The Long March 5b Incidents

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Executive Summary

The launch of the Tianhe module of China's Tiangong-3 space station was followed by two incidents of note One, immediately after the separation of the module from the core stage, both made close pass to the International Space Station, sparking speculation that it was a deliberate signal. Two, the core stage made an apparently uncontrolled re-entry into the Earth's atmosphere, splashing into waters not far from India. We conclude that:

- It remains unclear if these two incidents were intended as signals, given China's own imperfect safety record in space and the lack of corroborating evidence.

- China already has nascent co-orbital capabilities and long-range precision guided missiles, which could make such signals superfluous for signalling capabilities. However, they can be used to signal resolve.

- The launch of the Tianhe module and the speculation over the incidents that followed are products of a decline in space cooperation between great powers, the creeping weaponisation of space, and concerns about China's own counterspace capabilities.

- To detect and interpret any signalling China might undertake in the near future, India must bolster its space situational awareness (SSA) capabilities by increasing its own capabilities, cooperating with other states, and sharing information.

I. Long March 5b

29 April – 9 May 2021

The remnants of a Long March 5b rocket’s core booster stage splashed down in the Indian Ocean near the Maldives on Sunday, 9 May 2021(Krishnan 2021). The debris reportedly fell into the ocean without any incident of damage to life or property(Churchill and Xin 2021). The exact coordinates of the splash down according to China are “72.47°E longitude and 2.65°N latitude”(Fang Chao 2021).

The rocket’s remnants re-entered the Earth’s atmosphere around 1024 Beijing time / 0754 IST(Fang Chao 2021).

The rocket was launched more than a week earlier, on 29 April 2021, depositing the first module of China’s planned space station in orbit. This module was named ‘Tianhe,’ which when roughly translated means “harmony of the heavens (Jones 2021a)”.

According to the astronomer and space watcher Jonathan McDowell, about 300 seconds after the separation of the module and the core, both passed just 300 kilometres from the International Space Station, a close distance by celestial standards. McDowell speculated that this appeared to be deliberate, “given that really careful timing was needed to achieve it.(McDowell 2021)”

The 30-metre-long core, weighing around 18 tonnes entered an orbit with an elliptical elevation of 160 km x 375 kilometres (Amos 2021).

Most of the core presumably burnt up during re-entry. However, some of its components were made up of heat-resistant material meant to survive the heat and friction generated during launch. These included the “fuel tanks, thrusters, large parts of the rocket's engines, and bits of metal and insulation”(McFall-Johnsen 2021).

II. Gauging China’s Intentions

A Pattern of Behaviour

Concerns about the re-entry of the core were well founded. In May 2020, a previous Long March 5b rocket also underwent an uncontrolled re-entry that ultimately resulted in large segments of metallic pipes falling around two villages in Ivory Coast in West Africa, causing some mild property damage but no casualties (O’Callaghan 2020). Earlier, in 2018, China’s space lab Tiangong-1 broke apart as it re-entered the Earth’s atmosphere and splashed into the southern Pacific Ocean, though Chinese authorities denied reports that the descent was “uncontrolled” (Wall 2018).

Even close passes to the International Space Station were not unprecedented. In 2008, the Shenzhou-7 spacecraft, carrying China’s human spaceflight mission passed within 45 kilometres of the ISS (Fisher 2008). The spacecraft also released a 40-kilogram microsatellite BX-1, which some speculated could have hostile ‘co-orbital’ capabilities (Weeden 2008). An initial English-language news story also suggested BX-1 was “drifting away from its intended trajectory” but this was later attributed to a mistranslation from the original Mandarin (Kulacki and Lewis 2009).

Suspicion about the BX-1 was rooted in China’s own behaviour in space. The previous year, China had tested a direct-ascent anti-satellite (ASAT) missile against a defunct weather satellite at an altitude of 863 kilometres. The collision generated 3,037 pieces of trackable space debris along with an estimated 32,000 untracked fragments across Low Earth Orbit. The test generated the largest debris cloud ever created in a single event (Weeden 2010).

Deciphering Signals

While the two incidents noted above (the close pass of the core of the Long March 5b and Tianhe module to the ISS and the uncontrolled re-entry of the core) sparked some speculation about their intent, it is uncertain if they were meant to be signals from China to other states.

Reckless behaviour like China’s ASAT test has the power to signal intent and resolve. By conducting the test, China clear signalled its intent to develop space-denial capabilities. Whether intended or not, its willingness to create a perilous debris cloud also signalled a willingness to flout international norms and place at risk the space assets of other states.

However, unlike with China's 2007 ASAT test, it is difficult to gauge intentions from the incidents involving the BX-1 satellite or the Long March 5b core. There are two reasons for this. One, neither are explicitly weapons and neither have made manoeuvres that can be clearly interpreted as having military intent. Two, there have been no public statements from Chinese sources suggesting the manoeuvres made had any strategic import. This reflects a challenge inherent in space strategy: most capabilities are dual-purpose and without clearly threatening actions or statements, manoeuvres can be open to multiple interpretations.

Furthermore, China's own imperfect safety record in space makes it challenging to differentiate between a carelessly chosen orbital path and an intentional signal. It is similarly challenging to distinguish between an uncontrolled re-entry and a carefully controlled re-entry path chosen to convey a signal to adversaries.

Finally, China is not the only state that has dealt with accidents and uncontrolled re-entries. As recently as March 2021, a SpaceX Falcon 9 rocket made an uncontrolled re-entry over the US state of Washington (Berger 2021). Indeed, the US' first space station, Skylab made a fiery re-entry over the Indian Ocean and the Great Australian Desert in July 1979, prompting a formal apology from President Jimmy Carter (Lyons 1979). The previous year, a Soviet naval reconnaissance satellite powered by a small nuclear reactor made an uncontrolled re-entry, spraying debris over thousands of square kilometres of remote territory in Canada (O'Toole 1978) (Weintz 2015).

Given this record of mishaps (and the consequential reputational costs), China would have limited incentives to use the re-entry of the core and its dramatic Indian Ocean splash-down as a signal of capabilities. This is especially so since China has a large arsenal of proven long-range precision strike ballistic missiles (CSIS 2021). However, this does not mean China is unaware of the attention the splashdown received in India or that possibility that it would serve to remind Indians of China's space and missile capabilities.

Also, there could be greater incentive for China to make a close pass to the International Space Station. However, we should note that China already has other capabilities for holding at risk spacecraft in Low Earth Orbit (LEO). These include its well-established direct ascent ASAT missiles, as well as its nascent co-orbital capabilities as indicated by the multiple rendezvous it has conducted between its satellites (Weeden and Samson 2021). There remains the possibility that the close pass was a signal of intent and resolve rather than capability. However, given the lack of corroborative evidence, this must remain speculative.

III. Placing the Long March 5b Incidents in Context

China's decision to build its own space station and the speculation surrounding close pass of the space station module and core to the ISS must be understood in the context of three factors: the decline in space cooperation between great powers, weaponisation of space and China's kinetic ASAT capabilities.

The Decline in Space Cooperation Between Great Powers

It is increasingly clear that China and Russia are growing sceptical about the utility of cooperation with the US in both space governance and space exploration.

This decline in space cooperation follows a post-Cold War interlude during which joint efforts between the US and Russia. This was symbolised by Russia's Mir space station. Mir was the predecessor to the International Space Station (ISS) and the first habitable research facility assembled module by module in orbit. It emerged as an important bastion for space-based research and hosted many collaborative missions, most notably the Mir-Shuttle programme between NASA and the Russians in the 1990s(Dunbar). The space station was decommissioned in 2001, its functions largely taken over by the ISS(Nasa).

While the US and Russia continue to cooperate in the ISS, it is already considering other options. Russian officials have indicated the country may look to with from the International Space Station(The Moscow Times 2021). Russia is also on track to launch its own space station by 2025(AFP 2021 a).

As China emerged as a major space power, the US Congress placed restrictions on scientific collaboration with Beijing (Pentland 2011) including a formal ban on Chinese participation in the International Space Station(Browne 2021).

These developments are not only rooted in the increasing divergence of interests between these states on Earth-based affairs but also disagreements over space governance. For instance, The US-led Artemis programme and the associated Artemis Accords have been described by Russia as being too US centric(Loren 2020). Similarly, Russia has been proposing a Prevention of an Arms Race in Space (PAROS) treaty but has made little headway with the US(NTI 2021).

Shrinking finances are likely to force Russia into greater partnership with China. It is no surprise that Russia has also recently hinted at reconsidering its national space development strategy and make every conceivable attempt to remain a major space power(AFP 2021 b). In April 2021, Russia and China signed an MoU to jointly pursue a Lunar research base together and are seeking to enlist other countries(Jones 2021b). China has, in turn, aligned its space goals with its national development(China's Space Activities in 2016) and military goals(Lal 2021).

China has already demonstrated its ability to conduct Lunar exploration and operating spacecraft that conduct complex orbital manoeuvres. These capabilities can be gauged from the recent Chang-e 5 sample return mission, which was the first such mission carried out by any state in nearly four decades(PTI 2021).

These developments suggest a heating up of competition in space between the US with its allies and the Russia-China combine.

Weaponisation of Space

Space has been militarised from almost the beginning of space exploration. Even the first artificial satellite, Sputnik-1, a small sphere with a diameter of 56-centimetres(Maskowitz 2012), sparked anxieties over its military implications(US Department of State). By 1960, the US was operating the CORONA series of satellites to collect intelligence(NRO).

The 1960s also saw attempts to weaponise space. For instance, the Soviets worked on a "Fractional Orbital Bombardment System" that was to launch a nuclear weapon into space, from where it would de-orbit and plunge into its Earth-bound target(Gyurosi 2010). During the Cold War, both sides also developed kinetic anti-satellite (ASAT) missiles that could be launched by aircraft or from the ground(CSIS 2018).

In 1967, the superpowers signed what is commonly called the Outer Space Treaty, which prohibited the stationing of nuclear weapons "or any other kinds of weapons of mass destruction" in space(UNOSSA a). This left out Earth-based or sub-orbital nuclear weapons as well as conventional weapons stationed in space. In 1983, the US initiated its over-ambitious Strategic Defense Initiative (SDI), which sought to create a space-based missile defence system using kinetic and directed energy weapons(Atomic Heritage Foundation). While this stoked fears of large-scale weaponisation in space, SDI was too fanciful to ever be realised. Furthermore, as the

Cold War fizzled out and Soviet Union collapsed, there remained little political rationale to continue the programme.

One consequence of SDI was an effective pause on kinetic ASAT missile tests. The Soviets reacted to the programme in 1983 by declaring a unilateral moratorium in an effort to signal restraint (Grego 2012). By 1986, the US followed. The moratorium would remain in place until 2007, with China's spectacular kinetic test.

China's Kinetic Counterspace Capabilities

China's ASATs have their inception in the country's anti-ballistic missile air defence programme going as far back as 1960s. The lineage of China's suspected D-ASATs can be traced back to the HQ-19 air defence solid fueled interceptor missile which is similar to the US's THAAD complex(Weeden and Samson 2021).

The first of the derivative D-ASAT systems SC-19(DN-1) has been tested five times between 2005 and 2013, it is generally believed to be a further development of a better-known Dong Feng DF-21C Ballistic Missile and may have an upper ceiling of 1,250 kilometres. The details of the follow up D-ASAT variants are less clear but at least two follow-up designs exist designated DN-2 and DN-3 by a US-China Economic and Security Review publication and several media reports quoting unnamed US officials.

Secure World Foundation's counterspace capabilities report also says that the DN series is more likely a "mid-course missile defence system akin to the U.S. SM-3"(Weeden and Samson 2021).

The SM-3 comparison makes sense because of the US's Operation Burnt Frost carried out in 2008. In the course of operation Burnt Frost a modified SM-3 air defence missile was fired at a malfunctioning and set to fall to earth US ISR satellite from a US Navy Aegis equipped Ticonderoga-class ship(Nicholas L. Johnson 2021).

It is also likely the DN-2 was tested in 2013 and 2014, though there is a possibility the 2013 test was a Transporter Erector Launcher(TEL) test of a DN-1 variant and not a completely new missile (DN-2)(Weeden and Samson 2021). The 2015, 2017 and 2018 ASAT tests may have been of the newer DN-3)(Weeden and Samson 2021).

According to US sources, China has already begun operationally deploying D-ASAT systems to some ground units. It may also be exploring the possibilities of developing air-launched as well as sea-launched variants based on surface ships or even submarines)(Weeden and Samson 2021).

D-ASATs have important advantages. At Low Earth Orbit (LEO) they can rapidly and completely destroy adversary satellites in a single shot. The chief drawback of D-ASATs is the massive debris fields they create which can threaten the space-assets of both China and other states with which it is not in conflict. For this reason, China is likely to focus on developing non-kinetic capabilities including rendezvous and proximity operations (RPO) space craft, electromagnetic jamming, directed energy weapons (DEWs), and the tools of cyber sabotage.

China has notably carried out both co-orbital rendezvous-proximity operations (RPO) and direct ascent ASAT tests. It is also believed to have developed Directed Energy Weapons which can incapacitate and jeopardize the operations of satellites in orbit (Bhat 2019).

Besides servicing China's own satellites in peacetime, RPO crafts can perform surveillance and work as a leg of China's broader space situational awareness apparatus. In times of crises or conflict, they can be purposed towards temporarily disabling or damaging adversary satellites. These attacks can be via simple blunt force of collision, through some appendage like a robotic grappling arm designed to primarily be a repair tool or a more advanced concealed directed energy weapon (DEW), Electronic Warfare Jammers or a projectile weapon (DIA 2019) (Weeden and Samson 2021).

IV. Recommendations for India

Even if the recent Long March 5b incidents are judged to not have been signals from China to other states, India must be prepared to detect and interpret such signals in the near future. To do this, India will need to significantly upgrade its space situational awareness (SSA). It must accomplish this by:

- Increasing its own home-grown capabilities. ISRO's SSA control centre presently runs a network for space object tracking and Analysis (NETRA) in Peenya, Bengaluru. It will have to increase investment in both sensory and computing capabilities to improve these capabilities (ISRO 2020).

- India will have to enhance international cooperation on SSA. This includes:
    - Information sharing with other states: India is heavily dependent on inputs from North American Aerospace Defense Command (NORAD). It should bolster information sharing with other states, including Russia and China.
    - Sourcing from OSINT sources and enthusiasts: Both the open source intelligence (OSINT) and other hobbyists and amateur space watchers continue to provide useful data to governments. India should make it easy for these communities to share information. In return, it should also make non-sensitive two-line element data – which can pinpoint the locations of space-based objects – available publicly.

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