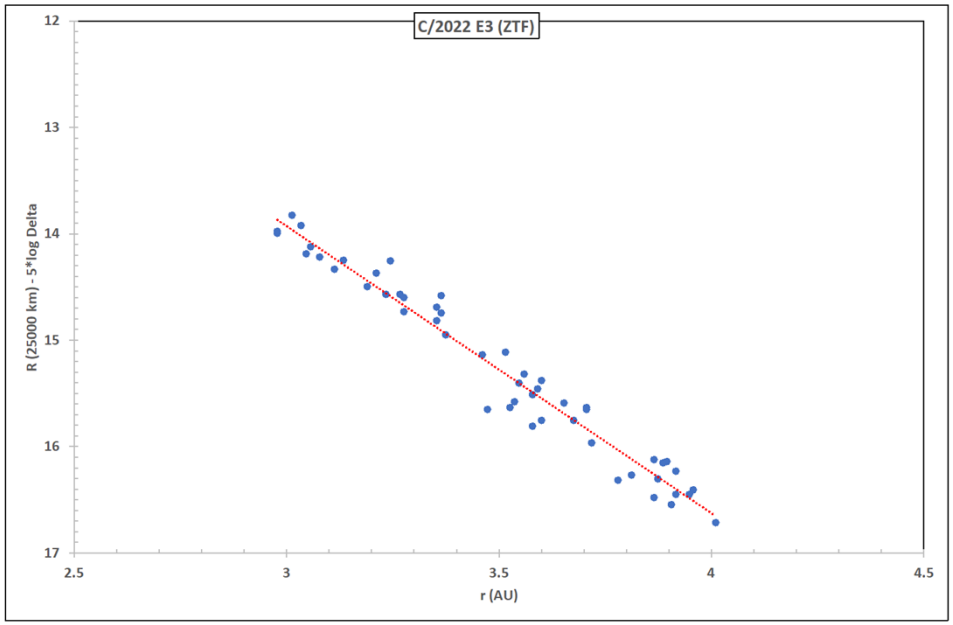




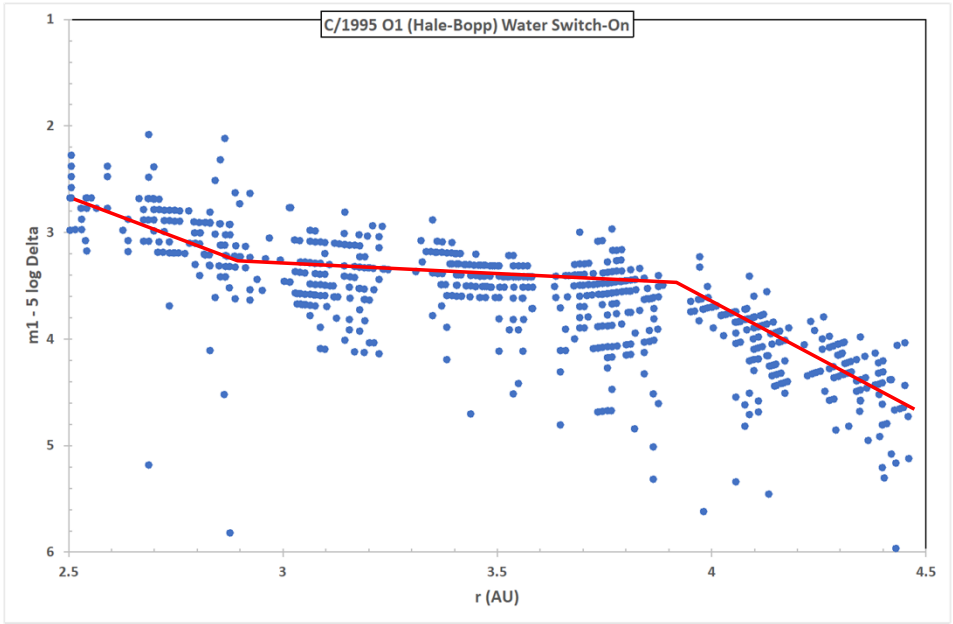
No Light curve breakpoint (yet) at ≈3.5 AU



$r^{-4.2}$ brightening, 3 < r < 4AU.

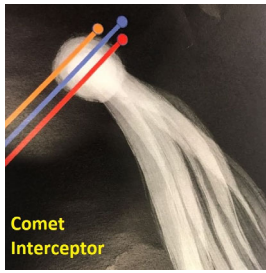


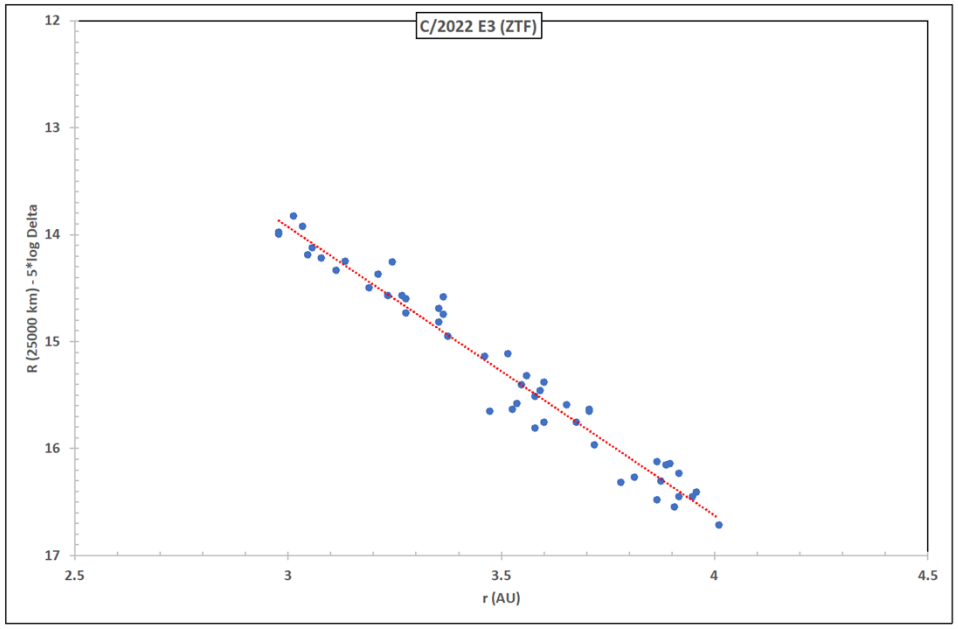
Switched from $r^{-4.5}$ to $r^{-2.3}$ brightening at r≈4AU, then to $r^{-3.3}$ at r<3AU.

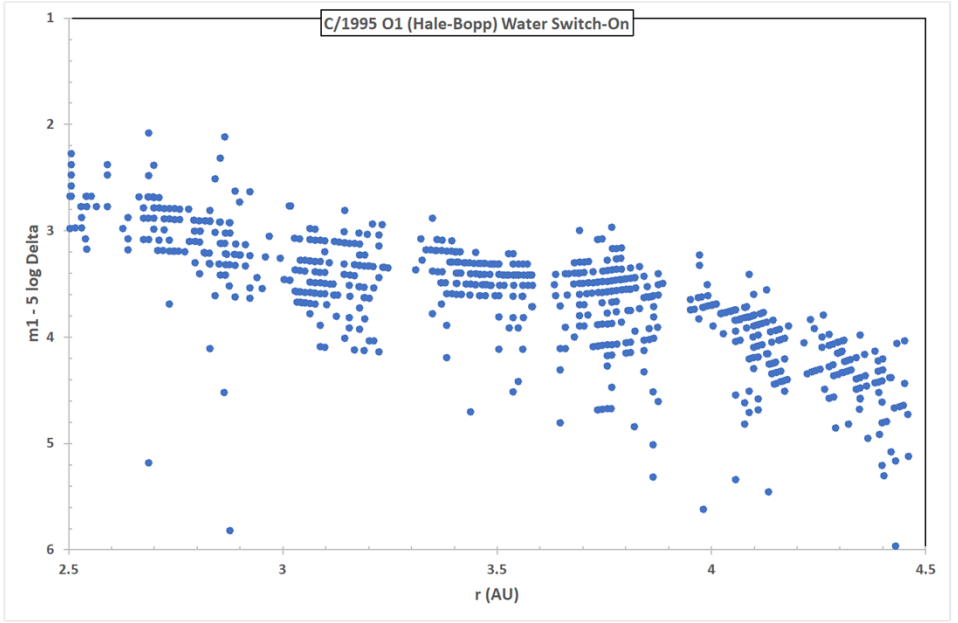


Gassy "new" comets are typically in the range r^{-5} to r^{-8} at r>3 AU and show a very pronounced decrease in power law from r≈1.5-2.5 AU to perihelion.

Does a later breakpoint indicate a more pristine comet?

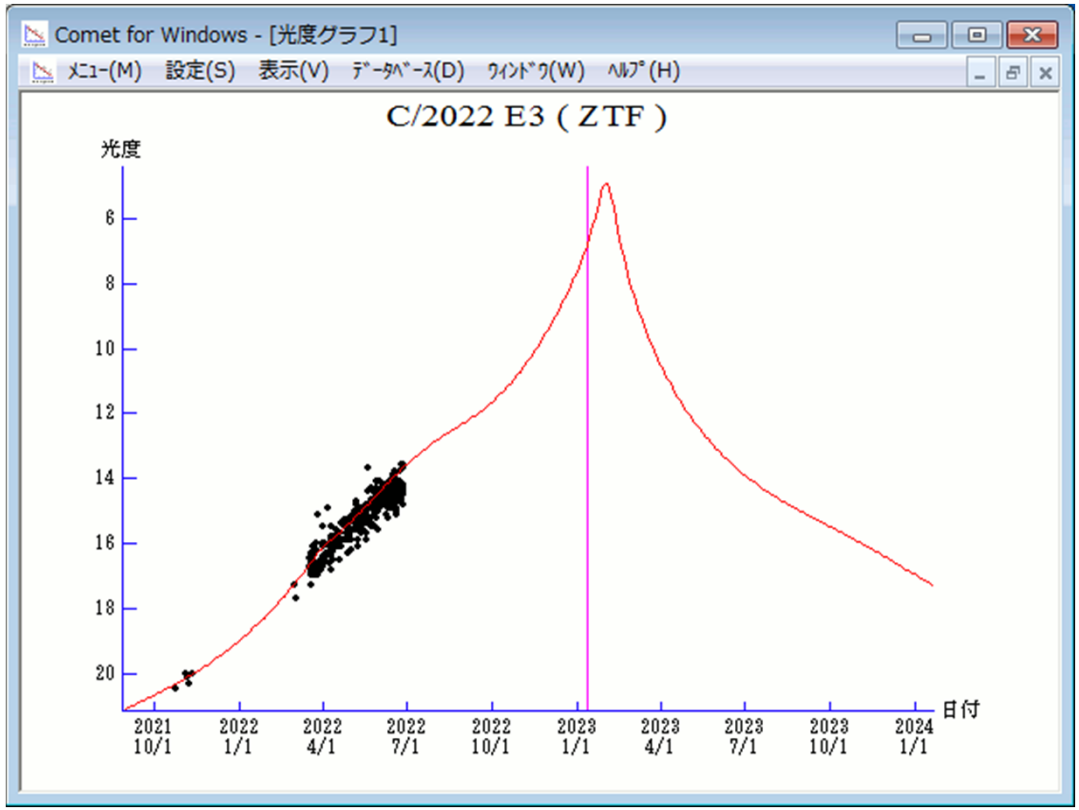




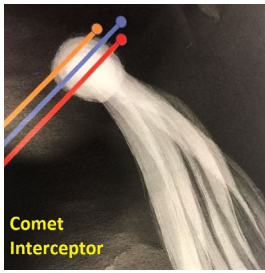


Not known how many previous passes through perihelion C/1995 O1 had made, but the consensus was "*a small number, but probably greater than one*".

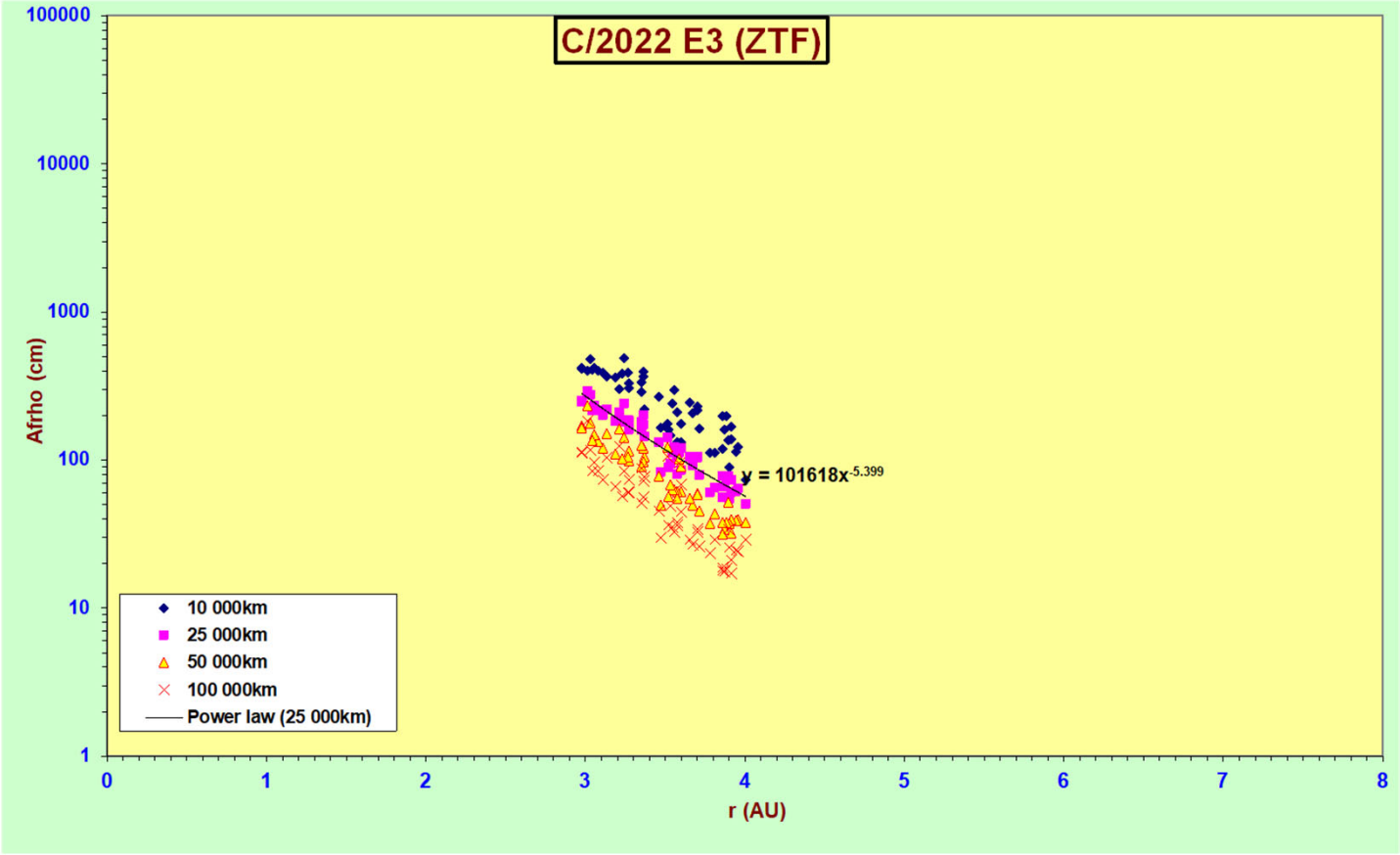
Pre-discovery Observations



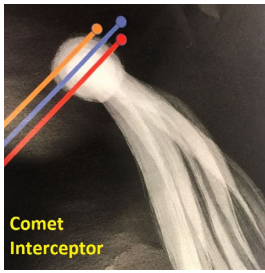
Observations suggest that the comet may have brightened at $>r^{-10}$ before discovery…
Sudden activation?



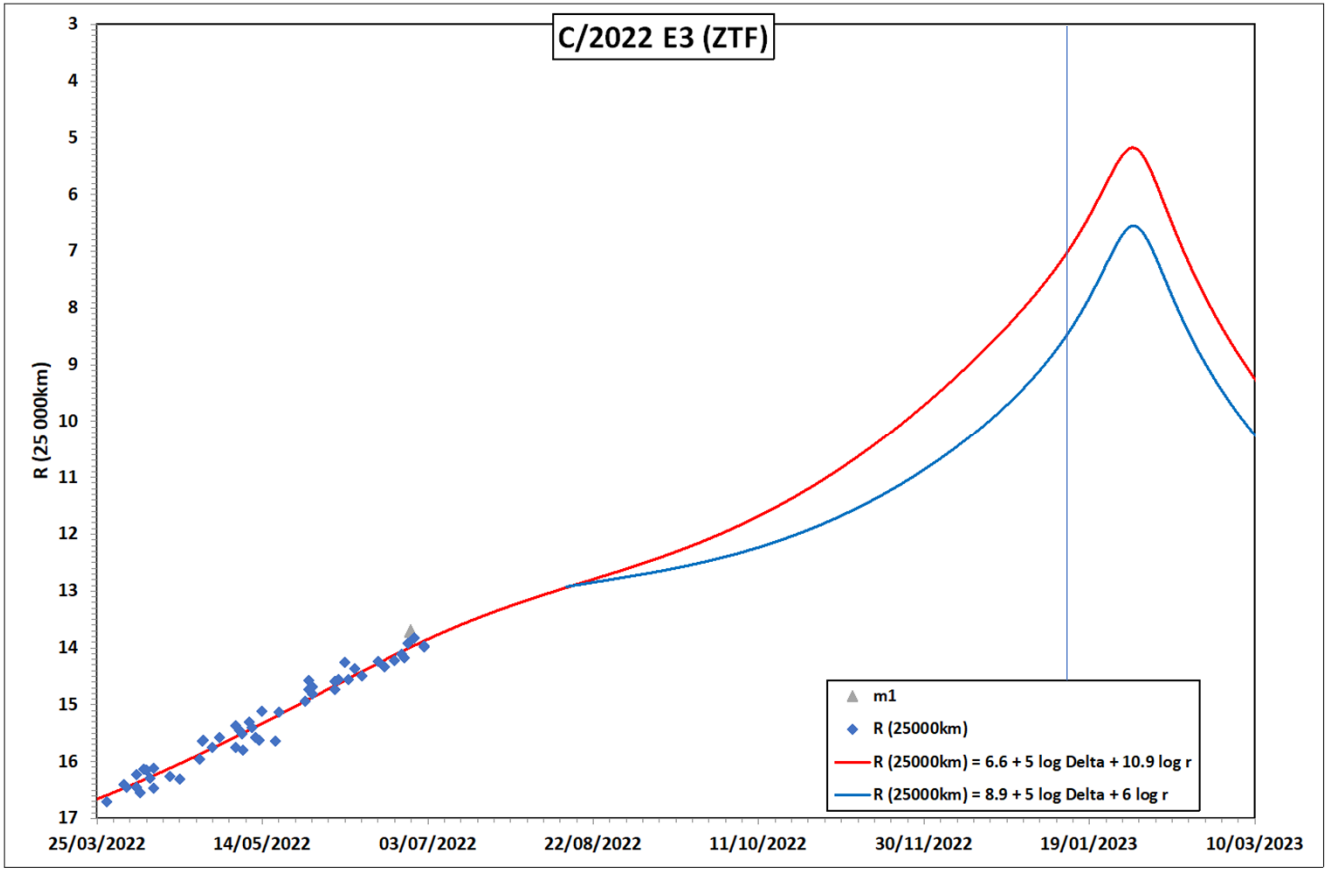
Is the Turnover Starting?



Hints in the last two weeks that the brightening rate may be slowing slightly, putting the turnover at ≈2.9-3.1 AU.

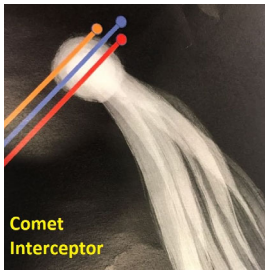


Taking out the crystal ball…



The blue curve assumes a substantial slowdown of brightening at r < 2.5 AU.

Conclusions



- C/2022 E3 appears to be a moderately gassy, but quite small, returning long period comet.
  - Very little tail development so far.
  - Very condensed coma promises further development closer to the Sun.
  - Probably its activity is ≈0.05-0.1 Halley.
  - Well-positioned and quite bright at *virtual encounter (≈magnitude 7)*.
- Its lightcurve turnover is later than that of C/1995 O1 (Hale-Bopp), but the behaviour at “large” heliocentric distance is similar.
  - Does the later lightcurve turnover indicate that it is more pristine than Hale-Bopp?
- Probably would be a good virtual target for Comet Interceptor.