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## Shenlong Space Plane Advances China's Military Space Potential

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 ARTICLES

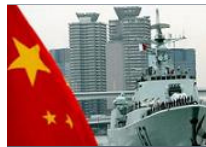
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A chance December 11, 2007 release of a photo on a Chinese website has led to a rare unofficial "declassification" of a new Chinese unmanned test space plane.<sup>[1]</sup> Designated the "Shenlong," or Divine Dragon, this small aircraft was shown suspended from the fuselage of a Xian H-6 bomber and launch aircraft. So far there has been no official Chinese government, PLA or Chinese corporate or space program related disclosure about this program. However, from this photo and other Chinese sources, it is possible to conclude that the Shenlong constitutes a second Chinese air-launched space-launch vehicle (SLV) program, but for the purposes of testing technologies for a future re-usable unmanned or manned space shuttle or other trans-atmospheric vehicle.



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**Original Shenlong Photo:** First seen on December 11, 2007, the Shenlong space vehicle is seen suspended from a Xian H-6 bomber from an unknown unit. Source: Chinese Internet

While both unmanned and manned space planes could serve a range of scientific and commercial missions, it is also clear that the PLA envisions such vehicles to perform military missions. Chinese military literature has long suggested the PLA seeks to dominate outer space and its successful January 11, 2007 interception and destruction of a satellite demonstrated the PLA now has an initial space combat capability not currently possessed by the United States.



**Shenlong Closeup:** This out-take from the December 11 photo shows the Shenlong to be a small rocket powered unmanned space plane, as seen from the black heat shielding. Source: Chinese Internet

#### Initial Shenlong Details

The photo made available on Chinese military issue Internet sites on December 11 shows a small rocket powered aircraft suspended beneath the fuselage of a Xian H-6 bomber. The small aircraft has a black underside consistent with heat-shielding necessary for re-entry to Earth's atmosphere from space. This would indicate that Shenlong is meant to be a reusable space craft. In November 2006 China revealed another air-launched space launch vehicle very similar in configuration to the U.S. Orbital Sciences Pegasus air launched SLV, which is not intended to be reusable. The new aircraft seen on December 11 does not appear to have a vertical stabilizer or wing-tip stabilizers, which would be necessary for stability, but a subsequent Chinese-Internet released photo indicates this aircraft may have a large vertical stabilizer that will require a different carriage method for the H-6 bomber. The absence of a stabilizer for the December 11 aircraft raises the possibility that its main purpose may be to test its aerodynamic compatibility with the bomber, and that it may not be the version that is launched into space.



**New Shenlong View:** On December 12, 2007 another Chinese web poster offered this computer generated rendering of the Shenlong with a vertical stabilizer using a

Chinese military issue websites. While interesting, much of this data cannot be confirmed in the absence of any official Chinese government, military or corporate disclosures. Nevertheless, various posters have suggested that the Shenlong space craft is a program funded by the famous "863 Program" for dual-use high-technology research established in 1986 to advance China's military modernization. The Shenlong carries the program number "863-706," and as such, is likely a PLA-priority program. Other posters revealed that the No. 611 Design Institute usually associated with the Chengdu Aircraft Corporation was involved in some design and testing aspects of the Shenlong. Another poster revealed an article from mid-October 2007 claiming to show the digital control center created by the 611 Institute to test the Shenlong. Mark Wade has noted that the 611 Institute may have gained insights regarding space planes from cooperative programs with France during the 1980s, which was developing the Hermes space plane.<sup>[2]</sup>



**Possible 611 Institute Shenlong Control Center:** One Chinese web poster states that this facility was created by the 611 Institute to conduct the test flights of the Shenlong. Source: Chinese Internet

Another interesting aspect of the Shenlong program is that it provides a rare example of how a state and military funded program is assisted by Chinese technical universities. One web poster revealed that the Nanjing University for Astronautics and Aeronautics (NUAA) was likely involved in devising early digital "computer-aided-design" (CAD) for the spacecraft, which likely used a version of the French Dassault CATIA design software, used throughout China's military industries. NUAA researchers may have also led the design of the control computer and re-entry control system. Northwest University, which also does extensive 863 Program funded research, is said to have helped design the INS/GPS (Inertial Navigation System/Global Positioning Navigation Satellite) control system for the 863-706 program. The Harbin Technical University, a key center for PLA-funded military-technical research, is said to have helped design composite structures for the Shenlong.

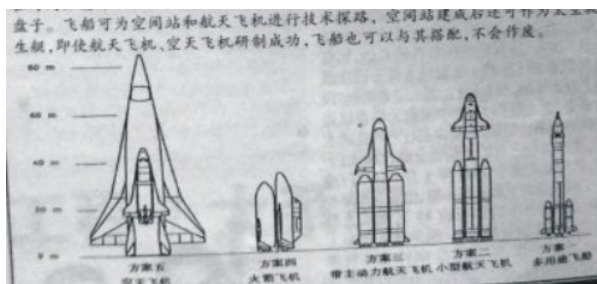
However, these websites were not clear regarding the status of the Shenlong program. It appears that much of the design work took place between 2000 and 2004. One Internet source indicates the original December 11 picture may have been taken in late 2005, but this cannot be confirmed. The existence of the 611 Institute run test facility might indicate that some degree of flight testing has occurred. In early 2007 a French publication noted that Western intelligence agencies were very interested in the first test flight of a "secret super-scrumjet demonstrator" which was tested in late 2006 and landed in the Indian Ocean.<sup>[3]</sup> Indeed, China is pursuing the development of air-breathing hypersonic vehicles,<sup>[4]</sup> but it is also possible this may have been a test of the Shenlong.

These same Chinese websites also did not offer details regarding the performance of the Shenlong. Even if launched from a new H-6K bomber, which reportedly will be powered by Russian D-30K turbopfans and capable of higher launch altitudes, the Shenlong does not appear to be large enough to reach sustained Low Earth Orbit (LEO) flight. As such, it may only be capable of short-duration LEO flight over Chinese territory, which would be consistent with a technology test and validation mission. The Shenlong would also likely help China with the development of hypersonic aircraft. The initial photo of the Shenlong does not indicate that it can carry a payload other than its motor, liquid fuel and its guidance system. That said, the Shenlong is broadly similar to U.S. and other unmanned space planes designed to test new technologies. These would include the U.S. Orbital Sciences X-34, Boeing X-37 and Japan's HOPE-X. A larger version presumably would be able to carry a payload and be capable of sustained LEO flight.

#### China's Interest In Space Planes

China's interest in space planes began in earnest with the arrival of Dr. Qian Xueshen, who was the co-founder of the Jet Propulsion Laboratory at the California Institute of Technology and made enormous contributions to early U.S. rocket programs. But in 1950 he was suspected of spying for China, lost his security clearances, put under house arrest, and then deported to China in 1955 as part of post Korean War prisoner exchanges. Controversy has since raged over whether Qian's prosecution was justified, or an example of McCarthy-era paranoia causing a travesty of U.S. justice.<sup>[5]</sup> But on his return, Qian became a key ally of Mao Zedong and led the creation of China's modern missile and aerospace sector. The release of the Shenlong picture occurred on his 96<sup>th</sup> birthday, and was thus likely intended as an unofficial tribute to Qian's profound contributions to China's missile forces, missile defense and anti-satellite programs, and broad manned and unmanned space capabilities.<sup>[6]</sup> It was Qian's 1949 concept for a space plane that formed the basis for the U.S. Air Force's "Dyna-soar" military space plane concept of the early 1960s,<sup>[7]</sup> which led to the U.S. Space Shuttle. Qian also proposed another space plane concept in the late 1970s that closely resembled the Dynasoar.

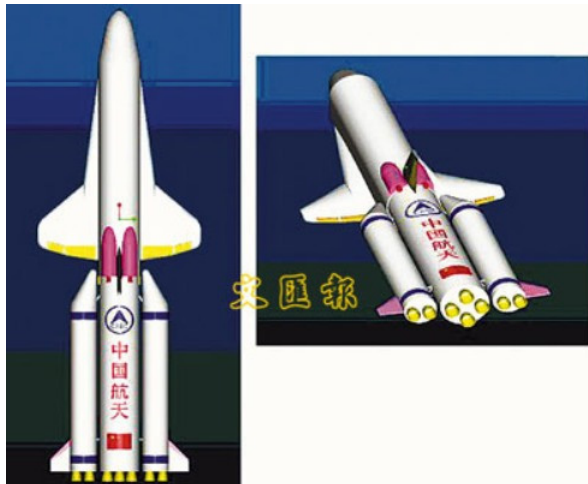
Spacecraft expert Mark Wade has noted that in 1988 Chinese designers proposed three space plane concepts. The Chang Cheng 1 was proposed by what is now the Shanghai Academy of Spaceflight technology, and was a 2/3 shuttle-size space plane atop three large boosters. What is now the China Academy of Launch Technology proposed a much smaller space plane atop Long-March size booster. Finally, the 601 Institute, connected to the Shenyang Aircraft Corporation, proposed a small space plane atop an air-breathing hypersonic launcher. Only the later would have involved a truly reusable space access system, but all were deemed beyond China's capabilities. But had they been implemented these proposals would have resulted in space planes flying in this decade.<sup>[8]</sup>





**Chinese Space Plane Concepts:** Chinese institutes have studied many space plane concepts over the last two decades. Perhaps most interesting was the involvement of the 601 Institute, a jet fighter designer, in a two-stage small space plane concept, with a model seen at the Shenyang Aircraft Co. factory museum (bottom). Source: Chinese Internet

This ambition has apparently been revived. In October 2006 the China Academy of Launch Vehicle Technology (CALT) revealed that China is developing a winged space shuttle for use in the 2020 time frame.<sup>[9]</sup> Concept images indicate the planned space plane may be about 2/3 the size of the U.S. and Russian space shuttles. But instead of using a large fuel tank that powered launch engines in the space plane, it uses a separate three-part liquid fuel booster.



**Recent CALT Shuttle Concept:** This is a possible CALT space shuttle concept that China may develop by 2020. Source: Chinese Internet

Chinese ambitions to build an unmanned space plane may also be longstanding. At the 1996 Zhuhai Airshow this analyst found a Chinese brochure depicting a wind tunnel test model similar in shape to the Shenlong, perhaps indicating that research for the "863-706" program began in the early 1990s. Chinese reports in 2006 noted the possible development of a "recoverable" space plane and a "reusable" space transportation vehicle.<sup>[10]</sup> The Shenlong may be one concept for a reusable space transportation vehicle. On December 12 Hong Kong's Wenweipo newspaper reported comments by spacecraft expert Chinese Academy of Sciences member Zhuang Fenggan, who is also member of the China Aerospace Science and Technology Group and a frequent spokesman for space matters, who noted that China was conducting extensive research on trans-atmospheric vehicles, but that there was no timetable for their completion. But the same Wenweipo report also noted an aviation industry report which stated that a test flight will occur during the 11<sup>th</sup> Five Year Plan, or possibly within the next three years.<sup>[11]</sup>

China's "Hermes"

Chinese ambitions to build an unmanned space plane may also be longstanding. At the 1996 Zhuhai Airshow this analyst found a Chinese brochure depicting a wind tunnel test model similar for what at the time appeared to be a shape for another unknown space plane. Its main feature is the use of small vertical stabilizers at the tip of the wings. This shape later seemed similar to the French "Hermes" space plane concept of the early 1980s, which was never realized. However, Mark Wade has noted that the 611 Institute may have gained insights regarding space planes from cooperative programs with France during the 1980s, which was developing the Hermes space plane.<sup>[12]</sup> This may account for the similarity. Since the 1996 picture there had been no disclosures of additional information about the 1996 wind tunnel model. But on December 16, 2007 a Chinese military issue web site disclosed a photo showing a model of the Shenlong along with a model of the Chinese "Hermes" space plane, perhaps indicating this space plane concept remains active.<sup>[13]</sup>





**China's "Hermes" Space Plane:** A December 16 photo shows a model of the Shenlong and a new model of the Chinese "Hermes" space plane, which is very to a wind tunnel test model the author found at the 1996 Zhuhai Airshow (bottom). Source: Chinese Internet

#### Military Potential of Unmanned Space Platforms

The Shenlong could validate technologies and form the basis for a range of unmanned and manned space vehicles, which both could serve civil-commercial as well as military missions. However, it appears be sufficient Chinese literature and statements to justify concern that China's space planes are being developed for military missions in space and to attack targets on Earth. In his recent review of Chinese literature on Chinese military views toward space warfare, Dr. Larry Wortzel noted that China was exploring a list of potential space weapons, which included "space planes that can transit and fight 'up or down' in the upper atmosphere or space."<sup>[14]</sup>

In May 2002 Dr. Zhuang Fenggan gave an interview to the Beijing Youth Daily in which he revealed new information on China's space plane plans. In this article Zhuang suggested that a space plane was intended to be a "space combat weapons platform" and serve "dual use" missions. He also noted that a mere "space shuttle" did not meet China's needs, which required a space plane that could move "freely" between space and the upper atmosphere. Zhuang also identified a number of technologies China would have to master for its space plane, to include hypersonic, high mobility, and advanced materials. But it is also curious that Zhuang would identify "high stealth" and "precision strike" technologies as important for China's space plane.<sup>[15]</sup>



**Dr. Zhuang Fenggan:** A principle expert guiding China's space and military space programs. Source: Chinese Internet

In 2005 three Chinese researchers from the Center for Precision Guidance Technology of the Beijing University of Aeronautics and Aeronautics indicated that China may have already been developing a space capability for attacking targets on Earth. In one article they noted, "The greatest advantage of a space-based ground attack weapon system is its high speed and short reentry time. It is extremely difficult for the enemy to intercept such a weapon."<sup>[16]</sup> While this article does not identify Chinese space plane or space shuttles as a potential space based "ground attack weapon," one cannot discount that China may be designing its unmanned or manned space plane for this purpose.

#### Space Bomber Concept

The concept of a space bomber is not new. During World War Two Germany's Dr. Eugene Albert Sanger proposed a 100 ton rocket powered bomber that would skip atop the upper atmosphere to attack the United States.<sup>[17]</sup> There has also been recent U.S. debate over making greater military use of space. In 1999 U.S. Congress created The Commission to Assess United States National Security Space Management and Organization, which was led by former Defense Secretary Donald Rumsfeld. In its February 2001 report the "Space Commission" concluded:

"The nation's vital interests depend increasingly on the capability of its military professionals to develop, acquire and operate systems capable of sustained space combat operations...It is also possible to project power though and from space in response to events anywhere in the world. Unlike weapons from aircraft, land forces or ships, space missions initiated from earth or space could be carried out with little transit, information or weather delay. Having this capability would give the U.S. a much stronger deterrent, and in combat, an extraordinary military advantage."<sup>[18]</sup>

After he took office as Secretary of Defense, Donald Rumsfeld tried to advance the goal of developing a sub-orbital hypersonic bomber that could reduce the response time for U.S.

strikes on the Earth to a few hours. But from the partisan atmosphere that greeted the Commission, to Congressional opposition to the hypersonic bomber, and then the change in national priorities that followed the September 11, 2001 attacks, Rumsfeld's ambition for such a hypersonic or space combat platform has not been realized.<sup>[19]</sup> To compensate, the Department of Defense has also proposed outfitting intercontinental ballistic missiles with non-nuclear warheads, which has also been opposed by the Congress. But following China's 2007 successful ASAT demonstration the Bush Administration has sought additional funding for programs designed to protect U.S. space assets, as well as new funding for a hypersonic strike aircraft.<sup>[20]</sup>

#### Implications for the United States

China appears to have made significant progress toward the development of an unmanned trans-atmospheric vehicle. While it has obvious commercial and scientific uses, it is also clear that much of the purpose behind the development of this craft is military. The comments of Chinese officials indicate that their rocket powered space plane program may be a reaction to U.S. and Indian ambitions to develop hypersonic transports and bombers. But the comments of some of these officials plus those of Chinese military academics indicate that a space plane may also form the basis for a space combat platform. This space combat platform may be intended to attack targets on Earth or it could carry out counter-space combat missions. In addition, China is aggressively pursuing air-breathing hypersonic propulsion technologies, which may provide another avenue to developing very rapid long-range "deep strike" weapons.

China's successful test of a direct-ascent anti-satellite interceptor on January 11, 2007, following two or three previous tests starting in late 2005, have provided one warning of China's intention to build a robust military space combat capability. The development of the Shenlong should be viewed as a second warning of China's commitment to building combat capabilities in space. The Shenlong program may also indicate that China intends to field a stealthy "space bomber" within the next decade. China's government has refused to discuss its ASAT test in any detail and shows no willingness to reveal its larger plans to develop military space combat capabilities. Meanwhile, the United States, which decided in the late 1980s not to deploy its own anti-satellite interceptor, today lacks a defense against China's ASATs and cannot deter China with corresponding space combat systems.

As such, it is critical that the U.S. proceed with current programs to protect U.S. military and civil space assets. In addition, the U.S. must now develop a range of capabilities necessary to deter Chinese military attacks in space or from space. This may require reconsideration of the decision to retire the U.S. Space Shuttle fleet in 2010. It may instead now be necessary to consider retaining one or two Shuttles and to develop defensive and offensive payloads for them, until a less expensive and perhaps smaller unmanned or manned space plane can be developed. Such a new multi-role space plane could be based on an existing air-launched rocket-powered experimental space plane, or be based on a hypersonic platform with the ability to go in and out of space. But instead of leading the world with this technology, the politics of Washington and the War on Terror may be putting the U.S. in a position of having to catch up to China.

[1] While it is not known on which web site the Shenlong photo appeared first, most of the data for this report has been drawn from the CJDBY (<http://bbs.cjdbynet/>) and FYJS (<http://www.fyjs.cn/bbs/index.php>) websites for December 11 and 12, 2007.

[2] Mark Wade, "China," *Encyclopedia Astronautica*, <http://www.astronautix.com/articles/china.htm>

[3] "Hypersonic: China In The Race," *Paris Air & Cosmos*, February 23, 2007, p. 8.

[4] Craig Covault, "China's Scramjet Ambitions," *Aviation Week and Space Technology*, September 3, 2007, p. 28-30.

[5] The argument that Qian was a victim of McCarthy era paranoia was made eloquently by the late Iris Chang in her 1995 biography of Qian, *The Thread of the Silkworm*. In 1999 the Select Committee of the House of Representatives led by Congressman Christopher Cox produced a report based largely on government sources, which noted Qian's contributions to China's missile and space sector, but also stated, "The allegations that he was spying for the PRC are presumed to be true."

[6] Chinese sources note that Qian was the inspiration for the 1963 "640 Program," China's first attempt to build an anti-ballistic missile defense system, which by the 1970s had expanded to include a sub-program to develop an anti-satellite interceptor. While the 640 Program was cancelled in 1980, the successful completion of a new ASAT program raises the question whether China also has an associated ABM program. In the late 1960s Qian also led China's first manned space program, which produced spacecraft designs and an astronaut training program, but was terminated by Mao in 1971 due to financial constraints.

[7] Mark Wade, "Tsien Spaceplane 1949," *Encyclopedia Astronautica*, <http://www.astronautix.com/lvs/tsie1949.htm>.

[8] For an excellent description of China's space plane history see Mark Wade, "Chinese Manned Spacecraft," *Astronautics.com*, <http://www.astronautix.com/craftfam/chicraft.htm>.

[9] Rob Coppinger, "First RLV By 2020?," *Flight International*, October 17, 2006.

[10] *Wenweipo*, December 1, 2006.

[11] Liu Ning-chol, "Domestic space plane test flight in three years," *Wenweipo*, December 12, 2007, <http://paper.wenweipo.com/2007/12/11/CH0712110034.htm>.

[12] Mark Wade, "China," *Encyclopedia Astronautica*, <http://www.astronautix.com/articles/china.htm>.

[13] This photo was seen in an article on China.Military.Com, [http://military.china.com/zh\\_cn/bbs2/11053806/20071216/14552048.html](http://military.china.com/zh_cn/bbs2/11053806/20071216/14552048.html). This photo also reveals what may be a model of the new JL-2 SLBM, with a blunt nose cone, perhaps indicative of multiple warheads. The photo also contains a flying body with a thin sharp delta wing, perhaps indicating a Chinese hypersonic test vehicle.

[14] Larry M. Wortzel, *The Chinese People's Liberation Army and Space Warfare, Emerging United States-China Military Competition*, Washington, DC: American Enterprise Institute, October 2007, p. 7, ref., footnote 76.

[15] *Beijing Youth Daily*, May 31, 2002, accessed on <http://www.fyjs.cn/bbs/read.php?tid=119268&page=2>, December 12, 2007. Article also mentioned in "China Begins To Fund Research Into Space Shuttle Program," *AFP*, May 31, 2002.

[16] Yuan Guoxiong, Bai Tao, and Ren Zhang (Center of Precision Guidance Technology, Beijing University of Aeronautics and Astronautics, Beijing 100083), "A Hybrid Reentry Guidance Method for Space-Based Ground Attack Weapon System," *Beijing Zhanshu Daodan Kongzhi Jishu*, September 1, 2005, Open Source Center CPP20060104424006.

[17] See James P. Duffy, *Target: America, Hitler's Plan To Attack The United States*, Praeger, 2004.

[18] Report of the Commission To Assess United States National Security Space Management And Organization, Pursuant to Public Law 106-65, January 11, 2001, p. X, 33., <http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA404328&Location=U2&doc=GetTRDoc.pdf>.

[19] For review of the Commission and reaction to Rumsfeld's space bomber concept see Benjamin Lambeth, *Mastering The Ultimate High Ground, Next Steps In The Military Uses of Space*, Washington, DC: RAND Corporation, 2003, [http://www.rand.org/pubs/monograph\\_reports/MR1649/](http://www.rand.org/pubs/monograph_reports/MR1649/); Robert Windrem, "Pentagon Planning for Space Bomber," *MSNBC*, August 14, 2001, <http://www.globalsecurity.org/org/news/2001/010814-space.htm>; Ed Vulliamy, "Bush Plans 'Space Bomber,'" *The Observer*, July 29, 2001, <http://observer.guardian.co.uk/international/story/0,6903,529208,00.html>.

[20] Walter Pincus, "Space Defense Programs Get Extra Funding," *The Washington Post*, November 12, 2007, p. A 19.