HUMANS TO MARS IN THE AGE OF AI

Pascal Lee
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(Opinions My Own)

2nd SPACE ROBOTICS WORKSHOP
Mars Settlement Starts with Autonomy & Robotics
28 July 2025

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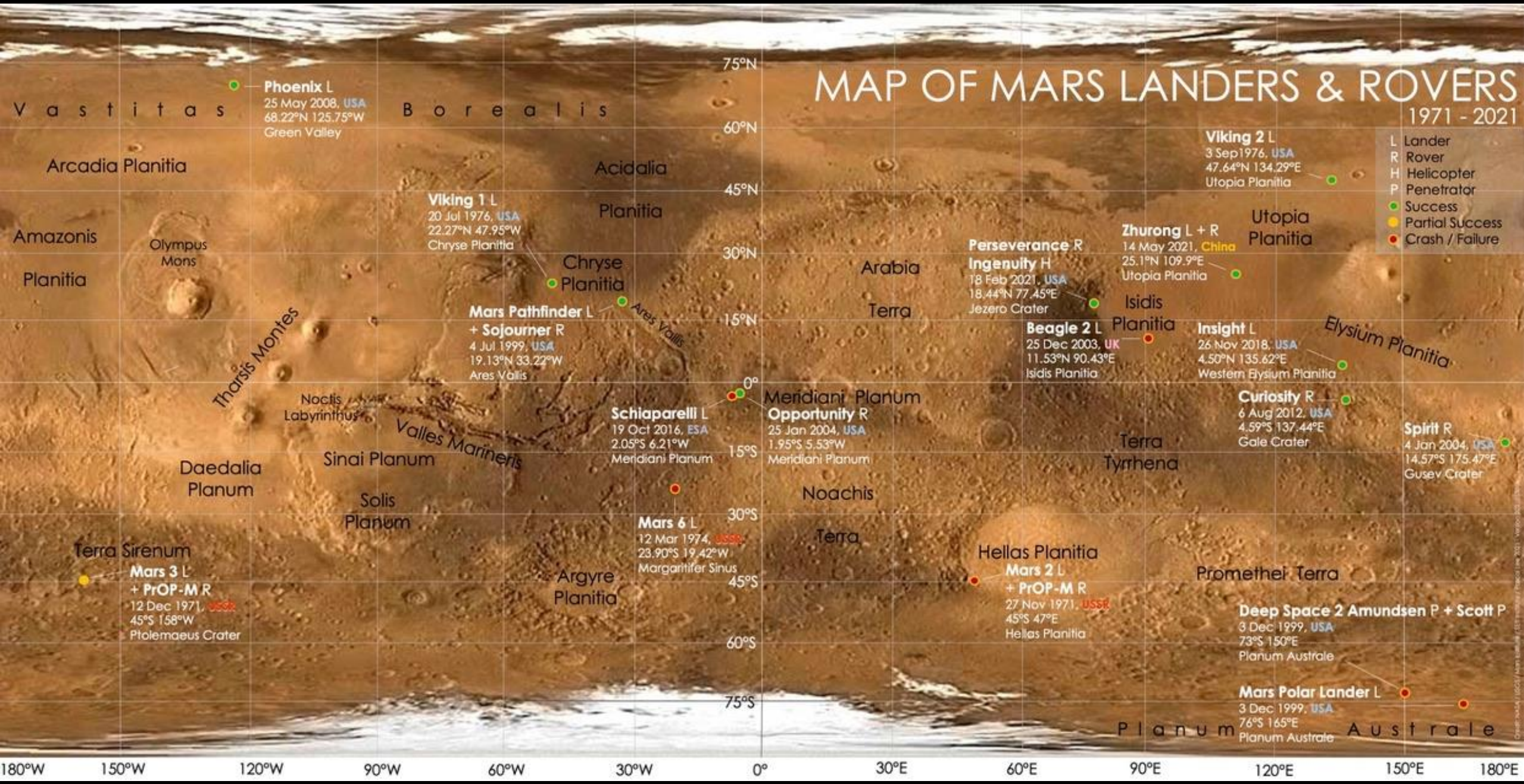
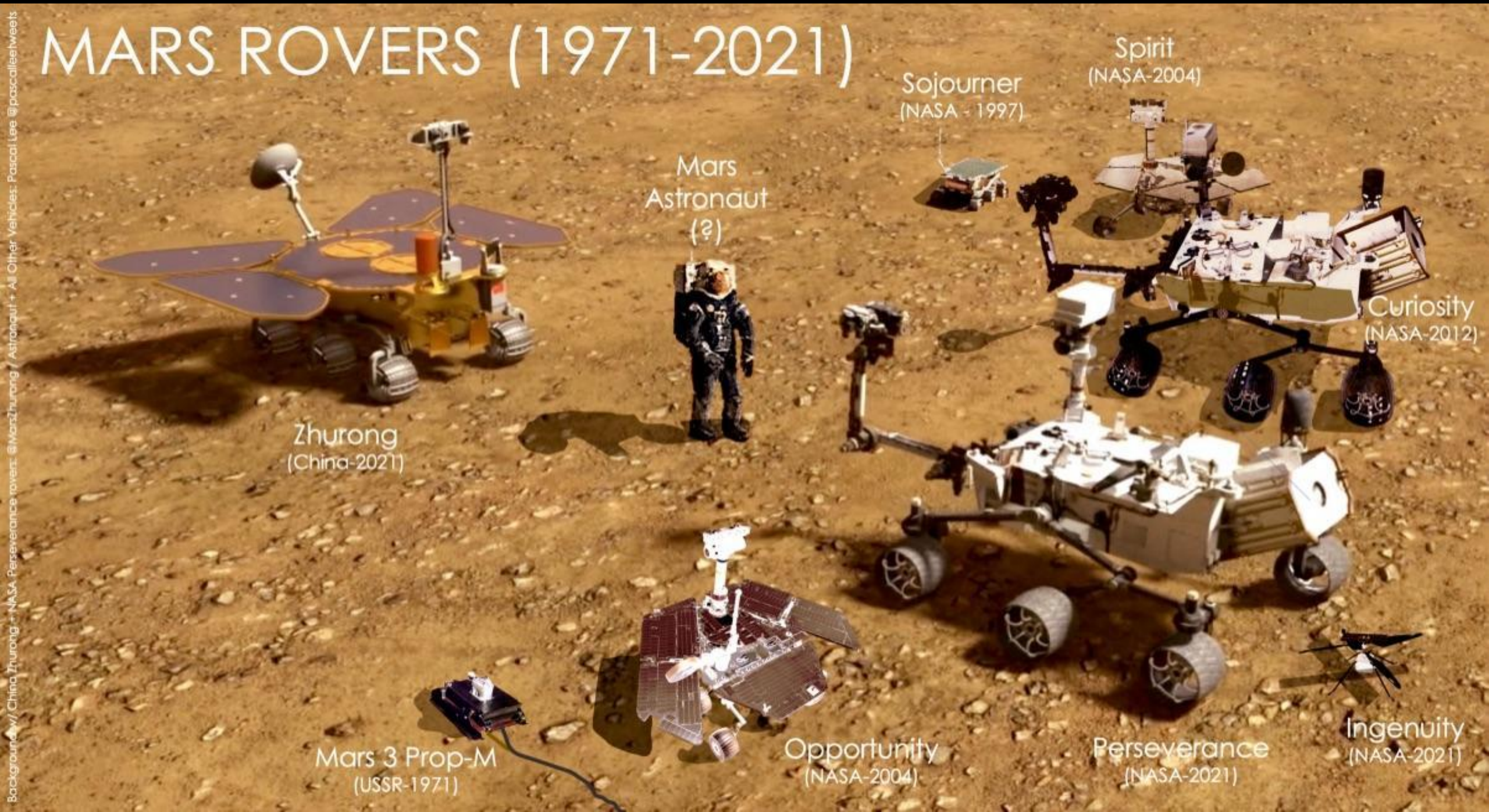
  - **Humans To Mars**, Due to Distance & Time, Requires Massive LSS & Supplies **High Cost**
  - **Early Robots** have been a Way to Explore Mars at Much Lower Cost, But **Slow Pace**


MAP OF MARS LANDERS & ROVERS
1971 - 2021
L Lander
R Rover
H Helicopter
P Penetrator
Success
Partial Success
Crash / Failure
Phoenix L
25 May 2008, USA
68.22°N 125.75°W
Green Valley
Viking 1 L
20 Jul 1976, USA
22.27°N 47.95°W
Chryse Planitia
Mars Pathfinder L
+ Sojourner R
4 Jul 1999, USA
19.13°N 33.22°W
Ares Vallis
Schiaparelli L
19 Oct 2016, ESA
2.05°S 6.21°W
Meridiani Planum
Opportunity R
25 Jan 2004, USA
1.95°S 5.53°W
Meridiani Planum
Mars 6 L
12 Mar 1974, USSR
23.90°S 19.42°W
Margaritifer Sinus
Mars 3 L
+ PrOP-M R
12 Dec 1971, USSR
45°S 158°W
Ptolemaeus Crater
Viking 2 L
3 Sep1976, USA
47.64°N 134.29°E
Utopia Planitia
Zhurong L + R
14 May 2021, China
25.1°N 109.9°E
Utopia Planitia
Perseverance R
Ingenuity H
18 Feb 2021, USA
18.44°N 77.45°E
Jezero Crater
Beagle 2 L
25 Dec 2003, UK
11.53°N 90.43°E
Isidis Planitia
Insight L
26 Nov 2018, USA
4.50°N 135.62°E
Western Elysium Planitia
Curiosity R
6 Aug 2012, USA
4.59°S 137.44°E
Gale Crater
Spirit R
4 Jan 2004, USA
14.57°S 175.47°E
Gusev Crater
Mars 2 L
+ PrOP-M R
27 Nov 1971, USSR
45°S 47°E
Hellas Planitia
Deep Space 2 Amundsen P + Scott P
3 Dec 1999, USA
73°S 150°E
Planum Australe
Mars Polar Lander L
3 Dec 1999, USA
76°S 165°E
Planum Australe
Vastitas Borealis
Arcadia Planitia
Acidalia Planitia
Amazonis Planitia
Olympus Mons
Tharsis Montes
Chryse Planitia
Ares Vallis
Noctis Labyrinthus
Valles Marineris
Sinai Planum
Daedalia Planum
Solis Planum
Terra Sirenum
Argyre Planitia
Arabia Terra
Isidis Planitia
Utopia Planitia
Elysium Planitia
Meridiani Planum
Terra Tyrrhena
Noachis Terra
Hellas Planitia
Promethei Terra
Planum Australe
75°N
60°N
45°N
30°N
15°N
0°
15°S
30°S
45°S
60°S
75°S
180°W
150°W
120°W
90°W
60°W
30°W
0°
30°E
60°E
90°E
120°E
150°E
180°E

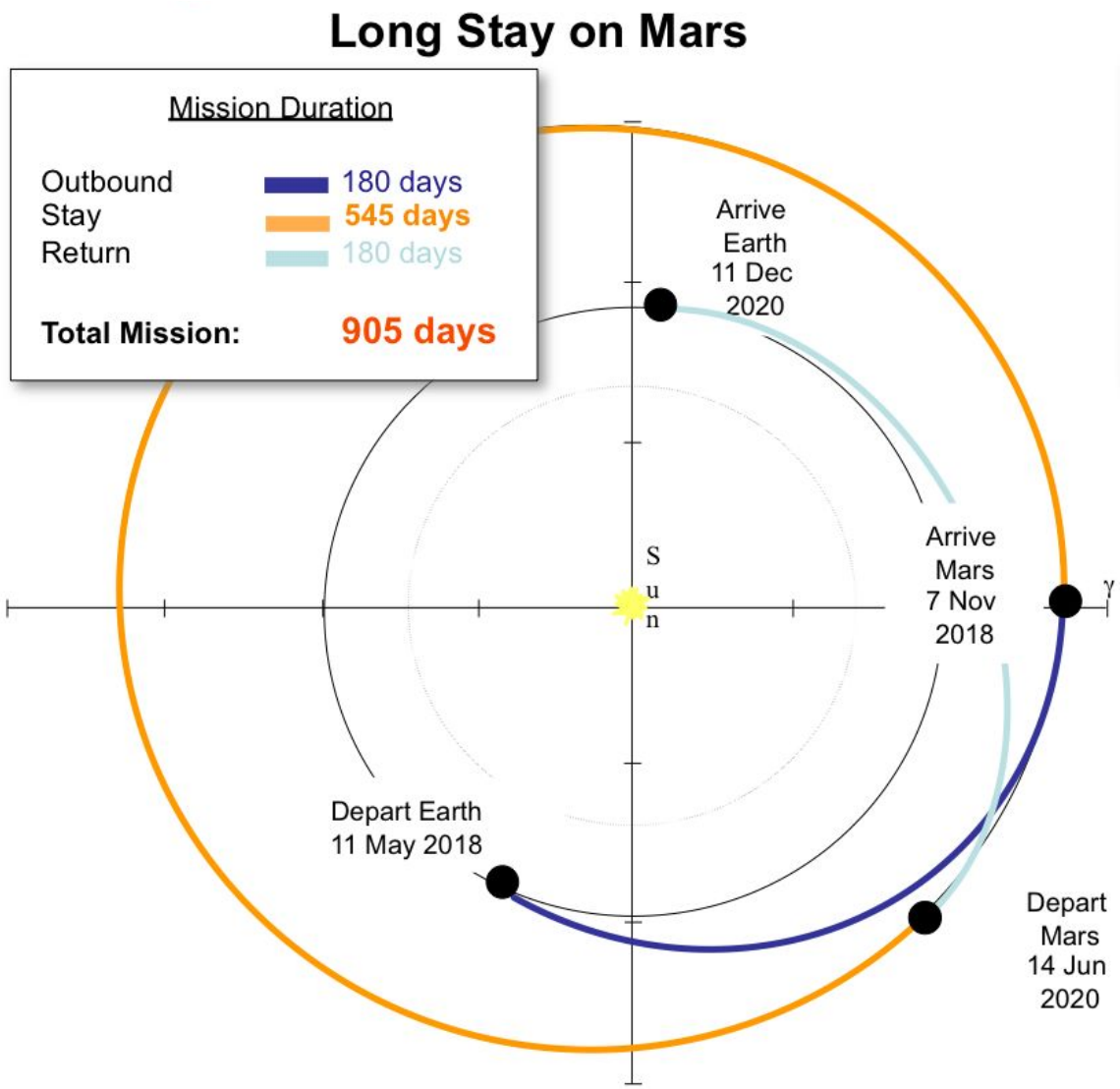
MARS ROVERS (1971-2021)



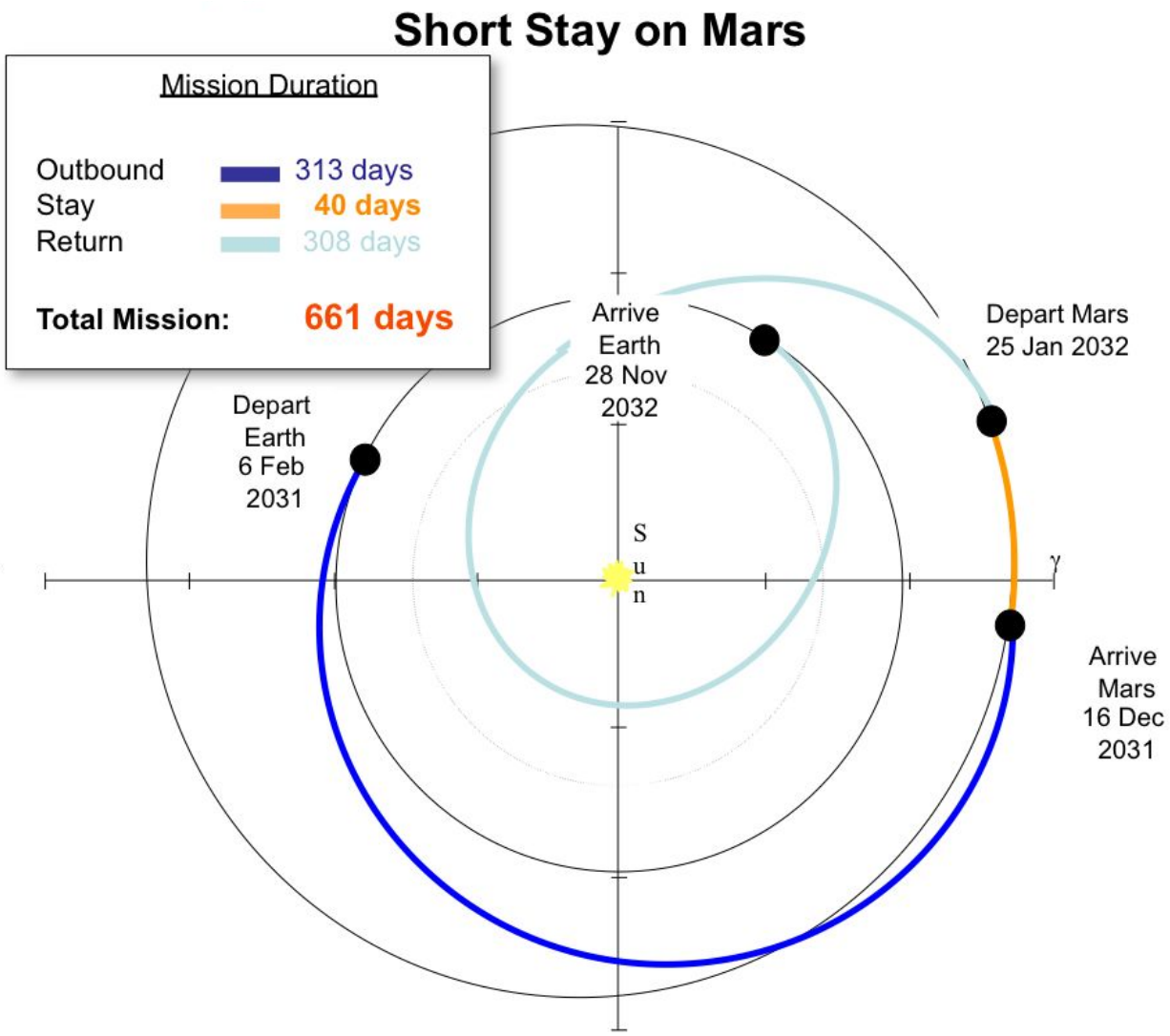
Background: w/ China Zhurong + NASA Perseverance rovers: @Mars2zhurong / Astronaut + All Other Vehicles: Pascal Lee @pascalleetweets

MARS TRANSFER

Conjunction Class Missions



Opposition Class Missions



After D. Beaty – NASA JPL

MARS REALITY CHECK

GOOD

Day
24 hr 37 min

Water
H_2O
Mostly Ice

Regolith
Minerals

Gravity
0.38 G

BAD

Super Low Pressure
P = 0.010 atm
Seconds

Toxic Atmosphere
CO_2
Minutes

Frigid Temperatures
-80°F
Hours

Ubiquitous Dust
Fine + Abrasive + Toxic
Weeks

Ionizing Radiation
GCR + SPE
Months

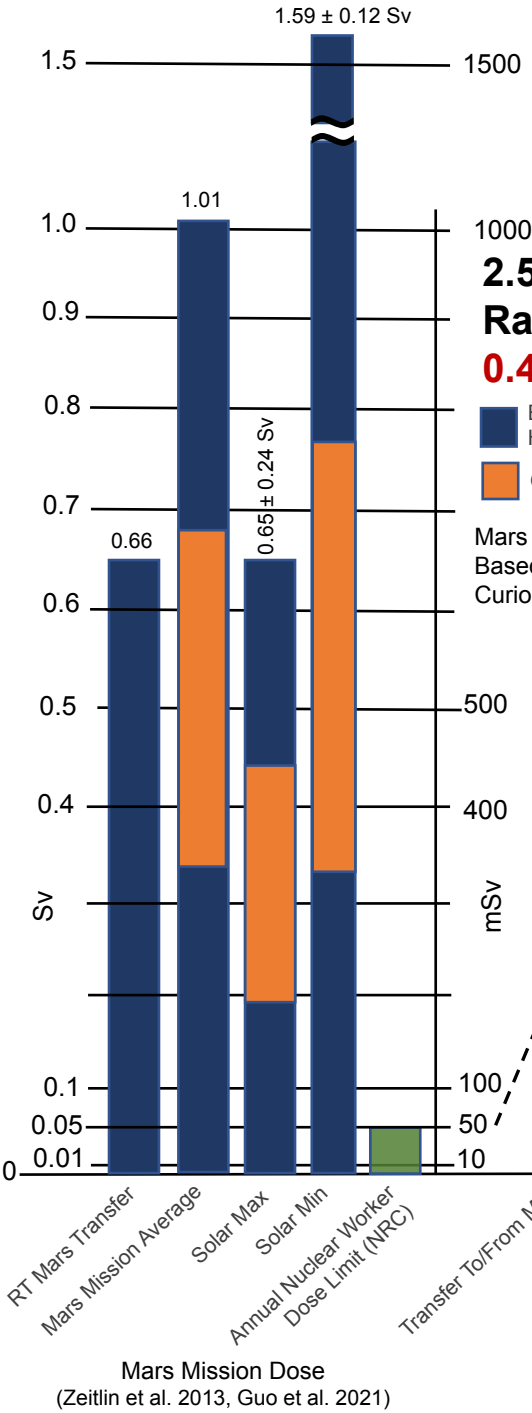
Pascal Lee

MARS MISSION: RADIATION DOSAGES

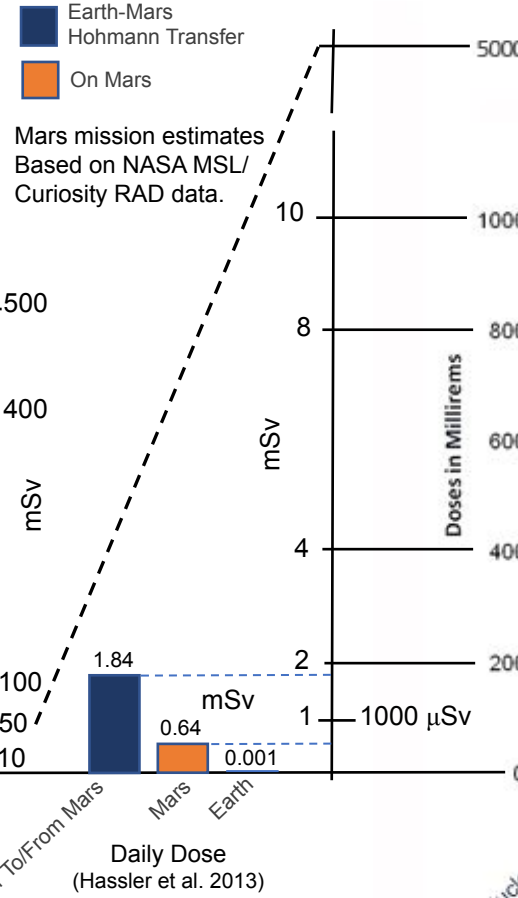
A **2.5-yr** human mission to Mars exposes crew to a radiation dose of **0.4 to 1.7 Sv**, ~ a nuclear worker's **10-30-yr** career dose limit. 1 Sv increases fatal cancer risk by 5.5%. But it is not so much the total dose that's of concern, as much as the high *rate* of exposure (2.5 yrs *vs* 10-30 yrs). Concentrated exposure also affects cognitive functions & performance.

Composite Infographic by Pascal Lee / Mars Institute / 20220425-A

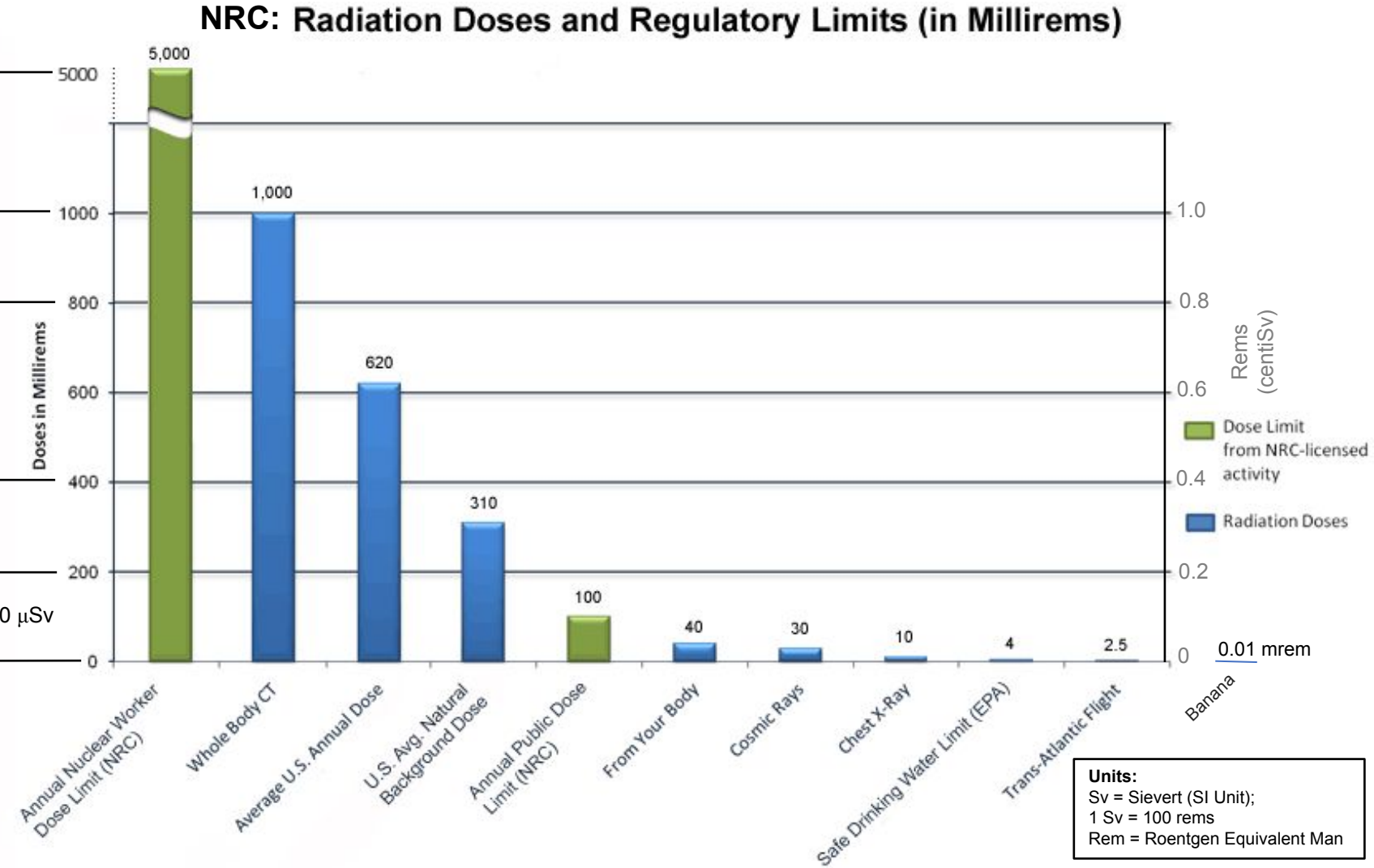
2.5-yr Mars Mission Radiation Exposure:
0.41 – 1.71 Sv



Mars Mission Dose
(Zeitlin et al. 2013, Guo et al. 2021)



Daily Dose
(Hassler et al. 2013)



Units:
Sv = Sievert (SI Unit);
1 Sv = 100 rems
Rem = Roentgen Equivalent Man

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- New Developments For Mars Exploration
  - **NASA *Moon To Mars***
  - ***Mars Starship*** Under Development
  - **Nuclear Thermal Propulsion** Under Revival
  - **New Robots**: ***Mars Drones***
  - **China** can Land on Mars + Doing ***Mars Sample Return***

→ **Humans To Mars** Programmatically Planned Again

STARSHIP

SPACEX

NIGHTHAWK

MARS CHOPPER MISSION

CONCEPT

SETI INSTITUTE

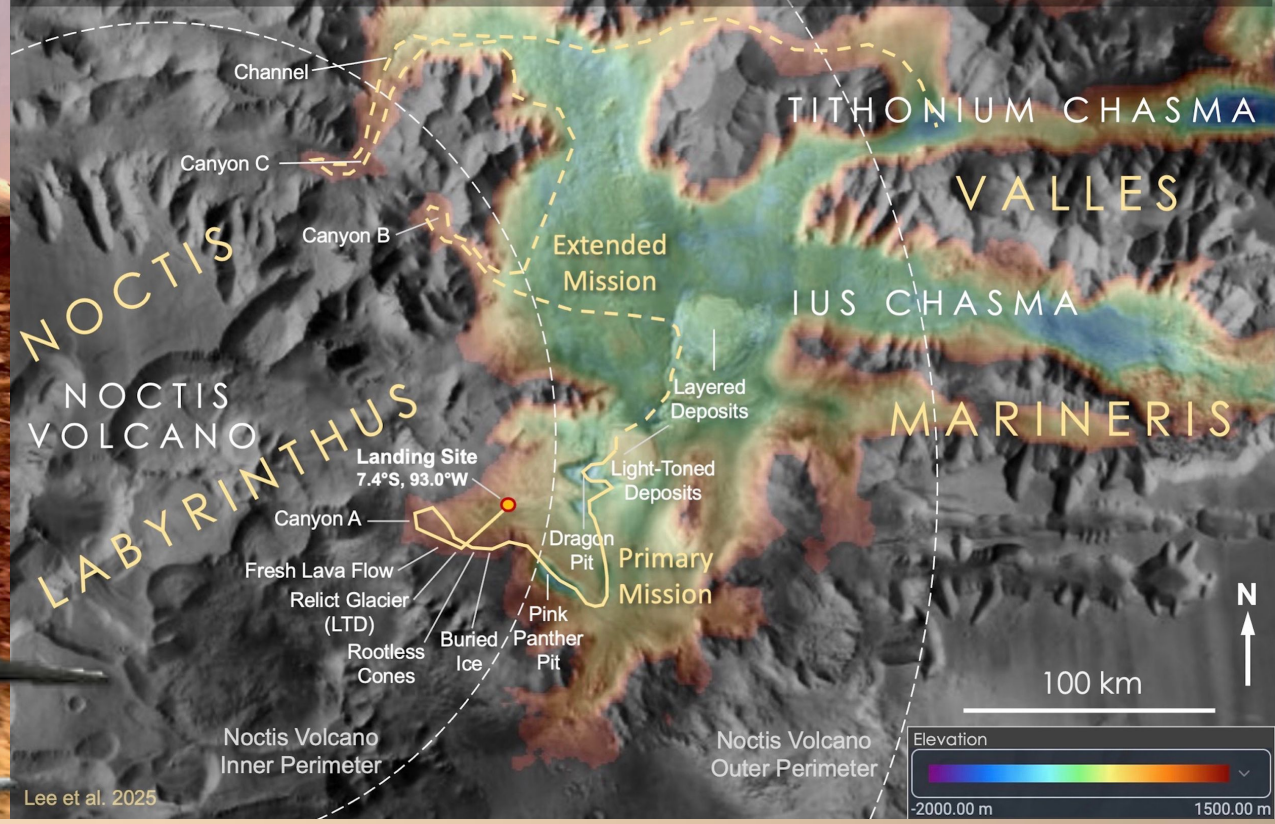
MARS INSTITUTE

KEPLER SPACE UNIVERSITY

NASA

NIGHTHAWK

A MARS CHOPPER MISSION TO THE NOCTIS GIANT VOLCANO, RELICT GLACIER ICE AND CANYONS OF NOCTIS LABYRINTHUS



Lee et al. 2025

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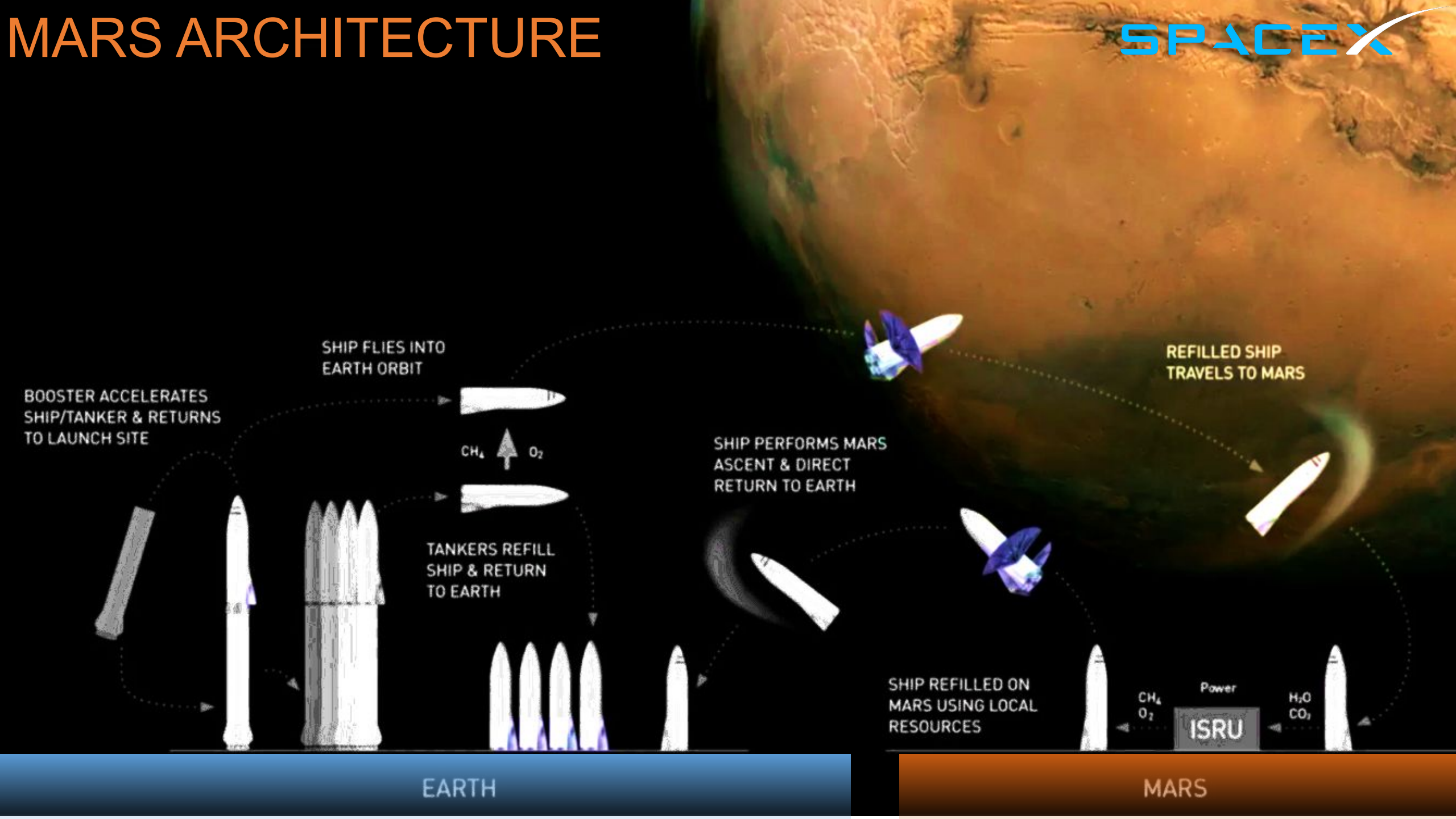
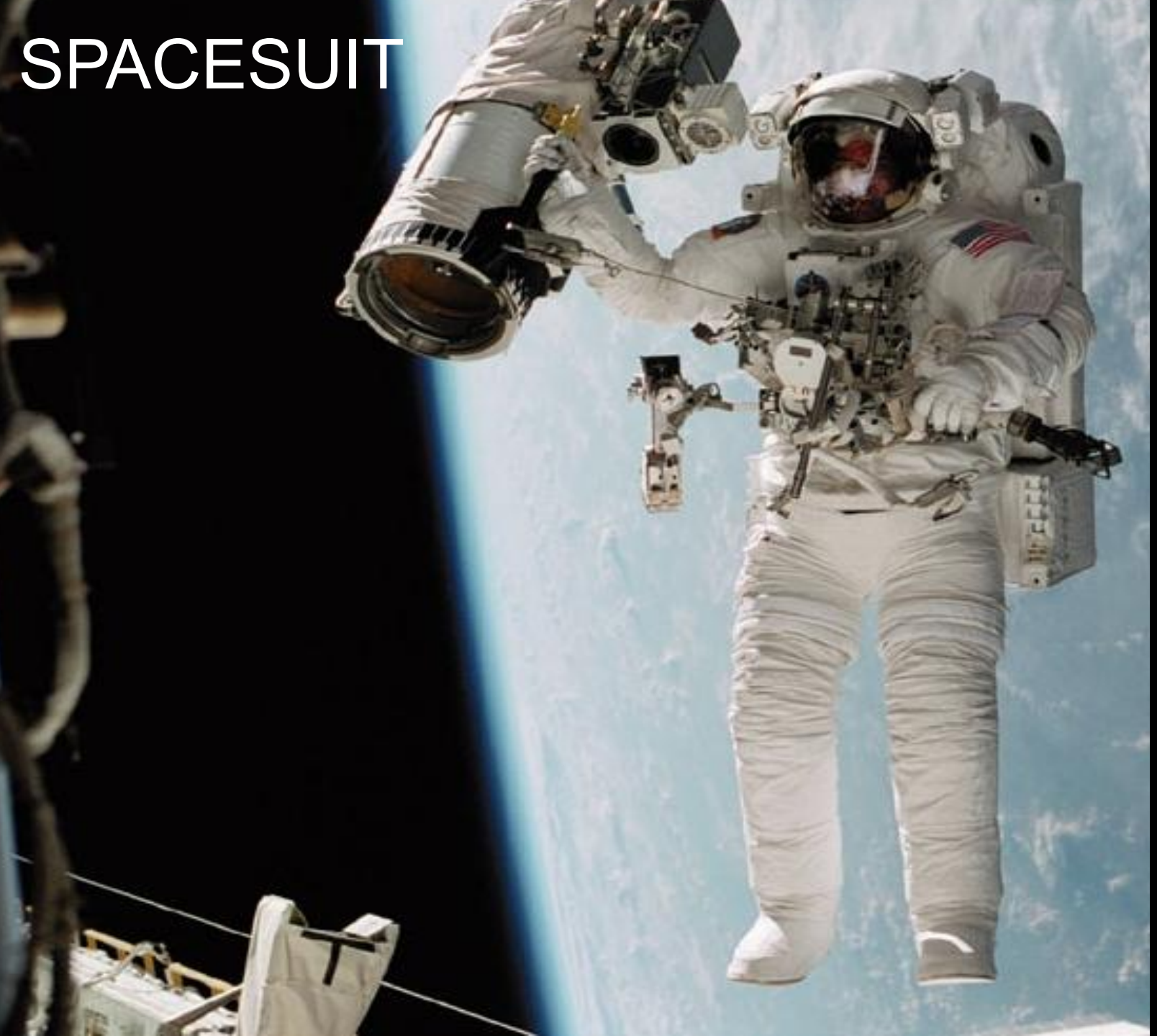
- Bigger Picture: Dawn of AI & Emergence of the Artificial Human (AH)
  - ***Starship*** Won't Be Ready for a While.
  - **Next Gen Robotics** is not your Grandmother's Robotics
  - Will it Still Make Sense to Send ***Humans*** **To Mars**?
  - **Artificial Astronauts**

MARS ARCHITECTURE

SPACEX

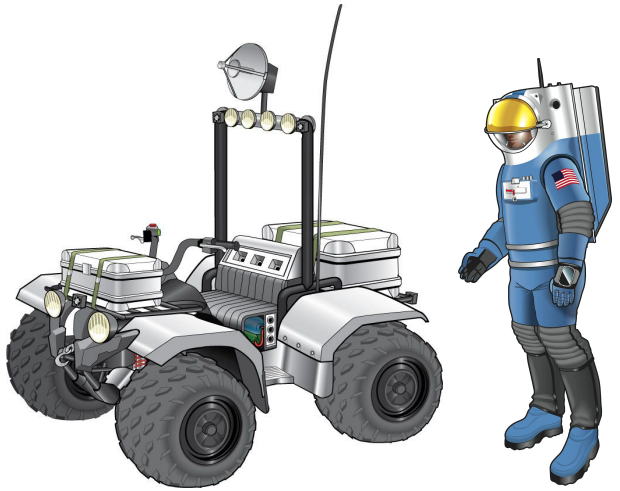


SPACESUIT



MARS ASTRONAUT + ROBOTIC ATV

A Mobile Portable Life Support System (MPLSS)



EVA Autonomy

Spacesuit: 2.5 Hours
Spacesuit+ATV: 10.5 Hours

Smart ATV

Voice & Gesture-Controlled
Self-Driving /Astronaut-Shadowing.
Carries 2 Astronauts in Contingency.

Lee 2000, 2013, 2025

MARS 2026

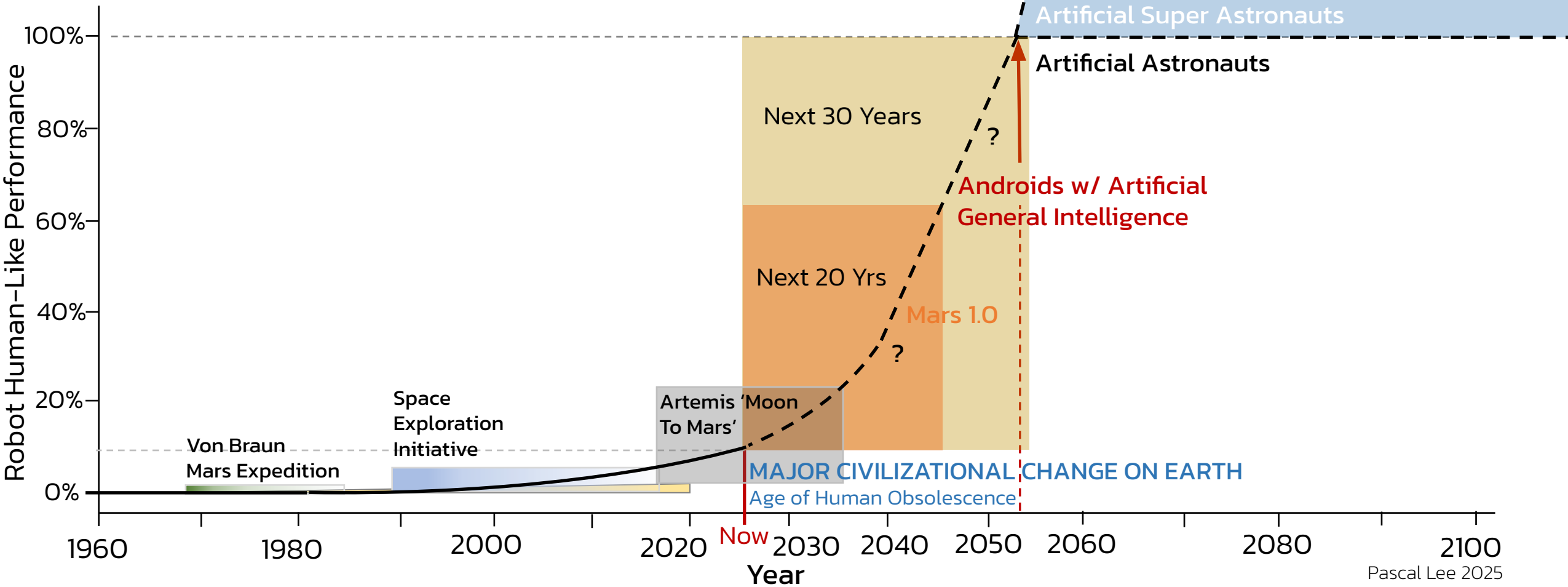
SPACEX

First Starships on Mars, gather critical data on transit, entry, and landing

Artificial Astronaut Timeline

Implications for the Human Exploration of Mars & Beyond

- Past **Humans To Mars** Planning Assumed Humans w/ Specialized Robots
- Now, Humans To Mars Planning Must Weigh Humans vs Androids
- Over Next Years/Decades, Androids w/ Integrated AGI Will Emerge
- Humans To Mars & Beyond: Done by Our Offspring: Super Androids w/ ASI



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