



Testimony for the United States House of Representatives, Committee on Foreign Affairs, Oversight and Investigations Subcommittee hearing, “Efforts To Transfer America’s Leading Edge Science To China,” November 2, 2011

Military Space Ambitions of the People’s Republic of China and How Near Term PRC-U.S. Cooperation with China In Outer Space Could Threaten U.S. Interests

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Mr. Chairman and Distinguished Members of this Committee:

It is an honor to offer testimony to assist the deliberations of this Committee concerning the effects of the transfer of leading edge American technological and scientific research to the People’s Republic of China (PRC). While this is a very broad area of concern to the United States, I would like to focus my testimony on an issue of particular interest to this Congress: the dangers to the United States that could result from a leakage of U.S. space technology to the PRC.

This challenge has been one of longstanding concern for the Congress. It was an accumulation of reports regarding the leakage of U.S. missile technology to the PRC in the mid-1990s that in part led to a 409-10 vote in the House of Representatives on June 18, 1998 to form the *Select Committee on U.S. National Security and Military/Commercial Concerns with the People’s Republic of China*, co-chaired by former Congressman Christopher Cox and Congressman Norm Dicks. This Select Committee’s unclassified report was released to the public on May 25, 1999 and it remains today the most comprehensive examination by the Congress of the PRC’s broad effort to acquire U.S. space and military technology.

More recently Congressional concern about the dangers of space cooperation with the PRC has been led by Congressman Frank R. Wolf. In testimony on May 11, 2011 before the U.S. China Economic and Security Review Commission, Congressman Wolf stated his concerns about cut backs in the National Aeronautics and Space Administration (NASA) space exploration programs while the PRC’s is expanding, and listed his concerns about PRC behavior regarding its military buildup, aggressive behavior toward U.S. Navy ships, intense espionage and cyberwarfare activities, proliferation of missiles and human rights. He then explained, “That is why I included language in the Fiscal Year 2011 Continuing Resolution preventing NASA and the Office of Science and Technology Policy from using federal funds ‘to develop, design, plan, promulgate, implement or execute a bilateral policy, program, order, or contract of any kind to participate, collaborate, or coordinate bilaterally in any way with China or

any Chinese-owned company.’’¹

However, the White House Office of Science and Technology Policy (OSTP) proceeded to hold meetings with PRC counterparts between May 6 and May 10, 2011 for the U.S. and China Strategic and Economic Dialogue (S&ED). In an October 11, 2011 letter to Congressman Wolf, the U.S. Government Accountability Office stated “ we conclude that OSTP’s use of appropriations to fund its participation in the Innovation Dialogue and the S&ED violated the prohibition” described by Congressman Wolf. The GAO also concluded that “OSTP’s involvement in the Innovation Dialogue and the S&ED resulted in obligations in excess of appropriated funds available to OSTP; as such, OSTP violated the Antideficiency Act, 31 U.S.C. § 1341(a)(1)(A).”²

Background On U.S.-PRC Space Cooperation Amid Increasing PRC Militarization of Space

This confrontation between the Congress, led by Congressman Wolf, and the Obama Administration is but the latest manifestation of controversy surrounding the question of whether the United States should pursue substantive cooperation with China in space. It is a controversy that has divided political parties and U.S. government agencies as factions in both the administrations of presidents George W. Bush and Barack Obama have sought to advance space cooperation with the PRC while the PRC has only increased the militarization of its manned and unmanned space program. Initial reports of Bush Administration interest in NASA and the State Department about cooperating with the PRC in space surfaced soon after the launch of the PRC’s *Shenzhou-2* space capsule in January 2001. This was encouraged by then China National Space Agency Director Luan Enjie during a November 2001 visit. However, in January 2001 former PRC leader Jiang Zemin signaled the People’s Liberation Army’s (PLA) lead over the PRC manned space program when he congratulated the Director of the PLA’s General Armament’s Department (GAD) on the *Shenzhou-2* flight. In October 2003 the PRC launched its first manned mission, *Shenzhou-5*. While lauded as a triumph for PRC science and technology, *Shenzhou-5*’s main payload were two high resolution surveillance cameras in its orbital module, which continued operations for another 152 days.



Shenzhou-5’s orbital module shows two large high-resolution cameras. This indicates that intelligence gathering was the primary mission for the PRC’s first manned space mission.

¹ WOLF STATEMENT AT U.S. - CHINA COMMISSION HEARING ON MILITARY AND CIVIL SPACE PROGRAMS IN CHINA, Says U.S. ‘Has No Business’ Helping China Develop Its Space Program, May 11, 2005, http://www.uscc.gov/hearings/2011hearings/written_testimonies/11_05_11_wrt/11_05_11_wolf_testimony.pdf

² Letter to The Honorable Frank R.Wolf, from Lynn H. Gibson, General Counsel, United States Government Accountability Office, October 11, 2011, B-321982.

In January 2004 President Bush announced his program to return the U.S. to the Moon by 2015 to 2020, which became NASA's Constellation Program. In December 2004 current Chinese Communist Party Secretary General and Chairman of the Central Military Commission of the People's Liberation Army Hu Jintao announced the "New Historic Missions" for the PLA, which included that it increasingly would defend the Communist Party's international interests. The following Five Year Plan starting in 2005 saw a higher emphasis on power projection weapons like aircraft carriers, amphibious assault ships, large transport aircraft and 5th generation fighters. There is also an increase in "dual use" PLA space programs like the space station, space planes and Moon programs.

Despite an increasing understanding of the military character of the PRC manned space program, by the end of 2005 reports emerged that outgoing NASA Administrator Sean O'Keefe was ready to begin official preliminary discussions regarding space. This period saw reports of consideration of initiatives like a common space docking adaptor to allow the *Shenzhou* spaceship to dock with the International Space Station. Then in September 2006 Michael Griffin made the first visit to the PRC by a NASA Administrator, during which he ruled out early manned space cooperation, but offered it was possible that unmanned space projects could be realized. Reflecting the optimism held by some during this period, at a July 11, 2006 forum, former Congressman (now Senator) Mark Kirk stated, "I think the manned space program has a potential all out of proportion to its size and cost for improving the diplomatic, political, and military atmosphere between the United States and China."³

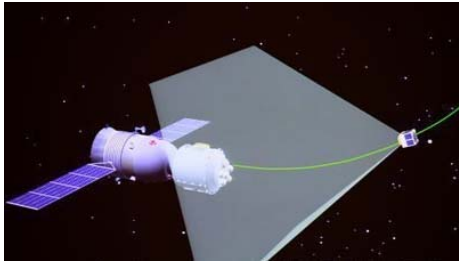
But unknown save to the U.S. intelligence community, since about 2005 the PLA had been testing its SC-19 ground-launched direct-ascent anti-satellite (ASAT) weapon, which successfully destroyed a PRC FY-1C weather satellite on January 11, 2007. This demonstration shocked the world and resulted in the largest cloud of space debris that will threaten the satellites and manned space ships of all countries for many years to come. It also served to confirm the longstanding concern of many analysts that the PLA was developing a range of military space and space combat capabilities. Though the Congress forced the Reagan Administration to stop development of an air-launched ASAT in the mid-1980s, the Bush Administration decided it needed to respond to the PRC with an ASAT demonstration, and quickly modified a U.S. Navy SM-3 anti-missile interceptor to shoot down the falling USA-193 surveillance satellite on February 11, 2008.

During 2008, Michael Griffin also raised the prospect that the PRC could become a space competitor to the U.S., noting in interviews the PRC manned space program could reach the Moon before the U.S. But Griffin would also offer cautious optimism about U.S.-PRC space cooperation, telling the BBC in July 2008, "I think we're always better off if we can find areas where we can collaborate rather than quarrel. I would remind your [audience] that the first US-Soviet human co-operation took place in 1975, virtually at the height of the Cold War...And it led, 18 years later, to discussions about an International Space Station (ISS) programme in which we're now involved."⁴ But then on September 27, 2008, while most in the U.S. were distracted

³ Quoted in Jeff Foust, "U.S. China space cooperation: the Congressional view," *The Space Review*, July 17, 2006, <http://www.thespacereview.com/article/661/1>

⁴ Paul Rincon, "China 'could reach Moon by 2020,'" *BBC Web Page*, July 15, 2008, <http://news.bbc.co.uk/2/hi/7506715.stm>

by the presidential election, during the second day of the PRC's *Shenzhou-8* space mission, this craft launched its BX-1 microsatellite hours before passing to a point 45km from the International Space Station.⁵ Despite what could have turned into dangers to the two Russians and one American onboard in the event of a malfunction, plus the appearance that the PLA was practicing a potential "co-orbital" combat interception of the ISS, no NASA or other U.S. official has to date offered a public reaction to this incident.



Shenzhou-7 approached to a point 45km from the ISS after having launched a 40kg microsatellite. A malfunction could have destroyed the ISS. No U.S. government official has offered a public reaction to this incident.

In 2009 the Obama Administration started by voicing a stronger interest in space cooperation with the PRC. In an April 2009 interview, White House Office of Science and Technology Policy Director Dr. John Holdren suggested that the PRC might provide transport to the ISS for U.S. astronauts following the planned retirement of the U.S. Space Shuttle. In response to a question whether the U.S. could have confidence in China's ability to launch U.S. astronauts, Holdren offered, "I think it's possible in principle to develop the required degree of confidence in the Chinese. I put it out there only as speculation, but I don't think it should be ruled out."⁶ Then in November 2009, in conjunction with the 60th anniversary of the PLA Air Force (PLAAF), its commander and other top officers began to describe a new "strategy" or doctrine for the PLAAF, which would in the future create an "integrated air and space force capable of offensive and defensive actions." PLAAF Commander General Xu Qiliang explained this shift in strategy:

"China's national interests are expanding and the country has entered the age of space. The Party and the people have given us a historic mission. After thorough consideration, we decided to change...The air force will extend its reach from the sky to space, from defense of Chinese territory to attack [of threats] as well. We will improve the overall capability to strike a long-distance target with high precision, fight electronic or internet warfare with back-up from space... and deliver our military strategic assets...China will become a world power by the mid-21st century and its air force must be able to counter many forms of security threats."⁷

⁵ Confirmation of the Shenzhou-8's near pass by the ISS was provided by the US Strategic Command (USSTRATCOM) via the NASA public affairs office in an email to this analyst on October 7, 2008. This incident is further explored in this analyst's article, "Closer Look: Shenzhou-7's Close Pass by the International Space Station," *International Assessment and Strategy Center Web Page*, October 9, 2008, http://www.strategycenter.net/research/pubID.191/pub_detail.asp

⁶ Jeffrey Mervis, "In Full Interview, John Holdren Eschews New Nukes, Hints At Spaceflight Delays," *ScienceInsider*, April 8, 2009, <http://news.sciencemag.org/scienceinsider/2009/04/in-full-intervi.html>

⁷ Comments as reported by Stephen Chen and Greg Torode: "China 'To Put Weapons in Space'," *South China Morning Post*, November 3, 2009.

These statements stood in stark contrast to longstanding PRC campaigning against the militarization of outer space. One PRC commentator made clear that the PRC intended to militarily deter “hegemonism,” in outer space, meaning the United States, noting, “The Chinese Air Force decided to make the historical change by adopting the strategy of ‘integration of air and space, possessing both offense and defensive capabilities’ precisely for the purpose of restricting the militarization of air and space and realizing an aerospace military balance.”

While the PLA was making clear its intention to militarily challenge the United States in space the Obama Administration took early steps to begin a dialogue that would lead to greater cooperation with the PRC in space. In the November 17, 2009 Joint Statement that was issued during President Obama’s November 15-18 visit to the PRC, it was stated:

“The United States and China look forward to expanding discussions on space science cooperation and starting a dialogue on human space flight and space exploration, based on the principles of transparency, reciprocity and mutual benefit. Both sides welcome reciprocal visits of the NASA Administrator and the appropriate Chinese counterpart in 2010.”

Then on January 11, 2010 the PLA conducted a successful missile warhead interception, though this was originally reported to be an ASAT exercise. This test could be viewed as part of the PRC’s strong reaction to the announcement of new U.S. arms sales to Taiwan in December 2009, which also included veiled threats to U.S. The PLA test also served to illustrate the relationship between the technologies needed to produce an ASAT capability and those needed to produce a ballistic missile defense (BMD) capability. Asian military sources have told this analyst that by the mid-2020s the PLA could have a national BMD capability to compliment a larger force of nuclear missiles. PRC belligerence continued as it loudly opposed planned U.S. exercises in the Yellow Sea which were a response to North Korea’s March 26, 2010 sinking of a South Korean corvette with the loss of 46 crew members.

By early February 2010, the Obama Administration was signaling its decision to end the Constellation Moon program of the Bush Administration, saving parts and instead focusing on a new large heavy SLV. By March 2010 PRC media sources revealed that the PRC was also developing a new 130 ton capable heavy space launch vehicle (SLV), providing a clear signal that several years of hinting at its own manned Moon program was moving closer to reality. Informal PRC sources suggest the PRC may intend to conduct its first manned Moon mission by 2024 and may develop a Moon Base by 2049. The PRC has also over the previous several years had gradually revealed its plans to loft a 60-100 ton space station by 2020, and to field a reusable SLV, possibly a space plane, by the same period.

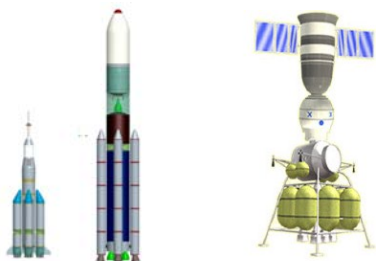


图 8 CZ-5A 和重型火箭 图 4 载人登月飞船

These illustrations from a recent PRC journal article show one concept under consideration for a Moon mission architecture. It is very similar to the cancelled U.S. Constellation program.

Near the end of this difficult year in U.S.-PRC relations and for the U.S. space program, from October 16 to 21, 2010, NASA Administrator Charles F. Bolden visited the PRC advance discussions with PRC space officials following on the U.S.-PRC decision to advance discussion in December 2009. Prior to his departure there was an exchange of letters between Administrator Bolden and Congressman Frank Wolf. In an October 5, 2010 letter to Bolden, Congressman Wolf warned, "It should go without saying that NASA has no business cooperating with the Chinese regime on human spaceflight. China is taking an increasingly aggressive posture globally, and their interests rarely intersect with ours."⁸ In an October 8, 2010 letter Bolden sought to assure Wolf, "my visit is intended to introductory in nature and will not include consideration of any specific proposals for humans pace flight cooperation or new cooperation in any other areas of NASA's activities. NASA is also planning to host a reciprocal introductory visit by Chinese Government officials to NASA facilities...let me assure you that under no circumstances will the visits include the conveyance of any non-public technical, operational, strategic or classified information."⁹

The year 2011 has seen the retirement of the Space Shuttle after 30 years in service, and a continuation of a standoff between Congress and the Obama Administration. Legislative language submitted by Congressman Wolf forbids the Administration from continuing discussions or undertaking joint programs concerning space cooperation with the PRC. Nevertheless the Administration continues to justify such cooperation, with OSTP Director John Holdren, during May 4, 2011 hearings before the House Appropriations Committee, stating that President Obama favors discussions with the PRC concerning potentially expensive missions to Mars and regarding cooperation over detection and tracking orbital debris. Chinese space officials have so far not returned Administrator Bolden's 2010 visit as intended. Meanwhile on September 29, 2011 the PRC launched its first *Tiangong* space laboratory, to practice space docking and conduct manned missions to develop a larger space station. The *Tiangong-1* is equipped with two cylinders that could house high-resolution camera or launch nano-satellites. PRC sources say *Tiangong-2*, to be launched by 2015, will stress Earth and space observation missions. In early 2011, informal PRC sources suggested that in 2009 or 2010 the PLA tested a small suborbital space plane called *Shenlong*, to validate technologies for future larger reusable SLVs. The *Shenlong* may be similar in size to the U.S. Air Force's Boeing X-37B small space plane, both of which could be configured to perform military missions.



Launched on September 29, 2011, Tiangong-1 continues the PLA's "dual-use" of manned platforms. While intended to develop a later space station, Tiangong-1 also has two cylinders amidship that could carry high resolution cameras or launch nano-satellites.

⁸ Quoted in Amy Klamper, "U.S. Lawmaker Balks At NASA Chief's China Visit," *Space News*, October 6, 2010, <http://www.spacenews.com/civil/101006-lawmaker-balks-nasa-china-visit.html>

⁹ Letter reprinted at "NASA's Bolden To Visit China's Space Leadership," *Spacecoalition.com*, October 13, 2010, <http://spacecoalition.com/blog/nasa%E2%80%99s-bolden-to-visit-china-space-leadership>

What Is To Be Gained From Space Cooperation With The PRC?

In their December 17, 2009 Joint Statement the U.S. and PRC governments proposed to pursue space cooperation under “the principles of transparency, reciprocity and mutual benefit.” It is not clear that PRC and U.S. officials share the same definitions of these words, but it is worth considering what they would mean for the United States, and whether the PRC is capable of fulfilling U.S. expectations sufficiently to justify confidence in cooperation. It is suggested that the Administration consider the following questions, and offer its explanations, as a way of addressing congressional, U.S. public and international concerns about the PRC space program.

1. Does the vast difference in PRC and U.S. space “transparency” mean that any level of contact between official, corporate and university sectors could pose a disproportionate threat to the United States?

Even though the most recent PRC space program is about 25 years old, compared to the U.S. space program the PRC space program is barely transparent. One does not have access to PRC space plans, official testimony, or annual or Five Year Plan budget documentation. Furthermore, it was not until 2001, or about 15 years into this program that the PRC leadership acknowledged that leadership of its manned space program rested with the PLA, specifically, the Director of the General Armaments Department (GAD) of the Central Military Commission (CMC). While there is a China National Space Agency (CNSA) subordinate to the PRC State Council, it is understood that CNSA remains subordinate to the GAD. It is not fully known how PLA leadership is implemented or what that means broadly for the PRC space program. Furthermore, neither the PLA nor the PRC government provide any details concerning how the PLA leads the PRC space program. Instead of inviting PRC space officials from CNSA to visit the United States, does it make more sense for NASA to invite the Director of the General Armaments Department to discuss space cooperation?



General Chen Bingde is currently Director of the General Staff Department of the CMC, or the PLA’s chief “warfighter.” From 2004 to 2007, he was Director of the General Armaments Department and overall commander of the manned space program. He also oversaw the January 11, 2007 ASAT demonstration. This makes him an experienced “space war fighter.”

Without a full understanding of the degree of, and methods for, PLA control over the PRC space program, how is the U.S. to pursue interaction in manner that protects U.S. technology, classified information or even U.S. security? Why should the U.S. have any contact with a PLA controlled enterprise intended to produce military advantages in space that can threaten U.S. security? Given what is known about how the GAD controls PRC space companies and research institutes, and even has influence over the research of PRC technical universities, it has to be considered that any PRC space government official, space company official or university expert is ultimately responsible to the PLA. This consideration should also be applied to PRC students

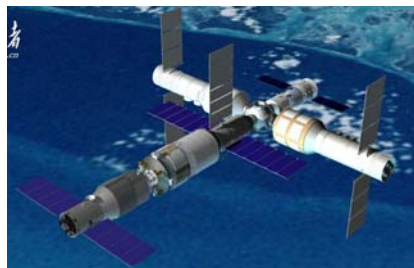
that come to the U.S. to pursue technical degrees in aerospace fields; will this education, and access to top U.S. experts, ultimately benefit the PLA's aerospace ambitions?

This stands in substantial contrast to the U.S. tradition of civilian leadership over most space and space exploration programs. Indeed there is a large U.S. military space program subordinate to the Department of Defense (DoD) and individual U.S. military services. There is also clear overlap; NASA space launch facilities are used to launch most DoD satellites, but as far as is publicly known, NASA is not designed, equipped or trained to perform military space or space combat missions. The first PRC astronaut on *Shenzhou-5*, arguably, was a secondary payload after the PLA's two large surveillance cameras. As far as is known publically the United States has not produced "dual use" space craft intended to perform space combat missions.

The challenge of promoting greater PRC transparency is just as difficult in the military and nuclear-strategic spheres. The PRC and the PLA have refused to substantively engage both the Bush and Obama Administrations regarding their current and future nuclear postures. It is likely that the U.S. does not know how many nuclear missiles the PLA has today, much less know of its future nuclear buildup plans. And while the U.S. has spent over 20 years trying to "engage" the PLA, the PLA has not revealed substantive official information concerning its goals, strategies or modernization plans as can be obtained in the case of the U.S. or Japan. Much can be discerned from PLA academic and engineering literature, interviews and contacts. But the PLA does not make reliable military data available to its own public or to a foreign audience in a manner that would promote confidence.

2. Does the clear "dual use" nature of the PRC/PLA manned space program mean that potential U.S.-PRC space cooperation will never produce the same "mutual benefit" for the United States?

One of the clear results of PLA domination is that the PRC manned space program is "dual use," or designed to produce specific benefits for the PLA. As the following chart indicates, all seven *Shenzhou* missions performed some missions useful to the PLA, mainly Earth surveillance from the detachable orbital module. *Shenzhou-7* could have demonstrated the potential to perform "co-orbital" combat interceptions by its 45km "close pass" by the International Space Station, just after having launched a microsatellite. The first *Tiangong* space lab has housing for high resolution cameras or nano-sat launchers. PRC sources note that the second *Tiangong* mission will focus on Earth and space observation missions. The future PRC space station will resemble the Soviet/Russian Mir, in that it will use large maneuverable modules to create a larger station. The Soviet intention for the Mir was to be able to accommodate dedicated military modules. It is reasonable to expect that the PLA will have similar designs for its space station.



This PRC illustration of a future space station shows its "modular" concept similar to the Soviet Mir space station concept. There is the potential for special military modules, or military-modified Tiangong cargo ships to be able to turn the space station into a combat platform.

A PRC history of their space plane program notes that while under consideration in the mid-to-late 1980s, military missions were a key priority for PRC space plane development.¹⁰ A 2006 space plane concept by the China Academy of Launch Vehicle Technology (CALT) has a substantial portion of the space's volume taken up by fuel. This is needed to reach orbit, but can also be used for maneuvers that would allow the space plane to reach different orbits, meaning it could be used to attack multiple targets.



A 2006 space plane concept from CALT (left), and a 2007 image of the Shenlong space plane technology validation platform, seen carried by an H-6 bomber for glide testing. It is likely that the PLA will use both as military mission platforms.

PRC sources also note that that the *Chang'e-3* Moon lander, scheduled for launch in 2013, may be equipped with a small radar and a laser rangefinder for “scientific” missions. Might later *Chang'e* missions, or later manned Moon missions, carry larger radar and laser equipment?

From the Moon such systems could provide an additional capability to target deep space U.S. satellites, like the Defense Support Program (DSP) satellites that provide vital warning of nuclear missile attack. PRC officials leading their Moon program, like Ouyang Ziyuan, often mention the Moon's military strategic value. Might the PRC someday seek to claim defend resources or strategic positions on the Moon?

Clearly, it can be argued that U.S.-PRC space cooperation will result in vastly disproportionate benefits. The PRC will be able to apply any benefits gained from cooperation with the U.S., such as insights into space stations or space planes, to similar PRC systems that perform military missions. Inasmuch as the U.S. does not have a “dual use” policy for its manned space platforms, any access the U.S. gains to PRC space programs cannot be used to achieve the same military benefits that would flow to the PRC.

3. Does the PRC's aggressive and pervasive espionage also dictate that the benefits of U.S.-PRC space cooperation will never be “mutual?”

From the beginning of the previous phase of U.S.-PRC space cooperation, the PRC sought to gain as much illicit benefit as it could via pressures and espionage. Following early 1990s failures of its Long March space launch vehicle (SLV) involving satellites from the Hughes

¹⁰ The most comprehensive Chinese history of the 863-204 program is by Li Chengzi and Zheng Xiaoqi (Beijing University of Aeronautics and Astronautics), “The Debate Over Placing Priority on the Space Shuttle or Manned Spacecraft During Consideration of China's Manned Space Program,” *Science and Technology Review*, Submitted August 2009.

Shenzhou and Tiangong: Scientific and Military Mission Highlights					
Mission	Launch Date	Crew Module Duration	Scientific Mission Highlights	Orbital Module In-Space Duration	Military Mission Highlights
Shenzhou 1	11/19 /99	.88 day	First mission to test craft flight and recovery of command module; carried seeds	6 days	ELINT module external to OM
Shenzhou 2	1/9/01	6.7 days	64 scientific payloads including monkey, rabbit; reported hard landing	6 months	ELINT or E/O module external to OM
Shenzhou 3	2/25/02	6.7 days	First near full man-rated version; use of sweating manikin to test space suit	260 days	Medium resolution imaging radar external to OM; E/O camera inside OM
Shenzhou 4	12/29/02	6.7 days	52 science payloads; orbital track simulated rendezvous with second spacecraft	6 months	E/O Earth observation cameras; monitored US buildup to Iraq War
Shenzhou 5	10/15/03	.89 day	First manned mission, one crew member	152 days operations	Two larger E/O Earth observation cameras internal and external to OM
Shenzhou 6	10/12/05	4.8 days	Two member crew; first manned use of orbital module; lengthy OM mission supported future docking missions	@ 2 years; boosted to higher orbit	Apparent one E/O camera internal to OM
Shenzhou 7	9/25/08	2.8 days	Three member crew; depressurization of OM; first use of PRC-made manned EVA suit; launch of microsat; external video of EVA mission; coms with TianLian-1 TDRSS	100 days ? which was the life of BX-1 mission	9/27: Launched BX-1 microsat just before passing to 45km of the ISS; could be viewed as co-orbital interception exercise
Tiangong 1	9/29/11	2 years	Validate habitation technologies for larger space station; validate space docking technology; undertake multiple manned missions; 1-2 more Tiangong missions may be planned before space station lofting about 2020	Not yet known how long Shen-8 OM will remain	Tiangong has two spaces that could house cameras or nano-sat launchers; Shenzhou OM could also carry surveillance systems; Tiangong could also be configured for space combat missions
Tiangong 2	2015 (?)	1-2 years	Earth observation and space observation reported to be main missions. May also launch micro satellites. Will likely further advance space docking and habitation technology.	NA	Earth and space observation and microsats could also serve military missions
Abbreviations: E/O: electro-optical; ELINT: electronic intelligence; EVA: extra-vehicular activity; NA: not available; OM: orbital module; TDRSS: tracking and data relay satellite system Sources: Mark Wade, <i>Encyclopedia Astronautica</i> ; Chinese press reports.					

Electronics Corporation and Loral Space and Communications Corporation, the PRC sought successfully to gain information from these companies to improve their SLVs, resulting in the

U.S. imposing fines on both companies. It is likely that this information was also used to improve their closely related DF-5 intercontinental ballistic missiles (ICBMs). The DF-5 ICBMs of the Second Artillery Corp of the People’s Liberation Army that likely were aided by this technology remain today targeted on the United States. The PRC also obtained information from the former Martin Marietta Corporation about how to perfect solid rocket motors, as a consequence of Martin Marietta’s provision of a solid fuel satellite “kick motor” for a U.S. satellite launched from a Long March SLV. A former PRC solid rocket engineer explained to this analyst that this data helped perfect the DF-21 medium range ballistic missile (MRBM). This missile has since been developed into the SC-19 ASAT, and the new DF-21D anti-ship ballistic missile (ASBM). This analyst has also learned that the DF-21C MRBM that likely resembles the dismantled U.S. *Pershing-2* MRBM is no accident; the PRC was able to purchase discarded *Pershing-2* information from U.S. military bases during the 1990s.

Russia has also been a likely victim of its willingness to enter into space cooperation with the PRC. In 2009, this analyst was told of a Russian-PRC space cooperation initiative from the 1998-1999 timeframe in which the PRC paid to place a hundred or more engineers as “students” at Russia’s “Star City” Cosmonaut training facility, and at major Russian space companies. According to Russian space company officials, these “students,” were able to learn enough about Russian space station technology to advance their own space station design, which owes a great deal to the Russian *Mir* design. These Russian officials were clear that the PRC did not purchase Russian space station designs.

NASA has also been a victim of a PRC “student.” In 1989, Professor Zhang Litong of Northwestern Polytechnical University (NPU) gained a prestigious Visiting Fellow position connected to the Lewis (now John Glenn) Research Center in Cleveland Ohio, to study Ceramic Matrix Composite (CMC) materials. According to her biographies, in 1987 the PRC government switched her career path from trying to copy the metallurgy of the British Rolls Royce *Spey* turbofan engine, to starting the PRC’s research on CMCs for use as thermal protection for future spacecraft. These biographies note that despite the 1989 Tiananmen embargoes, she was able to remain in her position until early 1991, when she returned with her “foreign research” and began to develop the PRC’s early ability to develop CMCs. In a January 8, 2011 PRC TV news program, Professor Zhang and her NPU laboratory were featured in a story about NPU’s contribution to the *Shenlong* space plane, which could be developed into a military platform. Zhang is now a much lauded “hero” of science in service to the leadership of the Chinese Communist Party.



On January 8, 2011 a Shanxi City TV program featured Professor Zhang Litong of Northwestern Polytechnical University and her laboratory’s contributions to the *Shenlong* space plane program. Zhang received early insights on Ceramic Matrix Composites from NASA from 1989 to 1991.

These known examples of PRC espionage and exploitation of commercial and academic relationships provide ample basis for caution about entering into future space related cooperative ventures with the PRC. Moreover, today's PRC's espionage effort is far more aggressive and pervasive. In addition to exploiting all contacts, from officials to business to students, the PRC is broadly understood to be the most aggressive country in terms of waging cyber warfare for espionage and for battle space preparation. A simple email address becomes a weapon when its owner falls for a phishing attack that opens his company to further exploitation. Were NASA to allow PRC engineers access to U.S. space station technology, or control and training facilities, as part of a program for joint use of the International Space Station, it can be expected that these engineers will be ordered to carry specific espionage assignments, which in the era of cyber warfare could inflict great damage.

4. Does the proposition that U.S.-PRC cooperation in space can improve their relations on Earth really stand up to historical examination?

Supporters of expanded U.S.-PRC cooperation in outer space often point to its potential to create a basis for improving overall U.S.-PRC relations. Many of these same proponents also often cite the example of the 1975 U.S.-Soviet Apollo-Soyuz mission as having improved U.S.-Soviet relations during the early phase of their "Détente." However, this historical example does not validate the initial proposition. After 1975, there was an increase in U.S. and Soviet military competition in space, as there was increasing strategic military competition on Earth. Soviet "Almaz" military space lab missions were followed by the development of space planes and space stations designed for space combat missions. Since the collapse of the Soviet Communist regime, Russian sources have revealed that had the Soviet Union survived another decade, by the mid-1990s there would have been Soviet space bombers derived from the Buran space plane, stationed on the Mir space station. The real lesson then, is that U.S.-Russian space cooperation in the 1990s and until today was facilitated less by any early instance of cooperation in the 1970s, than by the far more crucial change in its political system that removed Russia's reason for confronting the United States.

It is highly questionable whether the United States and the PRC can find a basis for cooperation in space that would then cause a fundamentally positive change to their relations here on Earth. As with the former Soviet Union, any real change in PRC relations with the U.S. will depend far more on a transformation away from the current Communist Party dictatorship and its military guarantors toward an open, accountable democratic system. The PRC Party-Military amalgam depends on domestic repression and recurrent reference to so-called external threats to remain in power. In fact, we see each of these escalating dangerously of late, leading to notable expressions of concern from its neighbors, this Congress and indeed this Administration. In such a context there is little NASA can do to effect positive change -- whilst conversely, it could do a great deal of harm to U.S. interests if it were to continue to enable the PRC to extract one-sided advantage from U.S. science and space technologies.

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