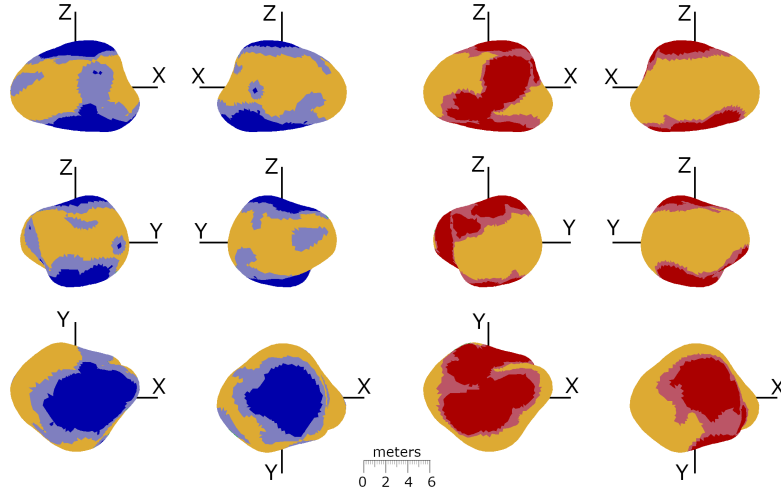


Supplementary Information

Hayabusa2# target asteroid 1998 KY₂₆ is smaller and rotating faster than previously known

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Supplementary Figure 1: **Shape uncertainty of the non-convex model of 1998 KY₂₆.** Heat map illustrating the uncertainties in SAGE shape model #1. Yellow areas indicate regions with uncertainties below 18% relative to the nominal solution. Blue areas highlight potential concavities exceeding 22%, while red areas denote regions where vector magnitudes could increase by more than 22%. The red and blue softened areas correspond to uncertainties ranging from 18% to 22%. The average uncertainty across the entire model is approximately 20%. The model is shown from the perspective of each principal axis (X, Y, Z), which are defined as three mutually perpendicular directions forming a right-handed coordinate system.

Supplementary Table 1: Photometric measurements of 1998 KY₂₆ as defined in the text, from 1) the discovery apparition in 1998 and 2) this paper.

	Date (UTC)	Magnitude	Phase (°)	Telescope	MPC code	Instrument	Band	Exposure time (s)	Seeing (")
1)	1998-06-02	18.0	24	Ondrejov Obs.	557	SBIG ST-8	<i>Clear</i>	50	–
	1998-06-03	17.7	25	Ondrejov Obs.	557	SBIG ST-8	<i>Clear</i>	30	–
	1998-06-05	16.9	28	Spacewatch	691	CCD	<i>Clear</i>	20	–
2)	2024-05-19	20.5	27	Blanco	W84	DECam	<i>r</i>	18	1.4
	2024-05-21	20.4	29	GTC	Z18	OSIRIS+	<i>r</i>	10	1.2
	2024-05-31	20.3	63	Gemini	I11	GMOS	<i>griz</i>	6	0.9
	2024-06-05	21.4	87	GTC	Z18	OSIRIS+	<i>r</i>	6	1.0
	2024-06-12	22.6	101	GTC	Z18	OSIRIS+	<i>r</i>	15	1.5
	2024-10-27	23.7	10	VLT	309	FORS2	<i>R_{SPECIAL}</i>	40	0.7
	2024-11-01	23.6	5	GTC	Z18	OSIRIS+	<i>r</i>	40	0.9
	2024-11-07	23.9	6	VLT	309	FORS2	<i>R_{SPECIAL}</i>	50	0.8

Note: Italicized entries in the Band column indicate the filter used for the observation.

Supplementary Table 2: Goldstone echo power spectra bandwidth variations

Date (UT) HH:MM	R.A. °	DEC °	Δ au	λ_{Obs} °	δ_{Obs} °	Bandwidth Hz
1998-06-06 04:00	264.1	9.0	0.00761	263.1	32.3	7 ± 2
1998-06-07 13:00	290.1	16.2	0.00566	294.7	37.9	11 ± 2
1998-06-08 09:00	314.2	19.6	0.00537	323.5	35.2	14 ± 2

The table lists the mid-time of observations in UT. RA and Dec are apparent right ascension and declination of the object, Δ is the object’s distance from Earth, λ_{Obs} and δ_{Obs} are observer-centred ecliptic longitude and latitude of the target centres’ apparent position, and Bandwidth is the echo power spectrum broadening (X-band, 8510 MHz). The error bars contain both the observed variation as well as the measurement uncertainties. On June 6, an error of 2 Hz represents 30% of the bandwidth, on June 7, an error of 2 Hz represents 20% of the bandwidth, and on June 8, an error of 2 Hz is equivalent to 15% of bandwidth. Thus, our measurement method also takes into account the differences in SNRs from day to day.

Supplementary Table 3: JWST visibility periods for 1998 KY₂₆, including its apparent magnitude (APmag), the heliocentric distance r , the JWST-centric distance Δ , the phase angle α , the change (deldot) in Δ (positive: target is moving away from the observer, negative indicates a movement toward the observer), MMAZ is the micro-meteoroid avoidance zone.

JWST visibility period	APmag	r [au]	Δ [au]	α [°]	deldot [km/s]	comment
2027-11-14 ... 2028-01-24	28.5...26.5	1.47...1.44	1.16...0.56	42.7...29.2	-14.4...-12.7	inside MMAZ
2028-03-26 ... 2028-05-31	25.7...26.9	1.31...1.11	0.40...0.53	33.0...66.5	+3.8... +0.6	outside MMAZ
2028-09-26 ... 2029-01-17	26.2...28.2	1.04...1.37	0.36...1.03	74.9...46.3	+1.2...+16.1	outside MMAZ

Date (UT) HH:MM	Telescope	r au	Δ au	α °	V mag	mag_{dust} mag	n_{grains}	m_{grains} kg	mag_{dust_n} mag	n_{grains_n}	m_{grains_n} kg
2024-05-19 00:00	DECam	1.058	0.052	27.028	20.613	21.76	5.65×10^{12}	8.28×10^{-2}	22.2	3.68×10^{12}	5.40×10^{-2}
2024-05-21 01:46	GTC	1.053	0.047	29.593	20.466	22.23	3.03×10^{12}	4.44×10^{-2}	23.7	7.78×10^{11}	1.14×10^{-2}
2024-05-21 02:13	GTC	1.053	0.047	29.622	20.465	21.66	5.07×10^{12}	7.44×10^{-2}	21.9	4.09×10^{12}	5.99×10^{-2}
2024-05-21 02:39	GTC	1.053	0.047	29.650	20.463	22.03	3.60×10^{12}	5.29×10^{-2}	23.9	6.55×10^{11}	9.60×10^{-3}
2024-05-21 03:05	GTC	1.053	0.047	29.678	20.462	22.15	3.22×10^{12}	4.73×10^{-2}	24.3	4.30×10^{11}	6.30×10^{-3}
2024-05-21 03:32	GTC	1.053	0.047	29.707	20.461	21.99	3.72×10^{12}	5.46×10^{-2}	24.3	4.53×10^{11}	6.65×10^{-3}
2024-05-31 Av.*	Gemini	1.029	0.031	60.780	20.386	21.61	2.75×10^{12}	4.03×10^{-2}	22.8	9.17×10^{11}	1.34×10^{-2}
2024-05-31 07:14	Gemini	1.029	0.031	60.663	20.383	21.61	2.75×10^{12}	4.04×10^{-2}	22.3	1.49×10^{12}	2.18×10^{-2}
2024-05-31 07:23	Gemini	1.029	0.031	60.691	20.384	21.91	2.10×10^{12}	3.07×10^{-2}	22.3	1.49×10^{12}	2.18×10^{-2}
2024-05-31 07:32	Gemini	1.029	0.031	60.720	20.384	21.90	2.10×10^{12}	3.09×10^{-2}	23.0	7.37×10^{11}	1.08×10^{-2}
2024-05-31 07:45	Gemini	1.029	0.031	60.760	20.385	21.76	2.40×10^{12}	3.53×10^{-2}	22.7	9.74×10^{11}	1.43×10^{-2}
2024-05-31 07:52	Gemini	1.029	0.031	60.780	20.386	21.81	2.30×10^{12}	3.38×10^{-2}	23.0	7.44×10^{11}	1.09×10^{-2}
2024-05-31 08:25	Gemini	1.029	0.031	60.885	20.388	21.47	3.15×10^{12}	4.62×10^{-2}	23.1	6.94×10^{11}	1.02×10^{-2}
2024-05-31 08:35	Gemini	1.029	0.031	60.914	20.389	21.58	2.85×10^{12}	4.18×10^{-2}	22.5	1.24×10^{12}	1.82×10^{-2}
2024-05-31 08:43	Gemini	1.029	0.031	60.940	20.389	21.52	3.00×10^{12}	4.40×10^{-2}	22.7	1.03×10^{12}	1.51×10^{-2}
2024-06-05 03:36	GTC	1.019	0.032	81.805	21.152	22.93	1.14×10^{12}	1.67×10^{-2}	24.1	3.77×10^{11}	5.53×10^{-3}
2024-06-05 03:52	GTC	1.019	0.032	81.848	21.154	23.23	8.71×10^{11}	1.28×10^{-2}	24.2	3.52×10^{11}	5.15×10^{-3}
2024-06-12 04:01	GTC	1.006	0.044	101.000	22.589	24.58	6.29×10^{11}	9.22×10^{-3}	24.1	9.89×10^{11}	1.45×10^{-2}
2024-06-12 04:22	GTC	1.006	0.044	101.023	22.592	24.58	6.28×10^{11}	9.21×10^{-3}	24.9	4.75×10^{11}	6.96×10^{-3}

Supplementary Table 4: $1\text{-}\sigma$ limits on the resolved dust mass. Data marked with a * show the average of the Gemini images with good image quality; PSF variations lead to an increase of profile dispersion, and do not lead to more stringent limits on the inner profile.