# Chinese Military and Intelligence Rendezvous and Proximity Operations

SECURE WORLD FOUNDATION

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## Summary

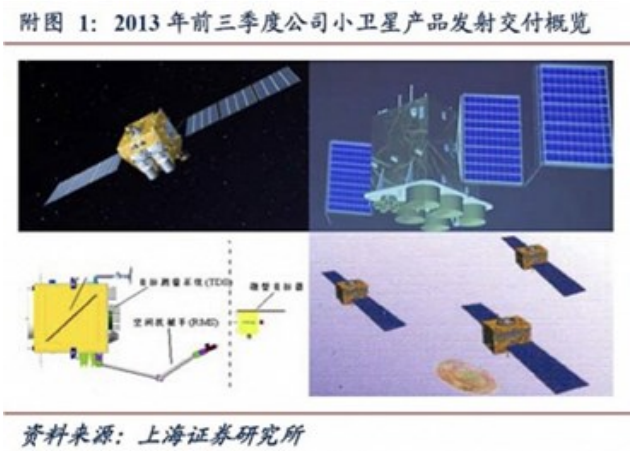
Since 2008, China has conducted multiple tests of satellite technologies for robotic rendezvous and proximity operations (RPO) to support surveillance and inspection of other space objects in both low Earth orbit (LEO) and geostationary Earth orbit (GEO), most of which are related to military or intelligence operations. While these missions have been publicly acknowledged by China, most have few public details and a few remain shrouded in secrecy. None of the programs listed here have strong evidence to link them to co-orbital ASAT testing or deployment.


## Rendezvous & Proximity Operations

Proximity operations are a series of orbital maneuvers executed to place and maintain a spacecraft in the vicinity of another space object on a relative planned path for a specific time duration to accomplish mission objectives. Rendezvous is a process wherein two space objects (artificial or natural body) are intentionally brought close together through a series of orbital maneuvers at a planned time and place. Taken together, RPO technologies enable a wide range of capabilities to support civil and commercial space activities such as on-orbit inspections, repair, refueling, assembly, and life extension. RPO capabilities can also be used for military and intelligence space activities such as intelligence, surveillance, and offensive weapons such as co-orbital anti-satellites. Since the late 2000s, China has conducted a series of robotic on-orbit demonstrations between different pairs of satellites.

## Chinese Military and Intelligence RPO Missions in LEO

The first known Chinese robotic RPO occurred in September 2008 when a Chinese human spaceflight mission Shenzhou 7 deployed a small satellite to practice on orbit inspection and control system flying capabilties.[1] Some observers concluded that the BX-1 was a test of the capabilities required for a co-orbital anti-satellite (ASAT) attack [2] but the mission has not been linked to any such military program.[3]



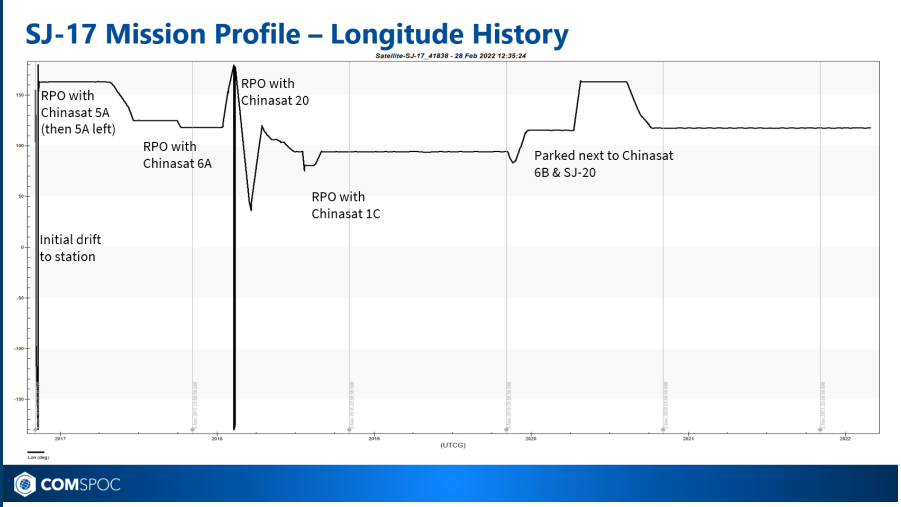

**SY-7** (lower left, with robotic arm) and its small companion satellite. Image credit: Liss1

In the summer of 2010, the Chinese satellites Shi Jian (SJ)-12 and SJ-06F conducted a series of robotic RPO.[4] The mission of SJ-12, as stated by the State media service Xinhua, is to carry out "scientific and technological experiments."[5] In the summer of 2010, the SJ-12 initiated a series of deliberate changes in its orbital trajectory to approach and rendezvous with the SJ-06F satellite.[6] The maneuvers occurred over several weeks between June 12, 2010, and August 16, 2010. On August 19, the two satellites came within 300 meters. A change in the orbital trajectory for the SJ-06F around that same time indicates that the two satellites may have bumped into each other, although there were no external indications of damage to either satellite or any debris created by the incident.

On July 19, 2013, China placed three payloads into roughly similar LEO orbits from the same launch — Shiyan 7 (SY-7), Chuangxin 3 (CX-3), and Shijian 15 (SJ-15)[7]. The SY-7 carried a teleoperated robotic arm while the SJ-15 was equipped with RPO capabilities**.** In August 2013, SJ-15 conducted an RPO of CX-3 within a few kilometers and another RPO with Shi Jian 7 (SJ-7), a Chinese satellite launched in 2005.[8] Anonymous U.S. officials claimed that the RPO was part of a "covert anti-satellite weapons development program," and that one of the satellites "grabbed" another,[9] although the satellite with the arm, SY-7, was not involved. On October 18, 2013, the SY-7 initiated a small maneuver to raise its orbit by several hundred meters and shortly thereafter released another object, which orbited in relatively close proximity for several days. Some reports claimed the two objects may have physically joined with each other,[10] but the publicly available tracking is not accurate enough to confirm. Both objects occasionally conducted small maneuvers throughout 2014 and 2015, and the SJ-15 through 2016 as well.[11]

### Chinese Military and Intelligence RPO Missions in GEO

China has also conducted robotic RPO demonstrations in GEO. On November 3, 2016, China placed the SJ-17 satellite in GEO, which was publicly declared to be designed to test advanced technologies.[12] Several days after reaching GEO, the SJ-17 began maneuvering to place itself into the active GEO belt close to another Chinese satellite, Chinasat 5A, at a longitude of 162.9 E.[13] The SJ-17 made several small maneuvers to circumnavigate Chinasat 5A at a distance of between 50 to 100 km for several days, slowly closing in to within a few km on November 30, before returning to a 50 to 100 km standoff distance.[14] The two satellites remained close until December 29, when Analytical Graphics, Inc, (AGI) reported that Chinasat 5A was drifting away.[15] The SJ-17 spent the next year drifting eastward then sharply westward until on March 20, 2018, it lowered its orbit to reverse its drift, indicating that it conducted survey of the GEO region. Over the first half of 2018, the SJ-17 made additional unusual changes to its orbit. SJ-17's reversal in inclination and maneuvering to a drift orbit between late January and July of 2018 appears to be linked to an unexplained anomaly in the orbital trajectory of Chinasat 1C, a Chinese communications satellite launched in December 2015.[16] The sudden, large change in inclination suggests the SJ-17 has significant delta-v capability as plane change maneuvers are among the most energy-intensive. SJ-17 rendezvoused with Chinasat 1C, coming to within 1.5 km on July 29. Ten days later, Chinasat 1C halted its drift and slowly drifted back to its operational location. SJ-17 remained with Chinasat 1C through until early August before departing, while Chinasat 1C arrived back at its original location on September 7. This strongly suggests that SJ-17 inspected Chinasat 1C to determine the source of the anomaly and then monitor the recovery attempt.[17] Additionally, in January 2020 and October 2020, SJ-17 made smaller changes to RPO with Chinasat 6B and SJ-20 respectively.




**Longitudinal history of the SJ-17.** Image Credit: COMSpOC

On December 23, 2018, China launched another mission to GEO that also exhibited unusual behavior. Like its predecessors, the Tongxin Jishu Shiyan (TJS)-3 satellite was launched from Xichang Space Launch Center into an elliptical geosynchronous transfer orbit (GTO). Chinese official media has described them as communications technology test satellites but observers believe they may also be testing missile warning sensors, deployable antennas, or other technology.[18] TJS-3 appeared to be similar in nature, and the U.S. military ended up cataloging two objects from the launch in GEO: the TJS-3 satellite and a second object that was assumed to be an apogee kick motor (AKM), a detachable rocket engine often used to circularize a satellite in GEO, as it was slowly drifting westward. However, shortly after the separation, object 43917 did a series of maneuvers to place it into a GEO slot at 59.07E, near TJS-3.[19] Object 43917 slowly drifted toward TJS-3 and according to AGI exhibited photometry consistent with a stabilized object, indicating it was a functional satellite and not a AKM.[20]

TJS-3 remained relatively close (within a couple hundred kilometer) to multiple satellites, including USA 263 in July 2019 and USA 233 in October 2023. Given that distance, this activity is not technically a RPO but is still likely to generate concerns.

**Dual-Use Operational Status**

The activities of the SJ-12, SJ-15, SJ-17, TJS-3 AKM, and SJ-21 are consistent with the demonstration of RPO technologies for the purpose of satellite servicing, space situational awareness, and inspection. Notably, a counterspace assessment released by the Defense Intelligence Agency (DIA) in February 2019 stated that China is developing capabilities for inspection, repair, and space debris removal that may also be used as a weapon but did not specifically state that any Chinese RPO activities was a weapons test.[24]

The most likely utility of the capabilities demonstrated by the SJ-12, SJ-15, SJ-17, and TJS-3 AKM satellites is for on-orbit space situational awareness and close-up inspections. Their operational pattern was consistent with slow, methodical, and careful approaches to rendezvous with other space objects in similar orbits. The satellites the SJ-12 and SJ-15 approached were in relatively similar orbits, differing in altitude by a couple hundred kilometers and slightly in inclination. They did not make huge changes to rendezvous with satellites in significantly different orbits. This behavior is similar to several U.S. RPO missions to test and demonstrate satellite inspection and servicing capabilities such as the XSS-11. While some skepticism exists relating Chinese rendezvous and proximity activities with co-orbital ASAT testing, there is no strong publicly available evidence link between these missions and a defined defense program. However, at least one recent Chinese research paper suggests using RPO capabilities to plant small explosive charges in the nozzle of a spacecraft's engine.[25] To date, China has not conducted any confirmed co-orbital ASAT testing on orbit — only testing of ground-launched direct ascent ASAT weapons.

**Summary of Known or Suspected Chinese Rendezvous & Proximity Operations in Space**

| Date | Target | Chaser Satellite | Launch Site | Result |
|---|---|---|---|---|
| Sep. 2008 | SZ-7 | BX-1 | Jiuquan | BX-1 was deployed from SZ-7 and proceeded to orbit around the spacecraft taking images |
| June - Aug 2010 | SJ-O6F | SJ-12 | Jiuquan | SJ-12 moved to rendezvous with SJ-O6F and may have bumped it |
| July 2013 - May 2016 | Multiple | SJ-15,SY-7, CX-3 | Taiyuan Satellite Launch Center | SY-7 released an additional object that it performed maneuvers with and may have had a telerobotic arm. CX-3 performed optical surveillance of other in-space objects. SJ-15 demonstrated altitude and inclination changes to approach other satellites. In Dec 2015, SJ-15 raised orbit to CX-3 demonstrating multi-orbit inspection |
| Nov 2016 - Mar 2018 | Chinasat 5A, Chinasat-20 | SJ-17 | Wenchang Satellite Launch Center | YZ-2 upper stage failed to burn to the graveyard orbit and stayed near GEO. SJ-17 demonstrated maneuverability around the GEO belt and circumnavigated Chinasat 5A |
| Jan 19 2020 | TJS-3 AGM | TJS-3 AGM | Xichang | TJS-3 AGM separated from TJS-3 in GEO and both maneuvered slightly to stay within close orbits |
| Jan-Aug 2020 | Chinasat 6B, SJ-20 | SJ-17 | Wenchang Satellite Launch Center | SJ-17 made smaller changes to RPO with Chinasat 6B in January 2020 and, SJ-20 a new high bandwidth communications satellite launched in December 2019, in October 2020. |

## Endnotes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