

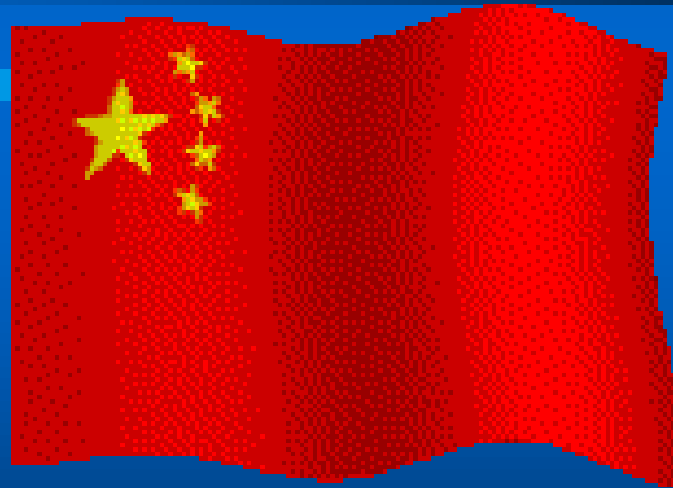
China in Space

from Wan Hu to Tianwen-1



by

Ben J. Huset
May 1st, 2021



China ? in Space ?



Serenity
(Níng jìng) 宁静
(2002)



<https://www.imdb.com/title/tt0303461/>

China in Space

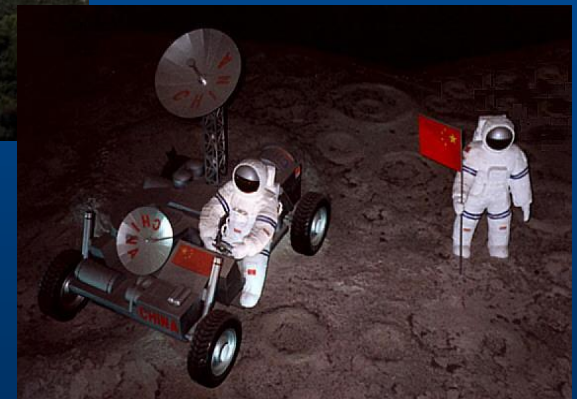
Past



Present



Future

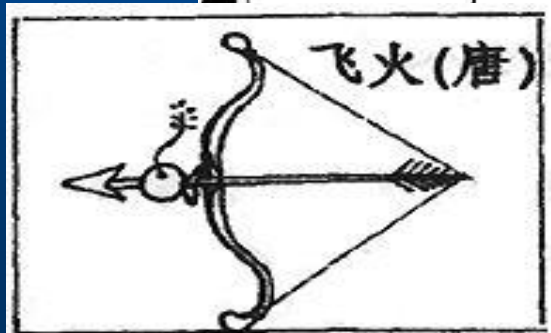
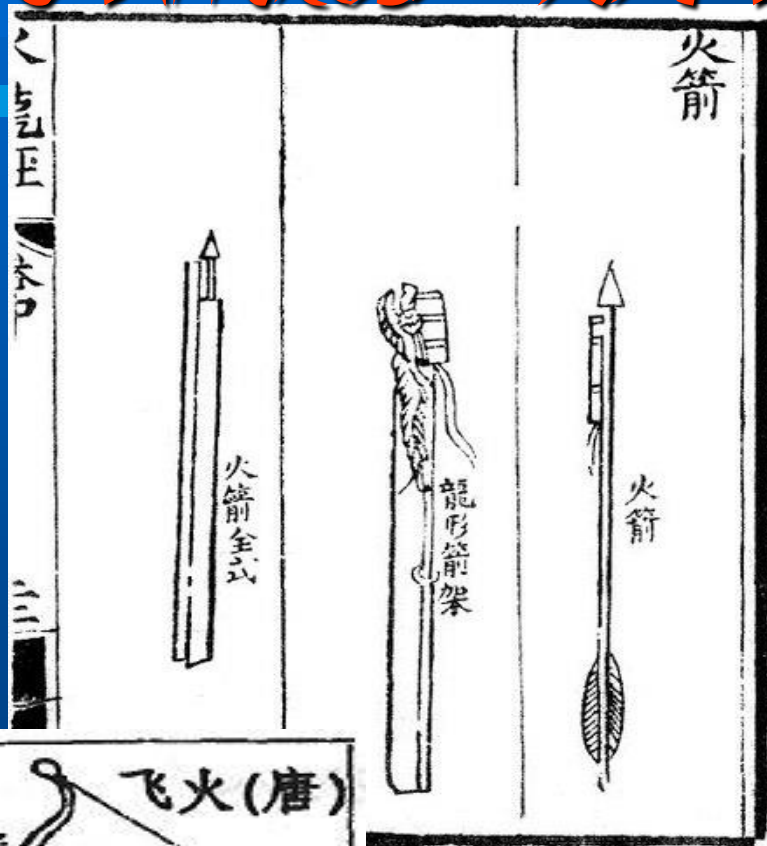


Past



Fire Arrows 904 AD

火箭



1232 AD

Siege of Kaifeng (Bianjing) Jurchen Jin battle the Mongols (Ögedei)

- Explosives, propelled by trebuchets
- Fire Lances



https://en.wikipedia.org/wiki/Mongol_siege_of_Kaifeng

Star Trek 'Arena' Ep 1x19 Jan '67

Stardate 3046.2

- Sulfur
- Coal
- Potassium nitrate
- Diamonds
- Bamboo tube



1500 AD

Wan Hu

Artist

Politician

Explorer

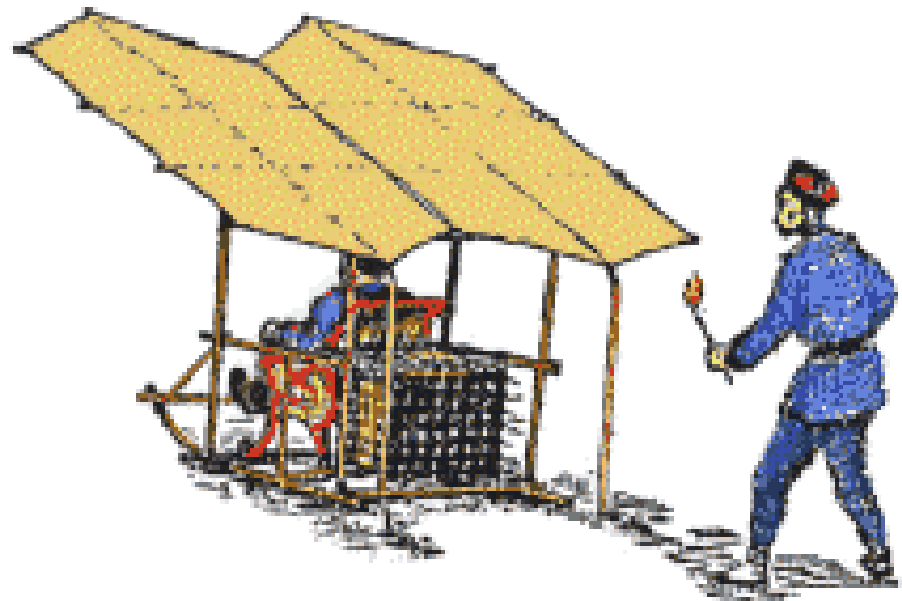
- 1 chair

- 2 kites

- 47 fire arrows

There was Big Boom,
a large cloud of smoke...
and Wan Hu was gone.

There is a Lunar crater named after him 8



Legendary Chinese official Wan Hu braces himself for "liftoff"



Father of Modern Chinese Rocketry

Qian Xuesen 钱学森
(Hsue-shen Tsien)
1911-1949



- 1911 - December 11 Born in Hangzhou, China
- 1935 - Aug 15 - Leaves China to study at MIT Gets MS Sci
- 1936 - Enters CalTech
- 1937 - Helped found Jet Propulsion Lab
- 1939 – Ph.D. Engineering Cal Tech
- 1942 - Manhattan Project scientist
- 1945 - Project Lusty – Col US Army scientists go into Germany, interviewed Von Braun's team
- 1947 – Married a Nat. Chinese General's Daughter Jiang Ying
- 1949 - Applied to become a US citizen

Father of Modern Chinese Rocketry

Qian Xuesen

钱学森

(Hsue-shen Tsien)

1950-1967



- 1950 - June 6th, FBI pulled clearances, house arrest
- 1955 - Sep 17th - Deported from U.S. to Communist China
Swapped for 11 US Korean war pilots.
A director in PRC 596 nuclear bomb program
- 1956 - Feb 17th - Plan for missile development proposed
- 1960 – Sept 10th, Launch R-2
Dec 5th Launch DF-1
- 1964 – Oct 16 China detonates 'Project 596' atomic bomb
- 1966 – August Put on "List of Cadres to be Protected"
from Cultural revolution purges.
- 1966 – Oct (Dong feng-2) ICBM launch with atomic warhead
- 1967 – June 'Test #6' Hydrogen Bomb detonation



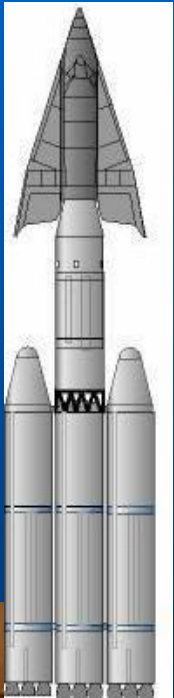
1968- 2009

- 1968 - Founded the Space Flight Medical Research Center
- 1970 – Launch DFH-1 (1st China Satellite)
- 1978 – Proposed winged spaceship based on his pre–DinoSoar work
- 1991 – Awarded State Scientist of Outstanding Contribution
- 2003 – Oct 15-16, 2003 – watched 1st China Astronaut's flight on TV

(his nephew Roger Y. Tsien,
2008 winner of Nobel Prize in Chemistry)

- 2009 – Oct 31 Died @ age of 98

https://en.wikipedia.org/wiki/Qian_Xuesen



M.C.R.N. _XUESEN

APPROACHING THE RING



Owner/Navy : Martian Congressional Republic Navy

Class :Scirocco-class

Type :Assault cruiser

Registration :EML-12

The Expanse TV series: Season 3, episodes 10,11

<https://expansion.fandom.com/wiki/Xuesen>



R-2/DF-1 Rocket

- Soviet/China Agreement Signed Dec. 6th, 1957
- Soviet Built R2 launched Sept. 10, 1960
- 1st Chinese built DF1 launched Nov. 5th, 1960
- A Chinese built copy of a Russian copy, of a German V2



Dong fang hong 1

● DFH-1 1970-34A NORAD #4382

- (East is Red)
- Launched April 24, 1970 9:35 pm
- Perigee: 434 km. Apogee: 2,162 km.
- Weight 173 kg. 1 meter in diameter 1.1980 RCS mag 3.5
- Design life : 15 days Max Vis Mag 3.5
- Broadcast song 'East is Red' on 20.009 MHz
- CZ-1(Chang zheng) [Long March] 1 rocket
- Jiuquan Satellite Launch Center
- Today's Ele: Perigee: 429 km. Apogee: 2,033 km.
- Period : 110.09 min Inclination: 68.42 deg.



Fanhui Shi Weixing (FSW)

Fanhui Shi Weixing (recoverable test satellite)

- Photo recon. (Spy satellites) also climate, geographical, and agricultural purposes.
- First Launched in Nov 1975 on Long March 2C
- 26 flights
- Last launched in September 2006
- Oak heat shield



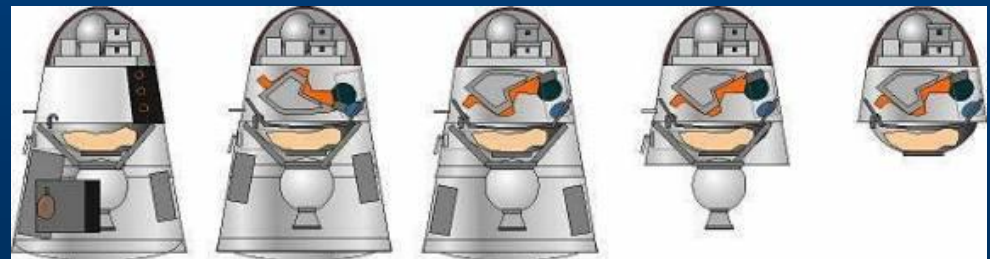
Shuguang 1 (Dawn-1) Project 714



- 1966-1980
- *Total Length:* 4.60 m
- *Maximum Diameter:* 2.20 m.
- *Mass:* 1,800 kg.
- CZ-2A booster
- 1st Flight target 1972
- Team dissolved in May 1972 after failed overthrow of Mao Zedong by Lin Biao and managers purged during cultural Revolution.

Dong Yuxiao, Chen Hongliang, Dong Xiaohai, Du Jincheng, Fang Guojun, Fu Zhanzi, Li Shichang, Liu Chongfu, Liu Zhongyi, Lu Xiangxiao, Ma Zizhong, Meng Senlin, Shao Zhijian, Wang Fuhe, Wang Fuquan, Wang Quanbo, Wang Rongsen, Wang Zhiyue, Yu Guilin, Zhang Ruxiang

Xiangxiao Wang Zhiyue Fang Guojun Lu Yu Guilin



Long March-5B Y2 ready to launch the Tianhe Core Module



Present

FIFTY CENTS

DECEMBER 8, 1968

TIME



RACE FOR THE MOON

ILLUSTRATION BY GARY BASEMAN

50 CENTS

TIME

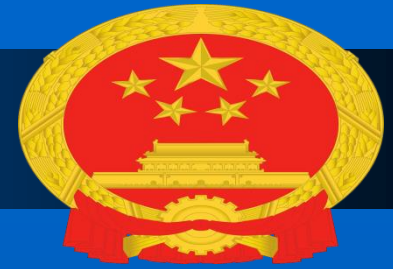


**THE
NEXT
SPACE
RACE**

BY JACQUES BLONDEL

ILLUSTRATION BY GARY BASEMAN

2016 White paper on China's Space Activities



Conclusion: ...It is mankind's unremitting pursuit to peacefully explore and utilize outer space. Standing at a new historical starting line, China is determined to quicken the pace of developing its space industry, and actively carry out international space exchanges and cooperation, so that achievements in space activities will serve and improve the well-being of mankind in a wider scope, at a deeper level and with higher standards. China will promote the lofty cause of peace and development together with other countries.

http://english.www.gov.cn/archive/white_paper/2016/12/28/content_281475527159496.htm

NORAD info

Space Objects Box Score

Peoples Rep. of China (PRC)

On Orbit as of 5-01-2021

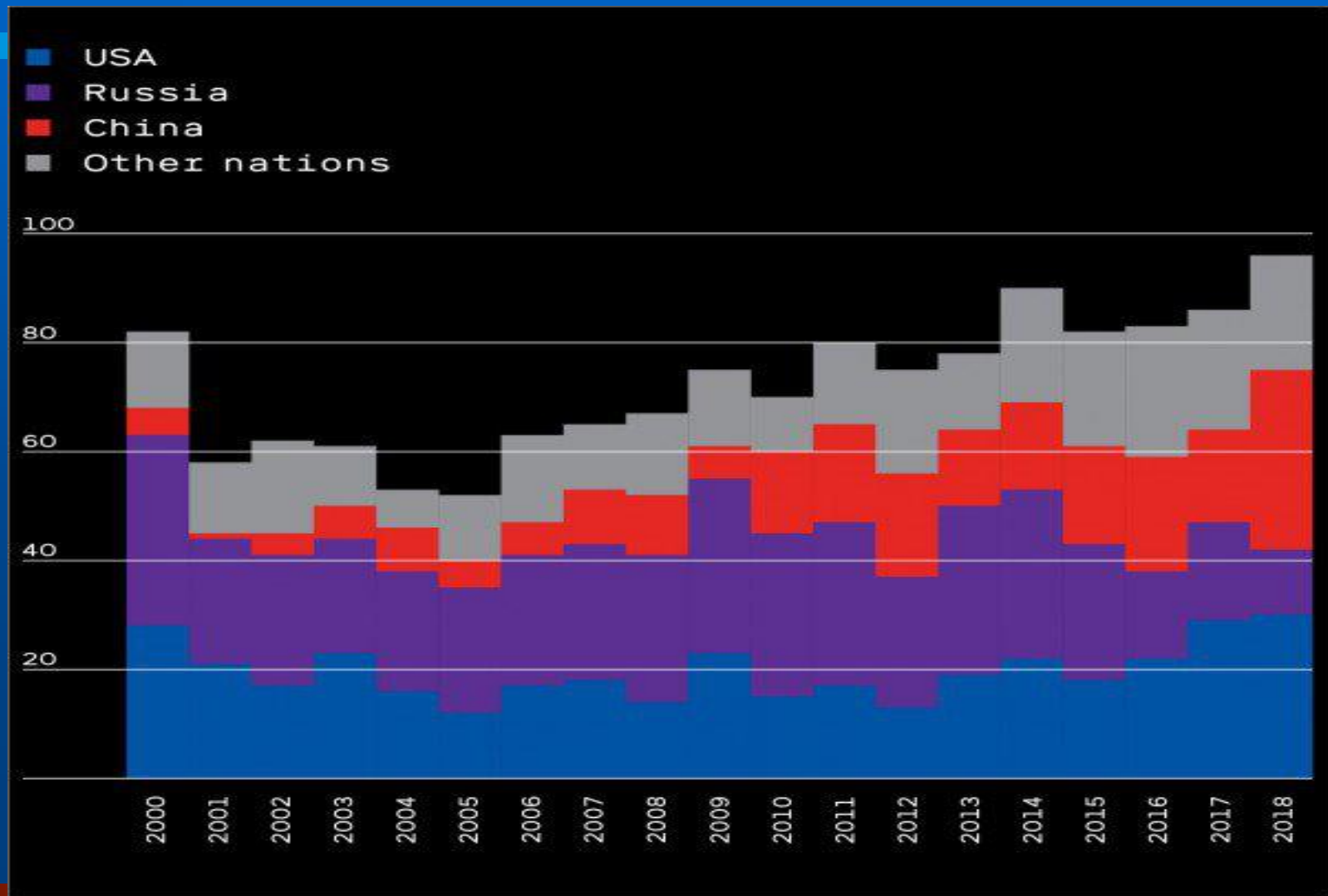
Payloads = 455	??? = 50
Debris = 3,644	RB = 179
Total = 4,328	

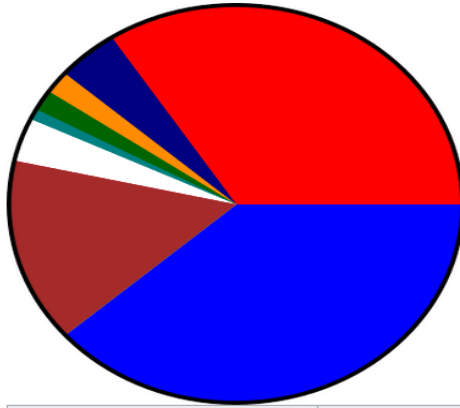
Decayed as of 5-01-2021

Payloads = 101	
Debris = 1,183	RB = 188
Total = 1,472	
Grand Total = 5,800	











2000-2018 Launch Market Share





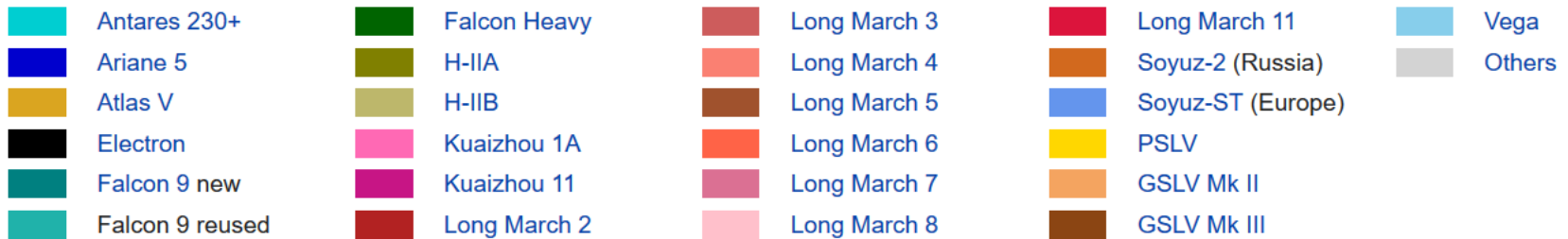
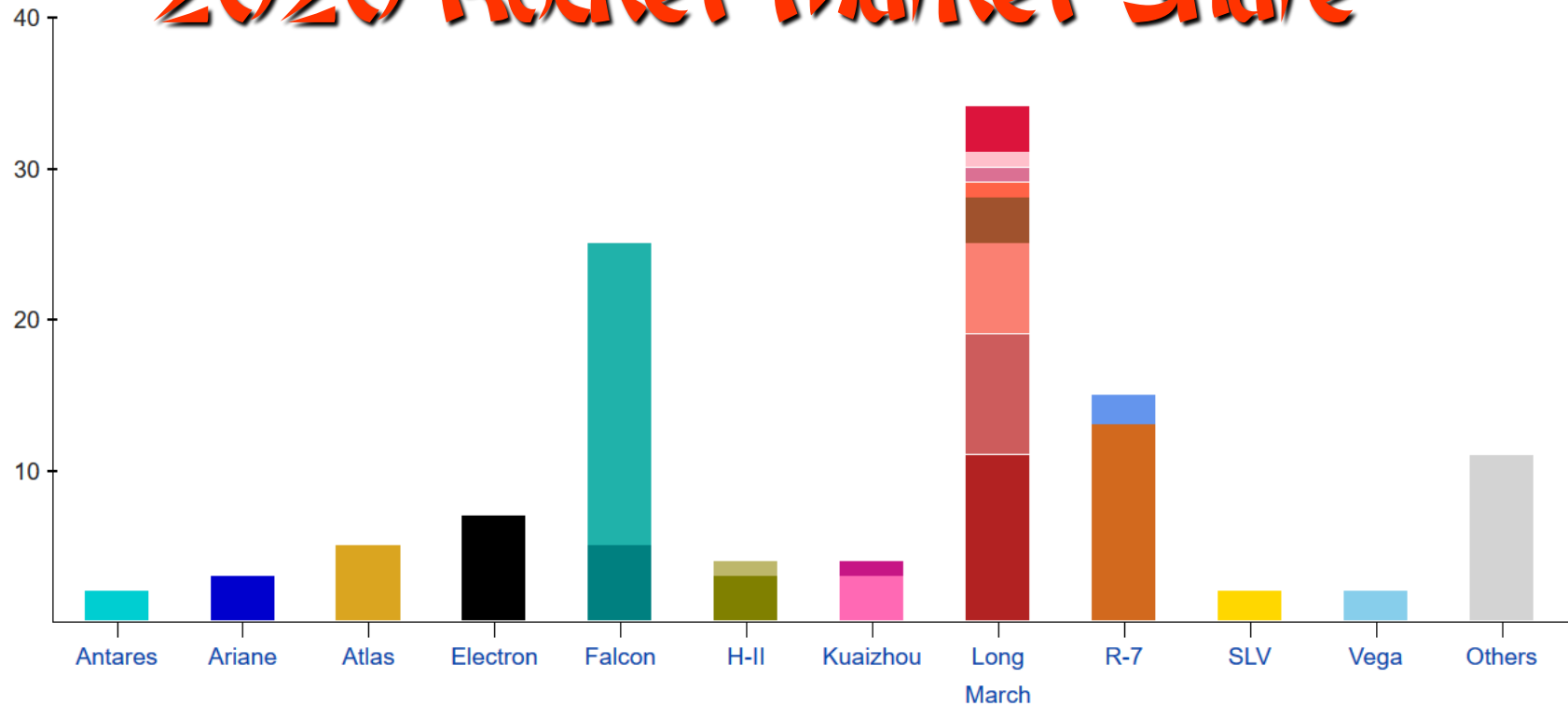
2020 Launch Market Share

Country	Launches	Successes	Failures	Partial failures	Remarks
 China	39	35	4	0	
 Europe	5	4	1	0	
 India	2	2	0	0	
 Iran	2	1	1	0	
 Israel	1	1	0	0	
 Japan	4	4	0	0	
 Russia	17	17	0	0	Includes two Soyuz launches from Kourou
 United States	44	40	4	0	Includes seven Electron launches from Mahia
World	114	104	10	0	

https://en.wikipedia.org/wiki/2020_in_spaceflight

By rocket

2020 Rocket Market Share



https://en.wikipedia.org/wiki/2020_in_spaceflight

CNSA 国家航天局



China National Space Administration

<http://www.cnsa.gov.cn/>

China National Space Administration (CNSA) is the governmental organization of People's Republic of China responsible for the management of space activities for civilian use and international space cooperation with other countries, and performs the corresponding governmental functions.



Administrator :ZHANG Kejian May 2018 to current
Time magazine:The 100 Most Influential People of 2019

<http://www.cnsa.gov.cn/english/index.html>



中国运载火箭技术研究院

China Academy of Launch Vehicle Technology

China Academy of Launch Vehicle Technology (CALT), headquartered in Beijing, has been the leading launch vehicle manufacture in China since its establishment in 1957. CALT is also one of the major launch service providers in the world. The Long March launch vehicles, designed and manufactured by CALT, can send various payloads to Low Earth Orbit (LEO), Sun-synchronous Orbit (SSO) and Geo-synchronous Transfer Orbit (GTO) with low cost and high reliability. CALT is also planning two space planes.

- 13 Research Institutes**
- 5 Factories**
- 33,000 People**

In August 2020, the United States Department of Defense released the names of “Communist Chinese military companies” operating directly or indirectly in the United States. CALT was included on the list.

In November 2020, U.S. President Donald Trump issued an executive order prohibiting U.S. companies and individuals owning shares in companies, including CALT, that the U.S. Department of Defense has listed as having links to the People's Liberation Army.

<http://www.calt.com/n840/index.html>

CASIC



中国航天科工集团公司
CHINA AEROSPACE SCIENCE & INDUSTRY CORP.



Yuan Jie
CASIC
Chairman

CASIC is a strategic, high-tech, innovative, state-owned enterprise with strong technical foundation and innovation capability. As one of the world's top 500 companies and among the top 100 global defense companies, CASIC is the backbone of space industry of China, and a leader in the development of China's industrial information.

CASIC owns 19 national key laboratories or engineering technology centers, and 28 science & technology innovation platforms; it has the first invention patent and the first utility model patent of China; it owns 22 subsidiary units and holds shares of 9 listed companies, with about 500 enterprises & institutions, and nearly 150,000 employees; it has enterprises or offices in many countries and regions in the world, covering Asia, Europe, Africa, and Latin America.

Dozens of technical products developed by CASIC have supported the launch of “**Shenzhou**”, docking of “**Tiangong**”, lunar exploration of “**Chang’e**”, networking of “**Beidou**” (GPS), Mars exploration of “**Tianwen**” and construction of “Tiangong”(space station)

[HTTP://WWW.CASIC.CN](http://www.casic.cn)

CASC



中国航天



Wu Yansheng
Chairman of
the Board

CASC, one of the Fortune Global 500 firms, is a large state-owned enterprise group with its own independent intellectual properties and famous brands, outstanding innovative capabilities, and strong core competitiveness.

Originating from the Fifth Academy of the Ministry of National Defense established in 1956 and experiencing the historic evolution of the Seventh Ministry of Machinery Industry, the Ministry of Astronautics, the Ministry of Aerospace Industry, and China Aerospace Corporation, CASC was formally founded on July 1, 1999.

As the leading force of China's space industry and one of China's first innovative enterprises, CASC has 8 large R&D and production complexes, 11 specialized companies, 13 listed companies and a number of directly affiliated units. *CASC is mainly engaged in the research, design, manufacture, test and launch of space products such as launch vehicle, satellite, manned spaceship, cargo spaceship, deep space explorer and space station as well as strategic and tactical missile systems.* Its R&D and industrial facilities are mainly located in Beijing, Shanghai, Tianjin, Xi'an, Chengdu, Hong Kong and Shenzhen.

CGWIC



中国航天

中国长城工业集团有限公司

China Great Wall Industry Corporation

Established in 1980, China Great Wall Industry Corporation (CGWIC) is the sole commercial organization authorized by the Chinese government to provide commercial launch services, satellite systems and to carry out space technology cooperation. It is a subsidiary of China Aerospace Science and Technology Corporation (CASC).

Partners : **CALT (China Academy of Launch Vehicle Technology)**
 CAST (China Academy of Space Technology)
 SAST (Shanghai Academy of Spaceflight Technology)
 CLTC (China Satellite Launch & Tracking Control General Department)

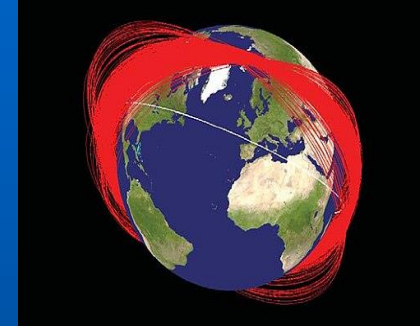


<http://cgwic.com/>

People's Liberation Army Rocket Force



ASAT started in 1964 Program 640 to Program 863 developing direct fire, directed-energy weapon, and micro-satellites. Some lead developers purged in cultural revolution.



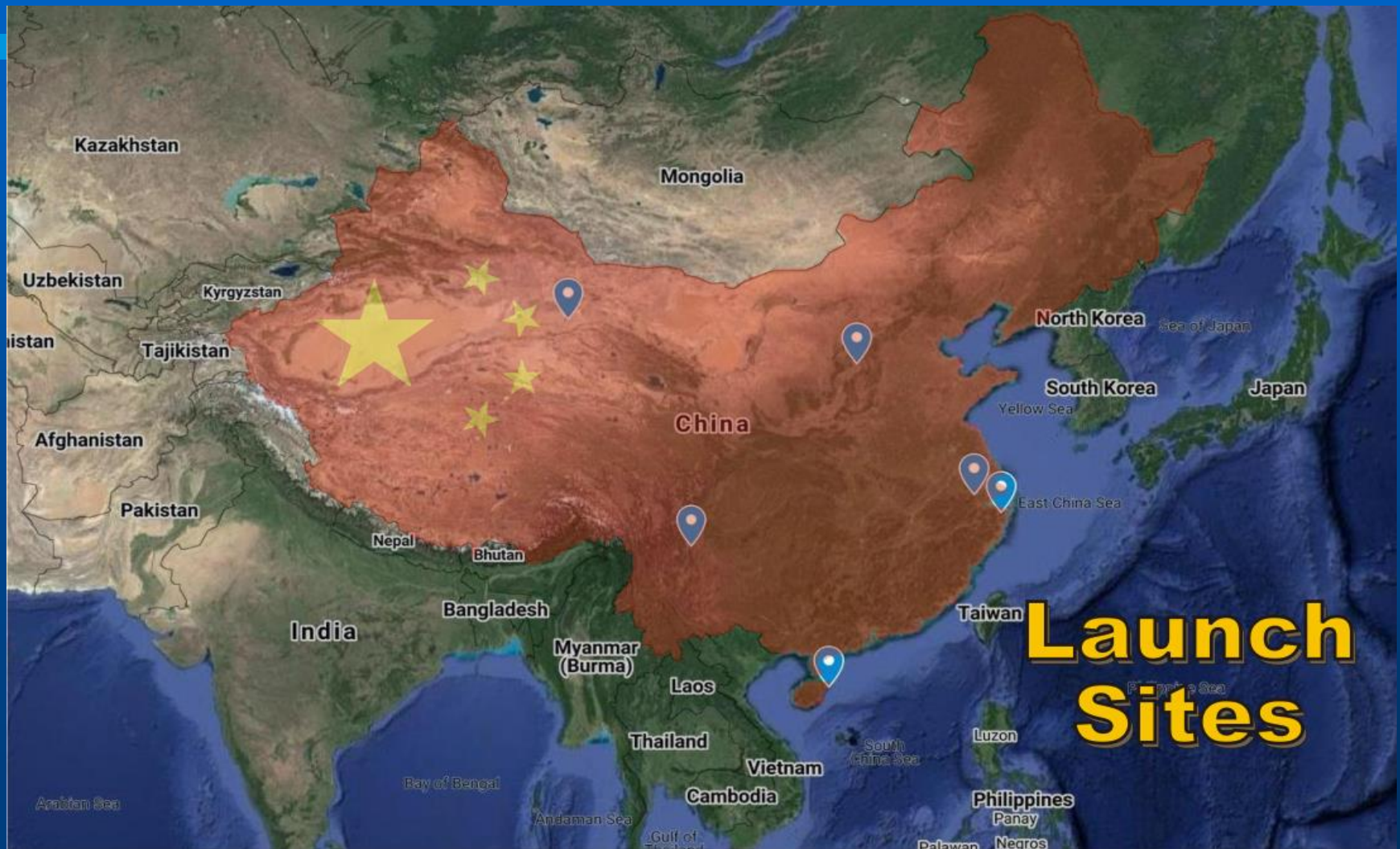
As of 2004 PLA mission includes 'safeguarding China's expanding national interests, specifically including access to space (taikong;太空).'

January 11, 2007 Feng Yun FY-1C WX Sat shot down by PLA SC-19 ASAT kinetic kill launched from Xichang. 865km up Leaving 3,438+ pieces in orbit.

As of April 2019, 3000 of the 10,000 pieces of space debris routinely tracked by the US Military as a threat to the International Space Station were known to have originated from the 2007 satellite shoot down.



China's Launch Sites Map



Jiuquan Launch Center - Base 20



- Construction started June 1956
- Gobi Desert in Gansu Province
- Launches all recoverable satellites

Lat: 40° 57' 38" N
Long: 100° 17' 54" E
Alt: 1,000m



Jiuquan Corona image 1972



Jiuquan Launch Center

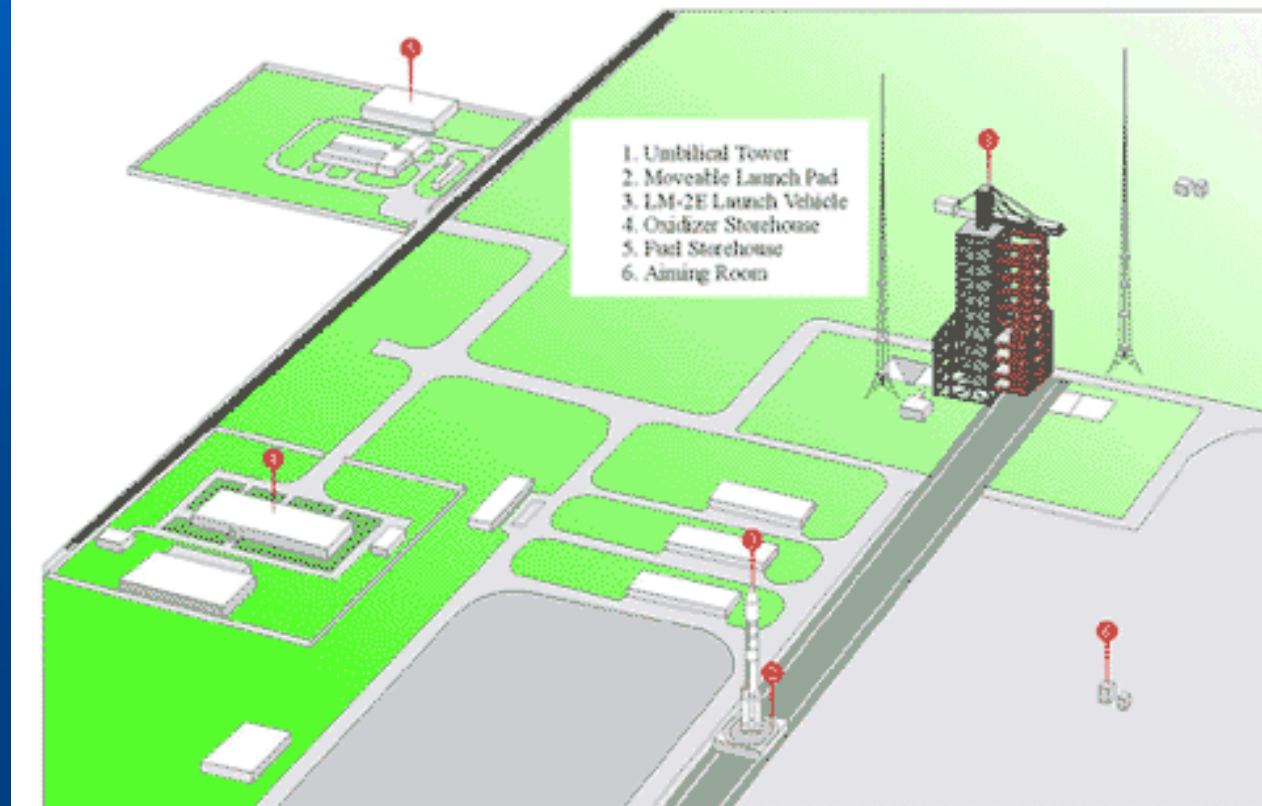
酒泉卫星发射中心



Lat: 40° 57' 38" N
Long: 100° 17' 54" E
Alt: 1,000m

Jiuquan Launch Center

Jiuquan Satellite
Launch Center



Jiuquan Launch Center VATB

Vertical Assembly and Testing Building (VATB)



Doors:

Height :74 meters (243 feet),

Upper width : eight meters (26 feet)

Lower width :14 meters (46 feet)

Gross weight : over 350 tons



NASA VAB Height 526 ft (160 m)
door 456 ft (139.0 m) high

Beijing Control Center

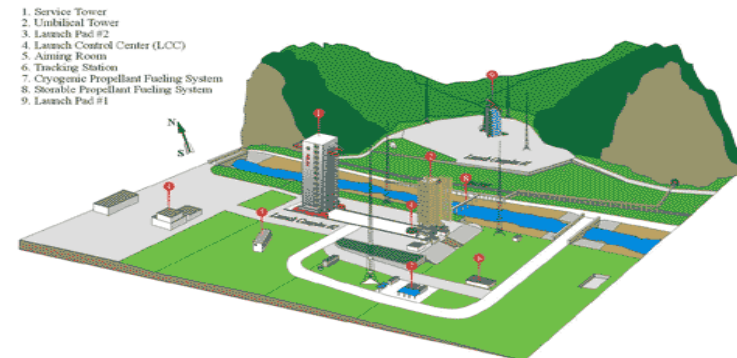


Xichang Launch Center Base 27

西昌卫星发射中心



Xichang Satellite Launch Center



• *Latitude:* 28° 14' 45.66" N.

• *Longitude:* 102° 02' 35.60" E.

• *Altitude:* 1,800.00 m

• *Opened in* 1984

• *Mountains of* Sichuan Province

• Designed to put geostationary satellites into orbit

• Cancelled Crewed 'Shuguang One' program

• Equipment to support a cryogenic upper stage.

• Lunar Chang'e 1-4 Lunar probes launched

• ASAT testing (SC-19) [2007]



Xichang Launch Failure 1996



- CZ-2E rocket explodes 22 sec after take-off of with a Hughes-built Intelsat 708 comm. satellite.
- Killing six people ??? 59 injured Maybe more??
- Western satellite insurers became nervous about the rocket's reliability.
- Western Satellite launches were stopped when Congress charged U.S. companies with sharing militarily sensitive launch technology with China.
- The Clinton administration cracked down on satellite exports to China.

Taiyuan Launch Center - Base 25



Lat 38° 50' 56.71" N
Long 111° 36' 30.59" E

- Near the mountain city of Taiyuan in Shanxi Province
- First launch: 1988.
- Tests ICBM/SLBM missiles
- Launches polar orbiting spacecraft.
- Twelve Iridium satellites were launched here on six Long March rockets from 1997 through 1999.



Look out Below...



2020
March 4B
en-11-02 Earth observation satellite

Cloud of hypergolic rocket propellant (dinitrogen tetroxide/ N_2O_4 /NTO, and unsymmetrical dimethylhydrazine/UDMH)

Sept 7, 2020 a Chinese Long March 4B rocket launched with the Gaofen-11-02 Earth imaging satellite. The launch was successful as the satellite entered its intended orbit, but the first stage booster fell back to Earth and crashed in a Chinese village, narrowly missing a school.

<https://www.youtube.com/watch?v=Gj1B48N7Tus>

Launch Sites

Wenchang / Haikou 文昌航天發射場



- Sounding rocket launch site plus
 - Long March 5, 7 (CZ-5/CZ-7)
- Latitude: $19^{\circ}36'1.7''$ N. (southern most)
Longitude: $110^{\circ}57'03.8''$ E.
1st launch : Dec 19th, 1988

Wenchang

New launch site for Geo Sync sats
Construction 2007 - 2014.

Launches of LM-5, LM-7 LM-8 started 2016



Launched Mars Probe Tianwen-1
Launched Moon Probe Chang'e 5
Launched Space Station Tianhe
2 launch pads

Hainan Wenchang Space Theme Park
Managed by CASC

Shijiedu Base 603

廣德火箭發射場

Guangde Rocket Launch Center



Sub-orbital Launch Site

Latitude: 30°57' N

Longitude: 119°13' E

T-7, T-7A, T-7A/S1, T-7A/S2 Sounding rockets launch site

Launched Xia Bao and Shan Shan (space dogs) July 1966

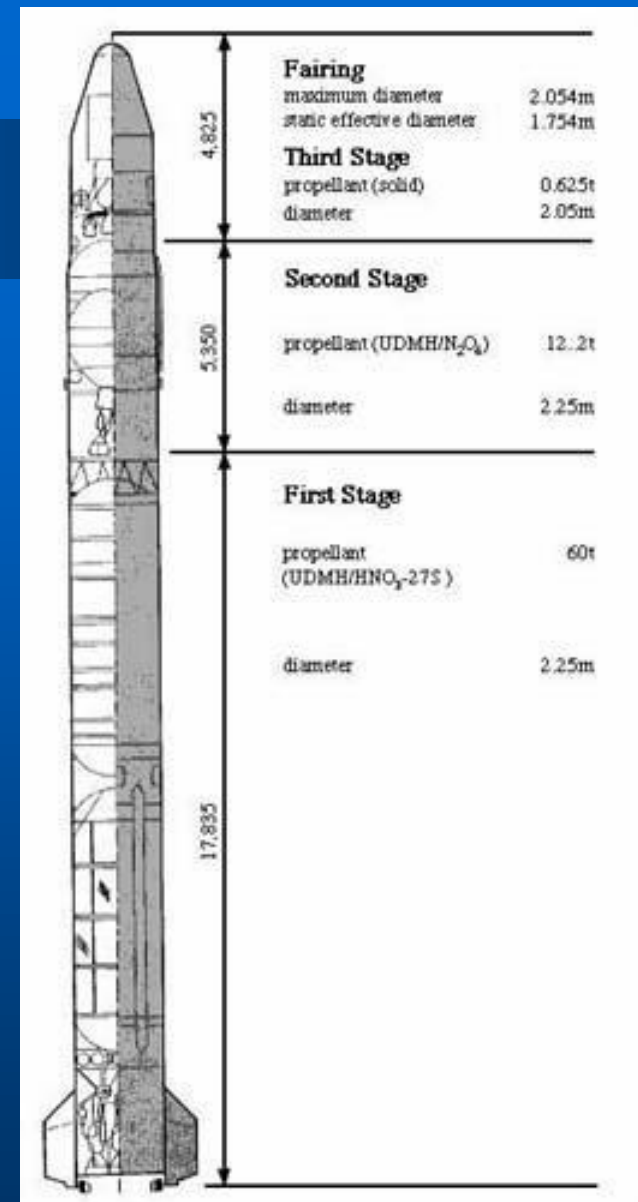
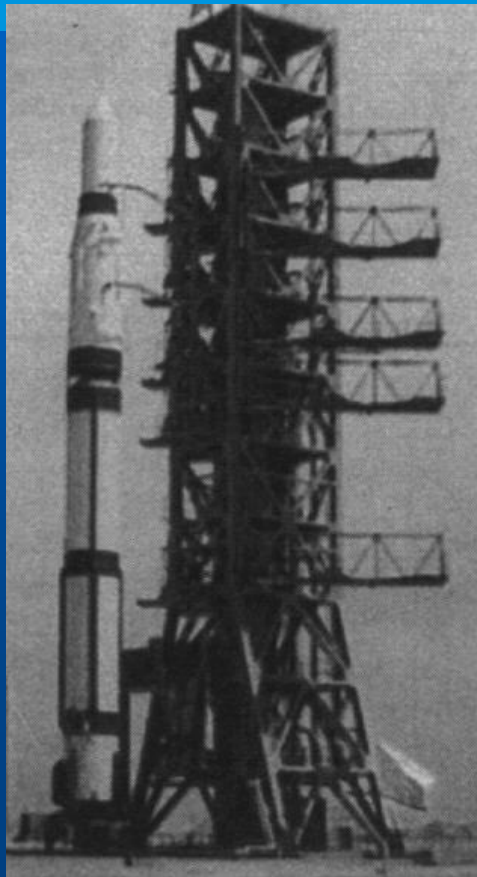
In use from September 1960 – July 1966._



Xia Bao and Shan Shan

<https://www.scmp.com/news/china/society/article/2134494/chinas-secret-1960s-mission-send-two-dogs-space>

ChangZheng CZ-1 Long March 1

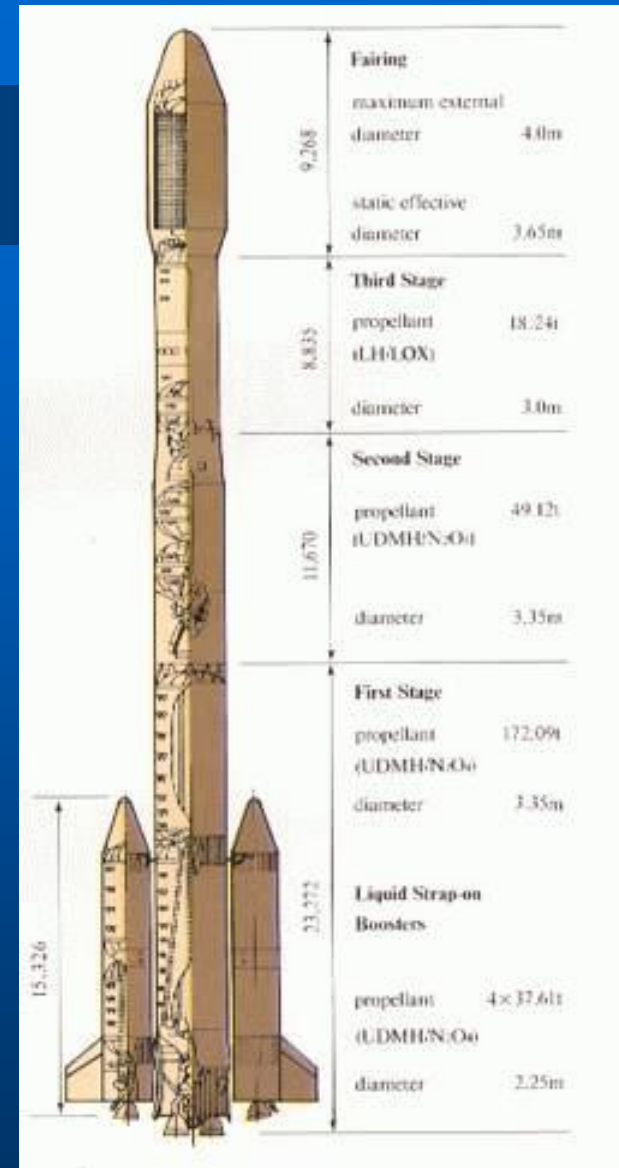


Launched China's first satellite Dong Fang Hong 1

50

https://en.wikipedia.org/wiki/Long_March_1

Long March 3 CZ3



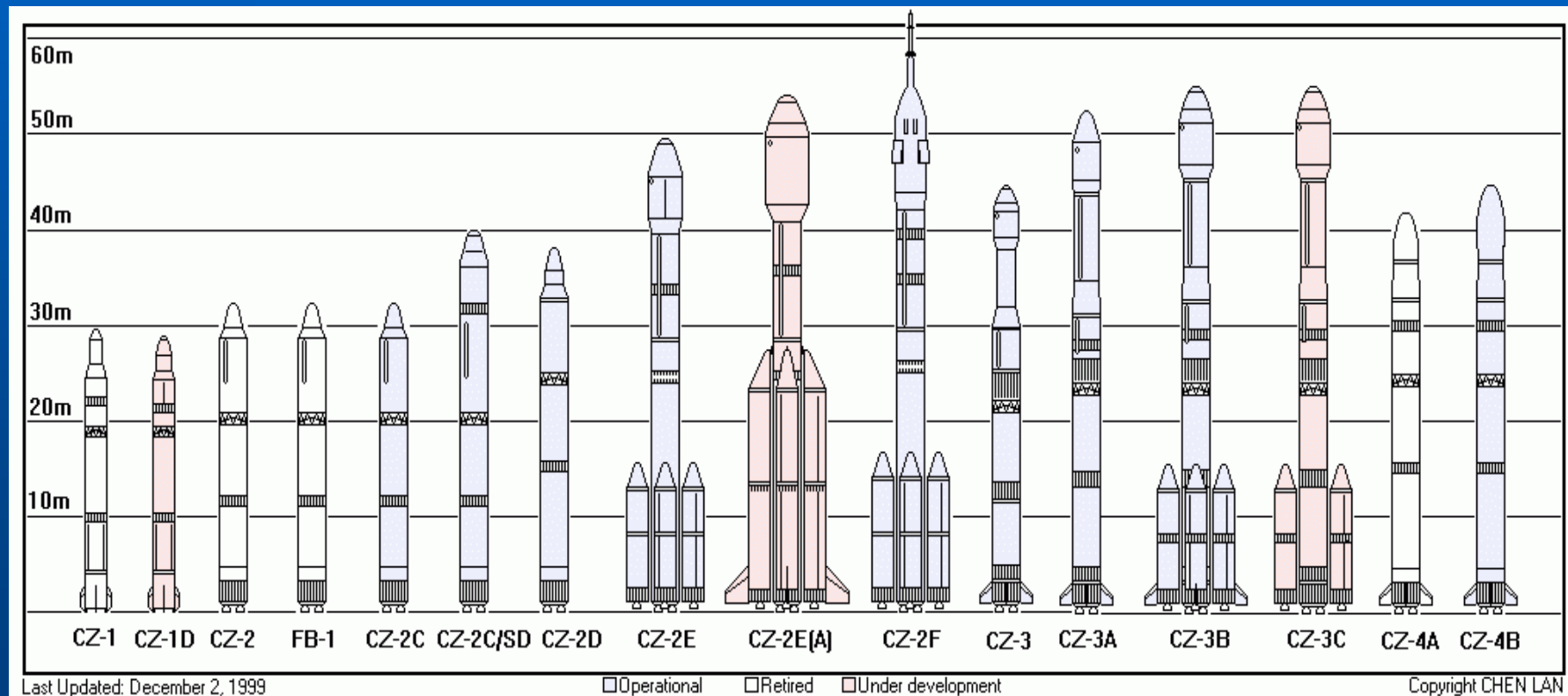
Geosynchronous transfer orbits

2,600-5,500 kg to GTO (~ Falcon 9)¹

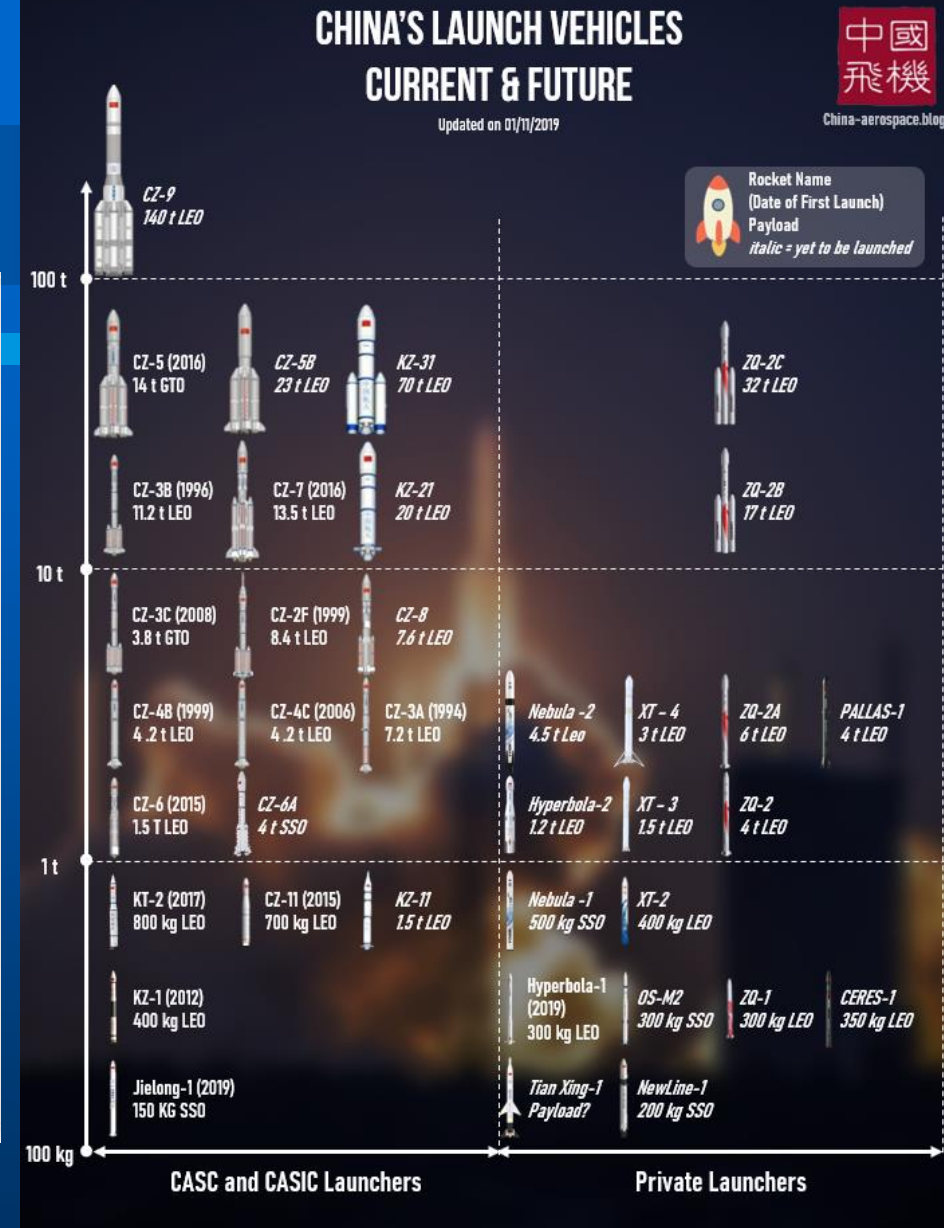
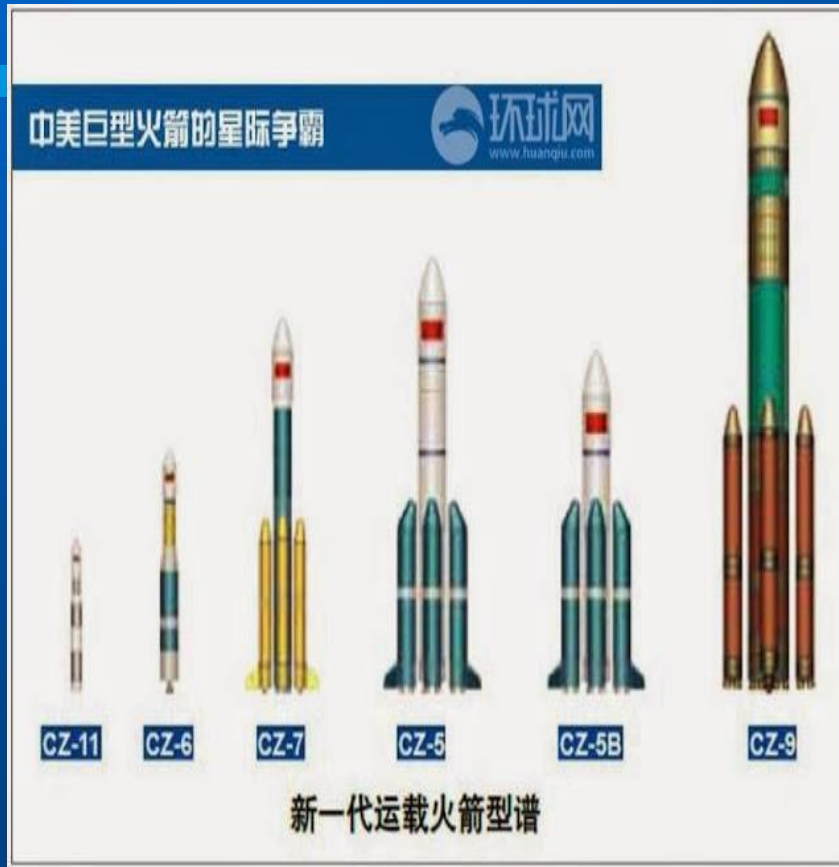
https://en.wikipedia.org/wiki/Long_March_3A

Long March Rocket Family

Blue Current
White/Pink Retired

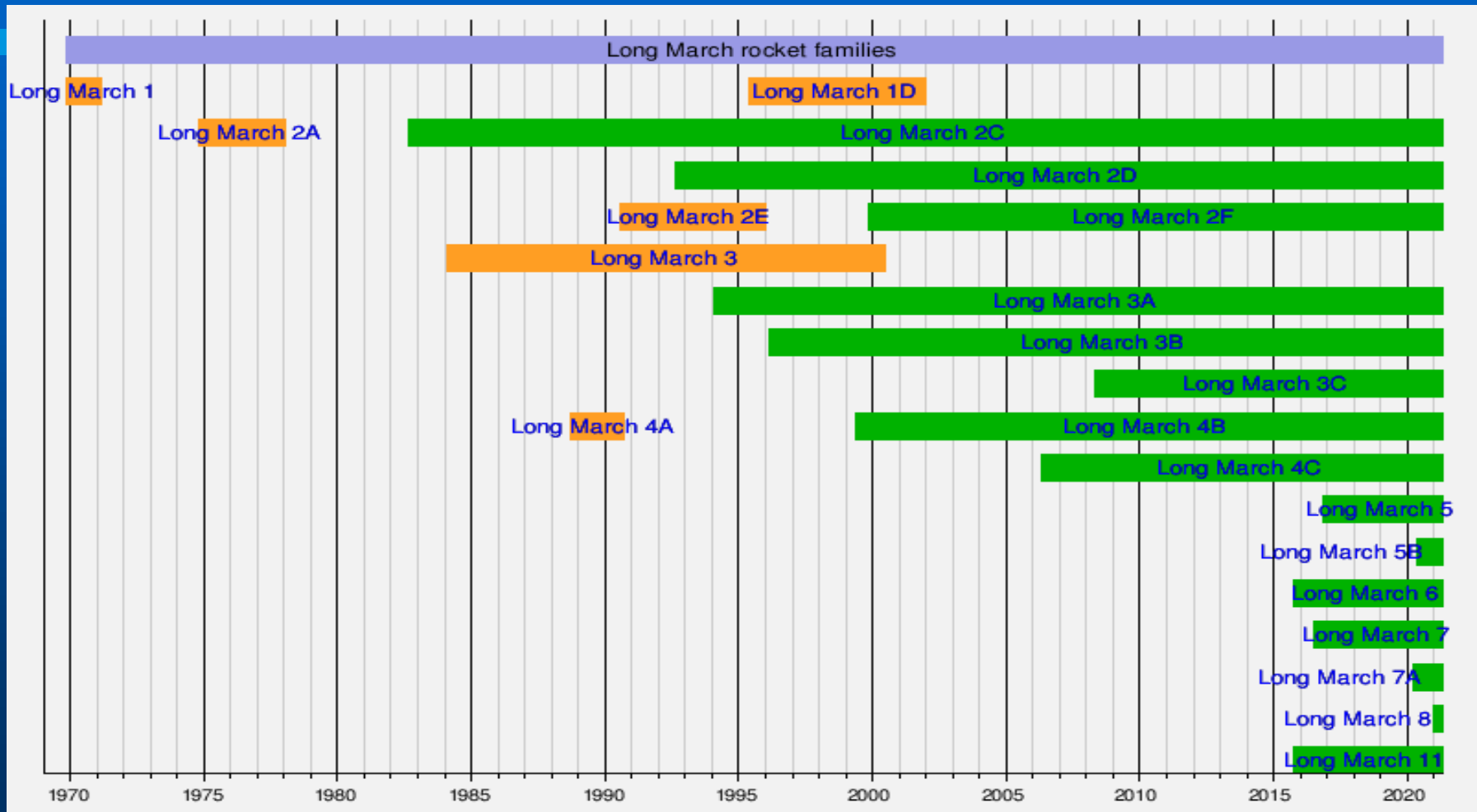


More Rockets

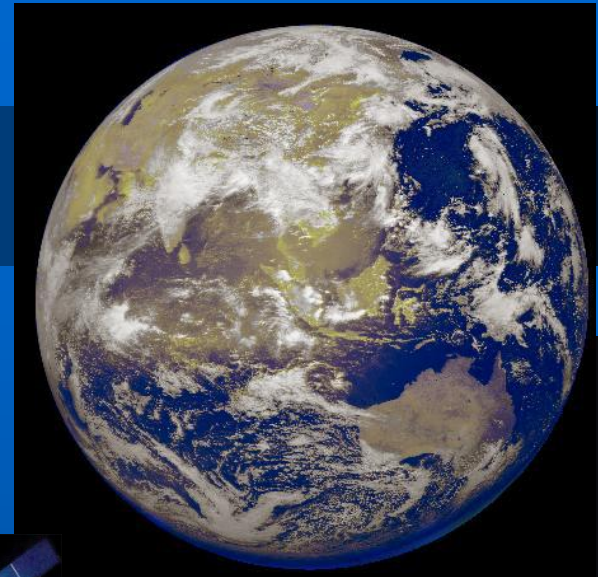


<https://chinaaerospace.files.wordpress.com/2019/11/chinas-launch-vehicles-current-and-future-4.png>

Long March Rocket Family Timeline



Land / Nav / Comm and Weather Sats



DFH-4



Hong Kong



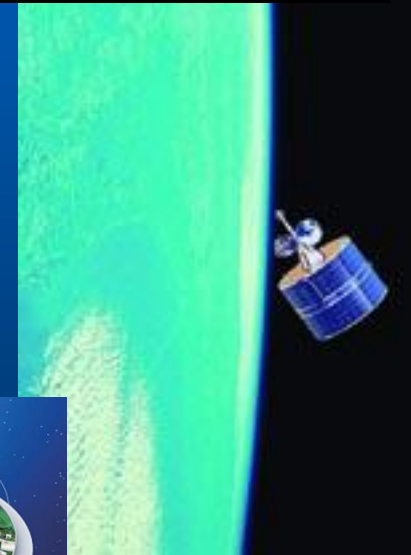
Beidou
(Sat Nav)



CBERS-1
Ziyuan
Gaofen (high resolution)
[10 cm] 1.5m primary mirror



56 FY-3D
Feng-Yun "Wind-Cloud"

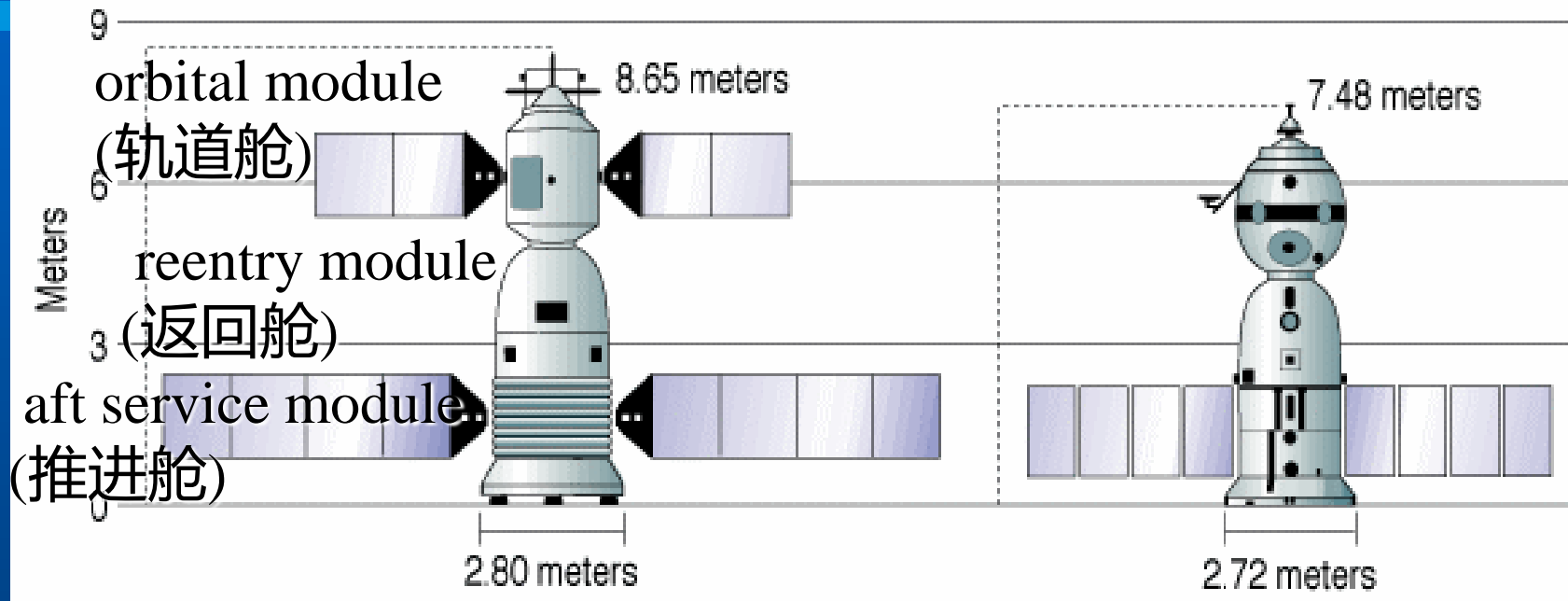


Project 921-1 神舟 Shen zhou [Sacred Vessel]

- Started in 1992
- Weight of 7,800 kg (17,000 lbs)
- 8.55 m (28 ft) long
- Maximum diameter of 2.8 m (9.2 ft).
- It is powered with four solar panels that generate a total of 1,500 watts
- Cost 19 billion yuan (\$2.3 billion) over 11 years



Shen zhou vs Soyuz



Shenzhou

2.8 m in diameter

9.25 m long

Mass of 7,840 kg.

Orbital module can stay up for months after crew returns

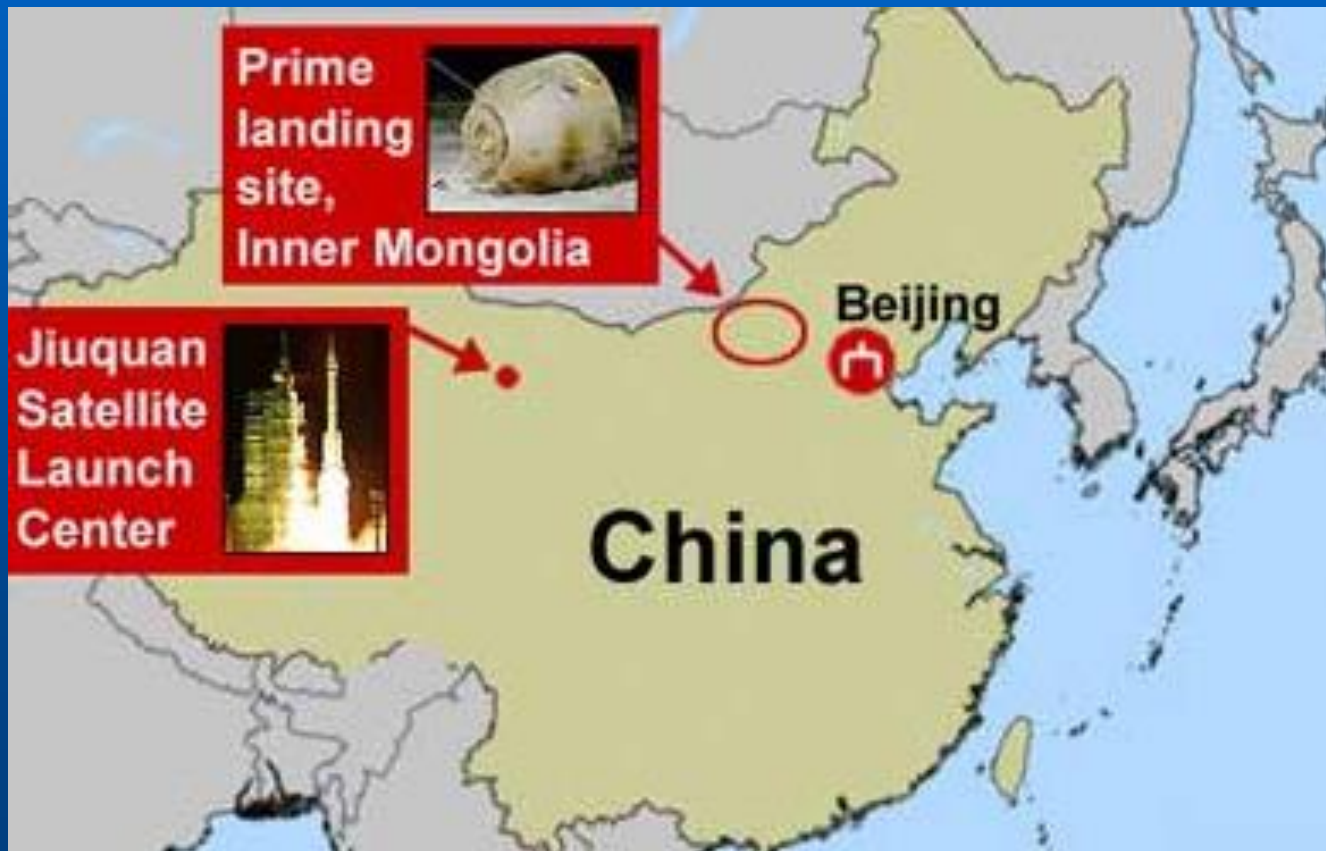
Soyuz-MS

2.72 m in diameter

7.48 m long

Mass of 7,080 kg

Map of Shen zhou sites



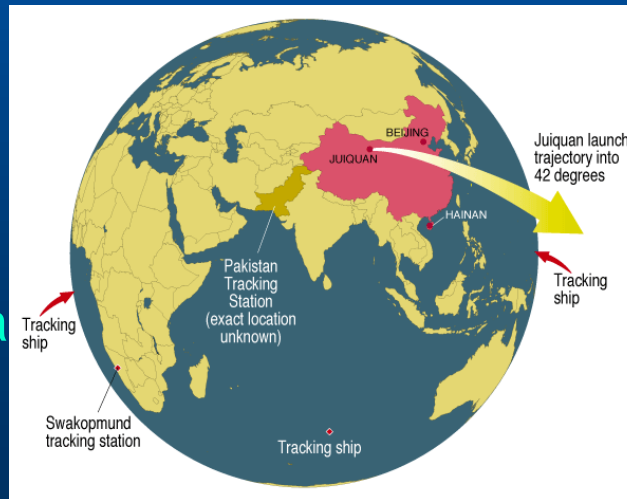
Tracking / Support ships Yuan Wang



Crew : ~400+
Length (m): 225
Width (m): 27
Height (m): 40
Speed (kts): 17
Draft (m) : 8
Displacement (t): 25,000

Yuan Wang 3 IMO: 8887935
Yuan Wang 5 IMO: 9413054
Yuan Wang 6 IMO: 9439527
Yuan Wang 7 IMO: 9804485

Swakopmund, Namibia
Constructed in 2001
Staff 5-20

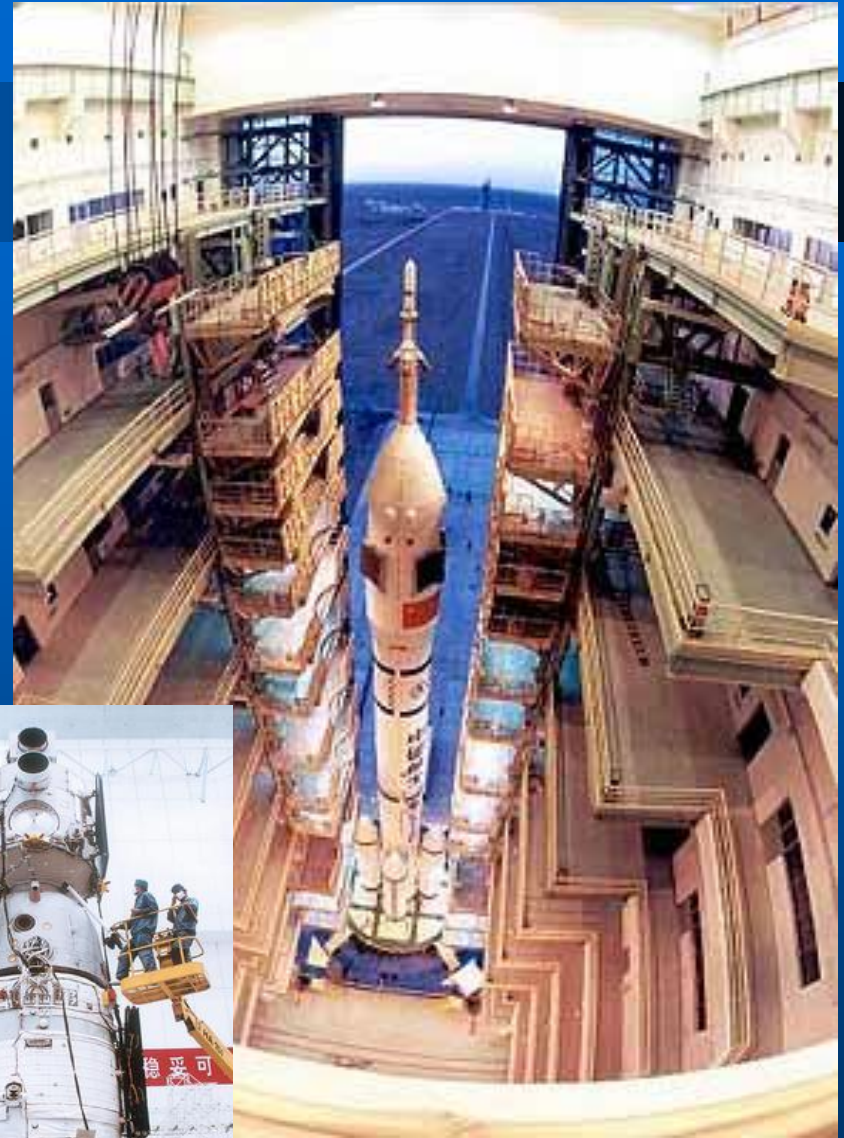


YuanWang ("Long View") 远望
7 built
4 Active ships #3,5-7

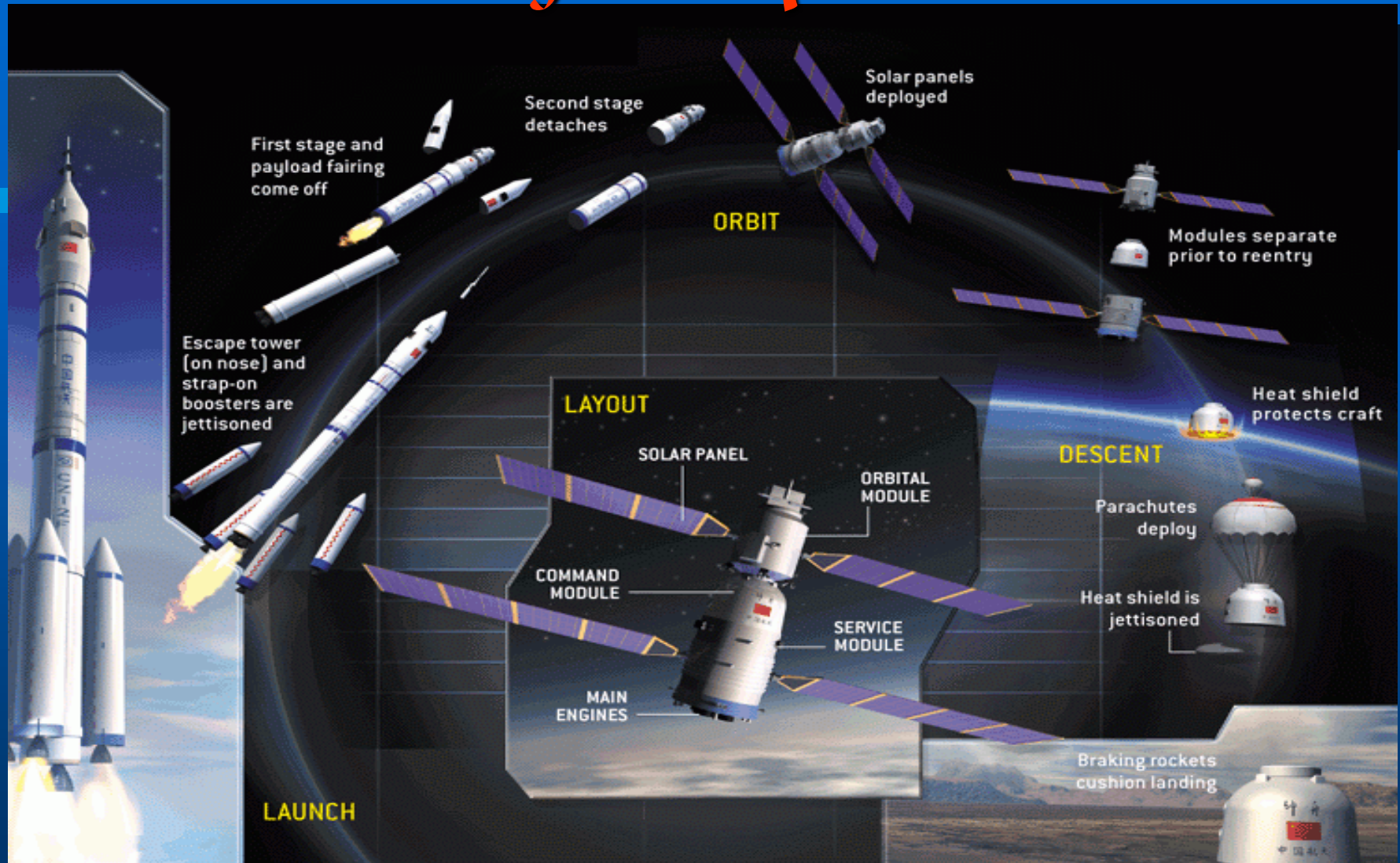


#21-22 cargo ships
designed to carry LM-5 rockets
Length (m): 130
Width (m): 19
Draft (m): 5.8
Displacement (t): 9,080

Shenzhou Assembly



Shen zhou Flight Sequence



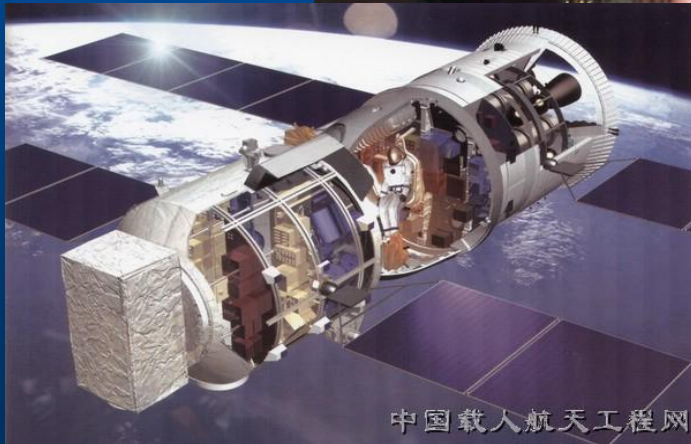
Inclination : 42.4deg – 343 km orbit height

Orbital module SZ-5 in the orbit for 228 days

Shen Zhou Missions 1-5



- 1 – Nov 20-21, 1999
- 2 – Jan 9-16, 2001 animals (bad landing?)
- 3 – Mar 25-Apr 1, 2002 (test dummy)
- 4 – Dec 30-Jan 5, 2002/3 Experiments
- 5 – Oct 15-16, 2003 - Yang Liwei
14 Orbits (21h 22m 45s)



中国载人航天工程网

Shen zhou Missions 6-8



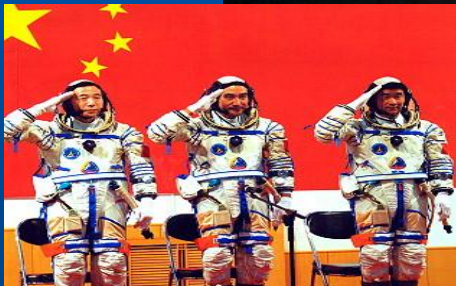
- 6 – Oct 12-17, 2005
- * Fei Junlong - CDR
- * Nie Haisheng -75 orbits



- 7 – Sept 25-28, 2008
- * Zhai Zhigang – CDR/EVA
- * Liu Boming
- * Jing Haipeng
- Sub sat 400 days



- 8 – Oct 31-Nov 17, 2011
- uncrewed Docked with Tiangong-1



Shen zhou Missions 9-11



9 – Jun 16-29, 2012

- * Jing Haipeng -CDR
- * Liu Wang
- * Liu Yang – Docked TG-1



10 – June 11-26, 2013

- * Nie Haisheng
- * Zhang Xiaoguang
- * Wang Yaping
- Docked TG-1



11 – Oct 17-Nov 18, 2016

- * Jing Haipeng
- * Chen Dong
- Docked with Tiangong-2



Tiangong -1 & 2 (Celestial Palace) Project 921-2

天宫

TG-1

Launched : Sept 29, 2011

Visited by : Shen zhou 8,9,10

Deorbited : April 2nd, 2018

TG-2

Launched : Sept 15, 2016

Visited by : Shen zhou 11

Tianzhou-1 (Cargo)

Deorbited : July 18th, 2019



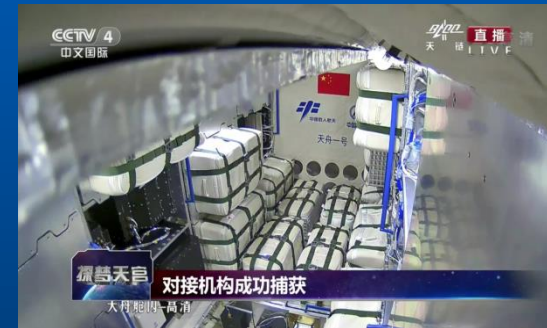
Mass: 8,506 kg (18,753 lb)

Length: 10.5 m (34.4 ft)

Diameter: 3.35 m (11.0 ft)

Pressurized volume: 15 m³ (530 cu ft)

TianZhou (Heavenly Ship) 天舟

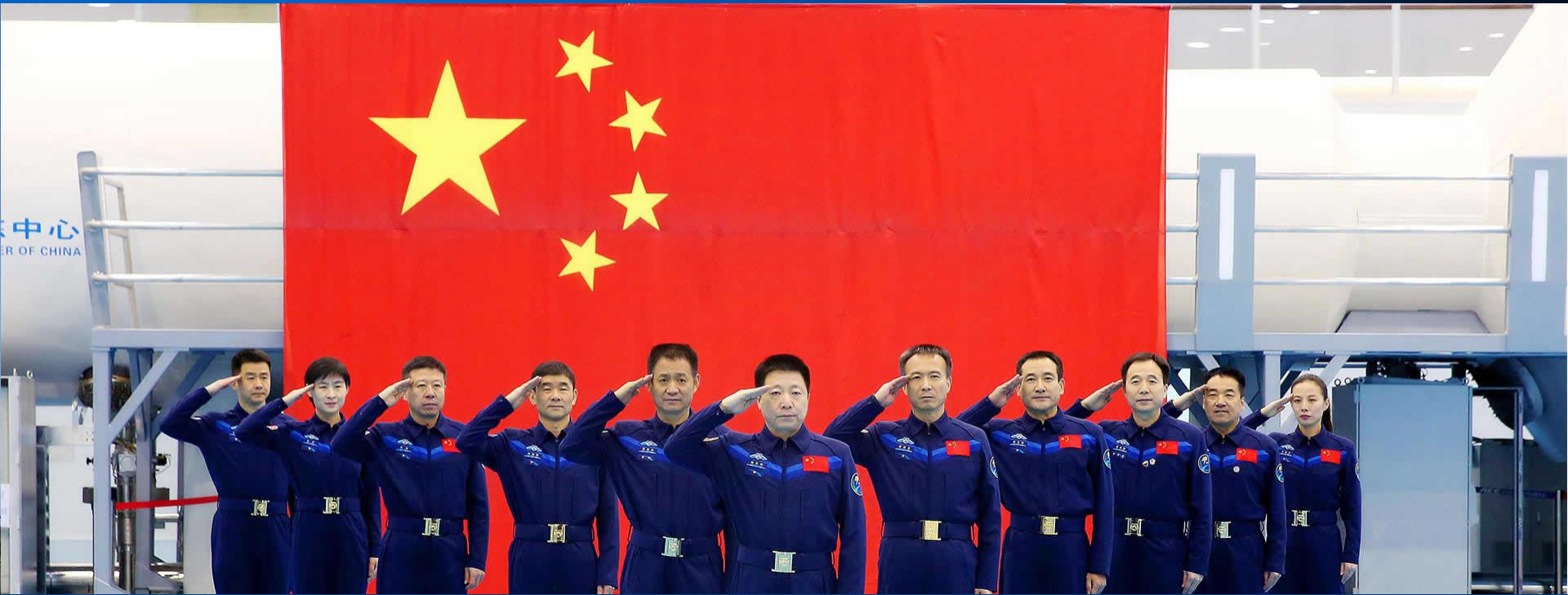


- Length: 10.6 m
- Diameter: 3.35 m (living & goods compartment)
- Weight: 6.41 t (empty) / 12.91 t (with goods & equipment)
- Docking port: One
- Energy supply: Two 3-segment solar arrays
- Expected life time: around 6 months
- Launch vehicle: Long March 7
- Flight profile: Inclination 41° / 350 km circular orbit

[https://en.wikipedia.org/wiki/Tianzhou_\(spacecraft\)](https://en.wikipedia.org/wiki/Tianzhou_(spacecraft))

Chinese Astronauts (yuhang yuans) (Taikonauts)

航天员 Hángtiān yuán



In total, China's astronaut corps consists of 34 individuals, as of the end of 2020. 11 have traveled to space. As of 5/1/2021

<http://www.cmse.gov.cn>

Other People born in China who flew in space:

- **William Anders**, born in Hong Kong, orbited the moon in December 1968 on Apollo 8.
- **Shannon Lucid**, born in Shanghai, holds the world record for a woman for time in space (over 223 days in space on 5 space flights).
- **Taylor Wang**, physicist, born in Shanghai, spent seven days in space aboard shuttle mission STS-51-B in 1985.



Taikonauts in Training

航天员



*"They'll be able to eat shredded pork with garlic sauce and kungpao chicken,"
"It will be more tasty than Western food.
After the meal, green tea will be available to increase the astronaut's spirits."
-- China.com*



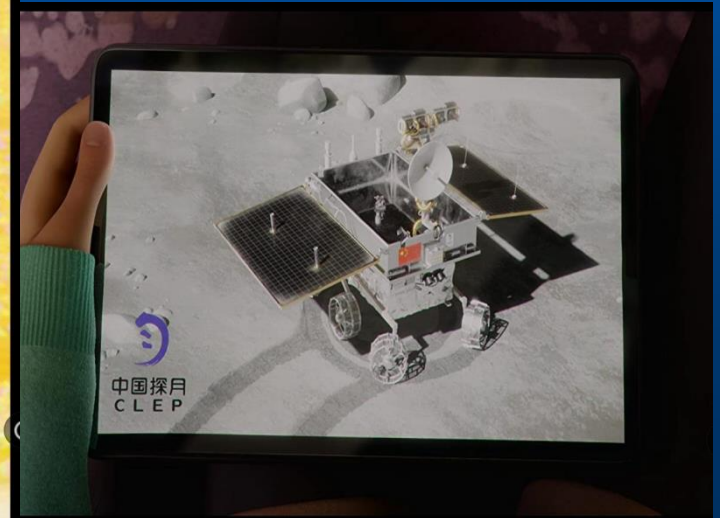
Taikonaut quarters



飞奔去月球

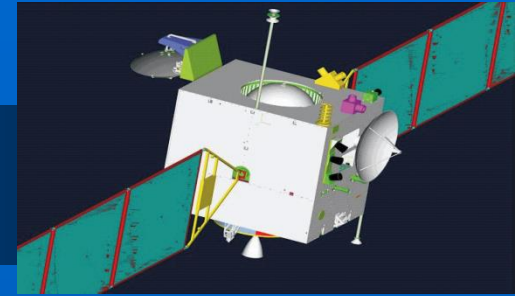


Bungee and Fei Fei



<https://www.netflix.com/title/80214236>

Chang'e 1



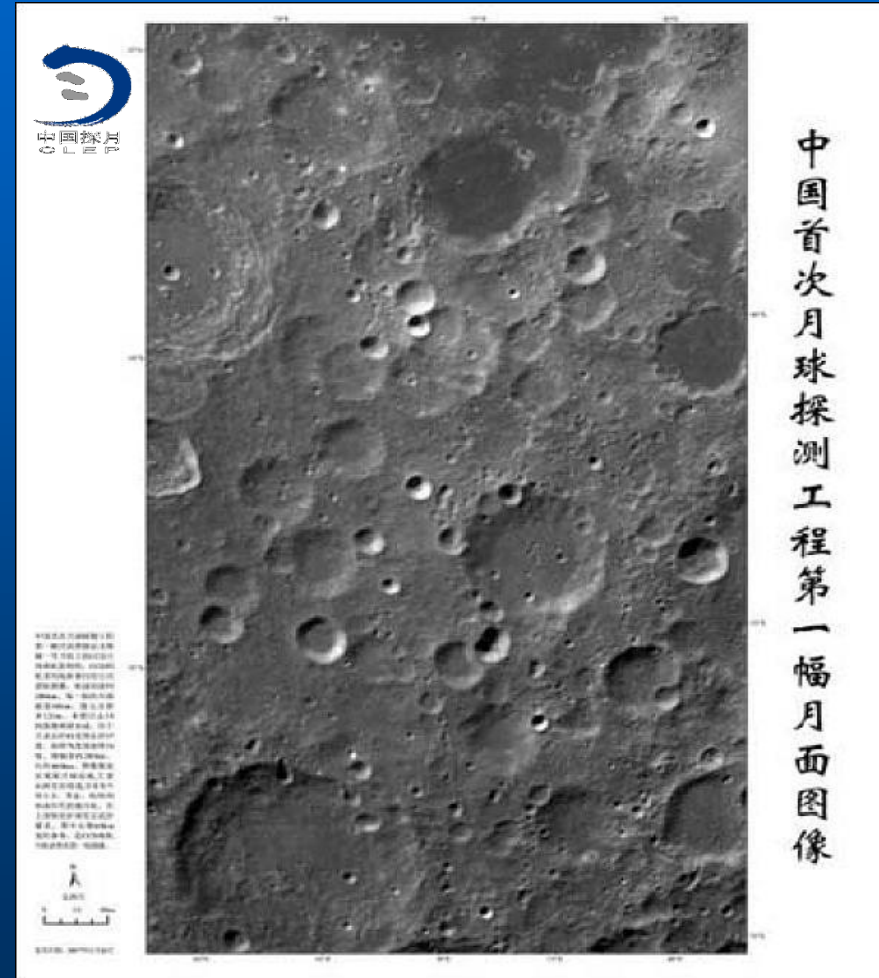
October 24th, 2007 Chang'e 1 was launched at 10:05:04 UTC from Xichang Satellite Launch Center

November 5th, 2007 -- Entered lunar orbit

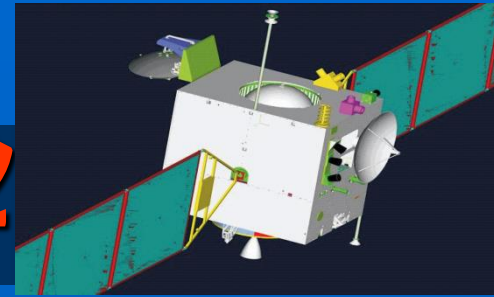
November 26th, 2007 -- The first picture of the Moon was relayed

November 12th, 2008, a map of the entire lunar surface was released, produced from data collected by Chang'e 1 between November 2007 and July 2008.

The mission was scheduled to continue for a year, but was later extended and the spacecraft operated until March 1st, 2009, when it was taken out of lunar orbit. It impacted the surface of the Moon at 08:13 UTC



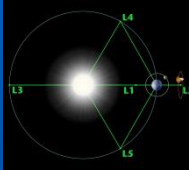
China on the Moon Chang'e 2



Chang'e 2 launched on October 1st, 2010. Chang'e 2 conducted research from a 100-km-high lunar orbit in preparation for a soft landing by the Chang'e 3 lander / rover. Chang'e 2 was similar in design to Chang'e 1, although it featured some technical improvements, including a more advanced onboard camera.

L2 Mission

June 8th, 2011, Chang'e 2 completed its extended mission, and left lunar orbit for the Earth–Sun L2 Lagrangian point, to test the Chinese tracking and control network. The probe reached L2 on 25 August 2011. After a 77-day cruise, becoming the first object ever to reach the L2 point directly from lunar orbit. The probe beamed its first batch of data from L2 in September 2011.



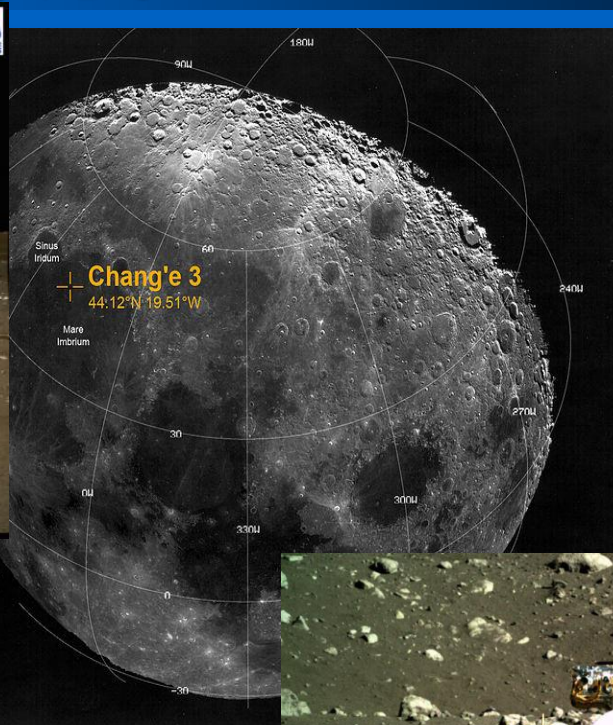
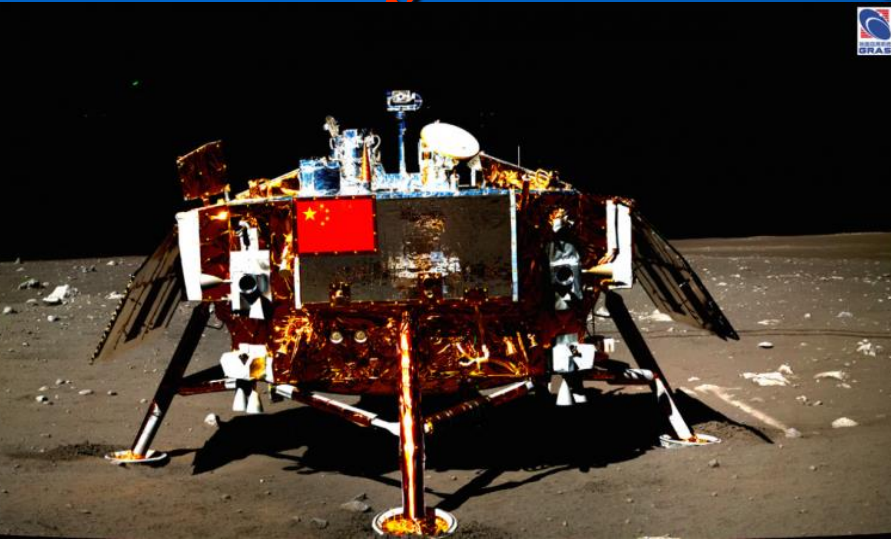
4179 Toutatis mission

Chang'e 2 departed from L2 on April 15th, 2012, and began a mission to the asteroid 4179 Toutatis. The flyby was achieved on December 13th, 2012. Close-up images of the asteroid, with a resolution of up to 10 meters per pixel, were later published online. The flyby was the first time an unmanned spacecraft had imaged the asteroid so closely. Chang'e-2 came as close as 3.2 kilometers (2.0 mi) to Toutatis, and took pictures of the asteroid at a relative velocity of 10.73 kilometers (6.67 mi) per second. China thus became the fourth space agency to conduct a successful mission to an asteroid, after NASA, ESA and JAXA.



Chang'e 3

嫦娥三



The planned landing site was Sinus Iridum, a lava-filled crater 249 km (155 mi) in diameter. The actual landing took place on Mare Imbrium. 44.12N 19.51W

Chang'e 3

Launched Dec 2nd, 2013

Landing Dec 14th, 2013

Lander Still Going (Sept 2020)

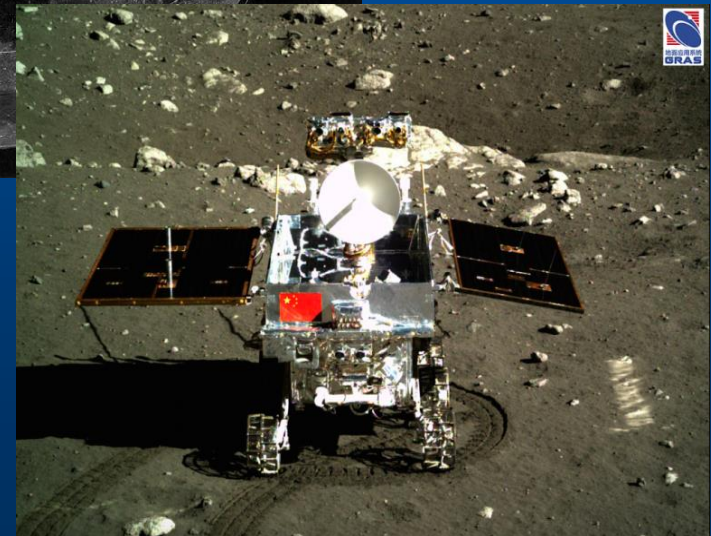
Landing Site named:

Guang Han Gong - "Moon Palace" motors froze 3/2015

https://en.wikipedia.org/wiki/Chang'e_3

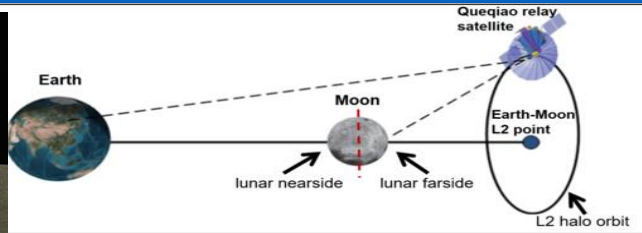
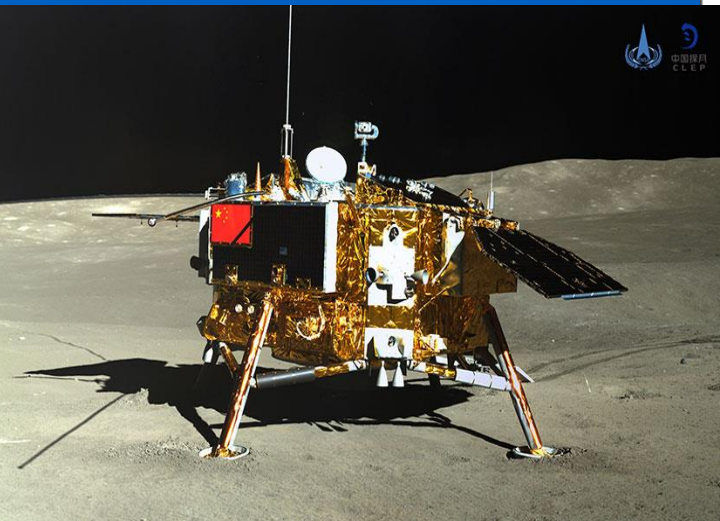
Yutu 1

(Jade Rabbit)



Chang'e 4

嫦娥四号



Yutu 2
now in 29th
lunar day
682.8m +

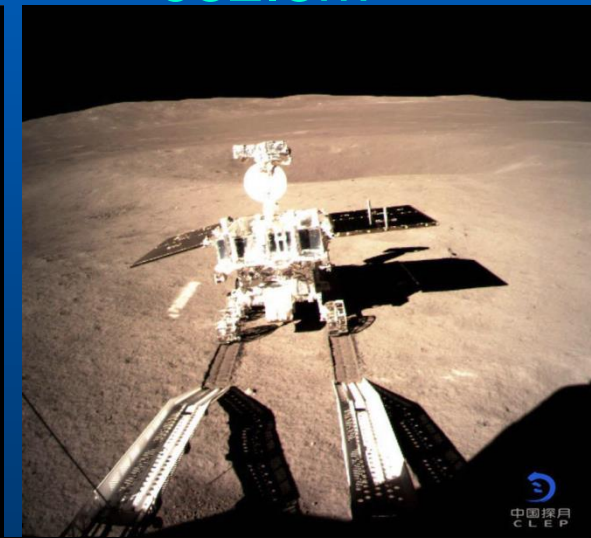
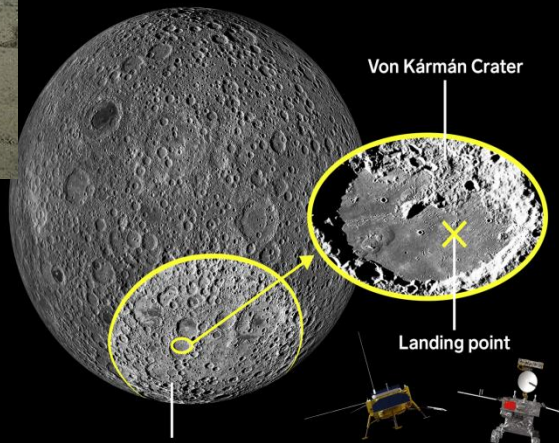
Chang'e 4

Launched-Dec 7th, 2018

Landed Jan 2nd 2019

45.457°S, 177.589°E

China's landing on the far side of the moon



https://en.wikipedia.org/wiki/Chang'e_4

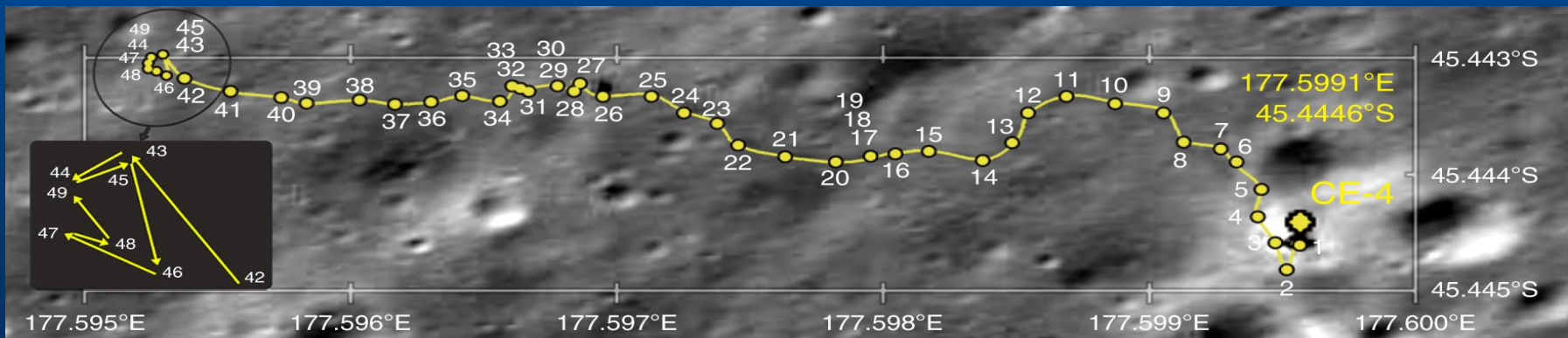
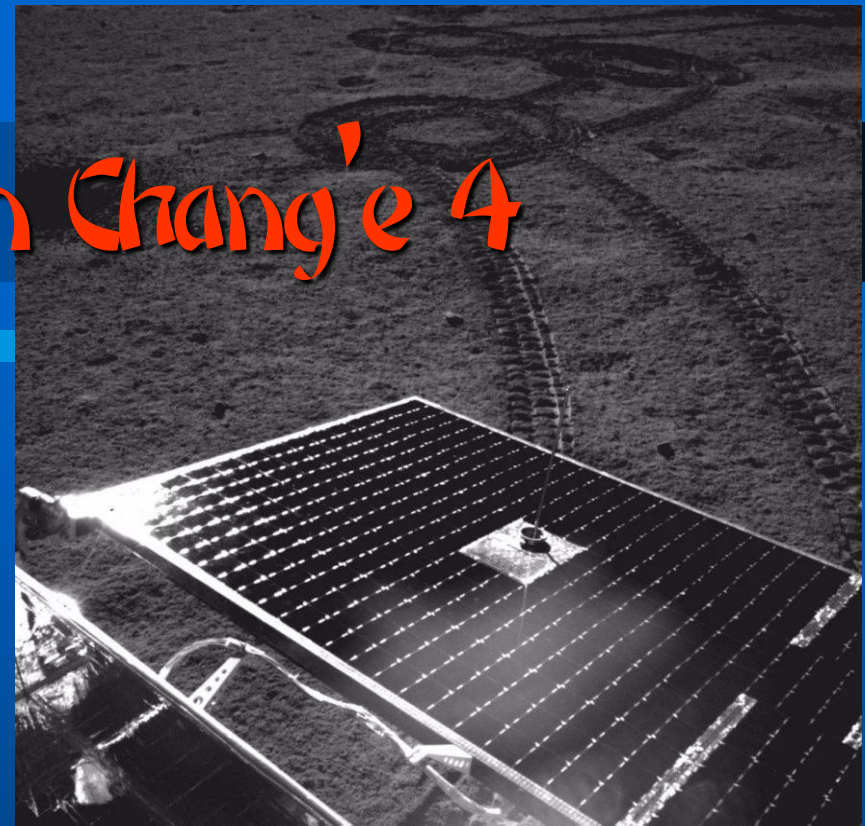
China on the Moon Chang'e 4

Lunar Day 6 in Von Kármán* crater during 3 month mission.

Weight : 140kg

Size : 1.5x1.0x1.0m

* Von Kármán was Xuesen's PHd advisor / mentor



嫦娥五號

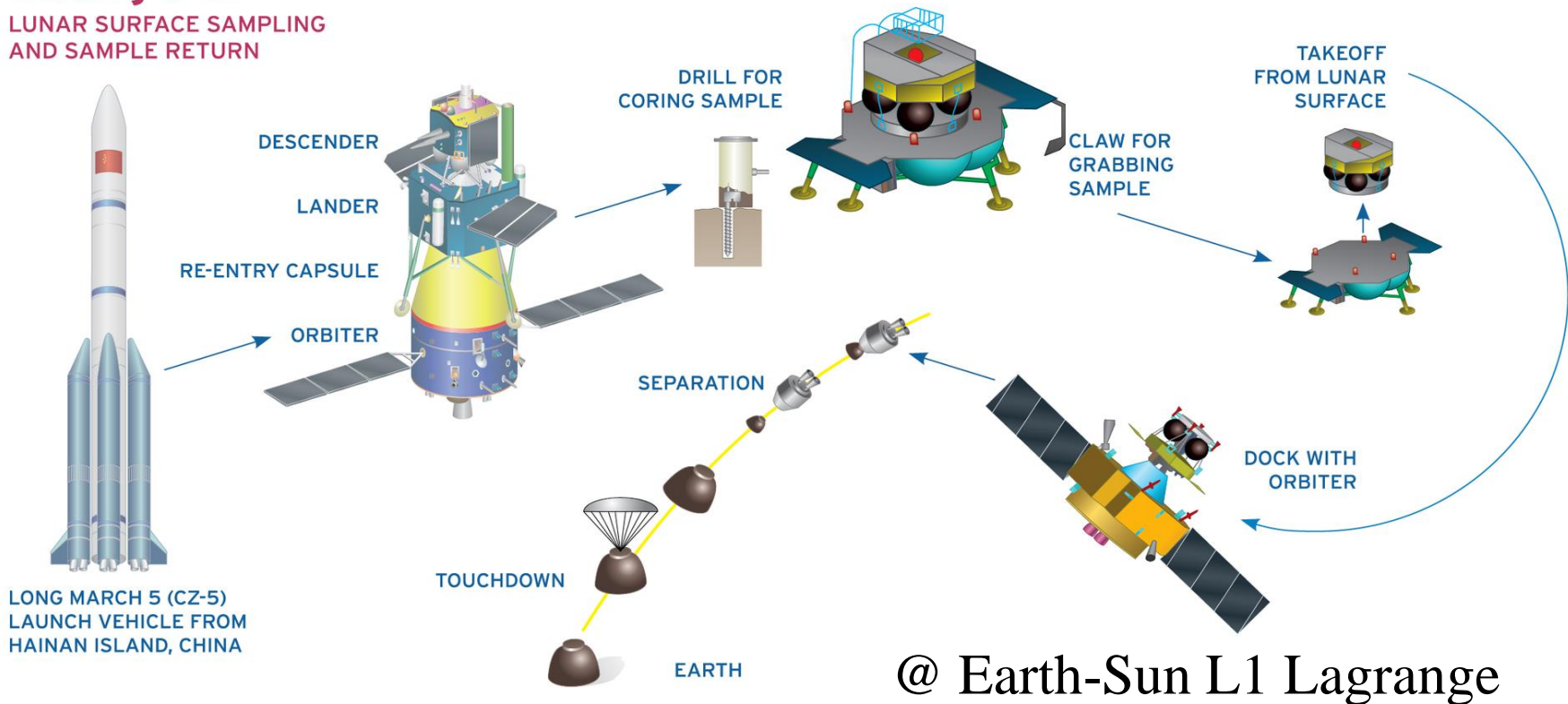
China on the Moon Chang'e 5 & 6

Launch date: November 23rd, 2020 Landed Dec 1, 2020
Oceanus Procellarum
43.06N 51.92 W

Launch 2023??
South Pole
Aitken basin ??

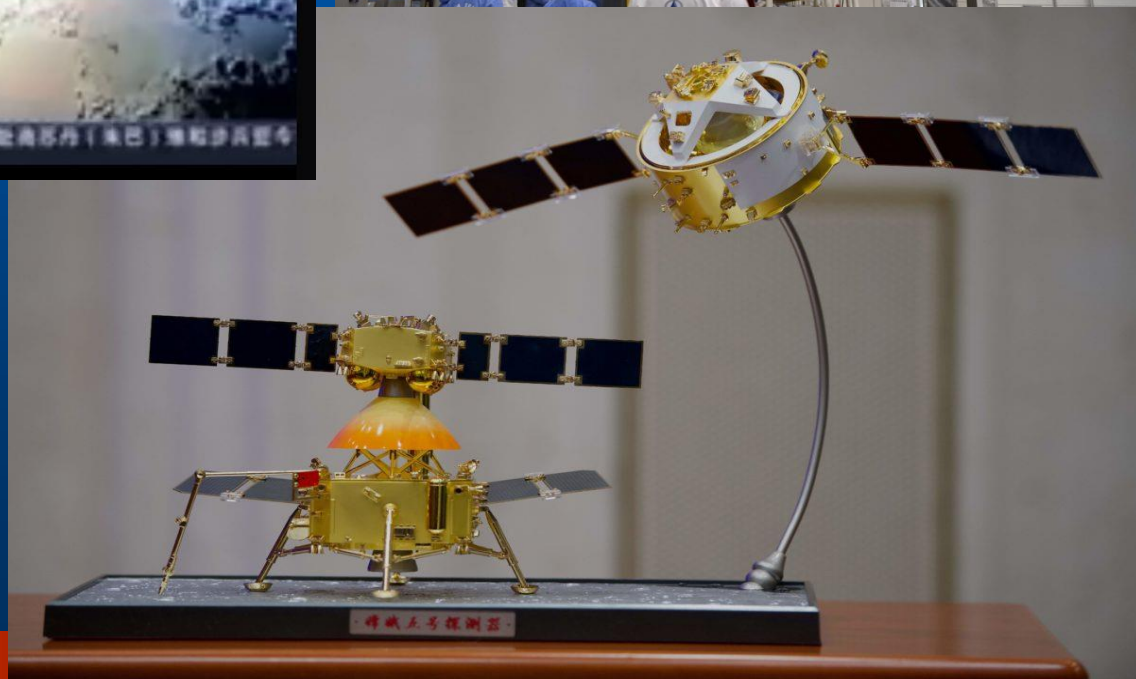
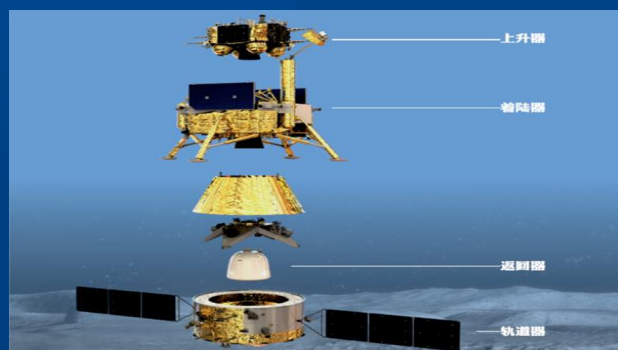
Chang'e-5

LUNAR SURFACE SAMPLING
AND SAMPLE RETURN



Dec 16, 2020 – 1.73 kg sample return

Chang'e 5



Chang'e 5 lunar sample on display



Visitors crowd around Lunar Sample 001, which is on display at the National Museum of China in Beijing, on Feb 27, 2021.

[Photo by Jiang Dong/chinadaily.com.cn]

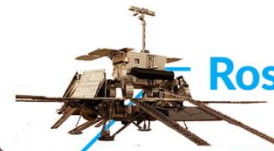
Phoenix

NASA lander
May–Nov 2008



Rosalind Franklin & Kazachok

ESA rover & Russian lander
Landing Apr or Jul 2023



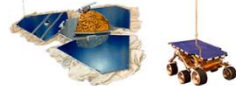
Viking 1

NASA lander
Jul 1976–Nov 1982



Opportunity

NASA rover
Jan 2004–Jun 2018



Pathfinder & Sojourner

NASA lander
Jul–Sep 1997

Viking 2

NASA lander
Sep 1976–Apr 1980



Tianwen-1

Chinese rover
Landing early 2021



Perseverance

NASA rover
Landing Feb 2021



InSight

NASA lander
Nov 2019–present



Curiosity

NASA rover
Aug 2012–present



Spirit

NASA rover
Jan 2004–Mar 2010



MARS LANDINGS Past & Future



Version 1.3 (2020-07-24.1)

China on Mars - Tianwen 1 天問

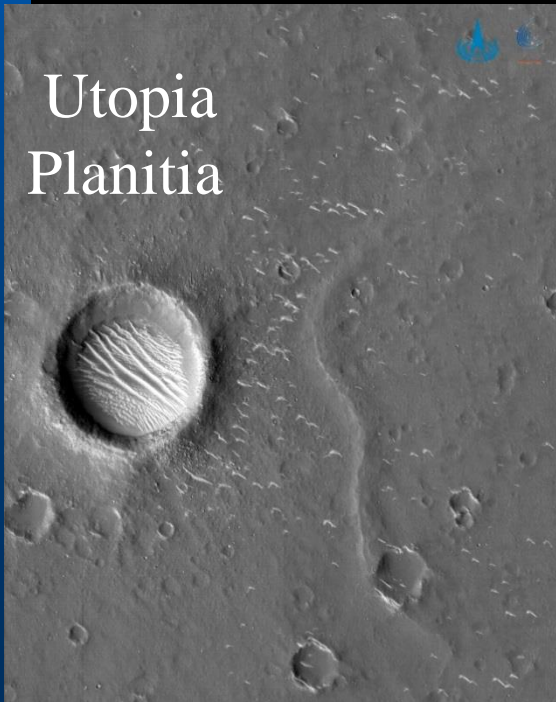
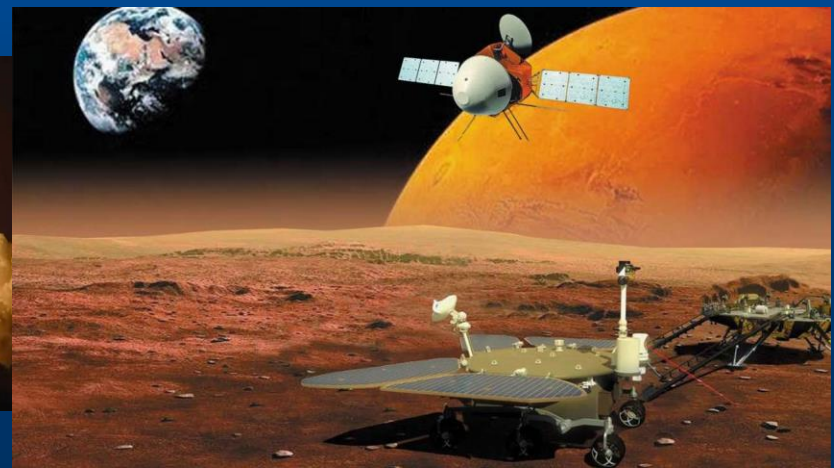
(172 Questions to Heaven
--Qu Yuan ~270 BC)

Launched on a Long March 5
July 23, 2020 from
Wenchang Space Launch Center
5-metric ton probe

Entered Mars orbit: Feb 10th, 2021

Landing : May ??, 2021

Utopia
Planitia



Zhu rong (God of Fire) 祝融

天问一号火星车 (Tianwen-1 Rover) 240 kilograms

Installation locations of instruments

1.85 meters tall

speed of 200 meters-per-hour

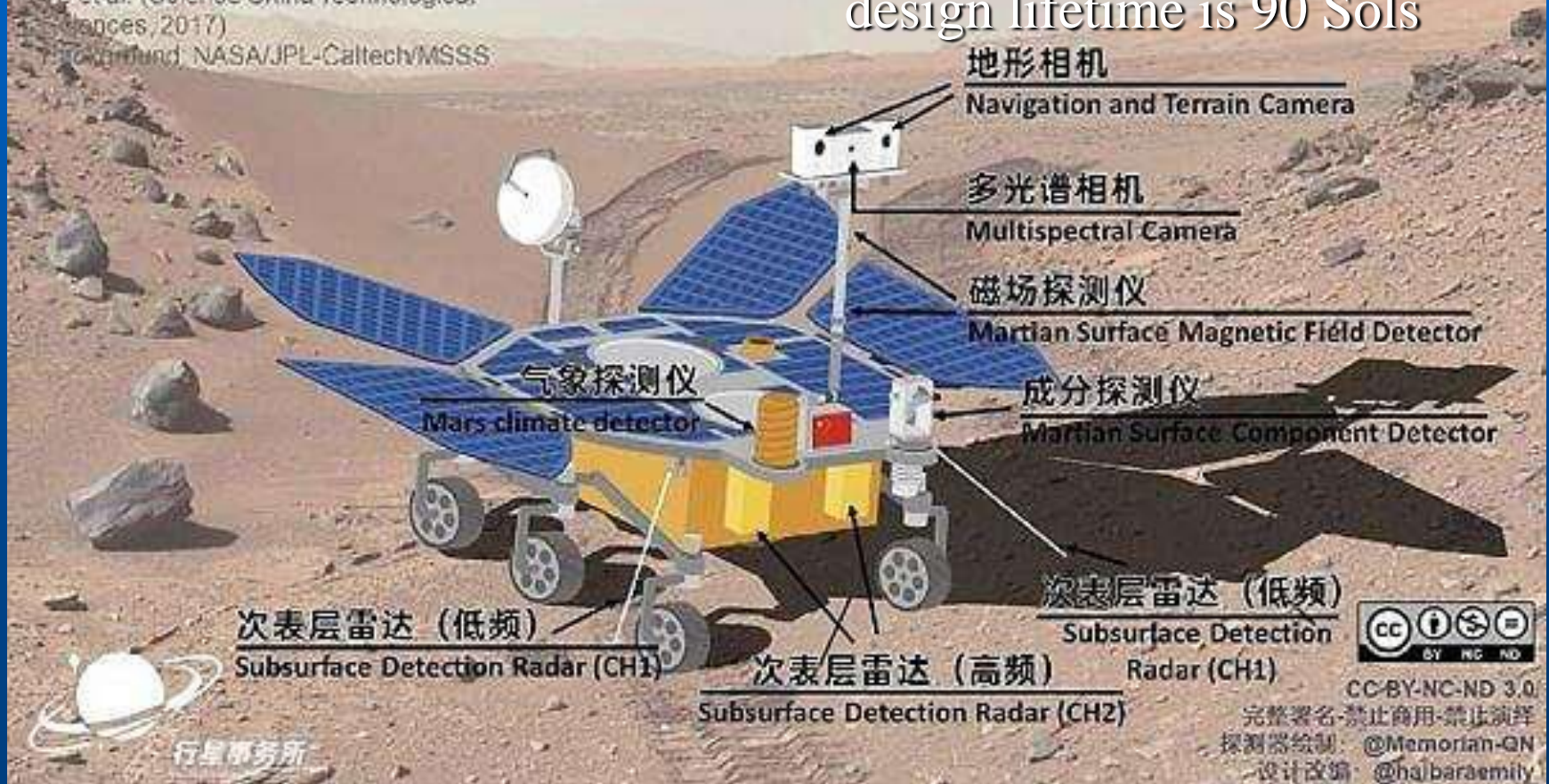
design lifetime is 90 Sols

Reference:

Yan et al. (EPSC, 2019)

Ye et al. (Science China Technological
Sciences, 2017)

Howard et al. NASA/JPL-Caltech/MSSS



Chinese name for Mars, "Huoxing," literally means "fire star."

iSpace Gets to Orbit



Beijing Interstellar Glory Space Tech Ltd.
(iSpace) July 25th, 2019

1st private Chinese Company
ham radio cubesat (CAS-7B)
tech payload for CCTV

3 microsats -- total 260kg sun sync)

Launcher Hyperbola 1 (SQX-1) from Jiuquan Center

4 stage, 3 solid (DF-11, DF-15) 4th liquid fuel

20.8m tall, 1.4m dia, 31 metric tons

Many other Chinese Aerospace Companies (141+) to follow :

Landspace, OneSpace, LinkSpace, Galactic Energy, Spacetrek,
Deep Blue Aerospace, China Rocket, Expace, CAS Space, Geely
Technology Group...



China NewSpace Companies

Chinese Aerospace Companies (141+)

Now bidding on China Station Resupply services

Top Funds raised in 2020
in US Dollars

Charming Globe: \$375 million

iSpace: \$180 million

LandSpace: \$275 million

Galactic Energy: \$30 million

Galaxy Space: (undisclosed)

Commsat: \$40 Million

MAPPING OF CHINA'S NEWSPACE As of June 2019

GENERAL VERSION
JUNE 2019



UPSTREAM

SATELLITE MANUFACTURING



LAUNCHER MANUFACTURING



DOWNSTREAM

SATELLITE OPERATORS



GROUND SEGMENT



TT&C



OTHER



SATELLITE SERVICE PROVIDERS



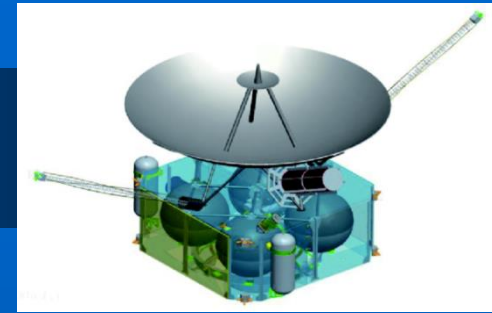
CHINA-AEROSPACE.BLOG

<https://china-aerospace.blog/space-industry-mapping/>

Chinese iSpace company is preparing to test landing legs for its Hyperbola-2 rocket. Photo credit: iSpace



Interstellar Express China To 100 AU and Beyond



To explore further on the dynamics on the heliospheric boundaries, even the hydrogen wall, and the local interstellar medium, Interstellar Heliosphere Probes (IHPs) mission has been proposed to Chinese national space agency (two spacecraft, one to-wards the nose of the heliopause, one opposite). Spacecraft is to reach 100 AU when it is 100th anniversary of the PR China (2049). IHP will allow us to discover, explore, and understand fundamental astrophysical processes in the largest plasma laboratory-- the heliosphere.

Additional Information: Wu Weiren,
Chief designer of China's lunar exploration project
call the ISPAT (62757422, or
e-mail toqgzong@pku.edu.cn).



Wolf Amendment

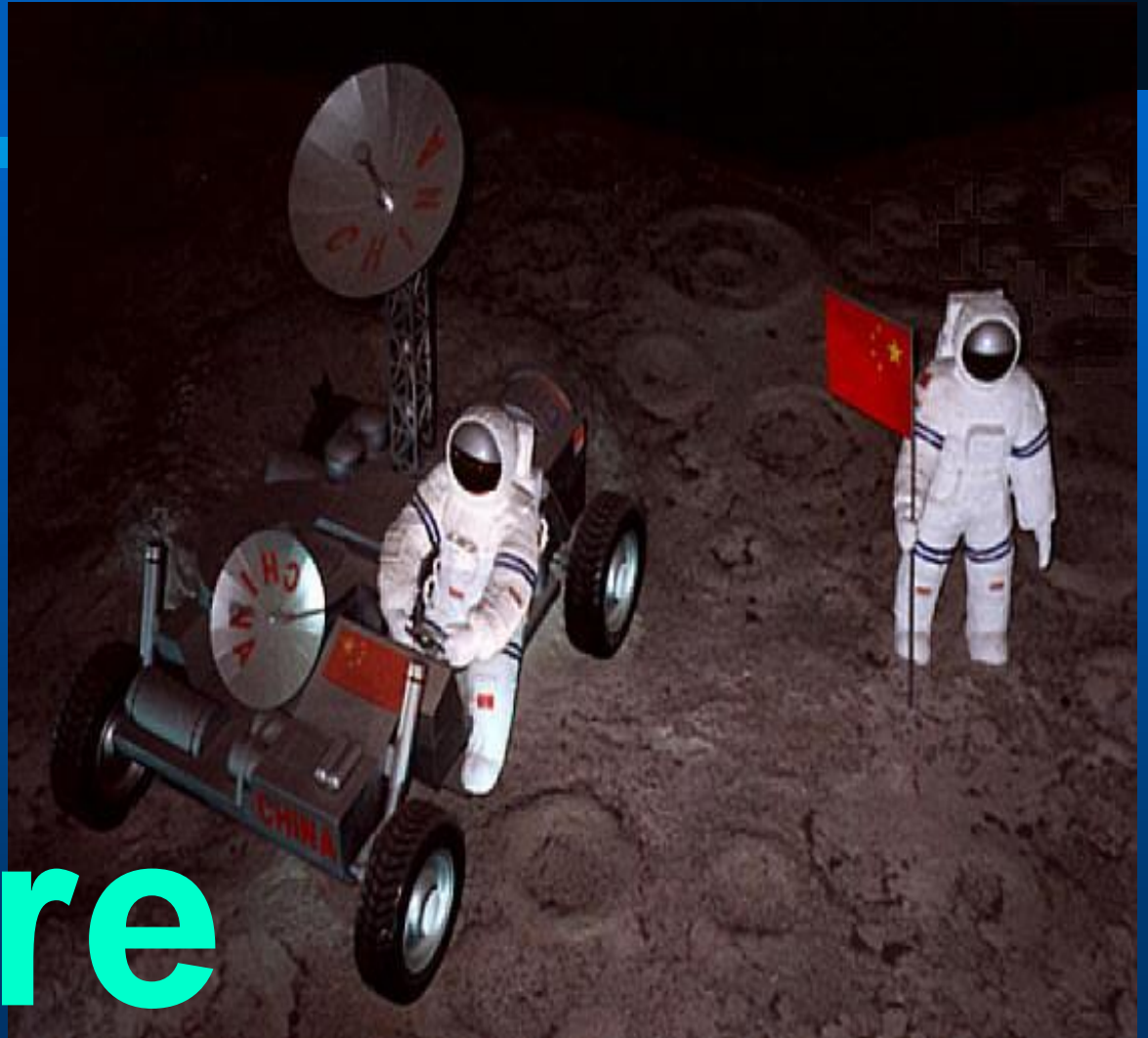


A provision in US law known as the **Wolf Amendment** prohibits most bilateral cooperation between the U.S. and Chinese space programs. The Wolf Amendment is named after former Rep. Frank Wolf, R-Virginia, who first inserted the language into a NASA budget bill in 2011.

But the law does NOT restrict ALL contact between NASA and China's space agency, provided the proposed collaboration **passes a review by the FBI**, and **NASA informs Congress of the exchange at least 30 days ahead of time.**

China on 3/31/21 confirmed it has traded ephemeris data with NASA regarding their respective Mars missions ... "to ensure the flight safety of Mars spacecraft."

Future



Ningbo city (Serene Wave) 宁波市

Zhejiang province

County of Xiangshan, or "Elephant Hill".

Latitude: 29°52' N.

Longitude: 121°33' E.

Home to East Sea Fleet

2nd largest sea cargo port

Announced Apr 8, 2021 :

NEW rocket launch site cost \$3 Billion

35-sq-km launch site

32-sq-km space industrial base

Launch pad

Command center

Assembly and testing facility

100 launches per year.

On line: TBD

94



Guowang

China is developing plans for a 12,992-satellite megaconstellation “Guowang” GW / “state grid” / StarNet satellite internet project.

State Grid 国网

GW to consist of sub-constellations ranging from 500-1,145 kilometers in altitude with inclinations between 30-85 degrees. The satellites would operate across a range of frequency bands.

Recent ITU filings suggest GW is Ka/V/Q band, GW-1 is Ka/L, and GW-2 is a smorgasbord of C/X/Ka/Q/V+ADS-B & AIS.

制表: 邢强	Alt (km)	Incl.	Planes	Sats/plane	Total sats
59-1	590	85°	16	30	480
59-2	600	50°	40	50	2000
59-3	508	55°	60	60	3600
加油! Constellation GW-A59					6080
2-1	1145	30°	48	36	1728
2-2	1145	40°	48	36	1728
2-3	1145	50°	48	36	1728
2-4	1145	60°	48	36	1728
Constellation GW-2					6912
Grand Total:					12992
©小火箭					小火箭



USA
≈ 26 constellations,
17600+ satellites

Number of Constellation projects* per Country (updated on Nov. 2019)



CHINA
≈ 22 constellations,
3500+ satellites



EUROPE
≈ 24 constellations,
2400+ satellites



OTHER
≈ 15 constellations,
1200+ satellites



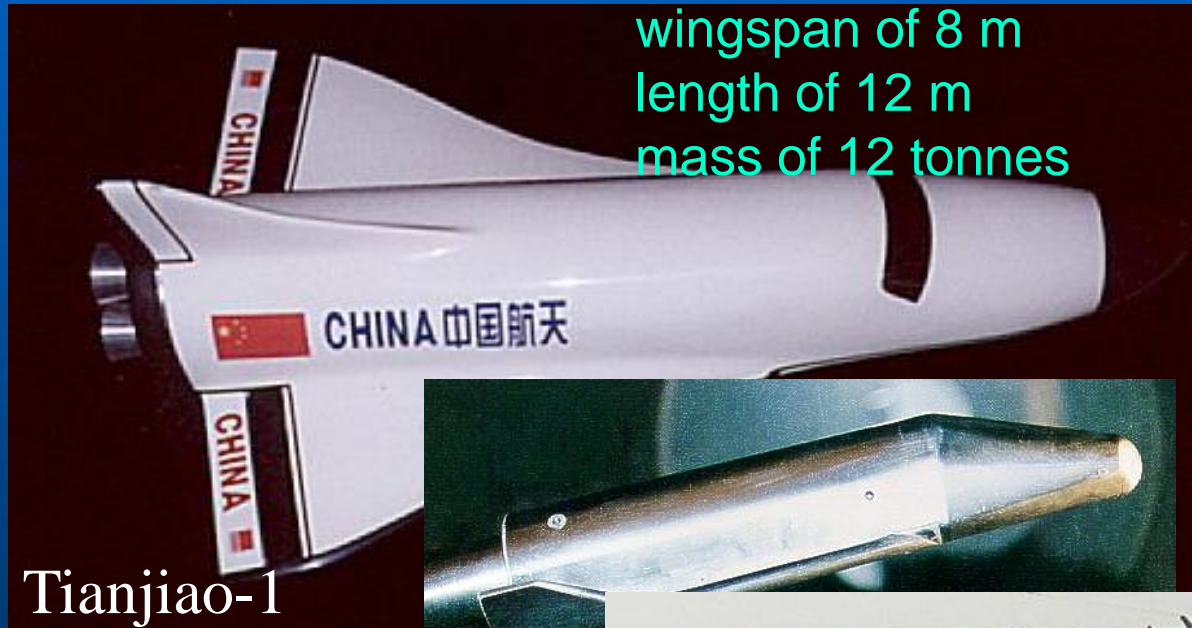
**This infographic intentionally does not include any constellation owned or operated by the military (including GNSS such as GPS, Glonass, Beidou). Classification is based on the incorporation of the company. The scope includes both very early stage/unfunded projects, as well as more mature constellations.*

<https://chinaaerospace.files.wordpress.com/2019/11/constellations-mapping9-1.png>

Space Shuttle 921-3

Shenlong (Divine Dragon)??
(X-37B)

Chongfu Shiyong Shiyang Hangtian Qi - CSSHQ
(Reusable Test Spacecraft)



wingspan of 8 m
length of 12 m
mass of 12 tonnes

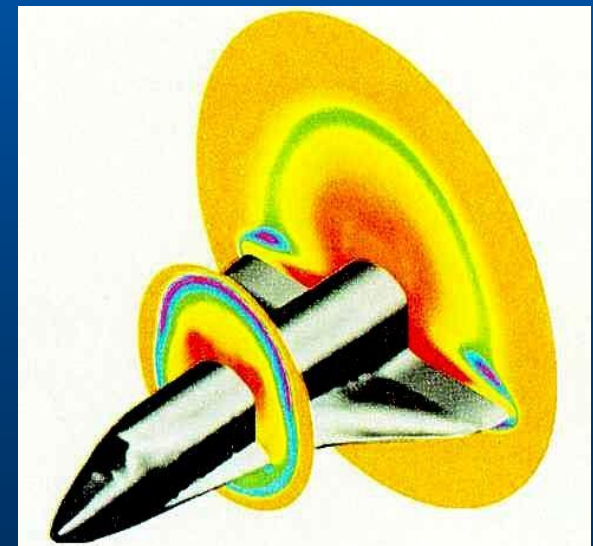
Tianjiao-1

Sept 4-6, 2020

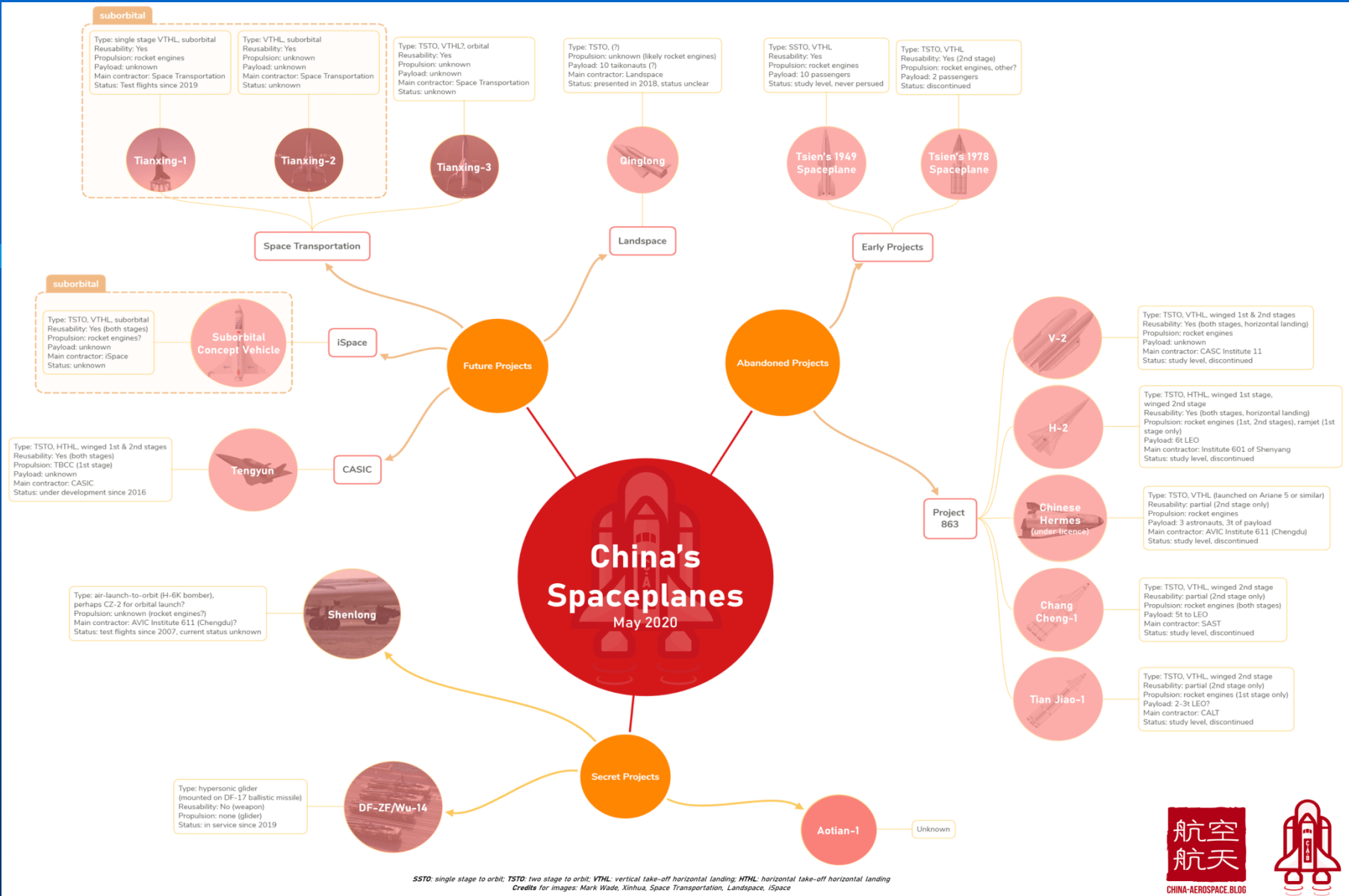
Seats 6, 21.6 ton, 8.8m long

Long March 2F/T booster

Jiuquan Launch, Lop Nur landing 2020-063A

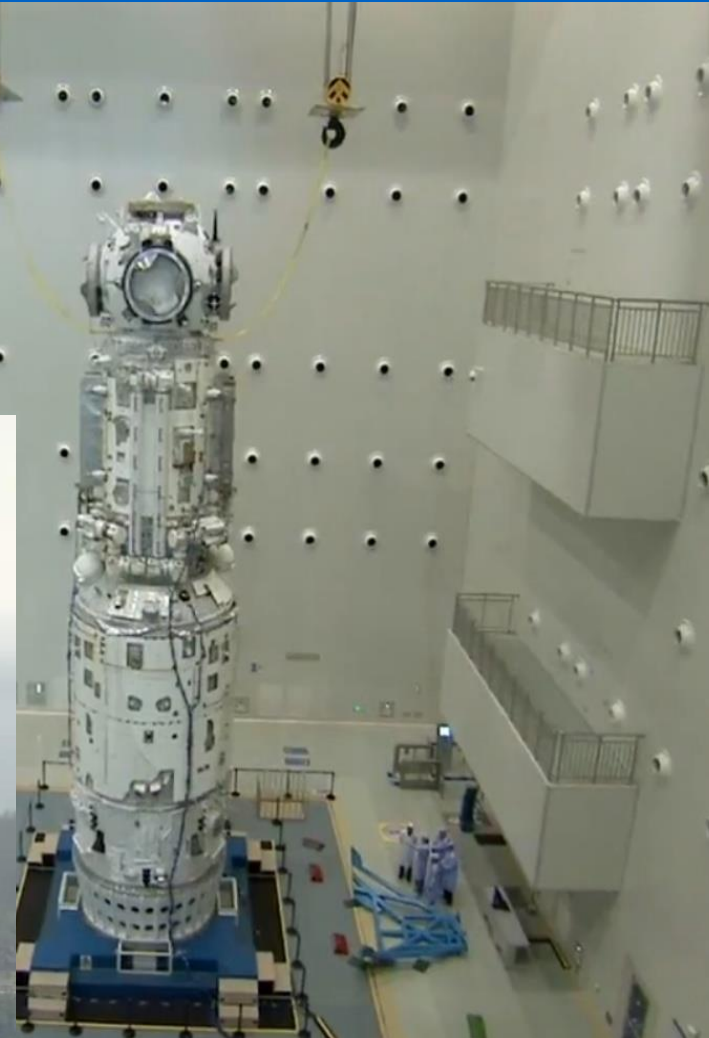
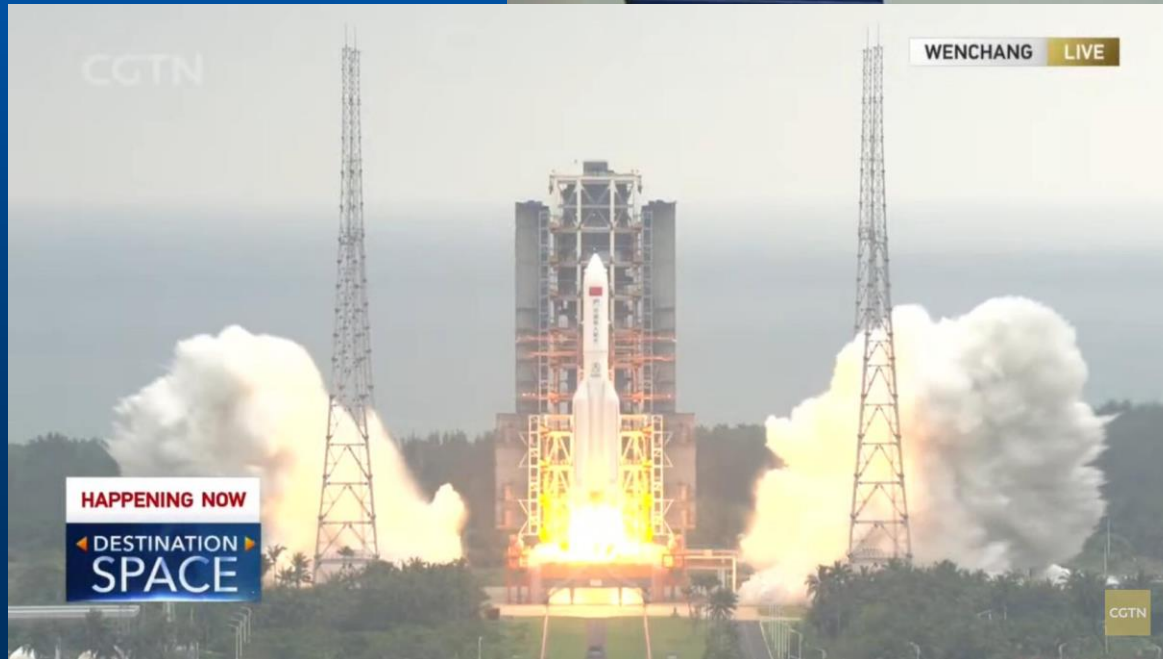


100



<https://chinaaerospace.files.wordpress.com/2020/05/chinas-spaceplanes4-e1588933419164.png>

Space Station 天和 Tianhe (Harmony of the Heavens)



Space Station 921-2 天和 Tianhe [Harmony of the Heavens]



Mengtian
(Dreaming of the Heavens)

Shenzhou-12 crew

Tianhe Core
(Harmony of the Heavens)

Wentian
(Quest for the Heavens)

Tianzhou-2 cargo

4 Crews of 3 taikonauts

11 Launches

3 modules / 4 cargo / 4 crew

Tianhe Core [Long March 5B] April 28, 2021

Tianzhou-2 cargo [Long March 7] May ??

1st crew Shenzhou-12 [Long March 2F] June 10??

2nd crew Shenzhou-13 [Long March 2F] Sept ??

Core Diameter 4.2m

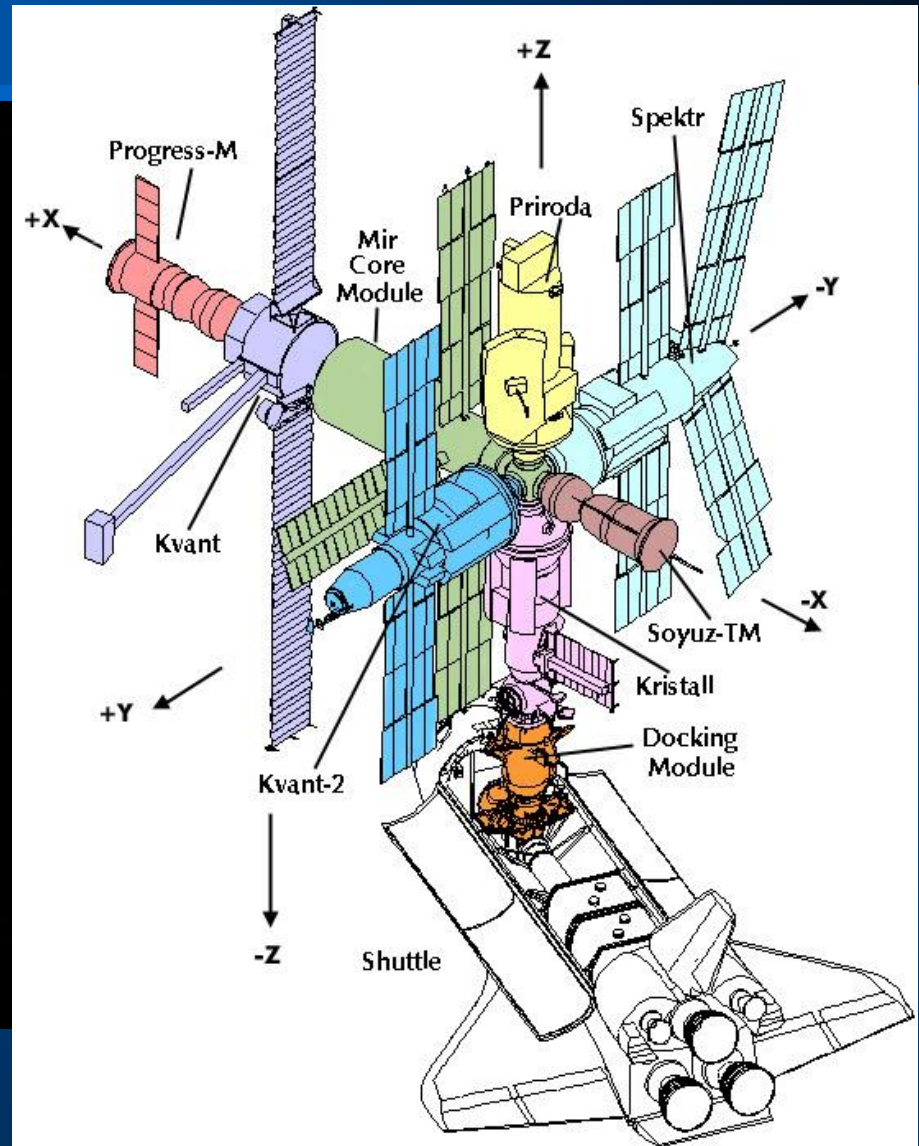
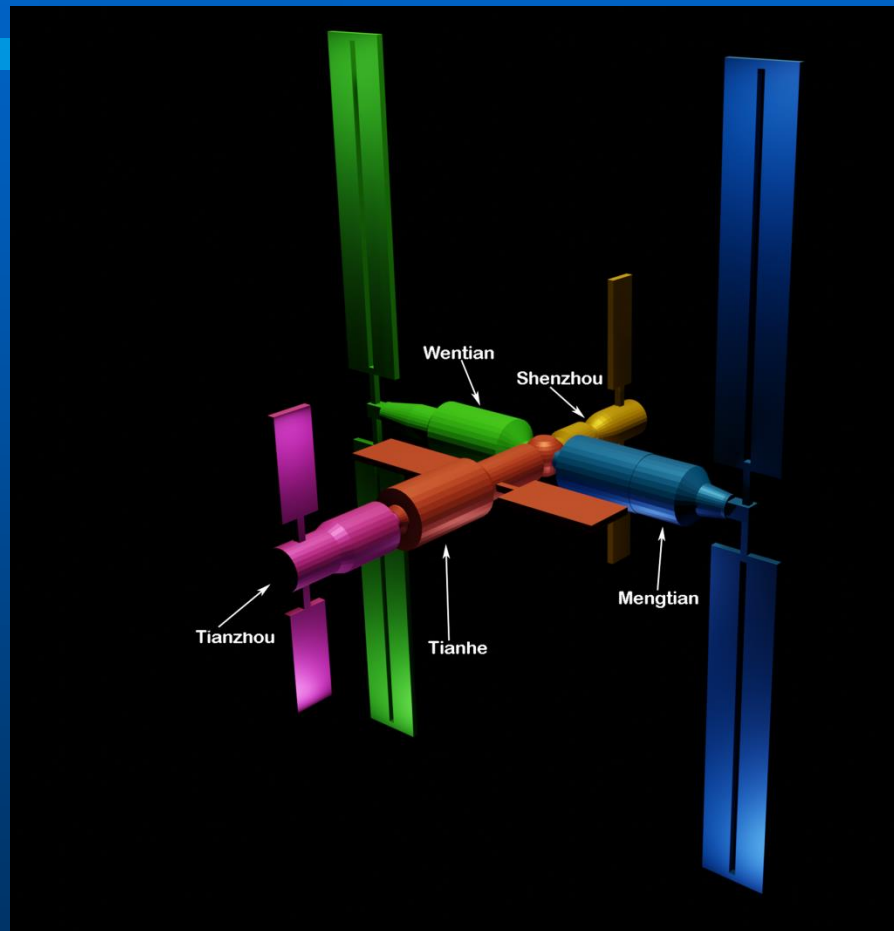
Core Length : 16.6m

Core Mass : 22 tonnes

Orbit Apogee : ~370km

Incl : 41 degree

Wait, that looks familiar...



Chinese Space Station Telescope Xuntian 巡天



Survey the Heavens



China Sky Survey Telescope / Chinese Space Station Telescope (CSST) (Xuntian) 2m primary mirror [HST 2.4m] 2.5 gigapixel camera 300 times Hubble's field of view (~ 13.5 deg?) and will address a wide range of science in the near-ultraviolet and optical wave bands. launching in 2024 to co-orbit with Tianhe station. Also four CSST science centers China wide. Credit: CCSNA

Space Station

天和

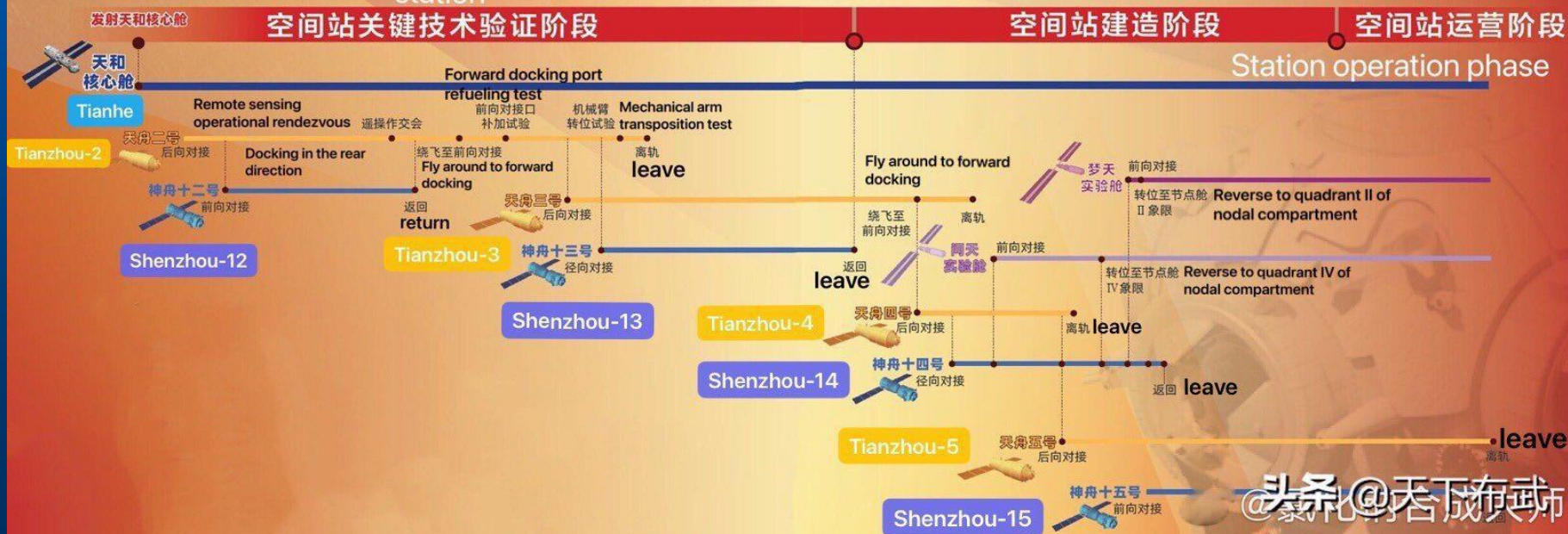
Tianhe (Harmony of the Heavens)

空间站建造阶段全过程

The entire construction phase of the space station

The stage of verifying key technologies for the space station

Station construction phase





CSS (TIANHE-1) - Visible Passes

Search period start: 30 April 2021 00:00

Search period end: 10 May 2021 00:00

Orbit: 352 x 385 km, 41.5° (Epoch: 30 April)

Passes to include: ☒ visible only ☐ all

Click on the date to get a star chart and other pass details.

Date	Brightness (mag)	Start			Highest point			End			Pass type
		Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.	
30 Apr	?	04:30:34	21°	NNE	04:30:34	21°	NNE	04:31:53	10°	NE	visible
30 Apr	?	06:04:40	10°	NW	06:05:58	12°	NNW	06:07:15	10°	NNE	visible
01 May	?	05:00:26	16°	NNW	05:00:46	17°	NNW	05:02:53	10°	NNE	visible
02 May	?	05:31:57	10°	NNW	05:32:39	11°	N	05:33:21	10°	N	visible
03 May	?	04:27:45	13°	N	04:27:45	13°	N	04:28:46	10°	NNE	visible
05 May	?	05:29:26	10°	N	05:30:11	11°	N	05:30:54	10°	NNE	visible
06 May	?	05:59:16	10°	NNW	06:01:22	17°	NNE	06:03:28	10°	ENE	visible
07 May	?	04:53:54	10°	NNW	04:55:12	12°	N	04:56:30	10°	NE	visible
08 May	?	05:23:31	10°	NNW	05:26:00	21°	NNE	05:28:26	10°	ENE	visible
09 May	?	04:18:55	13°	N	04:19:32	14°	NNE	04:21:18	10°	NE	visible
09 May	?	05:53:17	10°	NW	05:56:21	61°	NNE	05:59:22	10°	ESE	visible

10 May	?	04:48:09	17°	NNW	04:49:55	28°	NNE	04:52:38	10°	E	visible
11 May	?	05:17:39	18°	WNW	05:19:50	83°	SSW	05:22:54	10°	SE	visible
12 May	?	04:15:39	13°	E	04:15:39	13°	E	04:16:04	10°	E	visible
12 May	?	05:47:31	12°	W	05:49:19	19°	SW	05:51:36	10°	S	visible
12 May	?	20:36:53	10°	S	20:38:49	16°	SE	20:40:46	10°	E	visible
12 May	?	22:11:59	10°	WSW	22:12:47	16°	W	22:12:47	16°	W	visible
13 May	?	21:05:01	10°	SW	21:08:00	66°	SE	21:10:43	12°	ENE	visible
13 May	?	22:42:17	10°	WNW	22:42:34	11°	WNW	22:42:34	11°	WNW	visible
14 May	?	21:34:29	10°	W	21:37:15	33°	NNW	21:39:51	11°	NE	visible
15 May	?	20:26:57	10°	WSW	20:29:57	78°	NNW	20:33:00	10°	NE	visible
15 May	?	22:04:43	10°	NW	22:06:36	15°	NNW	22:08:19	11°	NNE	visible
16 May	?	20:56:24	10°	W	20:58:57	24°	NNW	21:01:31	10°	NE	visible
17 May	?	21:26:33	10°	NW	21:28:02	13°	NNW	21:29:30	10°	NNE	visible
19 May	?	20:47:50	10°	NNW	20:48:48	11°	N	20:49:47	10°	N	visible



CSS (TIANHE-1) - Pass Details

[Home](#) | [Ground track](#) | [Info](#) | [Orbit](#) | [Close encounters](#)

Click on the chart to zoom in on that part of the sky

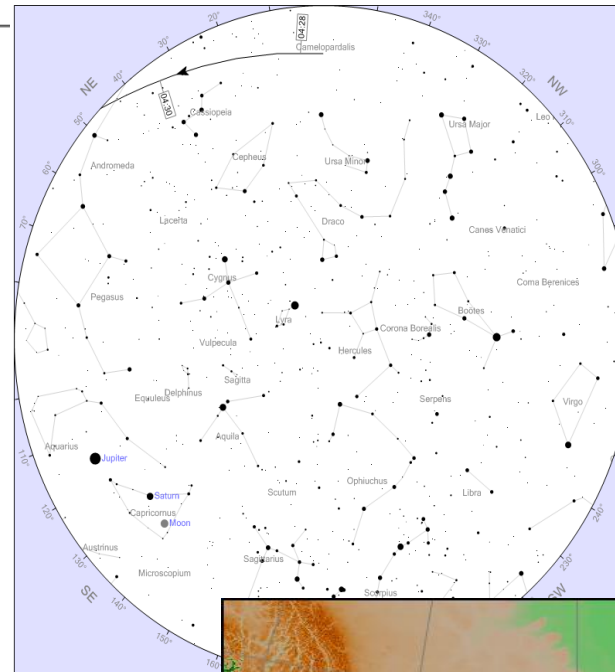
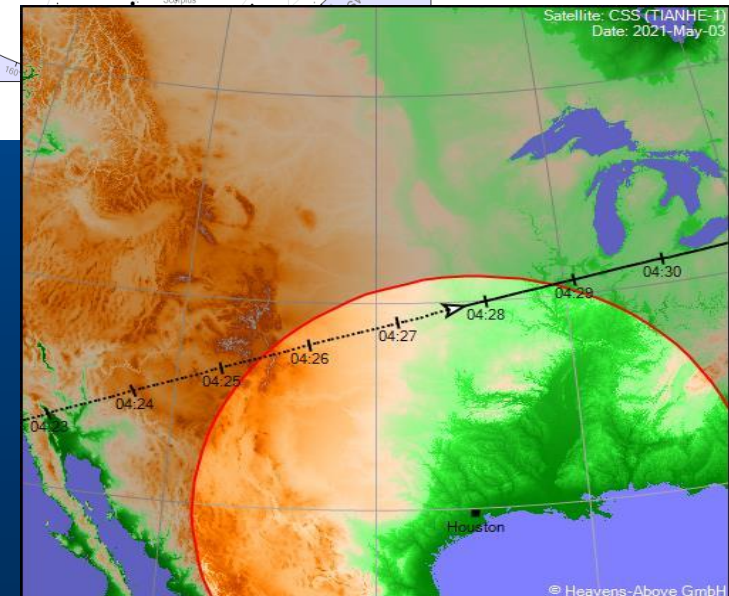


Chart size 800 (500 - 1600)

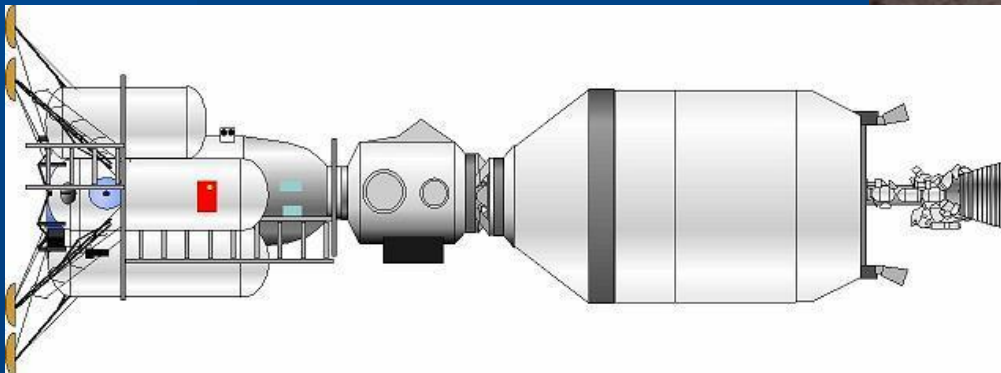
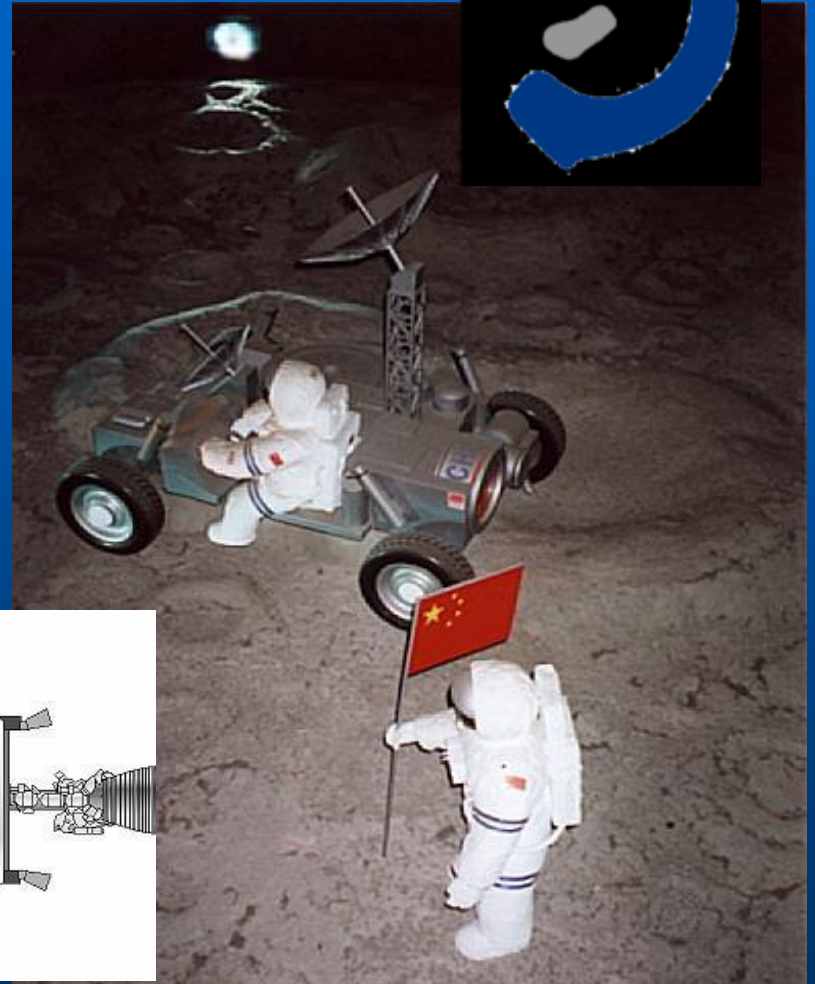
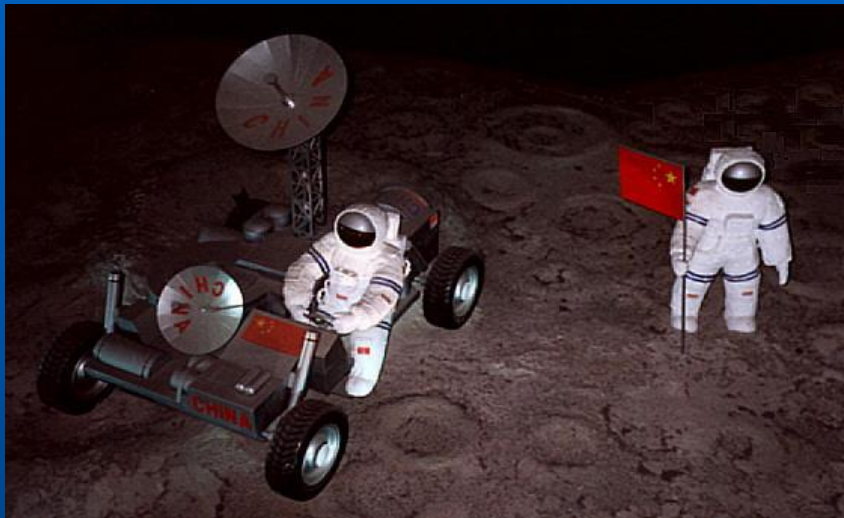
Date: 03 May 2021



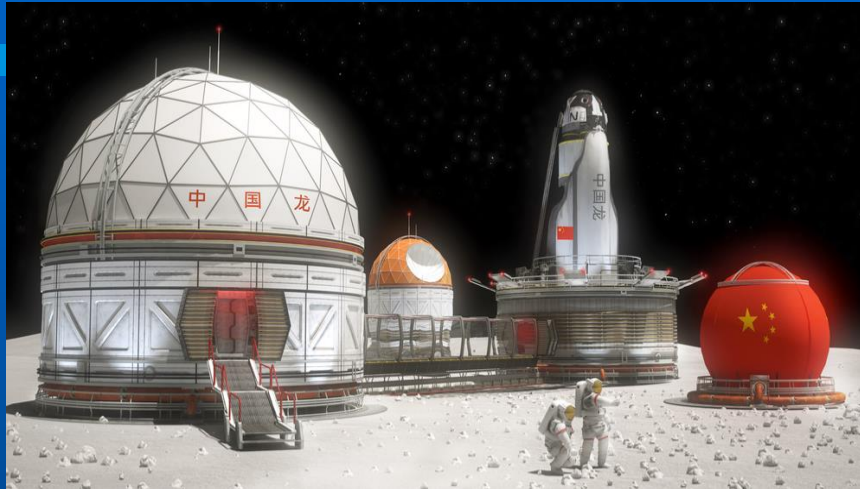
© Heavens-Above GmbH

User: benhuset [Logout](#)
Location: Houston
(29.7604°N, 95.3698°W)
Time: 18:41:57
(UTC-05:00)
Language: English

China on the Moon Chang'e



China on the Moon 2030s ???



Russia and China have formally invited countries and international organizations to join the International Lunar Research Station (ILRS) project



Credit: CNSA/CLEP

<https://spacenews.com/china-russia-open-moon-base-project-to-international-partners-early-details-emerge>

MARS Qaidam Training Camp

China's Mars Camp in Qaidam Basin, Qinghai Province



<https://www.humanmars.net/2019/03/chinas-mars-camp-in-qaidam-basin.html>

C-Space MARS Base i Training Camp

Gobi Desert -- Jinchang, Gansu Province

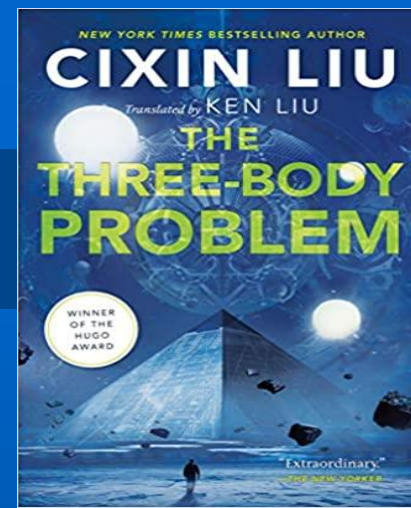
**CHINA'S MARS
SIMULATION BASE**



Thanks to ...

- Mark Wade
- Chen Lan
- Jim Oberg
- Sven Grahm
- Yang Liwei
- https://en.wikipedia.org/wiki/Chinese_space_program
- Wan Hu

Go Read

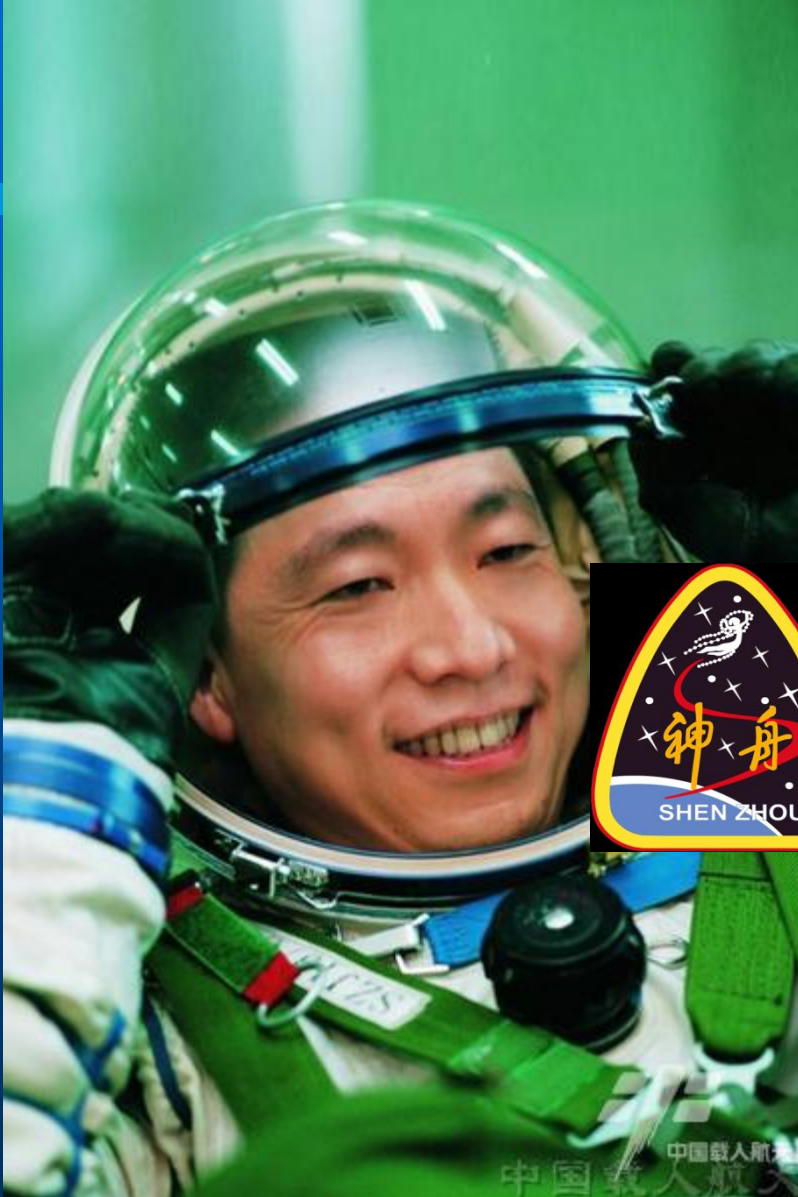


See on Netflix



Questions ?





Yang Liwei, 航天员杨利伟

Male, born in June 1965, a member of the Communist Party of Suizhong County, Liaoning Province.



From October 15 to 16, 2003, he carried out the Shenzhou V manned mission.

Awarded the title of "Space Hero".



Jing Haipeng, 航天员景海鹏

Male, born in October 1966, a native of Yuncheng City, Shanxi Province, and a member of the Communist Party.



The Shenzhou 7 manned mission was carried out from September 25 to 27, 2008;



The Shenzhou 9 manned mission was carried out from June 16 to 29, 2012;



The Shenzhou 11 mission was carried out from October 17 to November 18, 2016

Awarded title of "Heroic Astronaut".



Nie Haisheng, 航天员聂海胜

Male, born in September 1964, from Zaoyang City, Hubei Province, a member of the Communist Party.

The Shenzhou VI manned mission was carried out from October 12 to 16, 2005;

The Shenzhou 10 manned mission was performed from June 11 to 26, 2013

Shenzhou 12 ??? June 2021

Awarded title of "Heroic Astronaut".



Fei Junlong, 航天员费俊龙

Male, born in May 1966,
from Kunshan City, Jiangsu Province,
a member of the Communist Party.

From October 12 to 16, 2005, he
carried out the Shenzhou VI manned
mission

Awarded title of "Heroic Astronaut".

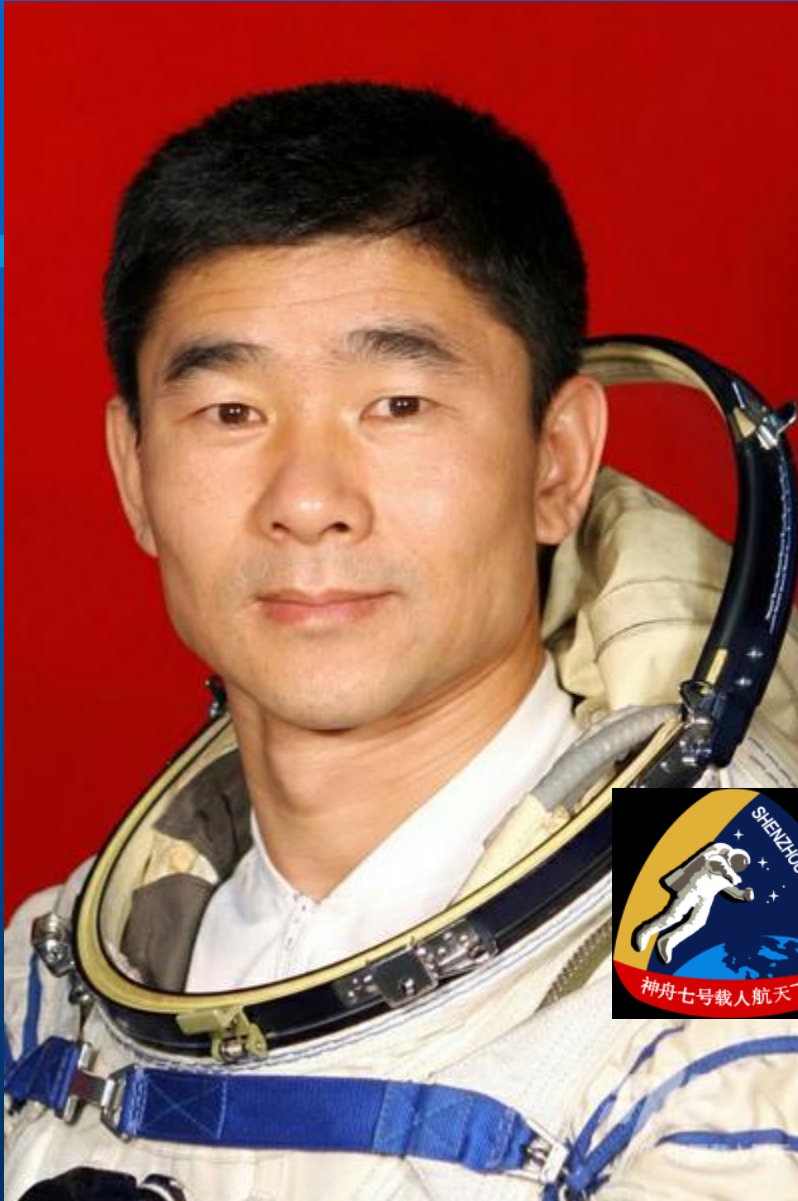


Zhai Zhigang, 航天员翟志刚

Male, born in October 1966, a member of the Communist Party of Longjiang County, Heilongjiang Province.

From September 25 to 27, 2008, he performed the manned mission of Shenzhou VII

Awarded the title of "Space Hero".



Liu Boming, 航天员刘伯明

Male, born in September 1966,
a member of the Communist Party
of Yi'an County, Heilongjiang
Province.

From September 25 to 27, 2008, he
performed the manned mission of
Shenzhou VII

Awarded title of "Heroic Astronaut".



Liu Wang, 航天员刘旺

Male, born in March 1969, is a member of the Communist Party of Pingyao County, Shanxi Province.

From June 16 to 29, 2012, he performed the manned mission of Shenzhou 9

Awarded title of "Heroic Astronaut".

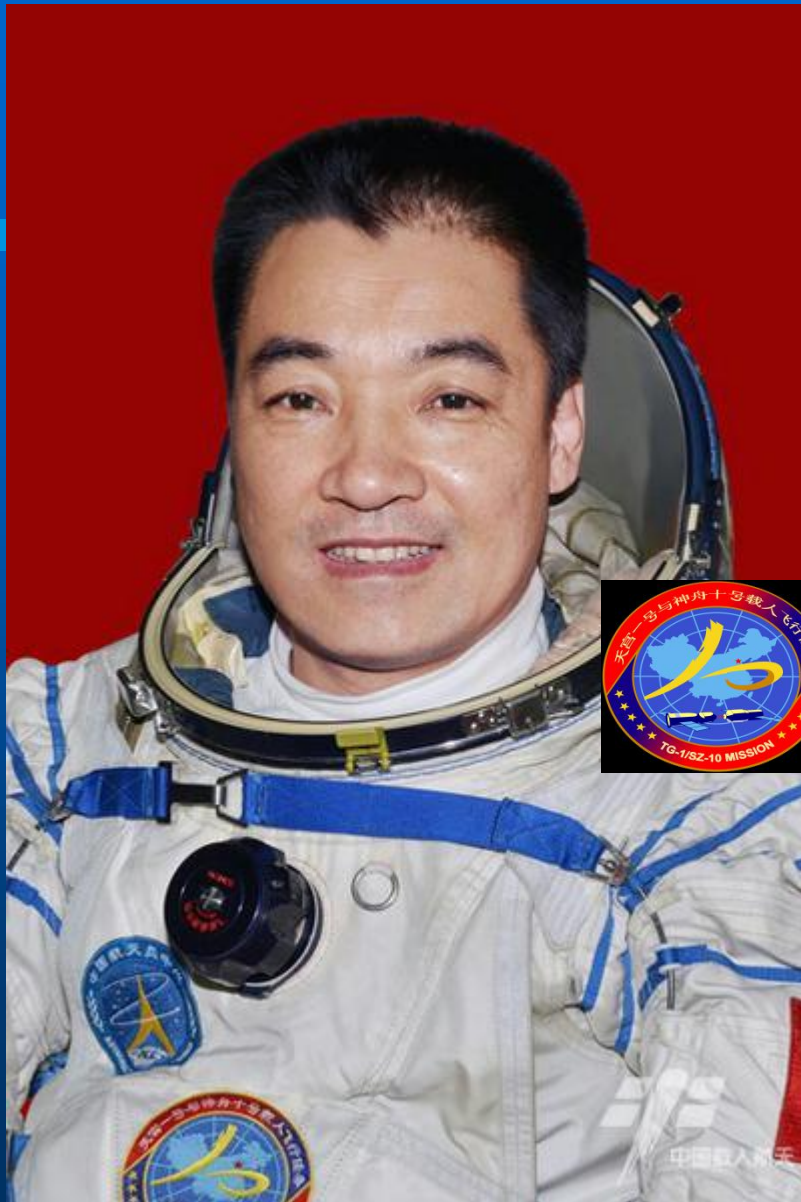


Liu Yang, 航天员刘洋

Female, born in October 1978, a native of Linzhou City, Henan Province, a member of the Communist Party.

From June 16 to 29, 2012, she performed the manned mission of Shenzhou 9

Awarded title of "Heroic Astronaut".

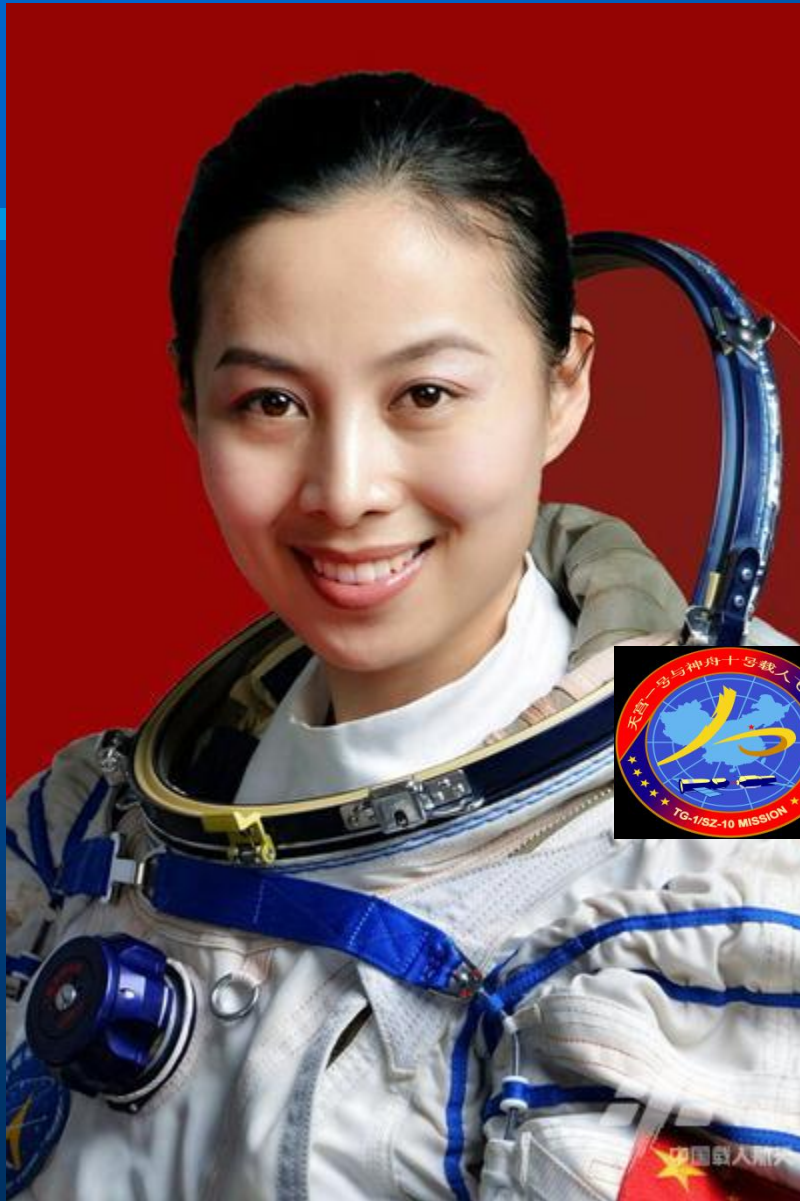


Zhang Xiaoguang, 航天员张晓光

Male, born in May 1966, a native of Jinzhou City, Liaoning Province, a member of the Communist Party.

From June 11th to 26th, 2013, he performed the manned mission of Shenzhou 10

Awarded title of "Heroic Astronaut".



Wang Yaping 航天员王亚平

Female, born in January 1980, from Yantai City, Shandong Province, and a member of the Communist Party.

From June 11th to 26th, 2013, she performed the manned mission of Shenzhou 10

Awarded the title of "Heroic Astronaut".



Chen Dong, 航天员陈冬

Male, born in December 1978, was born in Zhengzhou City, Henan Province and a member of the Communist Party.

From October 17th to November 18th, 2016, he carried out the Shenzhou 11 manned mission

Awarded title of "Heroic Astronaut".