24 MARCH 2024

THE FINAL FRONTIER FLASH

Developments & Analysis of the Space Domain

@RocketLab via X

In This Issue

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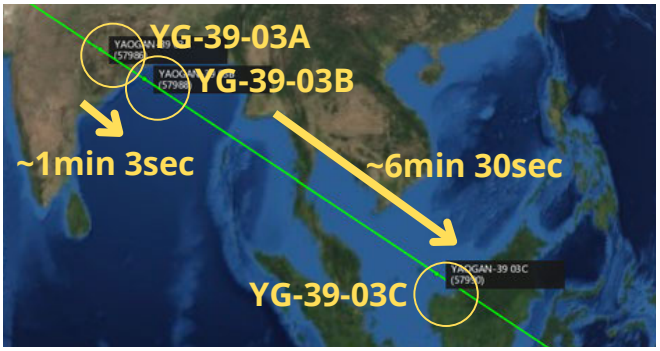
Catalog

Take a Lap? 7 YG-35/36 Trail2 Satellites Decrease SMA

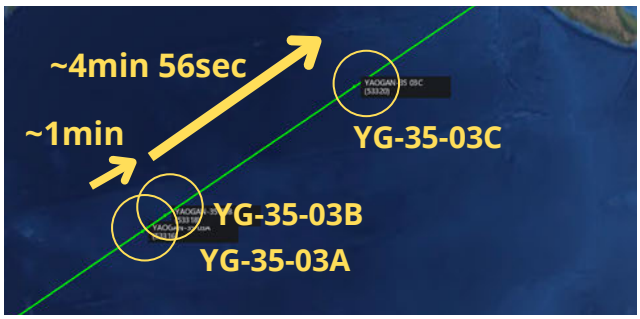
20 Mar: Checking in on the YG-35/36/39 satellites it appears that a significant number have (at least temporarily) fallen out of the "lead-trail1-trail2" formation. On ~29 Jan 2024 seven of the Trail2 satellites began decreasing their altitudes, thus increasing their orbital velocity (thanks again for the 10:1 explanation Jack!) As a result the Trail2 satellites for seven of the triplets passed both Trail1 and Lead satellites in early-Feb. In Dec 2023 the average time between YG-35 Trail1 & Trail2 was 1min 02sec. On Mar 20 the time difference was 40min 13sec. The average time difference for the 5 YG-36 triplets has increased from ~2min 47sec in December 2023 to ~32min 17sec in Mar 2024. The Lead to Trail1 time differential has remained relatively unchanged. The newest satellites, the YG-39s all appear to be holding their original formation.

The Good: 6 of the 15 triplets (40%) appear to be in "standard" formation. There appears to be some correlation with launch dates as only the more recently launched YG-39 triplets (01-05) appear to be maintaining their relative positions with one another. YG-39-01-05 are all in what was the standard formation with the average Lead-Trail1 being ~5min 30sec and Trail1-Trail2 at ~1min 49sec. I'm counting YG-36-05 as still being "good" but it's formation stretching out, Lead-Trail1 ~ 3min 17 sec and Trail1-Trail2 ~3min 28sec.



"Typical" YG-39-03 Mar 2024

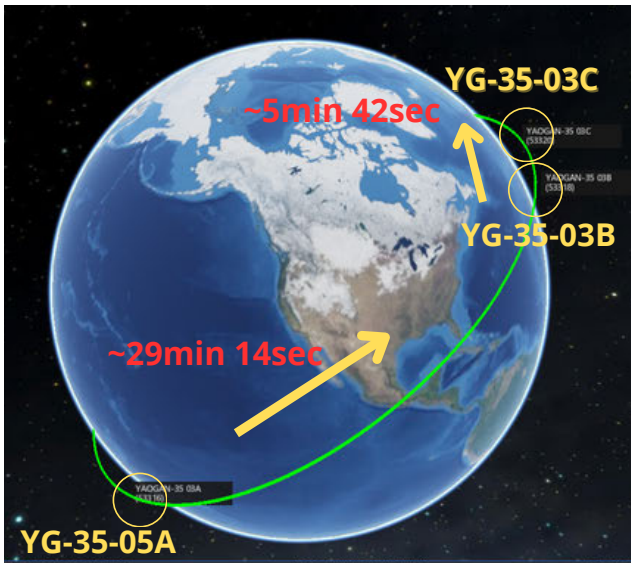
Formation Adjustment?: Trail2 satellites for all of the YG-35 triplets and 4 of 5 YG-36 triplets decreased their altitudes on ~29 Jan 2024. YG-35 Trail1-Trail2 time is now over 40min. For YG-36 01-04 triplets Trail1-Trail2 time difference increased from 2min 47sec in Dec 23 to 32min 17sec in Mar 24. The average Lead-Trail1 has remained steady ~6min 02sec in Dec 2023 and ~5min 43sec in Mar 2024. These averages do not include the 2 wayward satellites described below.



YG-35-03 Formation Dec 2023

The Ugly: Two of the 45 satellites continue their slow orbital decay and have shown no signs of maneuverability for over a year. YG-35-02C last maneuvered in Nov 2022 and its SMA is now 351.2km and dropping. YG-36-01B last maneuvered in Jan 2023 and now has an SMA of 407.6km and also continues to decline.

China likely executed a planned formation adjustment for 7 of the 15 triplets on 29 Jan 2024. It will be interesting to see if the 7 Trail2 satellites increase their altitudes and re-form with Lead and Trail2 satellites in the coming weeks.



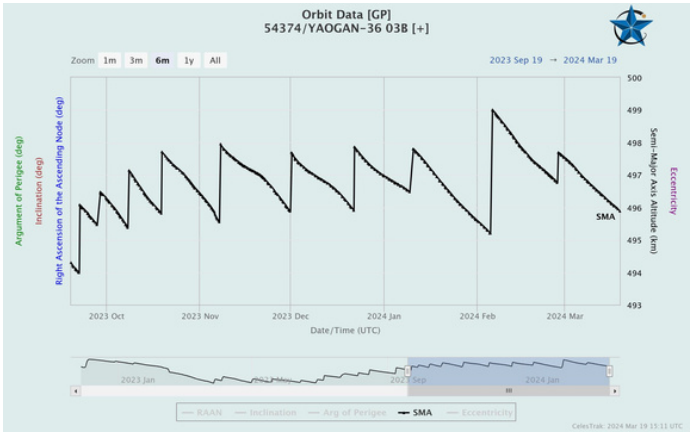
YG-35-03 "Formation" Mar 2024 Appears Trail2 (05A) Now Lagging (spaceaware.io)

A Graphical Look at YG-35/36/39 Formations

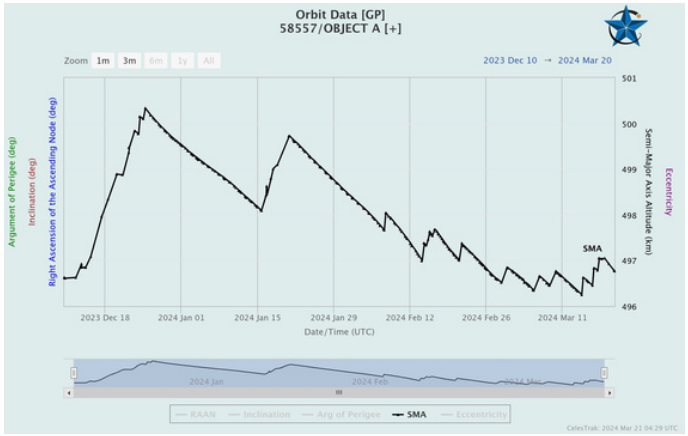
Orbit	Satellite	Lead Name	Time Lead	Follow1 Name	Time Follow1	Follow2 Name	Time Follow2	Time Diff Lead-Follow1	Time Diff Follow1-Fol
1	YG-35-01	01B/49391	3:45:57	01A/49390	4:05:54	01C/49393	4:50:10	0:19:57	0:44:16
1	YG-36-01	01C/53947	7:04:05	01B/53946	7:09:31	01A/53943	NA	0:05:26	
1	YG-39-03	03C/57989	8:31:30	03B/57988	8:37:57	03A/57986	8:38:40	0:06:27	0:00:43
2	YG-35-02	02B/52908	4:57:59	02A/52907	5:05:38	02C/52909	NA	0:07:39	
2	YG-36-02	02C/54045	7:05:40	02B/54043	7:11:18	02A/54042	7:33:09	0:05:38	0:21:51
2	YG-39-01	01C/57731	9:00:14	01B/57728	9:04:48	01A/57727	9:07:17	0:04:34	0:02:29
3	YG-35-03	03C/53320	5:16:03	03B/53318	5:21:45	03A/53316	5:50:59	0:05:42	0:29:14
3	YG-39-02	02B/57889	8:39:15	02C/57890	8:43:34	02A/57886	8:45:00	0:04:19	0:01:26
3	YG-36-04	04C/54750	8:24:06	04A/54746	8:28:55	04B/54748	9:10:43	0:04:49	0:41:48
4	YG-35-04	04B/53524	5:46:54	04C/53526	5:52:38	04A/53522	6:36:33	0:05:44	0:49:39
4	YG-39-05	05B/58558	8:50:45	05C/58559	8:56:05	05A/58557	8:58:07	0:05:20	0:02:02
4	YG-36-05	05C/57456	9:16:00	05B/57454	9:19:17	05A/57452	9:22:45	0:03:17	0:03:28
5	YG-35-05	05B/53761	6:30:36	05C/53763	6:37:13	05A/53760	7:14:56	0:06:37	0:37:43
5	YG-36-03	03A/54372	7:47:04	03B/54374	7:54:05	03C/54376	8:27:17	0:07:01	0:33:12
5	YG-39-04	04C/58145	8:38:48	04B/58143	8:45:39	04A/58141	8:48:05	0:06:51	0:02:26

	Time Follow 1	Time Follow 2	Overall AVG	0:06:37	0:20:47
YG-35 AVG	0:09:08	0:40:13	Orbit1	0:10:37	0:22:29
YG-36 AVG	0:05:43	0:32:17	Orbit2	0:05:57	0:12:10
YG-39 AVG	0:05:30	0:01:49	Orbit3	0:04:57	0:24:09
			Orbit4	0:04:47	0:18:23
			Orbit5	0:06:50	0:24:27

My Numbers Behind the Analysis



Nominal Example: Trail1 YG-36 03
SMA Increased Every ~3-4 Weeks
(celestrak.org)



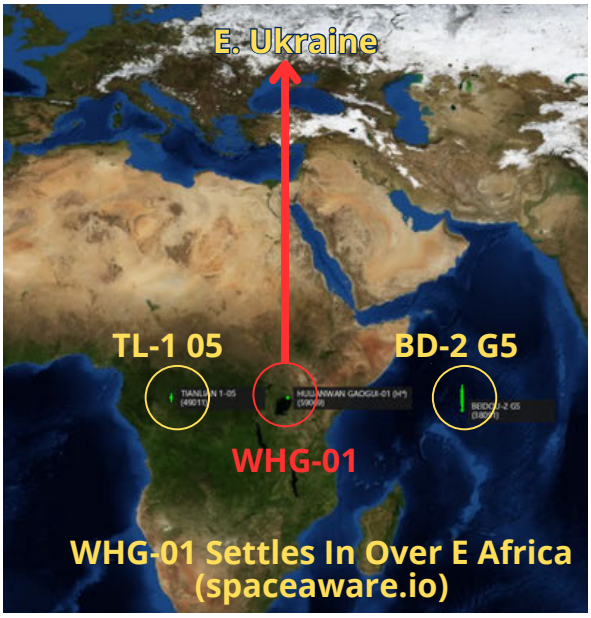
Nominal Example Trail2 YG-39 05
Frequent SMA Adjustments
(celestrak.org)

SMA Declines Begin
~29 Jan 2024
for 7 Trail2 Satellites
(celestrak.org)

~29 Jan 2024

China Internet - High Orbit Satellite 01 Settles Into GEO

15 Mar: After spending 2 weeks in Geostationary Transfer Orbit (GTO) China's Weixing Hulianwan Gaogui-01 (WHG-01) circularized its orbit in GEO on ~13 March. The satellite is now over Africa (and due south of Eastern Ukraine) at 33.7°E longitude. There was conjecture that China might intend to use the satellite to provide connectivity in the extreme Northern and Southern latitudes, however the satellite is 0° inclined making this impossible. There is also the potential that "high" in this case refers to throughput, or perhaps it has another mission entirely, one which would benefit from being over an active combat zone. China has not released any additional information regarding the WHG-01's mission.



- China has chosen an interesting orbital slot for WHG-01. 33.7°E is due south of Eastern Ukraine. Kharkiv is 36.3°E and Donetsk is 37.8° E.

-In June 2022 China re-located its test communications satellite, Shijian-20, to 33.5°E. The satellite remained at that location for exactly one year before relocating East. It is now at 68.1°E (over the Indian Ocean, just to the West of India).

-This is not to say that WHG-01 is related to SJ-20 in any way. SJ-20 is a 8,000kg+ satellite, based on the DHF-5 bus and required a LM-5 for launch. By comparison China launched WHG-01 on a LM-3B which is capable of placing 5,500kg into GTO.

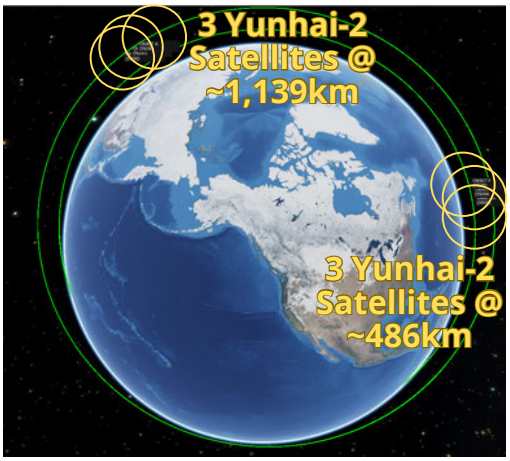
-The LM-3B was China's primary GEO/GTO launch vehicle for many years and is in the process of being phased out by the LM-7. LM-3B has launched TJS satellites suspected of being SIGINT collectors or Early Warning satellites. It also launched China's GEO based Gaofen observation satellites, the GF-4 (2015), GF-13-01 (2020) and GF-13-02 (2023).

- Using the incredible website resource, Orbitalfocus.uk, it appears that the closest Chinese GEO satellite to 33.7°E is the long-dead Chinasat-2 (launched 1988). Beyond that the closest Chinese built GEO satellites are the Tianlian 1-05 relay satellite at 16.8°E and the Beidou 2 G5 PNT satellite at 58.8°E.

This location would be well-suited to support or observe ongoing operations in the Ukrainian-Russian conflict.

China Launches 6 Yunhai-2 Group 02 Satellites

21 Mar: China launched a LM-2D from Jiuquan carrying the second group of Yunhai-2 satellites. The Yunhai-2 satellites are "mainly used in the fields of detection of atmospheric environmental elements, space environment monitoring, disaster prevention and mitigation, and scientific experiments". Yunhai-2 Group 1 launched in 2018. As with the 6 Group 1 satellites, Group 2 deployed in 2 distinct orbits, 3 satellites to 486km and the other 3 to 1,139km. Inclination is identical. The Group 1 satellites eventually equalized their altitudes at ~800km.



China PIESAT SAR Formation Takes Shape

15 Mar: After spending nearly a year on orbit it appears as if China's 4 PIESAT SAR (2023-047) satellites are beginning to operate in formation. China launched the four satellites 30 Mar 2023 with the objective delivering .5m resolution SAR imagery. The developer and operator of the PIESAT vehicles is GalaxySpace. Watch Formation and Operation Video.

- Thanks to a head's up from TS Kelso (Celestrak), background from Kristin Burke (CSIS), and analysis from Robin Planell (LSAS), it now looks like Galaxy Space is beginning to experiment with operating in formation. Full disclosure, this testing may have been going on for some time now and we just now noticed it.

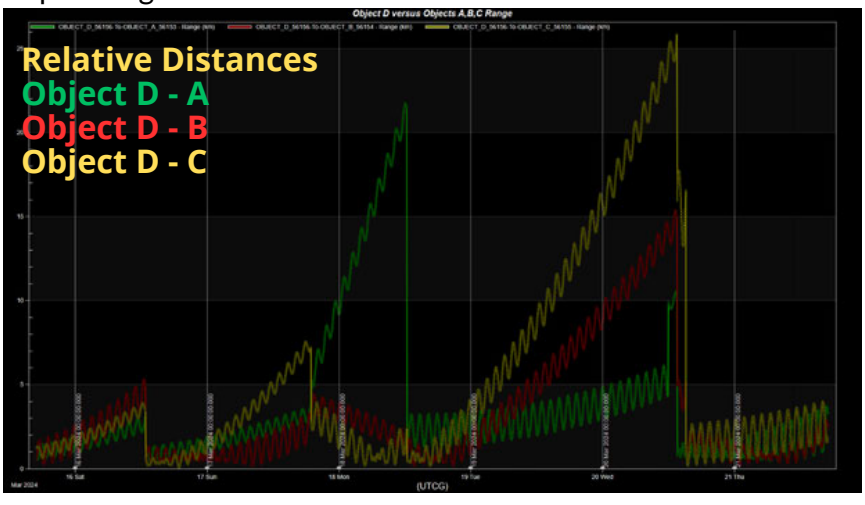
-The four satellites have not been named in the Spacetrack.org catalog. They are simply known as Object A, B, C, & D. The satellites, consist of one 320-kilogram pivot satellite and three 270-kg assistant satellites, are the first space-based assets in the Hongtu 1 network.

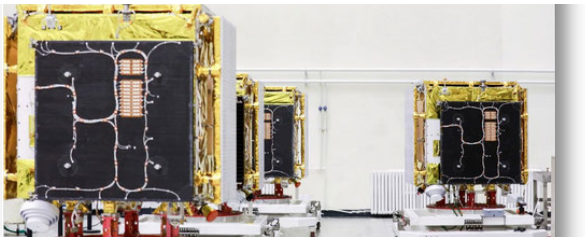
-It appears Object D maintains its orbit (likely it is the 320kg satellite) while the other 3 seem to rotate along Object D's axis. This is consistent with Galaxy Space's pre-launch rendering.

-The satellites are changing their orbital position. Looking at orbits for the same hour of the day (10:35:00.000 UTCG) from the 15th of March to the 21st of March, produced the following satellite orders:

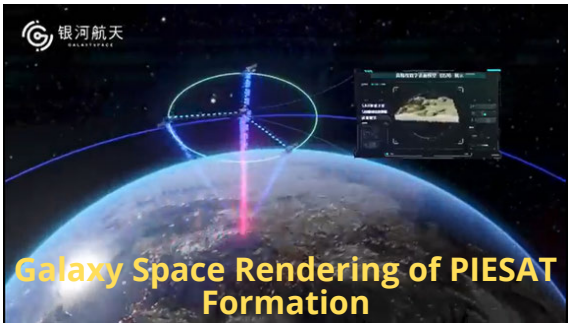
15 Mar C-A-B-D;
16 Mar B-C-A-D
17 Mar C-A-B-D
18 Mar A-C-D-B
19 Mar C-B-A-D
20 Mar C-B-A-D
21 Mar A-B-D-C

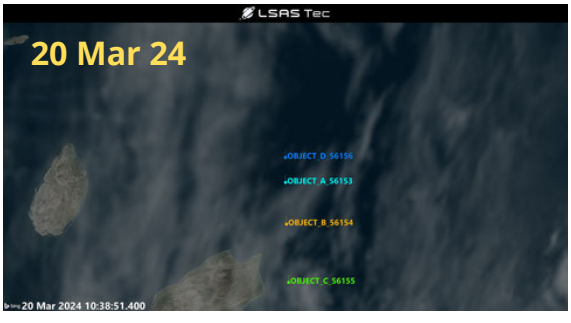
The satellite order seems to actually change within the day depending on the hour as well.





PIESAT Satellites Preparing for Launch





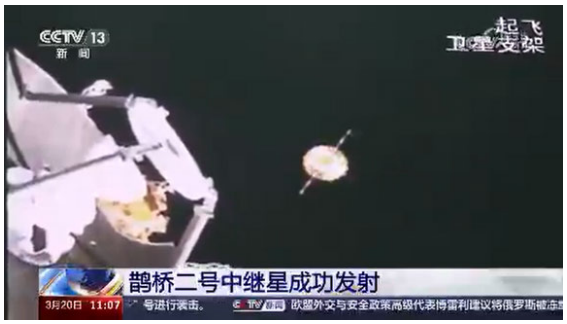
Great Gig in the Sky: China Launches Lunar Relay Satellite

20 Mar 2024: China launched a LM-8 from Wenchang carrying Queqiao-2 (Magpie Bridge-2) lunar relay satellite. According to the China National Space Administration the satellite separated from the rocket, and entered the planned Earth-Moon transfer orbit with the perigee at 200km and apogee of 420,000km. China will position the Queqiao-2 in a highly elliptical lunar orbit to provide provide communications services for the Chang'e-4, Chang'e-6, Chang'e-7 and Chang'e-8 lunar missions including those operating on the far side of the moon. Launch Video.

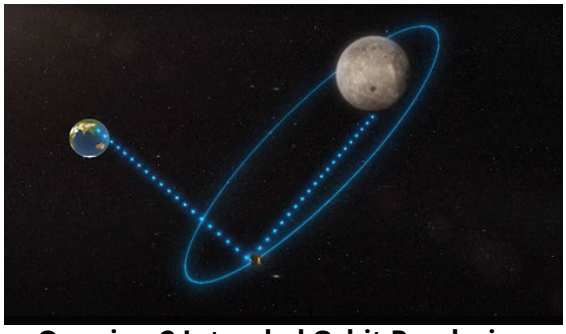
-Additional information from Andrew Jones:

- Queqiao-2 is a 1,200-kilogram satellite with a 4.2-meter parabolic antenna. It is part of China's plans for future lunar exploration and a steppingstone towards building a lunar base in the 2030s.
- Queqiao-2 will enter a highly elliptical lunar orbit inclined by 55° once it reaches the moon.
- With this orbit, Queqiao-2 will have line of sight to both Chang'e-6—which is targeting Apollo crater in the southern hemisphere of the far side—and Earth for a large portion of its orbital period.
- Queqiao-2's orbit is specially designed to support China's Chang'e-6 lunar far side sample return mission which is scheduled to launch in May 2024.
- In the future, Queqiao-2 will alter its orbit to support the Chang'e-7 and Chang'e-8 missions to the lunar south pole.
- Queqiao-2's orbit differs from its predecessor, Queqiao-1. The latter remains operational in a halo orbit around the Earth-moon Lagrange point L2 roughly 70,000 km beyond the moon.

Queqiao-2 Preparing for Launch (@CNSAWatcher via X)

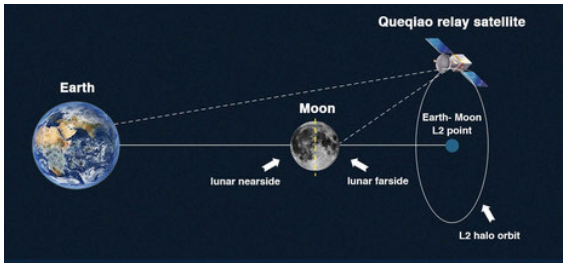


Queqiao-2 In Space 4.2m Antenna Deployed (@AJ_FI via X)



Queqiao-2 Intended Orbit Rendering (youtube.com)

Slide Depicting China's Space Exploration Goals (@SegerYu via X)



Queqiao-1 Halo Orbit around Earth-moon L2 (www.spacevoyaging.com)

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CT600 - Critical Thinking for Learning Professionals

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IADS100 - IADS Foundations
IADS200 - Rethinking IADS
IADS310 - Advanced IADS Analysis

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TGT210 - Target Development I
TGT211 - Target Development II
TGT212 - Target Capabilities Analysis
TGT213 - Target Force Assignments
TGT214 - Mission Planning & Force Execution
TGT215 - Combat Assessment
TGT310 - Weaponeering and Collateral Damage Assessment
TGT311 - HVI Target Development
TGT312 - Precision Point Mensuration
TGT315 - Targeting Professional

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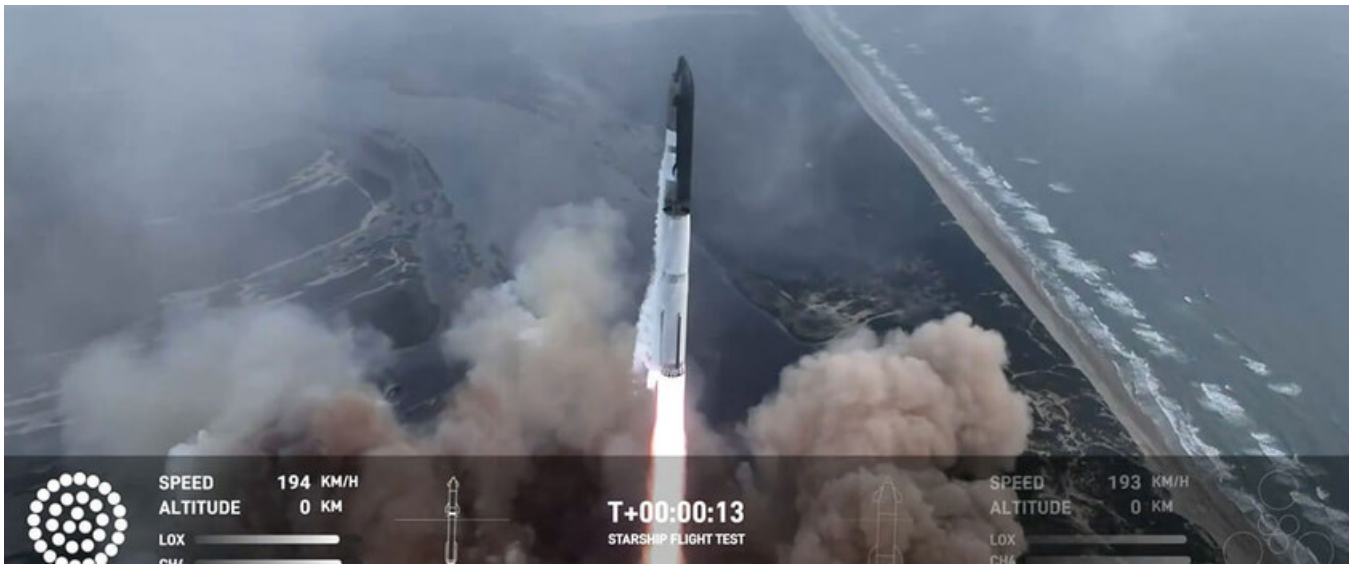
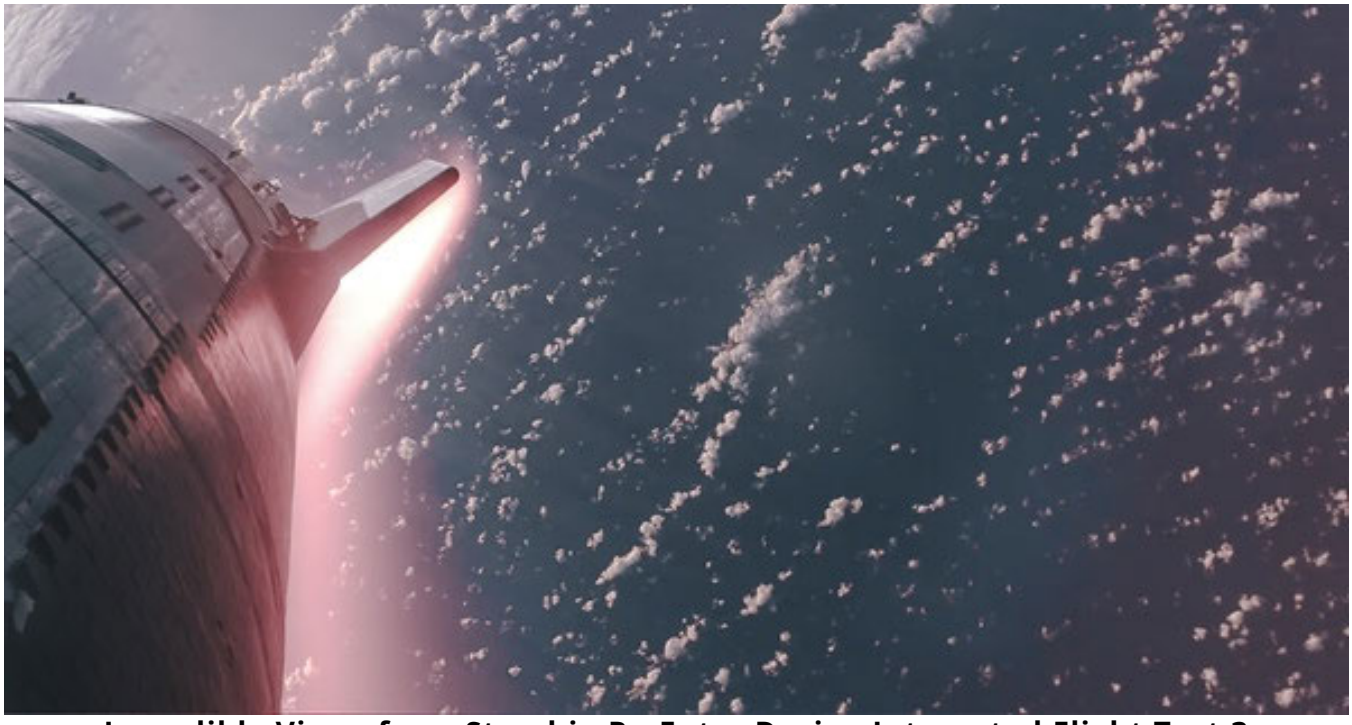
Pics o' the week!

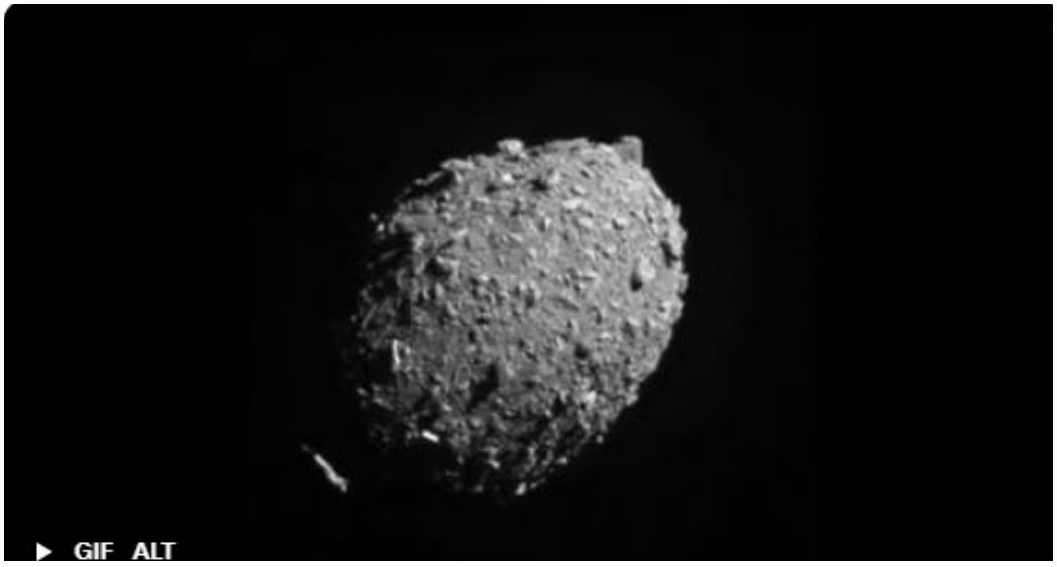


Starship Integrated Flight Test 3 Lift Off (news.sky.com)

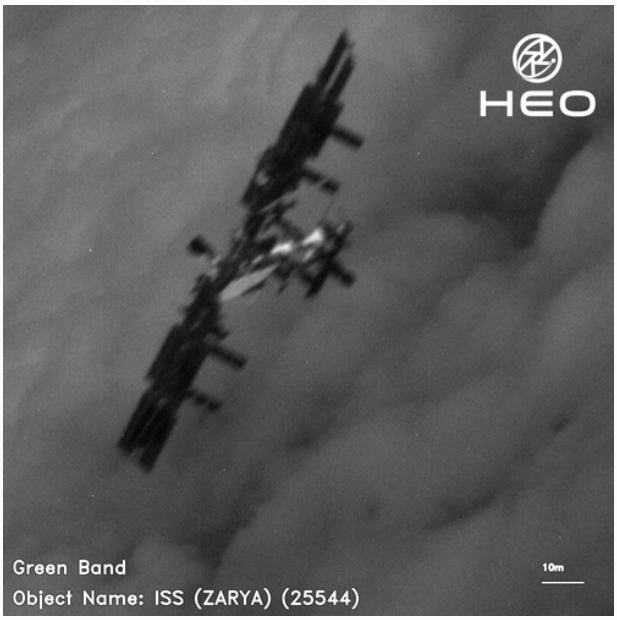


Incredible Views from Starship Re-Entry During Integrated Flight Test 3 (https://www.thespacereview.com/article/4761/1)

India Successfully Landed its Reusable Launch Vehicle: Pushpak
Watch the Video (@isro via X)



JPL-led study show DART changed the entire shape of the Dimorphos asteroid and shrunk its orbit.
(@NASAJPL via X)



HEO Space Image of the ISS over the South Atlantic Ocean on 8 Mar 2024 (@Harry__Stranger via X)

Space One's maiden launch of its Kairos rocket blows up a few seconds after launch. WatchVideo. (asianews.network & @koumeiShibata via X)

18 March Sunset Starlink Launch from Vandenberg as Viewed from My Driveway

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