

Planetary Exploration of China

-- Tianwen-1 (天问), Mars

X. Deng

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Declaration

- It can not be a comprehensive presentation
- All material in the talk is publicly available (mostly from Wikipedia)
- I was not involved in any part of this project
- No confidential information from any of my friends or classmates
- Not trying to influence anyone, just to share some information

Planetary Exploration of China

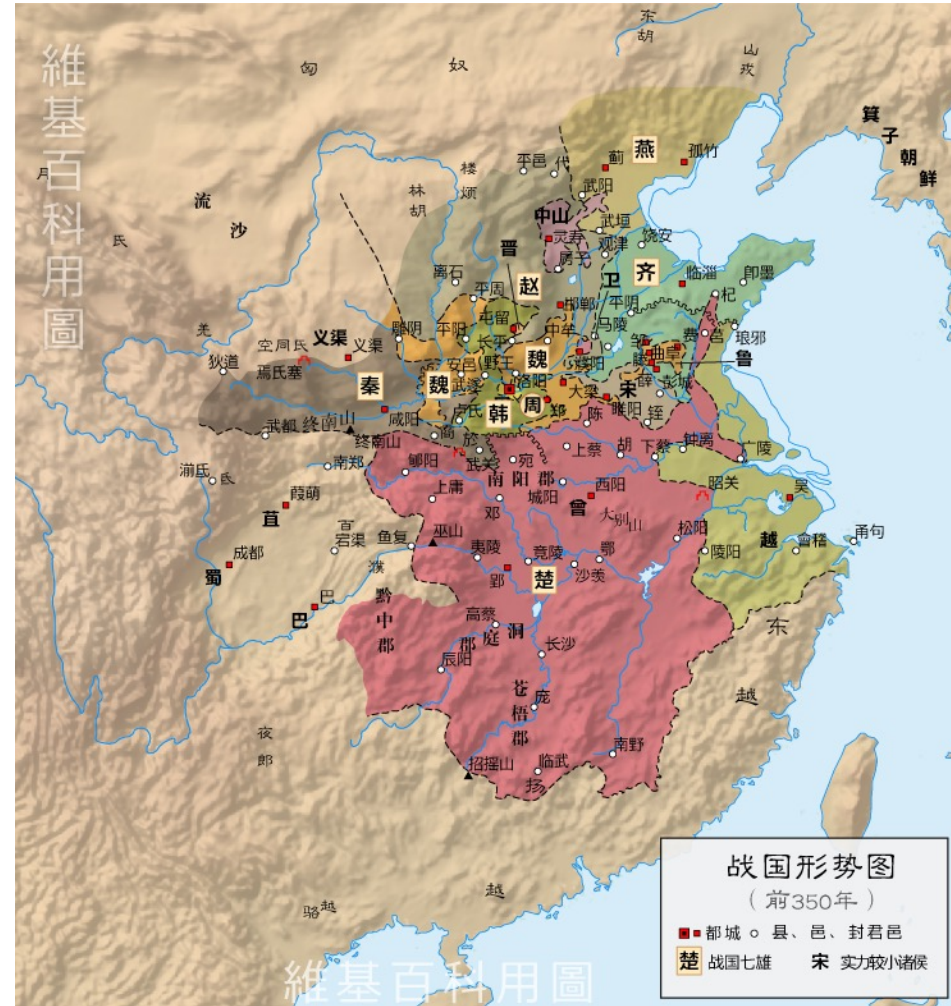
- The **Planetary Exploration of China** (PEC; [Chinese](#): 中国行星探测; [pinyin](#): *Zhōngguó Xíngxīng Tàncè*), also known as **Tianwen** ([Chinese](#): 天问; [pinyin](#): *Tiānwèn*; [lit.](#) 'Questions to Heaven'), is the [robotic interplanetary spaceflight](#) program conducted by the [China National Space Administration](#) (CNSA). It aims to explore planets of the Solar System.
- The first mission of the program, [Tianwen-1](#) Mars exploration mission, began on July 23, 2020. A spacecraft, which consisted of an **orbiter**, a **lander**, and a **rover**, was launched at that day by a [Long March 5](#) rocket from [Wenchang](#).
 - The rover: **Zhurong** ([Chinese](#): 祝融; [pinyin](#): *Zhùróng*) is a [Mars rover](#) that is the [People's Republic of China](#)'s first rover to land on another planet (they had previously landed [two rovers](#) on the [Moon](#)).

Future missions

- **Near-Earth asteroid sample-return and main-belt comet orbiter mission**
 - Planned to launch at 2025
- **Mars sample-return mission**
 - Planned to launch at 2028
- **Mars crewed mission**
 - Planned for 2033, 2035, 2037, 2041 and will shift to sustaining presence on Mars in near future.
- **Jupiter system exploration mission**
 - Likely be launched in 2029 and arrive at the Jovian system in 2035

Meaning of Tianwen

- The program's name "Tianwen", which literally means "questions to heaven", derived from [the eponymous poem](#) by the famous ancient poet [Qu Yuan](#) of the state of [Chu](#) during the [Warring States period](#) (475–221 BC).
- The name represents the Chinese people's relentless pursuit of truth, the country's cultural inheritance of its understanding of nature and universe, as well as the unending explorations in science and technology.

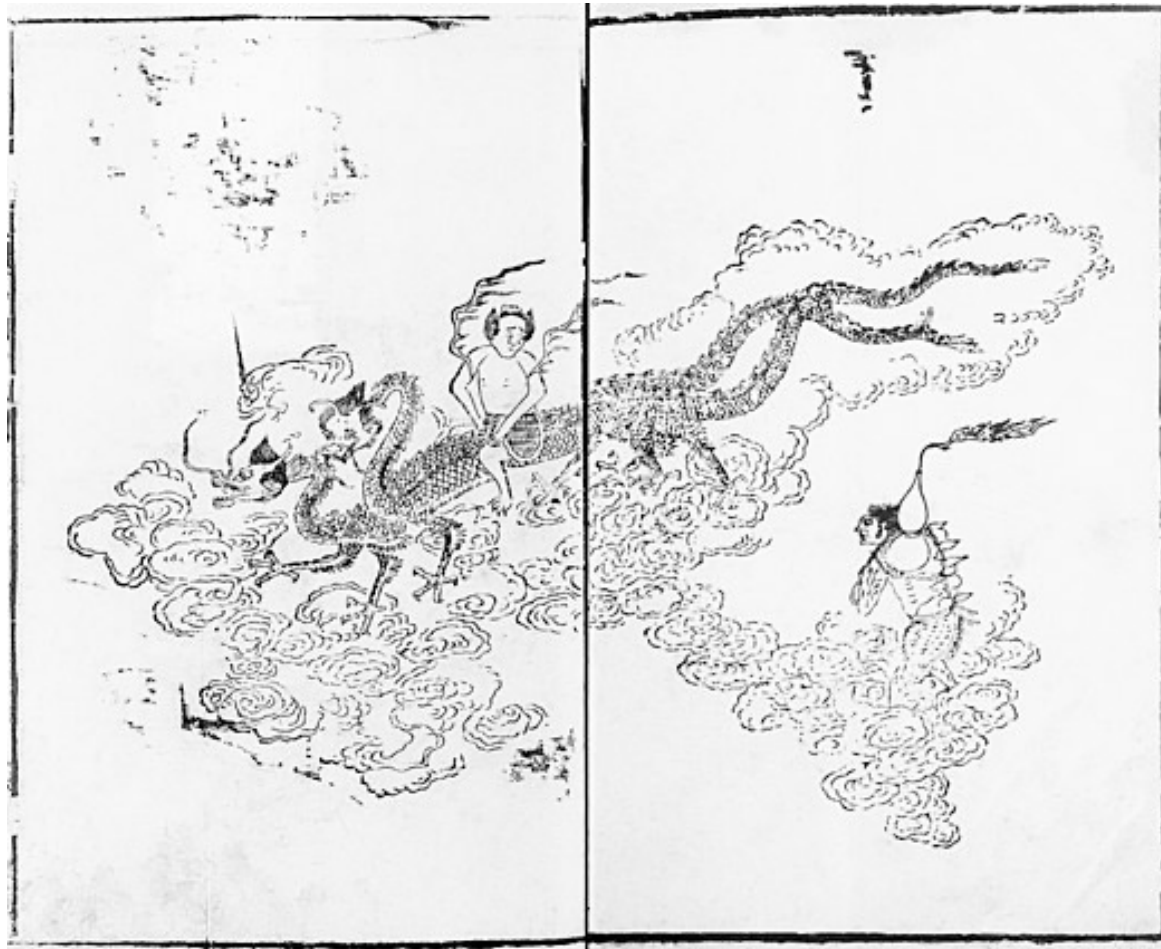


Meaning of Tianwen

- 明明暗暗，惟时何为？阴阳三合，何本何化？
 - Brightness became bright and darkness dark; What has caused them to be like this? Yin and yang commingle; What was basic, what transformed?
- 天何所沓，十二焉分？日月安属，列星安陈？
 - Upon what are the **heavens** folded? Where are the twelve stages divided? How are the **sun** and **moon** attached? How are the constellations arrayed?
- 出于汤谷，次于蒙汜？自明及晦，所行几里？
 - The **sun** emerges from the morning vale, It comes to rest on the crepuscular **horizon**. From dawn until dusk, How many miles does it travel?
- 夜光所德，死则又育？厥利维何，而顾菟在腹？
 - What virtue hath the **moon**, That it dies and then is reborn again? What benefit is there To harbor a bunny in its belly?
- 何阖而晦，何开而明？角宿未旦，曜灵安藏？
 - What closes and brings darkness? What opens and brings light? Before the Horn rises in the east, Where does the numinous **sunlight** hide?

Meaning of Zhurong

- Zhurong is named after [a Chinese mytho-historical figure](#) usually associated with fire and light, as Mars is called "the Planet of Fire" (Chinese: 火星) in China and some other countries in East Asia.
- The name was chosen with meaning of "ignite the fire of interstellar exploration in China and to symbolize the Chinese people's determination to explore the stars and to uncover unknowns in the universe".



Zhurong riding two dragons, depicted in the *Classic of Mountains and Seas* (Chinese: 山海经), 1597 edition

Tianwen-1 timeline

Mission	Launch date (UTC)	Launch site	Launch vehicle	Spacecraft	Orbital insertion date (UTC)	Landing date (UTC)	Landing location	Operational time	Status
Tianwen-1	July 23, 2020 04:41:15	Wenchang	Long March 5	Tianwen-1 orbiter	February 10, 2021 11:52	–	–	465 days	Operational
				Tianwen-1 lander		May 14, 2021 23:18	Utopia Planitia 25.1°N 109.9°E	3 hours	Success
				Zhurong rover				371 days	Operational

Launch of Tianwen-1

- Tianwen-1 was launched at **23 July 2020**
- NASA JPL also launched its Mars 2020 at **30 July 2020**
- [United Arab Emirates Space Agency uncrewed space exploration](#) mission launched its **Hope** orbiter to Mars at **19 July 2020**
- Why all Mars exploration projects choose July 2020 to launch?
 - The minimum-energy [launch windows](#) for a Martian expedition occur at intervals of approximately two years and two months (specifically 780 days, the planet's [synodic period](#) with respect to Earth). In addition, the lowest available transfer energy varies on a roughly 16-year cycle.

Launch opportunities 2013–2022^{[14][15]}

Year	Window	Spacecraft (launched or planned)
2013	Nov	MAVEN , Mars Orbiter Mission
2016	Mar	ExoMars TGO
2018	May	<i>InSight</i>
2020	Jul–Sep	Mars Hope orbiter, Tianwen-1 orbiter, deployable and remote camera, lander and <i>Zhurong</i> rover, Mars 2020 Perseverance rover and <i>Ingenuity</i> helicopter
2022	Aug–Nov	<i>Rosalind Franklin</i> rover
2024–2025	Sep–May	Mars Orbiter Mission 2 (MOM-2) Escape and Plasma Acceleration and Dynamics Explorer mission (EscaPADE)

Launch of Tianwen-1

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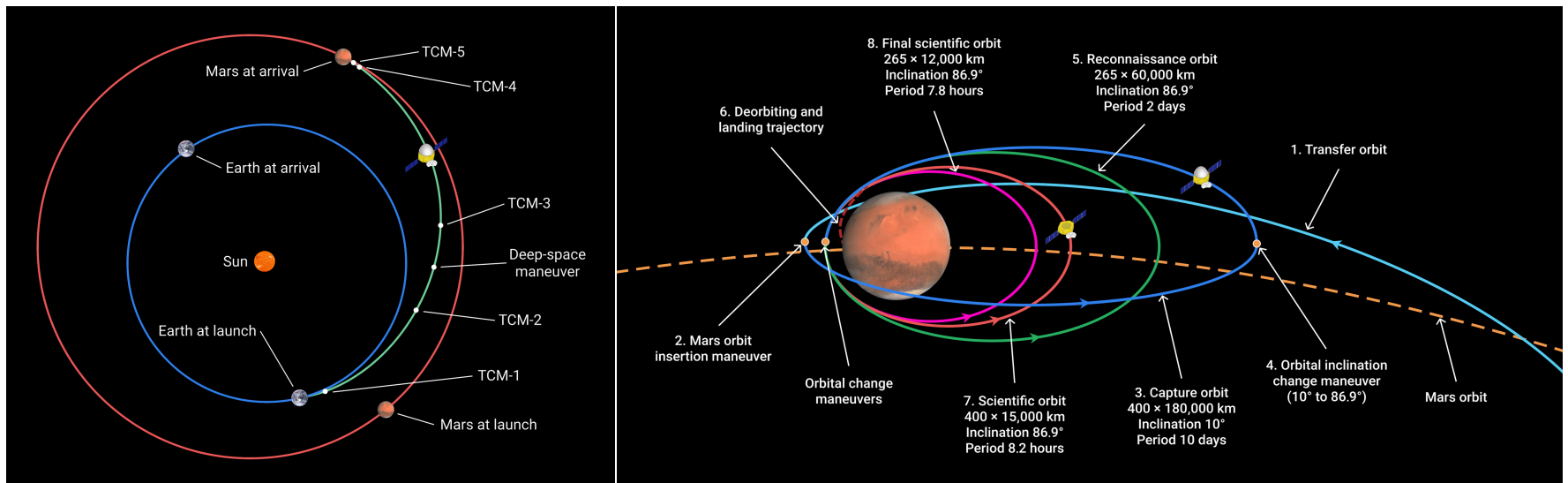


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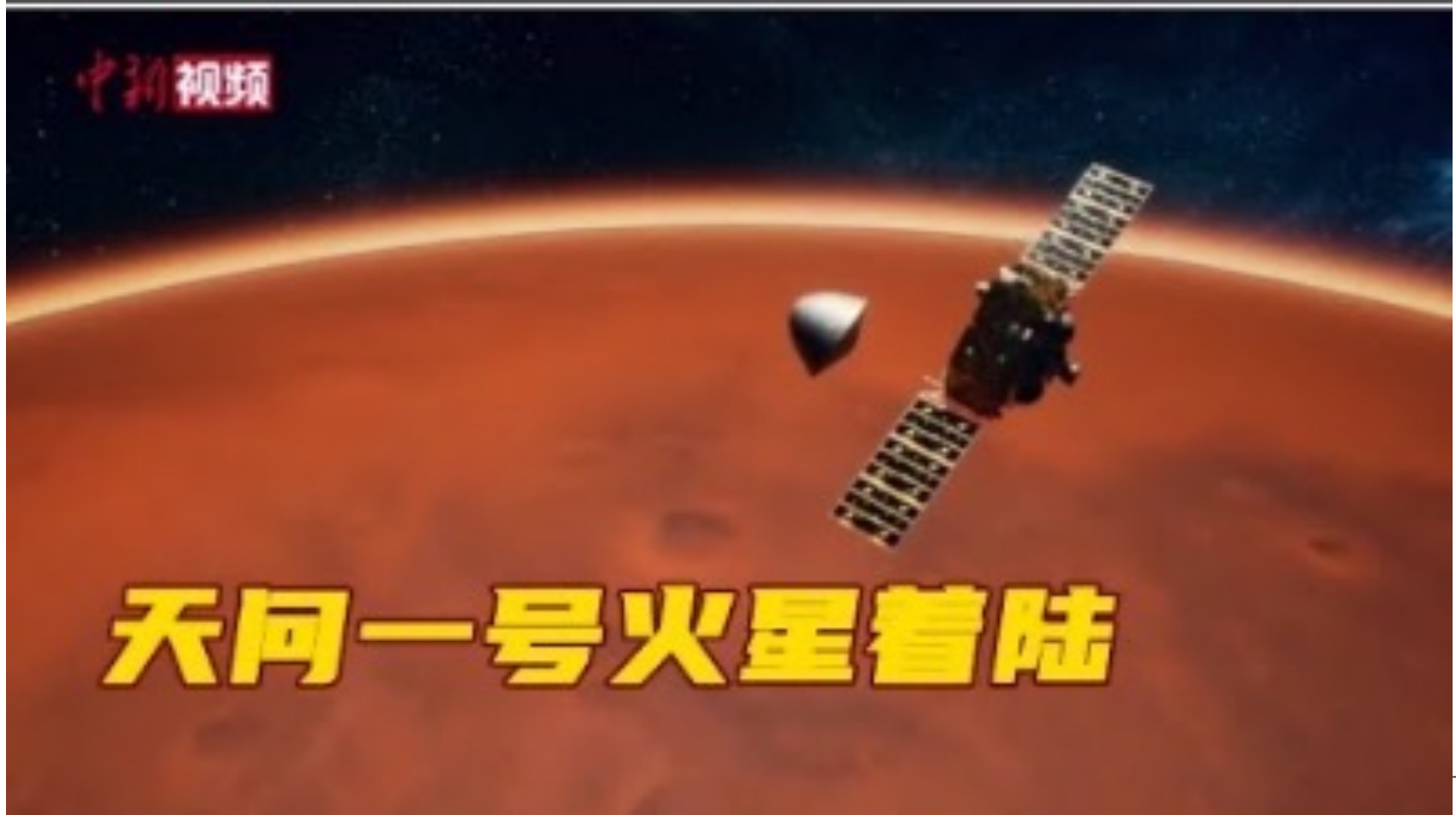
Tianwen-1 orbit

Hard to explain it with one slide, some basics:

- Lang March 5 rocket (the most powerful rocket we have so far) launched it to its transfer orbit
- Couple of trajectory corrections were done during the transfer phase to make sure that it is on its designed orbit to Mars
- Brake to make Tianwen-1 captured by Mars gravity
- More maneuvers at Mars orbit to get ready for landing
- More maneuvers to get to a scientific orbit



Tianwen-1 landing



Tianwen-1 landing and Zhurong roving



Future aerospace related talks?

- Talk about **specific projects**, like BeiDou (北斗) navigation system, Chang'e (嫦娥) moon exploration?
- Talk about **equipment**, like Lang March series rockets?
- Talk about **technique details**, like how to design an orbit to Mars, how to build a real rocket?
- Please feel free to send me an email (xinping.deng@csiro.au) on the topic you want me to cover.

Thank you

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