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# AEROSPACE

A M E R I C A



## **ORION** The Human Factor

Battling solar flares, galactic radiation, searing temps

Page 26

Webb telescope on the rebound/32

Proving SLS can take the heat/16

China-U.S. space relations/38

BRINGING

# CHINA

INTO THE  
SPACE FOLD

**THE AGENDA  
BEHIND U.S.–CHINA  
SPACE RELATIONS**



**ANALYSIS**  
by Marco Cáceres

Over the past four years, NASA has been looking for ways to cooperate with China in space. When NASA Administrator Charles Bolden testified before the U.S. House Foreign Affairs subcommittee on oversight and investigation, in November 2011, he said. “Some level of engagement with China in space-related areas in the future can form the basis for dialogue and cooperation in a manner that is consistent with the national interests of both our countries, when based on the principles of transparency, reciprocity, and mutual benefit.”

Bolden delivered his remarks only three days after the China National Space Administration launched its Shenzhou 8 un-

manned capsule to low earth orbit and docked it with the Tiangong 1 module, launched weeks earlier. The docking was an historic mission for the Chinese space program, because it marked the first major step toward realizing China’s vision of constructing its own orbiting space station.

Bolden had led a U.S. delegation to China in 2010, to “explore areas of mutual interest,” but it wasn’t until after Shenzhou 8 that one sensed a shift taking place — one in which the U.S. was starting to regard China as a legitimate competitor in space. Shenzhou 8 was a wake-up call not too dissimilar from the launch of the Sputnik 1 satellite by the Soviet Union in 1957. It con-



A Long March 2F rocket carrying China's Shenzhou 8 was rolled out in 2011 at the Jiuquan Satellite Center.

China might not be an enemy of the U.S., but it's definitely a competitor. Faced with an increasingly active Chinese space program, the U.S. has adopted a "keep your competitor close" strategy. Teal Group analyst **Marco Cáceres** examines China's space breakthroughs of recent years, and the U.S. reactions to them.

firmed that the Chinese were serious about building a space station and maintaining a permanent presence in space.

It was followed by more China successes. A crew of three docked to the Tiangong 1 module in June 2012, marking the first manned docking by China. The mission commander later entered the Tiangong 1. That mission was followed by the Shenzhou 10 manned docking in June 2013. Six months later, China launched its robotic Chang'e 3 lunar lander/rover, and it landed on the moon on Dec. 14.

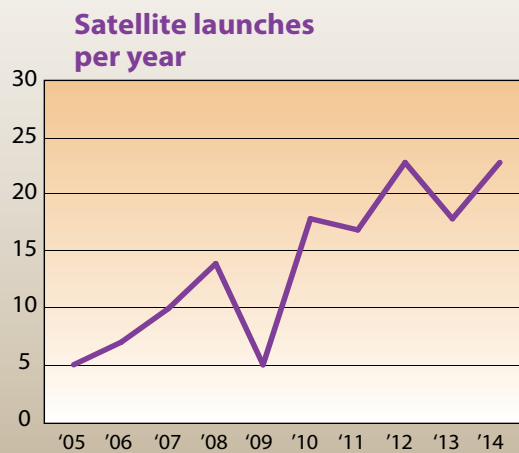
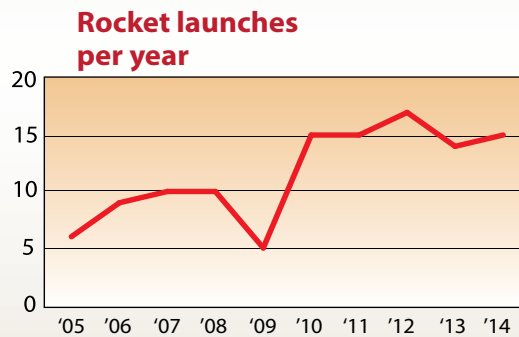
It wasn't only the Shenzhou and the Chang'e 3 missions that stimulated U.S. interest to China's space program. It was also

the marked increase in the number of launches by Chinese Long March rockets. China averaged 4.4 Long March missions annually during 1995-1999, 4.8 in 2000-2004 and eight per year in 2005-2009. The Long March launch rate rose sharply in 2010 to 15 launches, followed by 15 in 2011 and 17 in 2012.

Not only was China accelerating its Long March program, it was launching more diverse and more powerful versions of the rocket. During 2005-2009, Long March models launched included the 2C, 2D, 2F, 3A, 3B, 3C, 4B and 4C — eight different models. Of those, the 3C and 4C models were new.

## Busier launchpads

Any doubts about China's ability to maintain a viable space program are receding, as its launch pace grows. A look at the increase:



Source: Marco Cáceres

During 2010-2014, models launched included the eight listed above plus two others — 10 in all. The Long March 3B/E launched was a new model, while one called the Kuaizhou was an entirely new rocket.

### Taking notice

The surge in Chinese launches certainly caught the Obama administration's attention and may have been the key incentive for the U.S. government to begin earnestly finding ways to develop a close working relationship with China in space. In January 2014, NASA officials met with representatives from the China National Space Agency and the China Manned Space Agency at a conference in Washington, D.C., sponsored by the U.S. State Department and the International Academy of Astronautics.

Bolden met with his counterpart at the

CNSA, Xu Dazhe. Again, he publicly expressed the U.S.'s desire to cooperate with China. "We are looking for ways to find different ways we can be a partner to them," Bolden said.

What is not lost on the Obama administration is that the Chinese have been using their sizable rocket fleet to launch more military satellites. In looking at all the satellites launched by China during the 1995-2004 time frame, only several were dedicated military satellites. This began to change in 2005, and from 2005-2009, China launched 13 military satellites — an average of two to three annually. Those military-related launches — at least from a de facto standpoint — are "acknowledged" by China, in the sense that the government refers to the People's Liberation Army involvement in certain space programs such as the Tiangong 1 mission.

In 2010, China launched seven military satellites. Five were Yaogan Weixing surveillance satellites, the Tianhui-1A was a mapping satellite and the Chinasat 20A was for communications. As the Chinese numbers increased, the number of military satellites launched averaged about six per year during 2010-2013.

Last year, however, the number shot up dramatically to 13 — 10 Yaogan Weixings and three Shijian early-warning satellites. And 12 of the 13 satellites were launched aboard eight rockets during the August-December span. That is an extremely unusual surge of military launch activity for any country, and that activity was certain to spur concern within the Obama administration, particularly the Pentagon, about China's motives.

In November 2014, Bolden visited China and met again with Xu Dazhe. A NASA release issued after the meeting stated that the agency heads had "agreed to strengthen communications and exchanges." The NASA administrator also met with Wang Zhaoyao, director of the China Manned Space Engineering Office. While specifics of the talks have not been made public, Bolden said in interviews to media outlets including Aviation Week and Space News in December 2014 at Kennedy Space Center that it was a "listening opportunity" for him.

### A request on collisions

Perhaps the most interesting twist to the

quickly evolving relationship between the U.S. and China on space was the news that broke in December that China had formally requested that the U.S. Air Force Space Command provide space situational awareness reports, or close-approach notifications — also known as “conjunction warnings” — directly to the Chinese military instead of sharing them via the State Department.

The reports China receives include data about possible collisions between orbiting satellites and space debris. The newspaper Defense News quoted Air Force Gen. John Hyten, head of Air Force Space Command, as saying, “It takes a long time to get through that process, sometimes too long. It’s a big deal because [the Chinese] asked for that kind of information direct, and I think that’s a good thing.... Because that is the kind of international partnership we need to think about.”

Hyten’s comments implied that the simple act of China reaching out to the U.S. by making the request signaled a desire for

a cooperative relationship in exchanging space-related information. That is significant, and may have created a critical opening for establishing a broader space partnership between the two countries.

It also might have provided a needed offset to a closer relationship between China and Russia in the realm of space. Consider that during the past year, while NASA has suspended cooperation with the Russian space agency Rosaviakosmos because of Russia’s annexation of the Crimea and intervention in eastern Ukraine, the Chinese National Space Agency and Rosaviakosmos have been signing agreements to increase cooperation.

China’s growing technical capabilities in space, along with robust launch schedules and an expanding fleet of surveillance satellites, provide enough reason for the U.S. to be wary of the Chinese but also signal an effort to draw closer to them. Particularly when the emerging space partnership between the Chinese and the Russians demonstrates the need. ▲

## News From Intelligent Light

### Big Data, Big Challenge

The CREATE™-AV team undertook a simulation challenge last year: coupling the CFD solver, HPCMP CREATE-AV Kestrel, to the Navy flight simulator, CASTLE® for a fully coupled rotorcraft simulation in a ship’s airwake. The approach, hover and land had a simulation duration of 45 seconds. The time to save, transfer and read these visualization files and the massive space required to save them emerged as a significant roadblock to success.

### Sleek Solution: In-situ XDB Workflow via VisIt/libsim

The CREATE-AV team, aided by Intelligent Light, integrated VisIt’s in-situ post-processing library *libsim* into Kestrel. The resulting workflow created and saved FieldView XDBs (extract databases) as the simulation ran on the HPC resource. FieldView was then used for all visual flight checks and movie generation, without the burden of dealing with the volume grid and results. See AIAA 2015-0556 for details and acknowledgements.

**FieldView 15**  
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An image from work described in “Coupled Flight Simulator and CFD Calculations of Ship Airwake using HPCMP CREATE™-AV Kestrel”, James R. Forsythe et al, AIAA 2015-0556. Disclaimer: The US Government and Dept. of the Navy do not endorse products or services.