

# CHINESE SPACE EXPLORATION PROGRAM



COMMERCIAL SPACE TECHNOLOGIES LTD



**Date: 22 / 01 /16**

# **CHINESE SPACE EXPLORATION PROGRAM**

**A REPORT IN CONFIDENCE TO  
CST MEMBERS, ASSOCIATES  
AND CUSTOMERS**

**January 2016**



**Commercial Space Technologies Ltd  
67 Shakespeare Road, Hanwell, London W7 1LU  
Tel: 020 8840 1082 Fax: 020 8840 7776 E-mail: [cst@commercialspace.co.uk](mailto:cst@commercialspace.co.uk)**

## Document Change Log

Revision	Description	Date
A	Initial draft	1 <sup>st</sup> October 2015
B	Second draft	21 <sup>st</sup> January 2016
C	Master	22 <sup>nd</sup> January 2016

Written	VZ
Edited	RO
Checked	AW
Authorised	AW
Doc No.	2016-CST-TR-CSEP
Issue	C
Date	22 <sup>nd</sup> January 2016

# CONTENTS

<b>Introduction</b>	5
<b>Section 1. Brief History</b>	5
<b>1.1. Ancient</b>	5
<b>1.2. Recent</b>	6
<b>Section 2. Chinese Space Exploration Program goals</b>	12
<b>2.1. Goals</b>	12
<b>2.2. Budget</b>	12
<b>Section 3. Chinese Space Industry Structure</b>	15
<b>Section 4. Chinese launchers</b>	17
<b>4.1. Active</b>	17
<b>4.2. Under development</b>	21
<b>4.3. New engines development</b>	28
<b>Section 5. Satellites</b>	35
<b>5.1. Satellite platforms</b>	35
<b>5.2. Telecommunication</b>	47
<b>5.3. Remote sensing</b>	52
<b>5.4. Weather</b>	69
<b>5.5. Beidou satellite navigation</b>	71
<b>5.6. Shenlong space plane</b>	77
<b>Section 6. Manned program - Project 921</b>	80
<b>6.1. Space capsule</b>	80

6.2.	Space laboratory/station	99
<b>Section 7.</b>	<b>Chinese Lunar Exploration Program (CLEP)</b>	<b>106</b>
7.1.	Phase I	107
7.2.	Phase II	107
7.3.	Phase III	108
<b>Section 8.</b>	<b>Chinese Mars exploration program</b>	<b>108</b>
8.1.	Yinghuo-1	108
<b>Section 9.</b>	<b>Space supporting infrastructure</b>	<b>112</b>
9.1.	Chinese launch sites	112
9.2.	Tracking stations	116
<b>Section 10.</b>	<b>Summary</b>	<b>120</b>
<b>Referenced CST reports</b>		<b>121</b>
<b>Non-CST references</b>		<b>122</b>

## **INTRODUCTION**

The Chinese space exploration program is more than a demonstration of the national technical advancements, it is also a source of national pride uniting the society.

The fast progress in space exploration achieved during the last 15 years, has helped make China one of the world's leading players in the space field. Meanwhile due to the national cultural differences, and preconceived external perceptions, there is a lack of information regarding the country's true achievements in space. This report is designed to fill in the awareness gap. It is a concise reference to the major Chinese space exploration program features and achievements to date, as well as future plans, along with the authors' assessments regarding their feasibility.

## **REFERENCED CST REPORTS**

(indicated in square brackets in the text)

1. China's Launch Vehicle Fleet: Capabilities and Potentialities by Estimations of Russian Specialists, 2003.
2. A Further Continuation of the 'Long March' (The Current Development of the Chinese CZ-5 Launch Vehicle Family), 2014.

## NON-CST REFERENCES

(indicated in slant brackets in the text)

1. Brief History of Rockets, NASA, Data is correct to 30 September 2015. Internet: [https://www.grc.nasa.gov/www/k-12/TRC/Rockets/history\\_of\\_rockets.html](https://www.grc.nasa.gov/www/k-12/TRC/Rockets/history_of_rockets.html)
2. Biographies of Aerospace Officials and Policymakers, T-Z.National Aeronautics and Space Administration, NASA History Division, Data is correct to 30 September 2015. Internet: <http://history.nasa.gov/biost-z.html#Z>
3. Encyclopedia Astronautica Tsien, Data is correct to 30 September 2015. Internet: <http://www.astronautix.com/astros/tsien.htm>
4. 赵九章与中国卫星, Data is correct to 30 September 2015. Internet: <http://web.archive.org/web/20080314030932/http://www.cas.ac.cn/html/Dir/2007/10/16/15/33/09.htm>
5. 解密——640工程：中国超级反导大炮项目图, Data is correct to 30 September 2015. Internet: <http://ido.3mt.com.cn/Article/200609/show474021c30p1.html>
6. 焦点访谈]第一艘无人试验飞船发射成功—回首航天路（四），CCTV, Data is correct to 30 September 2015. Internet: <http://www.cctv.com/news/china/20051005/100369.shtml>
7. 《东方红卫星传奇》下（2003-65），CCTV, Data is correct to 30 September 2015. Internet: <http://www.cctv.com.cn/program/tsfx/20030729/100316.shtml>
8. China's Space Activities in 2006, Date：2006-10-12. Data is correct to 30 September 2015. Internet: <http://www.cnsa.gov.cn/n615709/n620681/n771967/79970.html>
9. China's Space Activities (White Paper), Date：2003-12-15. Data is correct to 30 September 2015. Internet: <http://www.cnsa.gov.cn/n615709/n620681/n771967/69198.html>
10. Frank E. Holmes, Guest Writer, China's Pyramid of Power, Data is correct to 30 September 2015. Internet: <http://moneymorning.com/2012/10/22/chinas-pyramid-of-power/>
11. Niall McCarthy, The World Trails NASA in Space Exploration Expenditure, October 14th, 2014, Data is correct to 30 September 2015. Internet: <http://www.statista.com/chart/2824/space-exploration-expenditure/>
12. Space Programs of India, China And Japan, Data is correct to 30 September 2015.



- Internet: <http://cyberleninka.ru/article/n/kosmicheskie-programmy-indii-kitaya-yaponii>
13. Table 1. Data is correct to 30 September 2015. Internet:  
<http://www.tssonline.ru/archive/p12/images/satcom-2012-28-31-fr-2-b.jpg>
  14. How much do the countries spend on space? (in Russian), Data is correct to 30 September 2015. Internet: <http://www.aif.ru/dontknows/1233582>
  15. Data is correct to 30 September 2015. Internet:  
<http://www.cnsa.gov.cn/n615709/n620681/n771918/index.html>
  16. Home > About CASC > Company Profile. Data is correct to 30 September 2015.  
Internet: <http://english.spacechina.com/n16421/n17138/n17229/c127066/content.html>
  17. Launch vehicle Index, Encyclopedia Astronautica, Data is correct to 30 September 2015.  
Internet: <http://www.astronautix.com/lvs/index.htm>
  18. CZ launchers, Encyclopedia Astronautica, Data is correct to 30 September 2015.  
Internet: <http://www.astronautix.com/fam/cz.htm>
  19. Chinese Launch Vehicles, Data is correct to 30 September 2015. Internet:  
[http://historicspacecraft.com/Rockets\\_Chinese.html](http://historicspacecraft.com/Rockets_Chinese.html)
  20. KT-1 (Kaituozhe-1), Data is correct to 30 September 2015. Internet:  
[http://space.skyrocket.de/doc\\_lau/kt-1.htm](http://space.skyrocket.de/doc_lau/kt-1.htm)
  21. Kaituozhe, KT-1 & KT-2, Data is correct to 30 September 2015. Internet:  
[http://www.b14643.de/Spacerockets\\_1/China/Kaituozhe/Description/Frame.htm](http://www.b14643.de/Spacerockets_1/China/Kaituozhe/Description/Frame.htm)
  22. Encyclopedia Astronautica, KT. Data is correct to 30 September 2015. Internet:  
<http://www.astronautix.com/lvs/kt.htm>
  23. Encyclopedia Astronautica, CZ-2F. Data is correct to 30 September 2015. Internet:  
<http://www.astronautix.com/lvs/cz2f.htm>
  24. Encyclopedia Astronautica, Chronological Index. Data is correct to 30 September 2015.  
Internet: <http://www.astronautix.com/chrono/index.htm>
  25. Итоги 2010 года, А. Железняков, Энциклопедия «Космонавтика». Data is correct to 30 September 2015. Internet:  
[http://www.cosmoworld.ru/spaceencyclopedia/hotnews/index.shtml?itogi\\_2010.html](http://www.cosmoworld.ru/spaceencyclopedia/hotnews/index.shtml?itogi_2010.html)
  26. Chang Zheng-7 (Long March-7). Data is correct to 30 September 2015. Internet:  
<http://sinodefence.com/rocketry/cz-7/>
  27. Leonard David, China Outlines New Rockets, Space Station and Moon Plans. Data is correct to 30 September 2015. Internet: <http://www.space.com/28809-china-rocket-family-moon-plans.html>
  28. Rui C. Barbosa, China conducts debut launch of Long March 6. Data is correct to 30

- September 2015. Internet: <http://www.nasaspaceflight.com/2015/09/china-debut-launch-long-march-6/>
29. Data is correct to 30 September 2015. Internet: <http://www.spaceflight101.com/long-march-6.html>
  30. Zhao Lei, Long March 6 launch to put new engine to the test, China Daily. Data is correct to 30 September 2015. Internet: [http://www.chinadaily.com.cn/china/2015-03/10/content\\_19762622.htm](http://www.chinadaily.com.cn/china/2015-03/10/content_19762622.htm)
  31. Chang Zheng-5 (Long March-5). Data is correct to 30 September 2015. Internet: <http://sinodefence.com/rocketry/changzheng-5/>
  32. Jeffrey Lin and P.W. Singer, China's Largest-Ever Space Rocket Takes Another Big Step Forward, Hainan Island is becoming China's Cape Canaveral. Data is correct to 30 September 2015. Internet: <http://www.popsci.com/chinas-long-march-space-rocket-5-takes-another-big-step-forward>
  33. Space Launch Report: CZ-5-7 Data Sheet. Data is correct to 30 September 2015. Internet: <http://www.spacelaunchreport.com/cz5.html>
  34. Long March 5 Will Have World's Second Largest Carrying Capacity. Data is correct to 30 September 2015. Internet: [http://www.spacedaily.com/reports/Long\\_March\\_5\\_Will\\_Have\\_World\\_Second\\_Largest\\_Carrying\\_Capacity\\_999.html](http://www.spacedaily.com/reports/Long_March_5_Will_Have_World_Second_Largest_Carrying_Capacity_999.html)
  35. Deadly Tianjin explosion seen from space: Aerial pictures show devastation in Chinese city as residents are evicted from two-mile radius of blast site. Data is correct to 30 September 2015. Internet: <http://www.dailymail.co.uk/news/article-3199058/China-orders-evacuation-residents-two-mile-radius-Tianjin-blast-site-police-confirm-area-contaminated-deadly-CYANIDE.html>
  36. КНР завершила наземные испытания силовой установки ракеты-носителя. Data is correct to 30 September 2015. Internet: <http://ria.ru/space/20150817/1191124395.html>
  37. Encyclopedia Astronautica, CZ-2E(A). Data is correct to 30 September 2015. Internet: <http://www.astronautix.com/lvs/cz2ea.htm>
  38. Craig Covault, First Look: China's Big New Rockets. Data is correct to 30 September 2015. Internet: <http://www.americaspace.com/?p=22881>
  39. China's first solid-fuel rocket to debut before 2016, Updated: 2013-03-02 12:59 Xinhua. Data is correct to 30 September 2015. Internet: [http://www.chinadaily.com.cn/china/2013-03/02/content\\_16269380.htm](http://www.chinadaily.com.cn/china/2013-03/02/content_16269380.htm)
  40. Long March-11. Data is correct to 30 September 2015. Internet:

- <http://www.whatsonxiamen.com/tag-Long+March-11.html>
41. Chang Zheng CZ-11. Data is correct to 30 September 2015. Internet:  
[http://www.b14643.de/Spacerockets\\_1/China/CZ-11/Description/Frame.htm](http://www.b14643.de/Spacerockets_1/China/CZ-11/Description/Frame.htm)
  42. China's carrier rocket Long March-11 succeeds in maiden mission. Data is correct to 30 September 2015. Internet: [http://news.xinhuanet.com/english/2015-09/25/c\\_134658859.htm](http://news.xinhuanet.com/english/2015-09/25/c_134658859.htm)
  43. China unveils new prototype of FT-1 solid rocket launch truck for small satellite or ICBM missile ? November 27, 2014 11:55 AM. Data is correct to 30 September 2015. Internet:  
[http://www.armyrecognition.com/airshow\\_china\\_2014\\_zhuhai\\_news\\_coverage\\_report\\_u\\_k/china\\_unveils\\_new\\_prototype\\_of\\_ft-1\\_solid\\_rocket\\_launch\\_truck\\_for\\_small\\_satellite\\_or\\_icbm\\_missile\\_.html](http://www.armyrecognition.com/airshow_china_2014_zhuhai_news_coverage_report_u_k/china_unveils_new_prototype_of_ft-1_solid_rocket_launch_truck_for_small_satellite_or_icbm_missile_.html)
  44. FT-1: A Small Solid Launch Vehicle, the launcher manual, Ver 1.0, LandSpace Ltd. Beijing, China, June 2015. Data is correct to 30 September 2015. Internet:  
[http://www.b14643.de/Spacerockets/Diverse/Asian\\_Rocket\\_engines/engines.htm](http://www.b14643.de/Spacerockets/Diverse/Asian_Rocket_engines/engines.htm)
  45. Nan, Zhang (2013-09-23). "The Development of LOX/LH2 Engine in China" (pdf). 64rd International Astronautical Congress, Beijing, China. (International Astronautical Federation). IAC-13-C4.1 (1x18525): 5. Data is correct to 30 September 2015. Internet:  
[IAC-13,C4,1,1,x18525.pdf](http://www.b14643.de/Spacerockets/Diverse/Asian_Rocket_engines/engines.htm)
  46. Wang, Weibin; Zheng, Dayong; Qiaot, Guiyu (2013-09-23). "Development Status of the Cryogenic Oxygen/Hydrogen YF-77 Engine for Long-March 5" (pdf). 64rd International Astronautical Congress, Beijing, China. IAC-13-C4.1 (2x17679): 7. Data is correct to 30 September 2015. Internet: [IAC-13,C4,1,2,x17679.pdf](http://www.b14643.de/Spacerockets/Diverse/Asian_Rocket_engines/engines.htm)
  47. YF-77火箭发动机. Data is correct to 30 September 2015. Internet:  
<http://baike.baidu.com/view/10657947.htm>
  48. Chinese YF-100 (Russian RD-120) to Power CZ-5, Data is correct to 30 September 2015. Internet: <http://spacepac.org/wp/china/chinese-yf-100-russian-rd-120-to-power-cz-5/>
  49. Chang Zheng-6 (Long March-6). Data is correct to 30 September 2015. Internet:  
<http://sinodefence.com/rocketry/cz-6/>
  50. CZ-6 launcher takes to the sky. Data is correct to 30 September 2015. Internet:  
<http://sinodefence.com/2015/09/20/cz6-takes-to-the-sky/>
  51. Zach Rosenberg, China completes longest hot-fire engine test for Long March 5 core stage. Data is correct to 30 September 2015. Internet:

- <https://www.flightglobal.com/news/articles/china-completes-longest-hot-fire-engine-test-for-long-march-5-core-374900/>
52. China Tests Powerful Rocket Engine for New Booster, SPACE.com, July 30, 2012 01:36pm ET. Data is correct to 30 September 2015. Internet: <http://www.space.com/16814-china-engine-test-long-march-5-rocket.html>
  53. "120吨级液氧煤油发动机项目验收" 120-ton liquid oxygen kerosene engine project acceptance (in Chinese). CASC. 2012-06-01. Data is correct to 30 September 2015. Internet: <http://baike.baidu.com/view/10271187.htm>
  54. "长征七号运载火箭 (The Long March 7 Launch Vehicle)" (in Chinese). Data is correct to 30 September 2015. Internet: <http://www.baike.com/wiki/%E9%95%BF%E5%BE%81%E4%B8%83%E5%8F%B7%E8%BF%90%E8%BD%BD%E7%81%AB%E7%AE%AD>
  55. "长征七号火箭发动机抽真空系统顺利通过试验 (Long March 7 rocket engine system passes vacuum test)" (in Chinese). CASC. Data is correct to 30 September 2015. Internet: <http://www.spacechina.com/n25/n144/n206/n214/c204909/content.html>
  56. Leonard David, Chinese Rocket Engine Test a Big Step for Space Station Project, Space.com. Data is correct to 30 September 2015. Internet: <http://www.space.com/21957-china-rocket-engine-test-space-station.html>
  57. Satellite Platforms, CAST. Data is correct to 30 September 2015. Internet: <http://www.cast.cn/CastEn/Class.asp?ClassID=85>
  58. DFH-4 BUS. Data is correct to 30 September 2015. Internet: <http://www.cgwic.com/In-OrbitDelivery/CommunicationsSatellite/DFH-4Bus.html>
  59. Bradley Perrett, China Developing Three Commercial Satellite Buses, Aviation Week & Space Technology, Nov 25, 2013. Data is correct to 30 September 2015. Internet: <http://aviationweek.com/awin/china-developing-three-commercial-satellite-buses>
  60. Chinese Satellite Communications Systems. Data is correct to 30 September 2015. Internet: <http://www.globalsecurity.org/space/world/china/comm.htm>
  61. DFH Communications Satellite, China Great Wall Industry Corp. Data is correct to 30 September 2015. Internet: <http://www.cgwic.com/In-OrbitDelivery/CommunicationsSatellite/DFHList.html>
  62. Gunter's Space Page, DFH-4 Bus. Data is correct to 30 September 2015. Internet: [http://space.skyrocket.de/doc\\_sat/ch\\_dfh-4.htm](http://space.skyrocket.de/doc_sat/ch_dfh-4.htm)
  63. History, China Great Wall Industry Corp. Data is correct to 30 September 2015. Internet:

- <http://www.cgwic.com/In-OrbitDelivery/index.html>
64. 返回式卫星 (China's First Returnable Satellite, from the website of the Central Government of P.R.China). Data is correct to 30 September 2015. Internet: [http://www.gov.cn/ztl/zghk50/content\\_420512.htm](http://www.gov.cn/ztl/zghk50/content_420512.htm)
  65. Ziyuan 3 Data is correct to 30 September 2015. Internet: <http://www.webcitation.org/64We7vwlH>
  66. Rui C. Barbosa, China opens 2012 with ZiYuan-3 launch via Long March 4B, January 8, 2012. Data is correct to 30 September 2015. Internet: <http://www.nasaspaceflight.com/2012/01/china-opens-2012-ziyuan-3-launch-long-march-4b/>
  67. 中国成功发射首颗高精度立体测绘卫星"资源三号" (in Chinese). ChinaNews.com. 9 January 2012. Data is correct to 30 September 2015. Internet: <http://www.chinanews.com/gn/2012/01-09/3590223.shtml>
  68. Krebs, Gunter. "ZY 3A, 3B". Gunter's Space Page. Data is correct to 30 September 2015. Internet: [http://space.skyrocket.de/doc\\_sdat/zy-3.htm](http://space.skyrocket.de/doc_sdat/zy-3.htm)
  69. Rui C. Barbosa, Chinese launch again with YaoGan Weixing-6 remote sensing satellite, April 22, 2009. Data is correct to 30 September 2015. Internet: <http://www.nasaspaceflight.com/2009/04/chinese-launch-again-with-yaogan-weixing-6-remote-sensing-satellite/>
  70. "YaoGan Weixing / Remote Sensing Satellites". Web article. SinoDefence.com. February 20, 2009. Data is correct to 30 September 2015. Internet: [http://sinodefence.com/?attachment\\_id=548](http://sinodefence.com/?attachment_id=548)
  71. "China launch YaoGan Weixing-9, announce increase in vehicle production". News article. NASA spaceflight.com. March 5, 2010. Data is correct to 30 September 2015. Internet: <http://www.nasaspaceflight.com/2010/03/china-yaogan-weixing-9-increase-in-vehicle-production/>
  72. "Yaogan 1 Erupts". Arms Control Wonk. February 11, 2010. Data is correct to 30 September 2015. Internet: <http://forden.armscontrolwonk.com/archive/2625/yaogan-1-erupts>
  73. Gunter's Space Page, Yaogan 2, 4, 7, 11, 24 (JB-6 1, 2, 3, 4, 5). Data is correct to 30 September 2015. Internet: [http://space.skyrocket.de/doc\\_sdat/yaogan-2.htm](http://space.skyrocket.de/doc_sdat/yaogan-2.htm)
  74. Chinese LM-4C launches three Yaogan-17 satellites. Data is correct to 30 September 2015. Internet: <http://www.china-defense-mashup.com/chinese-lm-4c-launches-three->

[yaogan-17-satellites.html](http://yaogan-17-satellites.html)

75. Stephen Clark, Chinese spy payload fired into orbit, August 27, 2015. Data is correct to 30 September 2015. Internet: <http://spaceflightnow.com/2015/08/27/chinese-spy-payload-fired-into-orbit/>
76. Gunter's Space Page, Yaogan 9, 16, 17, 20, 25 (JB-8 1, 2, 3, 4, 5). Data is correct to 30 September 2015. Internet: [http://space.skyrocket.de/doc\\_sdat/yaogan-9.htm](http://space.skyrocket.de/doc_sdat/yaogan-9.htm)
77. GF-1 (Gaofen-1) High-resolution Imaging Satellite / CHEOS series of China. Data is correct to 30 September 2015. Internet: <https://directory.eoportal.org/web/eoportal/satellite-missions/g/gaofen-1#23NaJ1138Herb>
78. Satellite Programme: Gao Fen. Data is correct to 30 September 2015. Internet: <http://www.wmo-sat.info/oscar/satelliteprogrammes/view/240>
79. "China launches Gaofen-1 satellite," Xinhua, April 26, 2013, Data is correct to 30 September 2015. Internet: [http://www.china.org.cn/china/2013-04/26/content\\_28668480.htm](http://www.china.org.cn/china/2013-04/26/content_28668480.htm)
80. H. Qi, "China High-resolution Earth Observation System (CHEOS) and its Latest Development," Proceedings of the 51st Session of Scientific & Technical Subcommittee of UNCOPUOS, Vienna, Austria, Feb. 11-22, 2014, Data is correct to 30 September 2015. Internet: <http://www.unoosa.org/pdf/pres/stsc2014/tech-47E.pdf>
81. Guang Zhou, "Construction and Development of China High-Resolution Earth Observation System," 42nd session of the Coordination Group for Meteorological Satellites (CGMS), Guangzhou, China, 19-23 May 2014, Data is correct to 30 September 2015. Internet: [http://www.eumetsat.int/website/wcm/idc/idcplg?IdcService=GET\\_FILE&](http://www.eumetsat.int/website/wcm/idc/idcplg?IdcService=GET_FILE&)
82. "China High-resolution Earth Observation System (CHEOS) and its Latest Development," The Earth Observation System and Data Centre , CNSA, 2014-2, Data is correct to 30 September 2015. Internet: <http://www.oosa.unvienna.org/pdf/pres/stsc2014/tech-47E.pdf>
83. Peter B. de Selding, "China Pushing Ahead on Hi-Res Satellite System," Space News, Feb. 28, 2014, Data is correct to 30 September 2015. Internet: <http://spacenews.com/article/civil-space/39665china-pushing-ahead-on-hi-res-satellite-system>
84. Rui C. Barbosa, Chinese Long March 4B conducts surprise Gaofen-8 launch. Data is

- correct to 30 September 2015. Internet: <http://www.nasaspacesflight.com/2015/06/china-longmarch4b-gaofen-8/>
85. Satellites, China Meteorological Administration. Data is correct to 30 September 2015. Internet: <http://www.cma.gov.cn/en2014/satellites/>
86. Jonathan O'Callaghan, China Wants To Build A Lunar Base On The Far Side Of The Moon, July 20, 2015. Data is correct to 30 September 2015. Internet: <http://www.iflscience.com/china-wants-land-moons-far-side-first-time-and-build-lunar-base>
87. BeiDou Navigation Satellite System Open Service Performance Standard. Data is correct to 30 September 2015. Internet: [http://www2.unb.ca/gge/Resources/beidou\\_open\\_service\\_performance\\_standard\\_ver1.0.pdf](http://www2.unb.ca/gge/Resources/beidou_open_service_performance_standard_ver1.0.pdf)
88. Spaceflight Now - Launch Log <http://www.spaceflightnow.com/tracking/launchlog.html>
89. 北斗卫星导航系统卫星状态  
<http://www.beidou.gov.cn/2014/09/27/2014092742e415d8d94b49a39b17e32fad6adae4.html>
90. Tiangong 1 Spacecraft Overview. Data is correct to 30 September 2015. Internet: <http://www.spaceflight101.com/tiangong-1-info.html>
91. 天宫一号将连接三艘神舟飞船 建空间实验平台. Data is correct to 30 September 2015. Internet: <http://news.sina.com.cn/c/2011-09-21/030023189106.shtml>
92. 何为空间实验室? Data is correct to 30 September 2015. Internet: [http://news.xinhuanet.com/mil/2011-09/21/c\\_122067644.htm](http://news.xinhuanet.com/mil/2011-09/21/c_122067644.htm)
93. 中国计划在2015年前后发射天宫二号. Data is correct to 30 September 2015. Internet: <http://news.guhantai.com/2013/0701/253060.shtml>
94. Chinese Satellite Communications Systems. Data is correct to 30 September 2015. Internet: <http://www.globalsecurity.org/space/world/china/comm.htm>
95. National Center for Space Weather, Position:Home>Satellite Operation>FY-3 Program>FY-3A. Data is correct to 30 September 2015. Internet: [http://www.nsmc.cma.gov.cn/NSMC\\_EN/Channels/100184.html](http://www.nsmc.cma.gov.cn/NSMC_EN/Channels/100184.html)
96. СМИ: Китай хочет посадить космический зонд на обратной стороне Луны, 08.09.2015. Data is correct to 30 September 2015. Internet: <http://ria.ru/technology/20150908/1238576910.html>

97. Lakdawalla, Emily (9 September 2010). "China's Yinghuo-1 Mars Orbiter". The Planetary Society. Data is correct to 30 September 2015. Internet: <http://www.planetary.org/blogs/emily-lakdawalla/2010/2655.html>
98. "Russia takes aim at Phobos". Nature.com. 4 November 2011. Data is correct to 30 September 2015. Internet: [http://www.nature.com/news/2011/111104/full/news.2011.630.html?s=news\\_rss](http://www.nature.com/news/2011/111104/full/news.2011.630.html?s=news_rss)
99. Запуск станции "Фобос-Грунт" к спутнику Марса отложен до 2011 года (in Russian). РИА Новости. 21 September 2009. Data is correct to 30 September 2015. Internet: <http://ria.ru/science/20090921/185905786.html>
100. "Phobos-Grunt: Failed Russian Mars Probe Falls to Earth". ABC News, 15 January 2012. Data is correct to 30 September 2015. Internet: <http://abcnews.go.com/Technology/phobos-grunt-failed-russian-mars-probe-falls-earth/story?id=15366151>
101. "Daring Russian sample return mission to Martian moon Phobos aims for November Liftoff". Universe Today, 2011-10-13. Data is correct to 30 September 2015. Internet: <http://www.universetoday.com/89845/daring-russian-sample-return-mission-to-martian-moon-phobos-aims-for-november-liftoff/>
102. "Back to Mars: Russian probe to visit red planet – Joint observation". Russia Today, 2011-09-23. Data is correct to 30 September 2015. Internet: <http://www.rt.com/news/fhobos-grund-mission-123/>
103. Маршевая двигательная установка станции "Фобос-Грунт" не сработала (in Russian). RIA Novosti. 9 November 2011. Data is correct to 30 September 2015. Internet: <http://ria.ru/science/20111109/484401134.html>
104. "Yinghuo Was Worth It". Space Daily, Morris Jones, 17 November 2011. Data is correct to 30 September 2015. Internet: [http://www.spacedaily.com/reports/Yinghuo\\_Was\\_Worth\\_It\\_999.html](http://www.spacedaily.com/reports/Yinghuo_Was_Worth_It_999.html)
105. Jonathan Amos, "Phobos-Grunt: Failed probe “falls over Pacific”". BBC News, 15 January 2012. Data is correct to 30 September 2015. Internet: <http://www.bbc.com/news/science-environment-16491457>
106. "China and Russia join hands to explore Mars". People's Daily Online. 30 May 2007. Data is correct to 30 September 2015. Internet: [http://en.people.cn/200705/30/eng20070530\\_379330.html](http://en.people.cn/200705/30/eng20070530_379330.html)
107. Zak, Anatoly (7 May 2011). "Phobos-Grunt mission". Russianspaceweb.com. Data is correct to 30 September 2015. Internet: [http://www.russianspaceweb.com/phobos\\_grunt.html](http://www.russianspaceweb.com/phobos_grunt.html)



108. Ken Kremer, "Phobos-Grunt and Yinghuo-1 arrive at Baikonur Launch Site". Universe Today, 19 October 2011. Data is correct to 30 September 2015. Internet: <http://www.universetoday.com/90012/phobos-grunt-and-yinghou-1-arrive-at-baikonur-launch-site-to-tight-mars-deadline/>
109. "Russia Running Out Of Time, As Mars Mission Seems Destined To Fail". NPR, 11 November 2011. Data is correct to 30 September 2015. Internet: <http://www.npr.org/sections/thetwo-way/2011/11/11/142241163/russia-running-out-of-time-as-mars-mission-seems-destined-to-fail>
110. "China to launch first Mars probe in 2009". Xinhua, 22 May 2007. Data is correct to 30 September 2015. Internet: [http://news.xinhuanet.com/english/2007-05/22/content\\_6132750.htm](http://news.xinhuanet.com/english/2007-05/22/content_6132750.htm)
111. Leonard David, China's New Spaceport to Launch Country's Largest Rocket Yet. Data is correct to 30 September 2015. Internet: <http://www.space.com/25323-china-new-spaceport-rocket-launches.html>
112. Rocket launch sites. Data is correct to 30 September 2015. Internet: <http://city.samondeo.com/images1/wenchang-china-2.jpg>
113. Shenlong space aircraft, Data is correct to 30 September 2015. Internet: <http://www.cobanengineering.com/images/mainpage/Unveiled-anUnmanned-Aerial-Vehicle-2.asp>
114. Jeffrey Lin and P.W. Singer, China Is Building One Of The World's Largest Space Launch Vehicles, Data is correct to 30 September 2015. Internet: <http://www.popsci.com/long-march-goes>
115. Leonard David, China's Mystery Space Plane Project Stirs Up Questions, Data is correct to 30 September 2015. Internet: <http://www.space.com/18410-china-space-plane-project-mystery.html>
116. "Shenlong 'Divine Dragon' Takes Flight: Is China developing its first spaceplane?" China Signpost. 2012-05-04. Data is correct to 30 September 2015. Internet: <http://www.chinasignpost.com/2012/05/04/shenlong-divine-dragon-takes-flight-is-china-developing-its-first-spaceplane/>
117. "International Assessment and Strategy Center > Research > PLA and U.S. Arms Racing in the Western Pacific". Strategycenter.net. 2011-06-29. Data is correct to 30 September 2015. Internet: [http://www.strategycenter.net/research/pubID.247/pub\\_detail.asp](http://www.strategycenter.net/research/pubID.247/pub_detail.asp)



Credits: CGWIC

