JAXA 宇宙航空研究開発機構
Japan Aerospace Exploration Agency

Japan's Mars Exploration Plan: MELOS

MELOS Working Group represented by Sho Sasaki (NAOJ)

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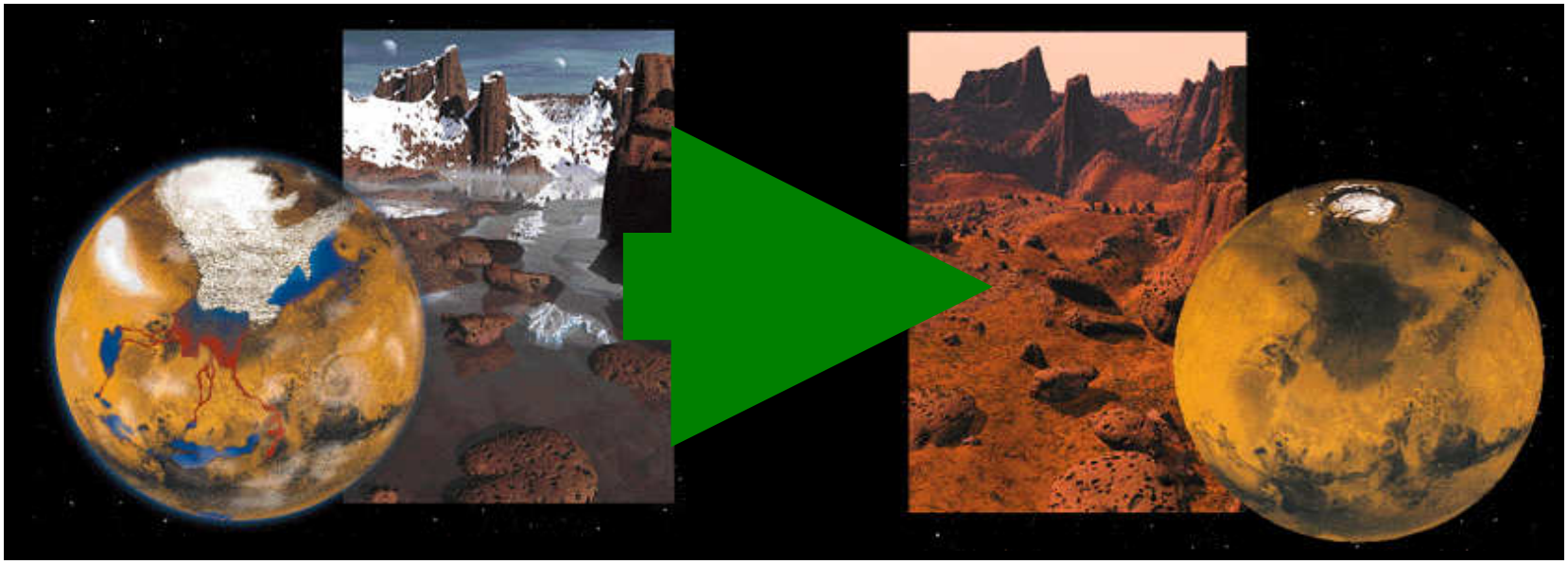
An Outstanding Question

Did Mars really have a warm and wet environment in its early days??

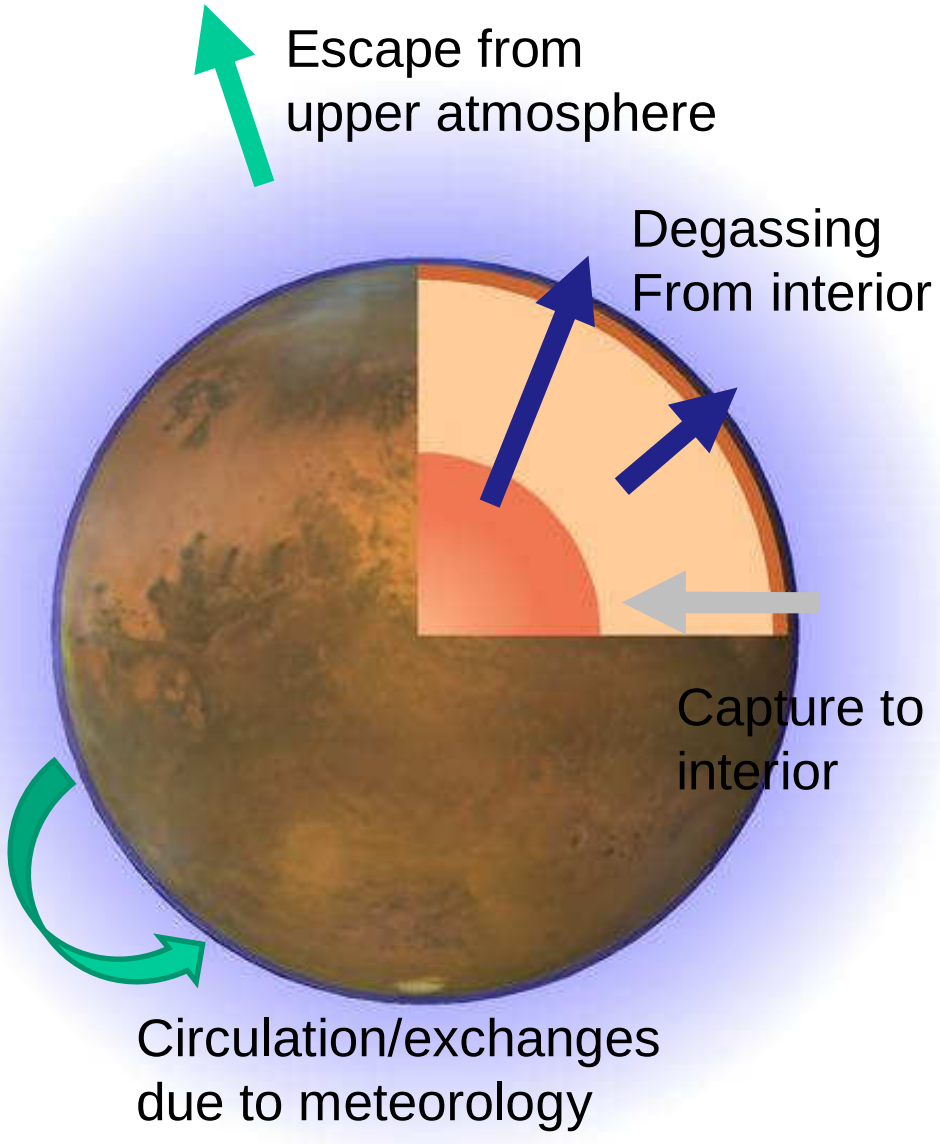


To answer the above question:

Need to fully understand the evolution of Martian atmosphere, the water, and its climate. The atmosphere to solid-body interactions are significant also. The MELOS mission challenges the following 3 science objectives.

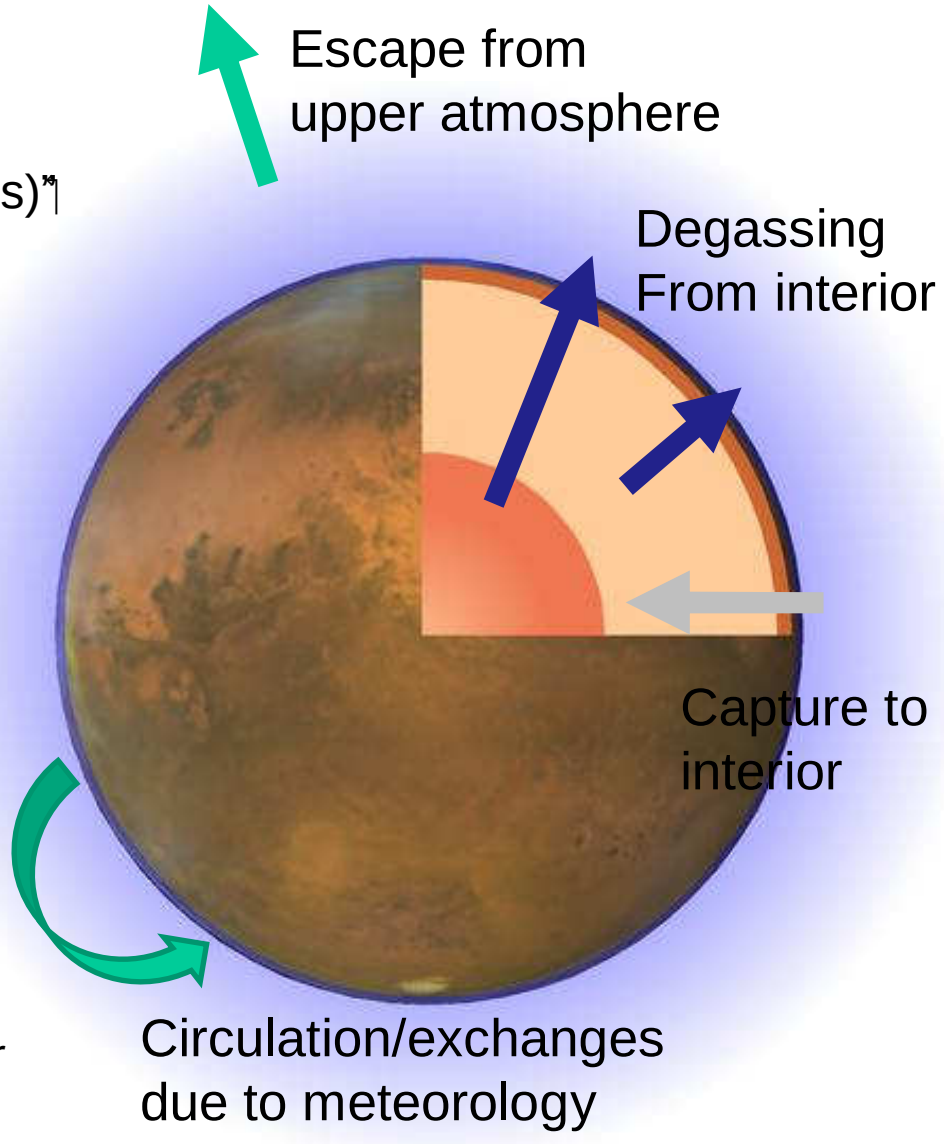
Science Objectives (1/3)

- **Escaping Atmosphere:**
  to understand how Mars atmosphere has evolved
  - Will study in detail controlling processes on removal of ions/neutrals from the upper atmosphere with special focus on the solar-wind interactions.
  - Will complements the study by 2013 Scout mission, MAVEN
  - Observation in orbit during the solar maximum of the 25th solar cycle (around 2022)
  - Solar wind and radiation monitored on the companion orbiter
  - The study will be enhanced by the noble-gas isotopic measurements on the lander
    - Heritage from *NOZOMI* (launched in 1998) and *ERG*



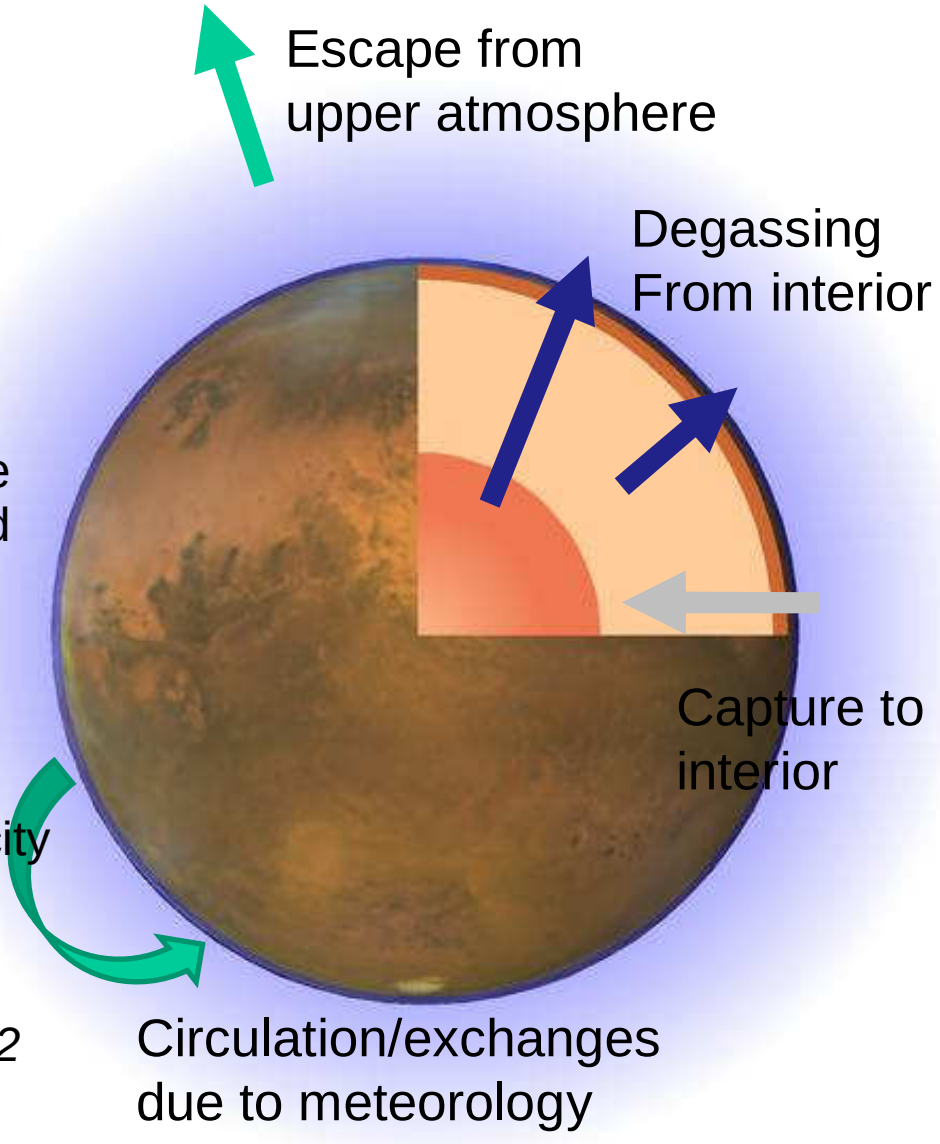
Science Objectives (2/3)

- **Meteorology:**
  to understand what is going on now
  - Part of "comparative meteorology of 3 terrestrial planets (Earth, Venus and Mars)" with particular interests on water cycles (transportation and re-distribution)
  - Global mapping of atmospheric motions with imaging cameras from an elongated orbit with its apocenter near the ecliptic
  - A sub-mm sounder will provide vertical information up to 150 km altitude, connecting meteorology to escaping atmosphere
  - Form a network of ground stations with other mission(s), such as *Mars NEXT*
  - Will complements *Mars Science Orbiter* (2018?)
    - Heritage from *Venus Climate Orbiter* (to be launched in 2010)



Science Objectives (3/3)

- **Interior Structure & Surface Environment:**
  to understand how solid body affects the atmosphere
  - Seismic study will improve knowledge on interior structure, contributing to understand evolution of Mars as a “solid” planet and its roles on climate history.
  - Particular interest on determination of the core dimension, which may have dictated thermal activity of the solid planet
  - Will establish the crater chronology on Mars by measuring ratios of radio-active elements
  - Plan to measure the atmospheric electricity
  - Will greatly benefit from network science with ESA's *Mars NEXT* (2018)
    - Technology developed for *SELENE-2* and earth science studies



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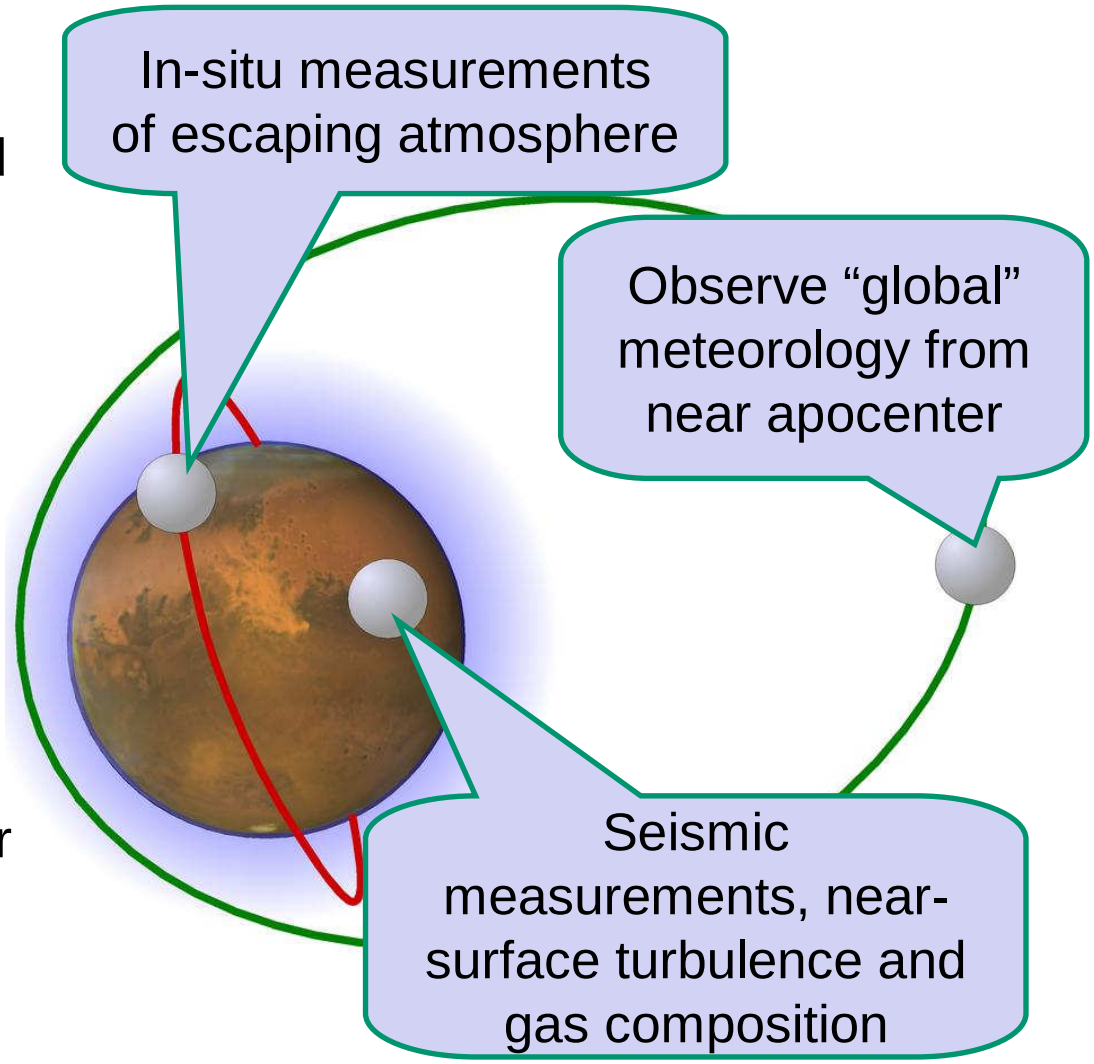
Mars Exploration with a Lander and Orbiters

- **Orbiters**
  - Comparative meteorology (on a 3-axis-stabilized orbiter) and atmospheric escape studies (on a spin-stabilized orbiter)
    - Imaging cameras and a plasma science package
- **A Lander**
  - Seismic measurements (+ heat flux) for interior structure studies
    - Configuration of the lander & possible science packages are being discussed by researchers in the wider field



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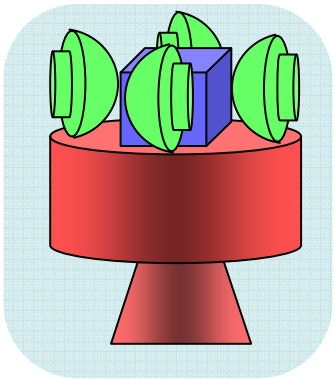
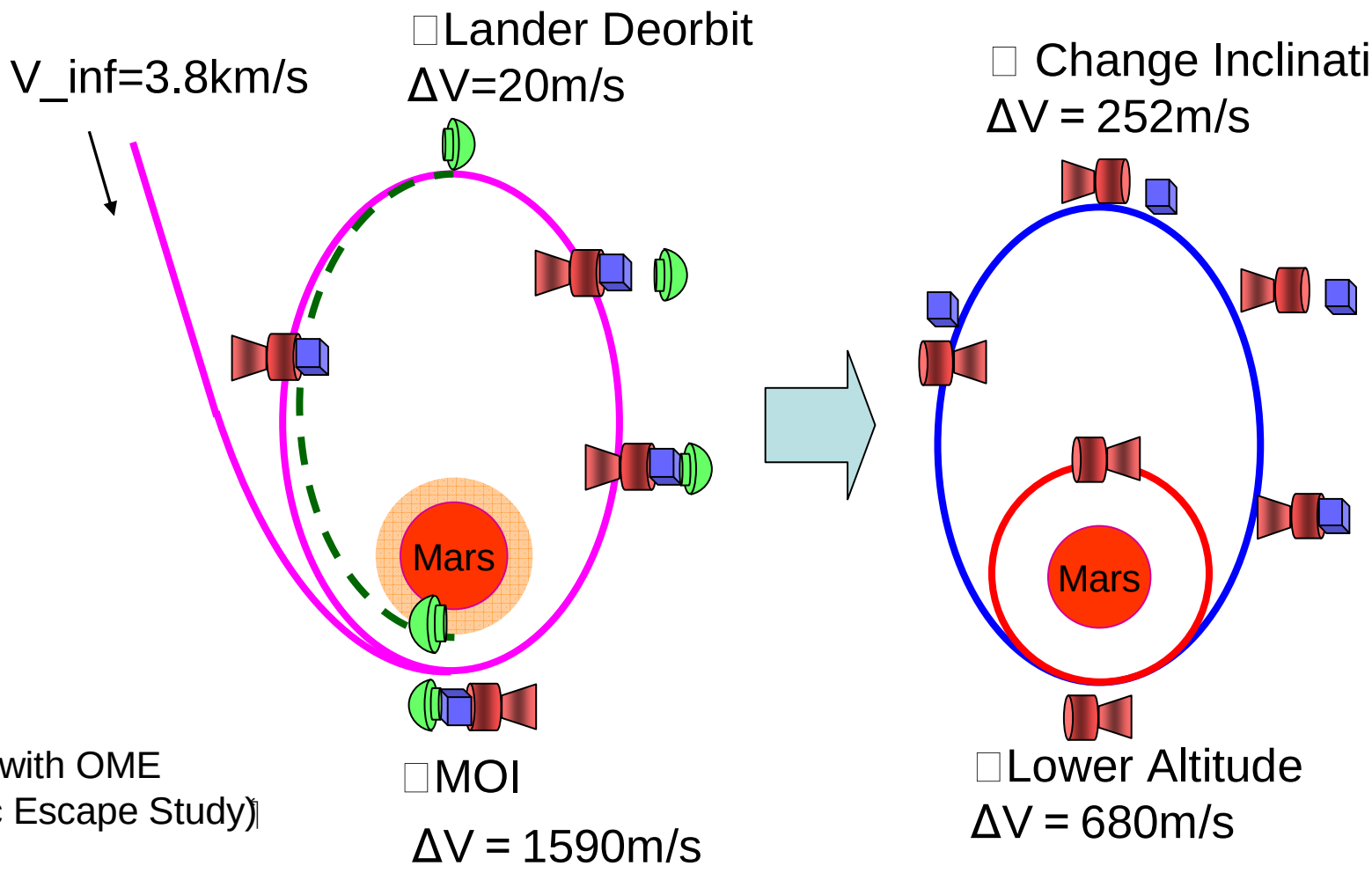
Orbital Insertion Plan



Main Orbiter with OME
(Atmospheric Escape Study)

Sub Orbiter with ACS
(Meteorology Study)

Lander(s)
(Interior Structure Study)



Target launch windows in 2016 or 2018
(2020 also good): Solar max in 25th cycle

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Mass Budget (Very Preliminary)

	Sub Orbiter	Lander	Main Orbiter		
Vehicle Capability/ # of Landers			2.5t 1 Lander	3.0t 2 Landers	3.5t 3 Landers
Science	33.3	13	36.1	36.1	36.1
Common	200.5	237	528.7	570.8	598.5
Power	60.0	43.7	43.7	43.7	43.7
Comm	22.0	11.7	11.7	11.7	11.7
DHS	6.9	10.0	10.0	10.0	10.0
LAUNCH S/S	2.2	3.6	3.6	3.6	3.6
AOCS	41.4	22.7	11.7	11.7	11.7
Wire Harness	10.1	8.4	50.0	53.7	57.4
Structure	29.5	33.6	199.1	213.8	228.5
Thermal	8.34	4.3	25.5	27.4	29.3
Propulsion (3N)	20		30	30	30
Propulsion (500N)		91	143.4	165.2	172.6
Legs		8			
Dry	233.8	250	564.8	606.9	634.6
Fuel	10	50	1064	1298	1452
Wet	243.8	300	1895	2035	2175
Heat Shield		20			
Parachute		40			
Wet w/ Entry System		360			
Margin			266	130	88

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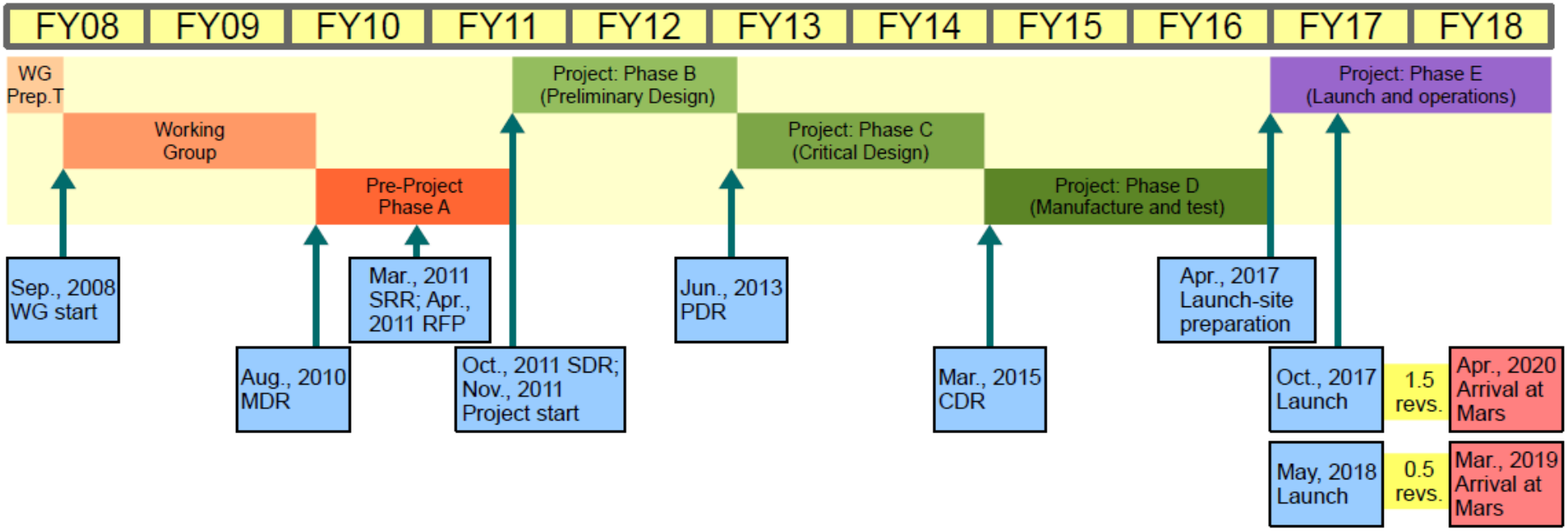
Mission Schedule (Preliminary)



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"MELOS" Working Group

- **JAXA and Research Institutes**
  - National Institute of Information and Communications Technology
  - National Astronomical Observatory of Japan
  - National Institute of Environmental Studies
- **Universities**
  - University of Tokyo
  - Aizu University
  - Kobe University
  - Osaka University
  - Nagoya University
  - Tsukuba University
  - Kyoto University
  - Tokyo Institute of Technology
  - Tohoku University
  - Tokyo Gakugei University
  - Rikkyo University
  - Toyama University
  - Kyushu University
- **Foreign Countries**
  - IRF (Sweden); MPI (Germany); Caltech (USA); Cornell U (USA)

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"Lander Science" discussion meeting at ISAS/JAXA (5 Aug 2008)