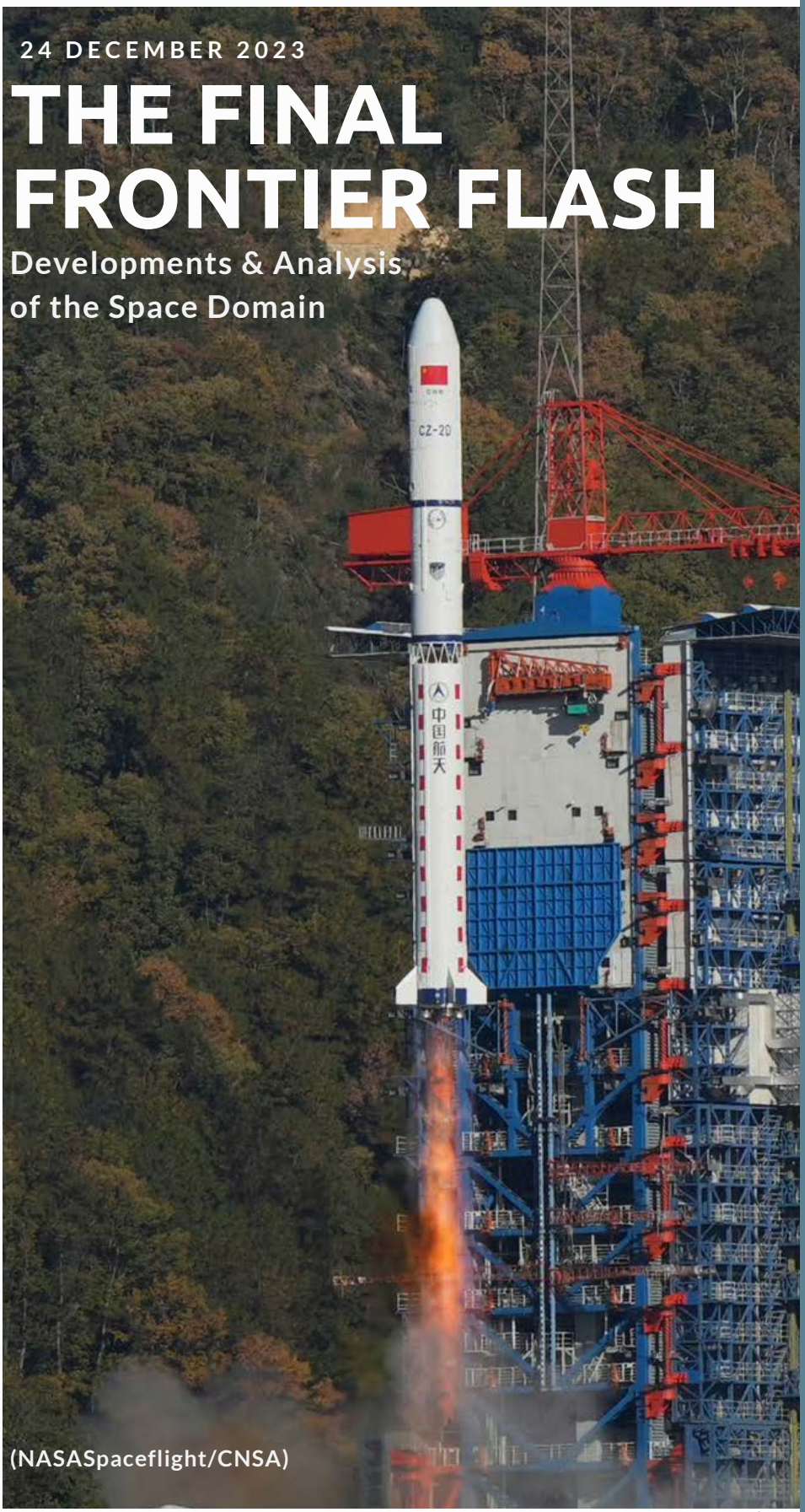
24 DECEMBER 2023

THE FINAL FRONTIER FLASH

Developments & Analysis of the Space Domain



(NASASpaceflight/CNSA)

In This Issue

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Catalog

China Launches Third Space Plane Mission

14 Dec 2023: China launched its Shenlong (Divine Dragon) spaceplane using a LM-2F from Xichang. The winged vehicle reached a 332.9 x 347.9 km orbit, with a 49.99° inclination. There was speculation Shenlong released up to six objects, and that some of these were transmitting radio signals. This has not been confirmed, and other observers have noted the standard LM-2F launch typically generates six objects: payload, rocket stage and four fragments, with expected deviations in height/period and inclination – usually described as solid motor cover separation. No Launch Video released, however there is an amazing Tiktok video showing the retrieval and display of the 1st Test Flight fairing.

- China has revealed no details of its experimental reusable spacecraft project, nor have they published any launch images. The suspected spaceplane is launched vertically on a Long March 2F, the rocket used to launch China's Shenzhou crewed missions.
- According to China's official announcement, the spaceplane will be used to conduct verifications of reusable technologies and space science experiments, to provide technical support for the peaceful use of space.
- Analysts expect the spaceplane's flight duration will be a few months, before returning to Earth.
- This is the third mission for the spacecraft. The first of its previous missions started in September 2020, with a duration of two days, while its second was a 276-day mission between August 2022 and May 2023.
- These previous missions included deploying satellites into orbit, and may have involved scientific and other experiments. Further, the spacecraft performed numerous small and much larger orbital maneuvers during its second flight. This third flight will likely have a different scope, and seek to further test the spacecraft's capabilities.
- The China Aerospace Science and Technology Corporation (CASC), the space plane will be used up to 20 times.
- The six objects have been designated as either a rocket body or debris in the public space catalog.
- According to satellite tracker and amateur astronomer Scott Tilley, OBJECT A appears to be emitting signals reminiscent of those emitted by objects that China's space plane released on previous missions.

(nkknspace via X)

Orbit of PRC Test Spacecraft3 (58573)

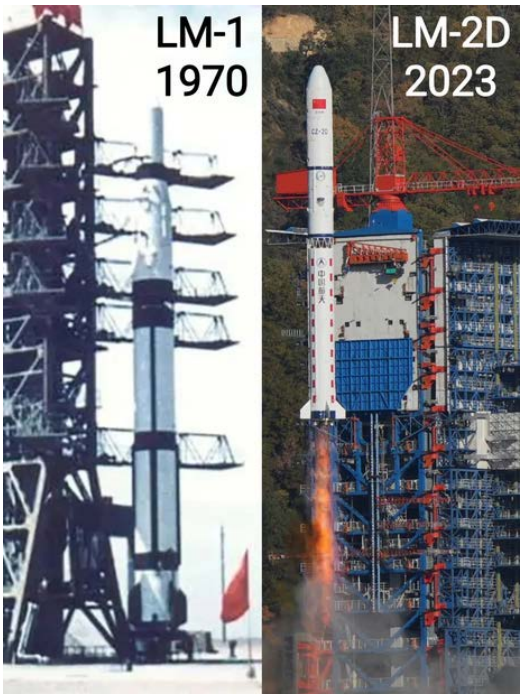
Fairing On Display after 1st Test (Watch Video) (nkknspace via X)

The development of reusable spacecraft technology is part of China's broader strategy to become a major spacefaring nation. Chinese President Xi Jinping has set a national goal for China to become a powerful aerospace country. Xi also noted the space industry to be a critical element of overall national strategy.

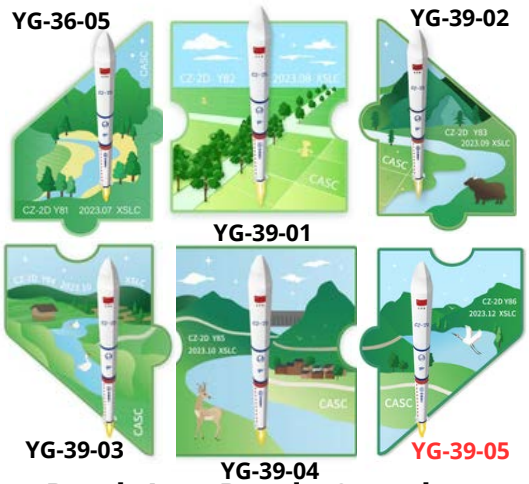
China Completes Constellation with YG-39-05 Launch

10 Dec 2023: For the 15th time in 2.5 years, China launched a Long March-2D from Xichang carrying three Yaogan-39 satellites, now in a 495 km orbit with a 35° inclination. This is the fifth trio of Yaogan-39 satellites. China has also launched five sets of Yaogan-35 satellites, as well as five sets of Yaogan-36 satellites to the same altitude and inclination. Launch Video.

- Little is publicly known about the Yaogan satellites. State media outlet China Daily described the spacecraft as remote-sensing satellites tasked with observing, surveying and measuring objects on land or at sea, as well as monitoring weather.
- Western observers believe Yaogan satellites have partially military purposes. The wider series includes optical, radar and electronic intelligence gathering satellites.
- Some analysts speculate the A & B spacecraft of the YG-35, 36 and 39 triplets might be imaging satellites, & the C spacecraft might be a radar satellite. SIGINT / ELINT or communications missions are also possibilities.
- YG-39-05's launch vehicle (LM-2D) and location (Xichang) matches all 14 previous YG-35, YG-36 & YG-39 launches.
- YG-39-05A/B/C are still conducting initial maneuvers, and it is too early for analysts to assess formation. (More on next page).
- As with its predecessors, YG-39-05 satellites are co-planar with other YG-35 and YG-36 satellites. In this case YG-39-05 is co-planar with YG-35-04 and YG-36-05.
- All YG-35/36 and 39 satellites are co-planar with other satellites of this family.
- Here are all five orbits:
  - YG-35-01, YG-36-01 & YG-39-03
  - YG-35-02, YG-36-02 & YG-39-01
  - YG-35-03, YG-36-04 & YG-39-02
  - YG-35-04, YG-36-05 & YG-39-05
  - YG-35-05, YG-36-03 & YG-39-04
- Each group will pass over the same points above Earth at different times, providing more frequent coverage over areas of interest.



The Yaogan-39-05 was the 500th Launch of the Long March Rocket Series

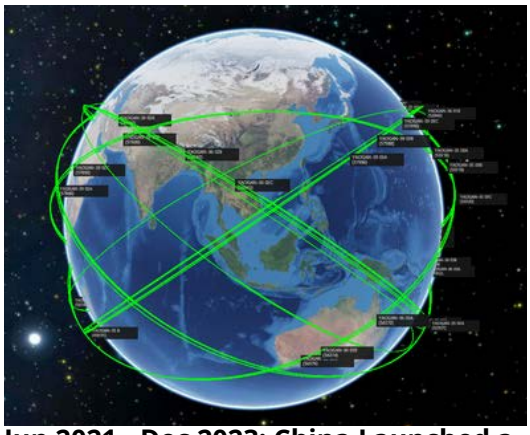


Patch-Int: Puzzle Complete

- More broadly, it appears that China is continuing to experiment with various spacing alternatives for the YG-35/36/39 satellites.
- Per the *2023 DoD Annual Report to Congress*: China is deploying "… ISR systems, most of which could support monitoring, tracking, and targeting of U.S. and allied forces worldwide, especially throughout the Indo-Pacific region. These satellites also allow the PLA to monitor potential regional flashpoints, including the Korean Peninsula, Taiwan, the Indian Ocean, and the South China Sea."
- The orbits of the 45 YG-35/36/39 satellites appear to be optimized to perform such monitoring.

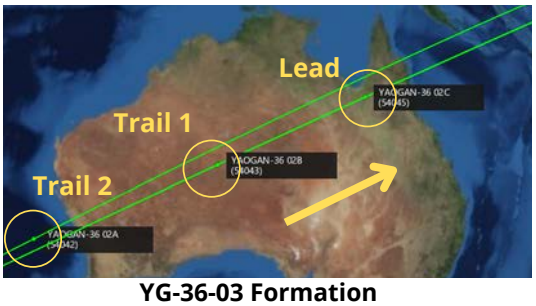
China's YG-35/36/39 Constellation: A Closer Look

24 Dec 2023: China launched its first Yaogan-35 satellites on 11 June 2021. Over the next 30 months it conducted another 14 LM-2D launches from Xichang, placing 45 satellites into five orbital planes, all ~495 km and inclined 35°. The spacing between the satellites appears consistent for 9 of the 15 triplets,



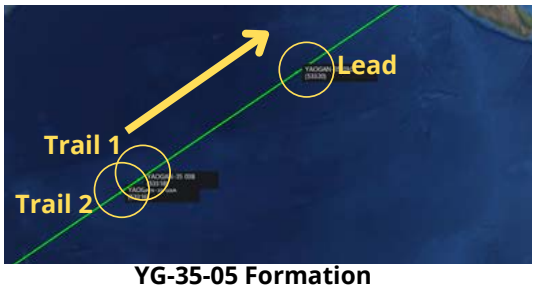
Jun 2021 - Dec 2023: China Launched a 45 Satellite ISR Constellation

- Spacing: 9 of the 15 of the YG-35/36/39 triplets operate in a similar Lead-Trail-Trail formation, with the lead satellite being considerably further ahead than the two followers.
- On average, the lead satellite is 5 min 16 sec ahead of Trail 1, and Trail 1 is 1 min 51 sec ahead of Trail 2. There is some variance between the formations. Discounting recently deployed trios (or those with anomalous satellites), the range between Lead and Trail 1 is ~2 min 49 sec through 9 min 39 sec. The range between Trail 1 and Trail 2 is 0 min 35 sec through 3 min 28 sec.
-Three of the trios (YG-36-02, YG-39-02 & YG-39-03) appear to have an elongated formation with nearly equal distance between all three satellites. China is potentially experimenting with different spacing to optimize performance.



YG-36-03 Formation

- YG-35-02 & YG-36-01 appear to have had an anomaly with one of their spacecraft, and are not able to maintain formation.
- YG-35-02C (SCC 52909) has lost nearly 60 km in altitude, and has not maneuvered in months. YG-36-01B (53946) has lost 47 km, and also has not maneuvered in over six months.
- It is too early to make a determination of the YG-39-05 satellites at this time.



YG-35-05 Formation

- China has launched other satellites with same 35° inclination as the YG-35/36/39 satellites.
- From 2018-2021, China launched 30 Yaogan-30 satellites which <u>are suspected of having a SIGINT mission, especially to detect ships by their radio emissions.</u> China also launched the YG-30 satellites in batches of three, but they are evenly spaced 120° apart in their orbital planes. Yaogan-30 satellites also orbit ~100 km higher than YG-35/36/39 satellites.

Elongated Formation (Dec 2023): Likely Transitory (YG-39-02)

- Another 35° inclined system is the eight XJS experimental satellites. China launched XJS A & B on a LM-2C in 2018. There were two launches in 2020: one with XJS C, D, E & F on a LM-2D; and XJS G & H on a LM-11. All launches were from Xichang. In addition to sharing the same inclination, the XJS satellites operated at an altitude of 460-475 km, much closer to the 500 km altitude of the YG-35/36/39 satellites.
- Open source reporting notes <u>the XJS satellites' mission is to conduct tests on inter-satellite links and Earth observation technology.</u>

China: LM-5 Launches with Yaogan-41 to GEO

15 Dec: China launched its most powerful rocket – the Long March-5 with an extended fairing – from Wenchang, carrying the Yaogan-41 satellite to Geostationary Transfer Orbit (GTO). As of 22 Dec, YG-41 remained in GTO. Launch Video.

Feb 2023: Extended Fairing Under Construction in Tianjin

- China provided no images nor further details regarding YG-41 mission or capabilities. Xinhua news described the satellite as an optical remote sensing satellite.
-The LM-5 included a new, elongated 18.5 m long, 5.2 m diameter payload fairing. The new fairing was 6.2 m (20 ft) longer than previous fairings (12.3 m). With the extended fairing, this was the *tallest rocket China has ever flown* (200 ft).
- The Yaogan series satellites are typically designated for military purposes. The classified nature of the mission suggests YG-41 has at least a partial military mission.
-From its perch in GEO, YG-41 will have a field of view covering about one-third of Earth's surface. Geostationary optical data would be useful for security, meteorology, climate studies, and environmental monitoring purposes.
-Given the LM-5's launch capacity and the extended fairing, YG-41 may use the DFH-5 bus. CAST produces the DFH-5 large satellite bus for GEO communications and remote sensing. The only other DFH-5 on orbit is the Shijian-20, which has a mass of up to 8,000 kg. DFH-5 satellites have a lifetime of up to 15 years.
- YG-41 will be China's 4th optical satellite in GEO. It will join the civilian Gaofen-4 (2015), Gaofen-13-01 (2020) and Gaofen-13-02 (2023). China also recently added the world's first SAR imaging satellite in GEO, Ludi Tance 4-01.

(CNSpaceflight, NASASpaceflight)

Although Chinese officials did not disclose the exact capabilities of Yaogan-41, it would almost certainly have the sensitivity to continually track US Navy ships and allied vessels across a wide swath of the Indo-Pacific. Aside from its use of the larger payload fairing, the Long March 5 rocket used to launch Yaogan-41 can haul approximately 31,000 pounds (14 metric tons) of payload mass into the orbit reached following Friday's launch.

Prior to this launch (exact date unknown), Li Guo, chief designer of Gaofen-4, talked about high-res optical imaging technology from GEO and described a rough evolutionary path:

1st stage Gaofen-4 with 50m resolution (Gaofen-4)

2nd stage 15m resolution, (Gaofen-13)

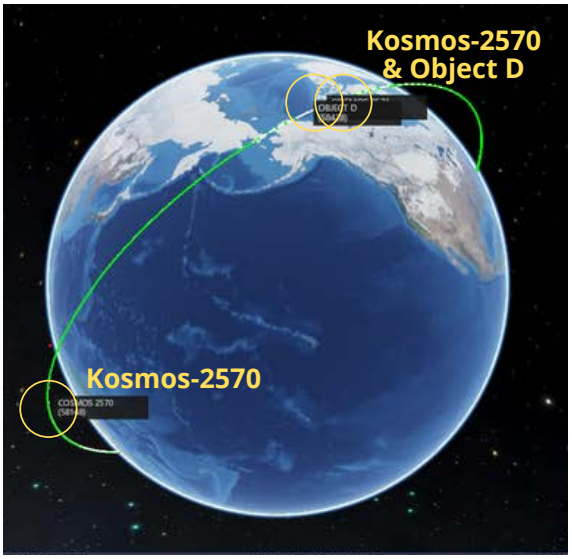
3rd stage 3-5m resolution with 3-4m mirror, (Yaogan-41?)

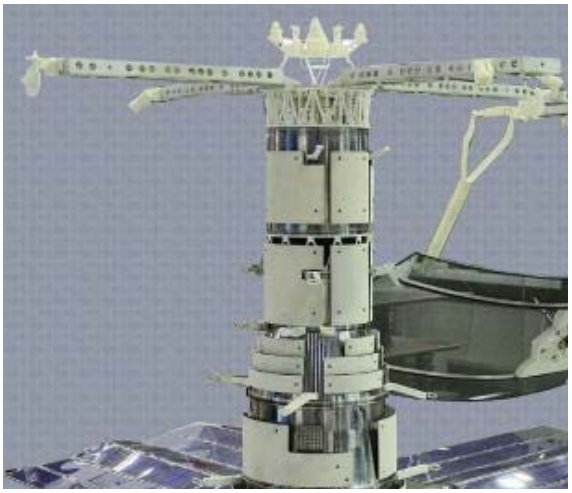
4th stage 1-2m resolution using "Open system imaging", "quantum imaging system", "thin film radiographic imaging system" etc.

Russia: Kosmos-2571 Releases Sub-Satellite

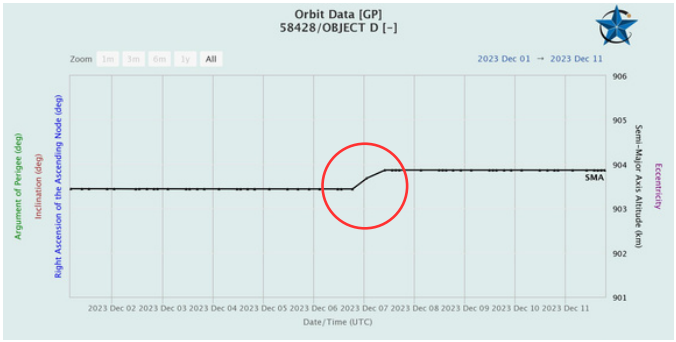
13 Dec: As noted previously, Russia launched Kosmos-2570 (58148) on 27 Oct 2023. This spacecraft is the Lotos-S1 No7 electronic intelligence satellite, and as predicted in open press, there was a secondary payload (Kosmos-2571) released 30 Oct 2023 after Kosmos-2570 circularized its orbit. Later Kosmos-2571 (58172) released "Object D" (58428). There is still confusion over naming assignment. Kosmos-2571 has not maneuvered, while "Object D" appears to have increased its altitude 0.5 km on 6-7 December.

- Kosmos-2570 releasing a sub-satellite is similar to the activity of Kosmos-2565, launched 30 Nov 2022, and also believed to be an Lostos-S1. Kosmos-2565 also released a daughter satellite (Kosmos-2566) on 2 Dec, followed by Kosmos-2566 releasing its own baby satellite on 24 Dec 2022 (Christmas Eve).
- LeoLabs released a report on Kosmos-2570's recent activity. Their analysis says Kosmos-2571 (also known as Object C) released Object D shortly after Kosmos-2570 maneuvered, resulting in the US Space Force temporarily losing track of the object.
- Per LEO Labs: "We were able to track both objects quickly and send frequent updates. On November 24, we were the first to detect, catalog, and deliver alerts to the Joint Task Force – Space Defense (JCO) on a secondary object released by sub-satellite Object C (Kosmos-2571) before the public catalog was able to respond. This prompted urgent action by all parties to track and identify the new object, now called Object D."
- Also Per LEO Labs: "Then on Dec. 6, Kosmos-2570's granddaughter (Object D) began another maneuver, bringing it within less than 1 kilometer of its mother (Kosmos-2571) — extremely close and well beyond what is normally considered safe for orbital operations." "That move happened in 'favorable lighting conditions,' suggesting that the granddaughter (Object D) 'has an electro-optical (EO) sensor payload.'"





Lotos-S1 Model w/ Adapter for Secondary Satellite (NASASpaceflight)



Object D .5km SMA Change 6 Dec (Celestrak)

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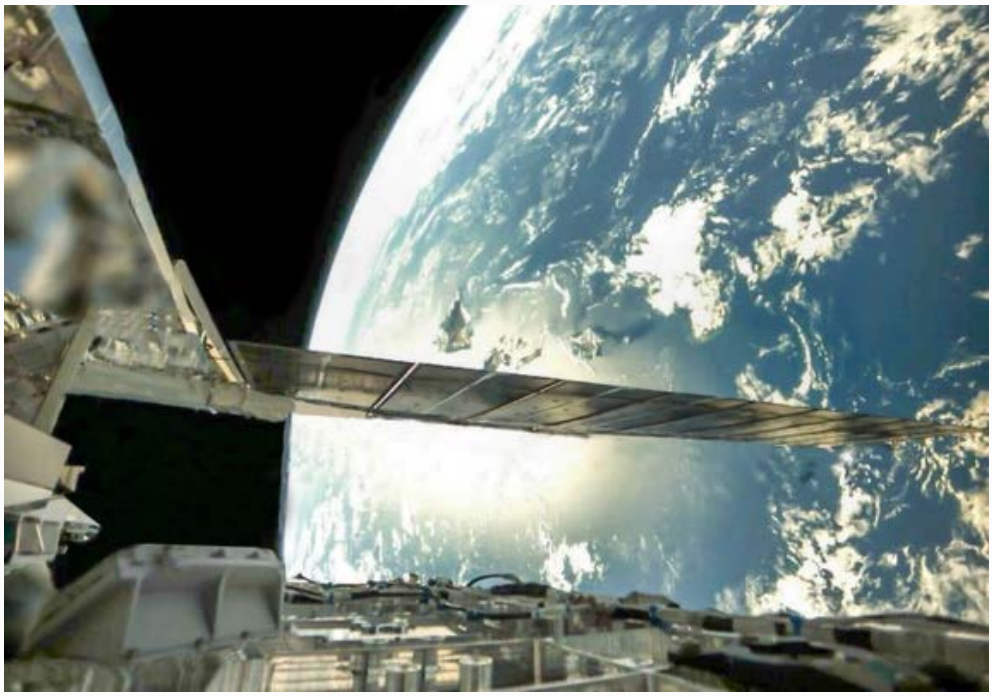
Pics o' the week!

Earth as pictured by North Korea's HS-18 ICBM 18 Dec 2023 (Inbarspace via X)

(Dex_eve via X)



First Image of Amazon Kuiper Prototype Satellite (Amazon.com, Pronounced_kyle via X)

New James Webb Space Telescope Image of Uranus (NASA, Lemomodor via X)

Orbit	Satellite	Time Lead	Time Follow1	Time Follow2	Time Diff A-B	Time Diff B-C	Notes
1	YG-35-01	5:13:18	5:20:19	5:20:58	0:07:01	0:00:39	
1	YG-36-01	5:47:12	5:54:00		0:06:48		anomaly 36-01B
1	YG-39-03	6:18:46	6:21:35	6:23:54	0:02:49	0:02:19	
2	YG-35-02	7:12:34	7:19:18		0:06:44		anomaly 35-02C
2	YG-36-02	7:44:46	7:47:56	7:51:36	0:03:10	0:03:40	
2	YG-39-01	8:15:27	8:19:16	8:20:20	0:03:49	0:01:04	
3	YG-35-03	8:24:27	8:29:23	8:30:23	0:04:56	0:01:00	
3	YG-39-02	8:52:34	8:57:43	9:01:11	0:05:09	0:03:28	
3	YG-36-04	9:21:56	9:31:35	9:33:46	0:09:39	0:02:11	
4	YG-35-04	9:36:31	9:40:48	9:41:23	0:04:17	0:00:35	
4	YG-39-05	10:02:41	10:05:33	10:13:22			Still deploying
4	YG-36-05	10:09:12	10:13:33	10:14:08	0:04:21	0:00:35	
5	YG-35-05	10:16:39	10:20:43	10:22:37	0:04:04	0:01:54	
5	YG-36-03	10:46:49	10:51:20	10:53:49	0:04:31	0:02:29	
5	YG-39-04	11:16:39	11:23:06	11:25:19	0:06:27	0:02:13	
				Overall AVG	0:05:16	0:01:51	

Nerd Alert: Data for Computing
TIme Difference Between YG-35/36/39 Satellites

Successful Firefly Launch from Vandenberg on 22 Dec 2023 (Noozhawk)

Merry Christmas & Happy Holidays!
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