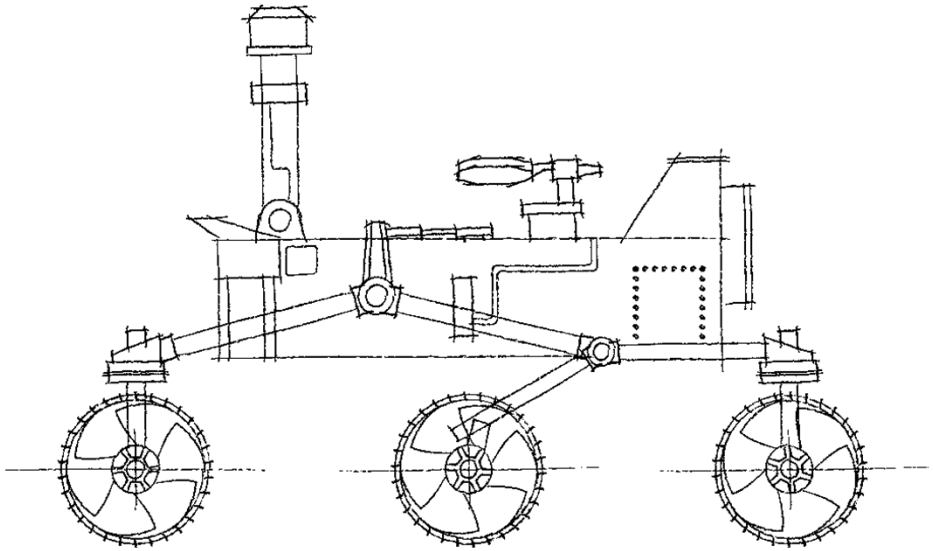
Jet Propulsion Laboratory
California Institute of Technology

Mars 2020 Project

Matt Wallace
Deputy Project Manager

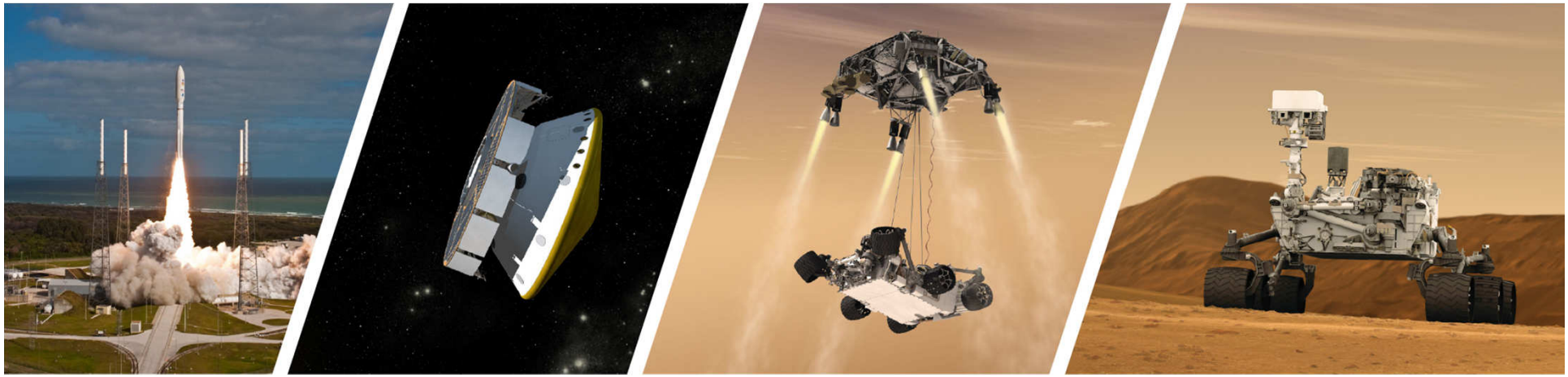
October 27, 2014



Pre-Decisional: For Planning and Discussion Purposes Only.

Mars 2020 Project

Mission Overview



LAUNCH

- MSL Class/Capability LV
- Period: Jul/Aug 2020

CRUISE/APPROACH

- 7.5 month cruise
- Arrive Feb 2021

ENTRY, DESCENT & LANDING

- MSL EDL system: guided entry and powered descent/Sky Crane
- 16 x 14 km landing ellipse (range trigger baselined)
- Access to landing sites ±30°latitude, ≤ -0.5 km elevation
- ~950 kg rover

SURFACE MISSION

- Prime mission of one Mars year
- 20 km traverse distance capability
- Seeking signs of past life
- Returnable cache of samples
- Prepare for human exploration of Mars

http://mars.jpl.nasa.gov/mars2020/

Chronology MCR => SRR/MDR

- 6-7 Aug 2013 - Mission Concept Review
- 12 Nov 2013 - Agency PMC/KDP-A Gate (Phase A start 01 Dec 2013)
- 15 Jan 2014 - AO proposals received
- 18 Feb 2014 - Acquisition Strategy Meeting
- 25 Mar 2014 - MEDLI DPMC
- 30 April 2014 - Flight System Baseline Workshop
- 14 May 2014 - 1st Landing Site Workshop
- 9-10 July 2014 - Mars Program Requirements Review
- 13 Aug 2014 - Entry, Descent, and Landing Review
- 26-28 Aug 2014 - Project Science Group Meeting
- 28 Aug 2014 - Investigation Tech/Mgt/Cost Debrief by TMCO Panel
- 30 Sep 2014 - Cost Review
- 1 Oct 2014 - Surface Operability Review
- 15 Oct 2014 - Sampling/Caching System Review
- 28-29 Oct 2014 - System Requirements Review/Mission Definition Review

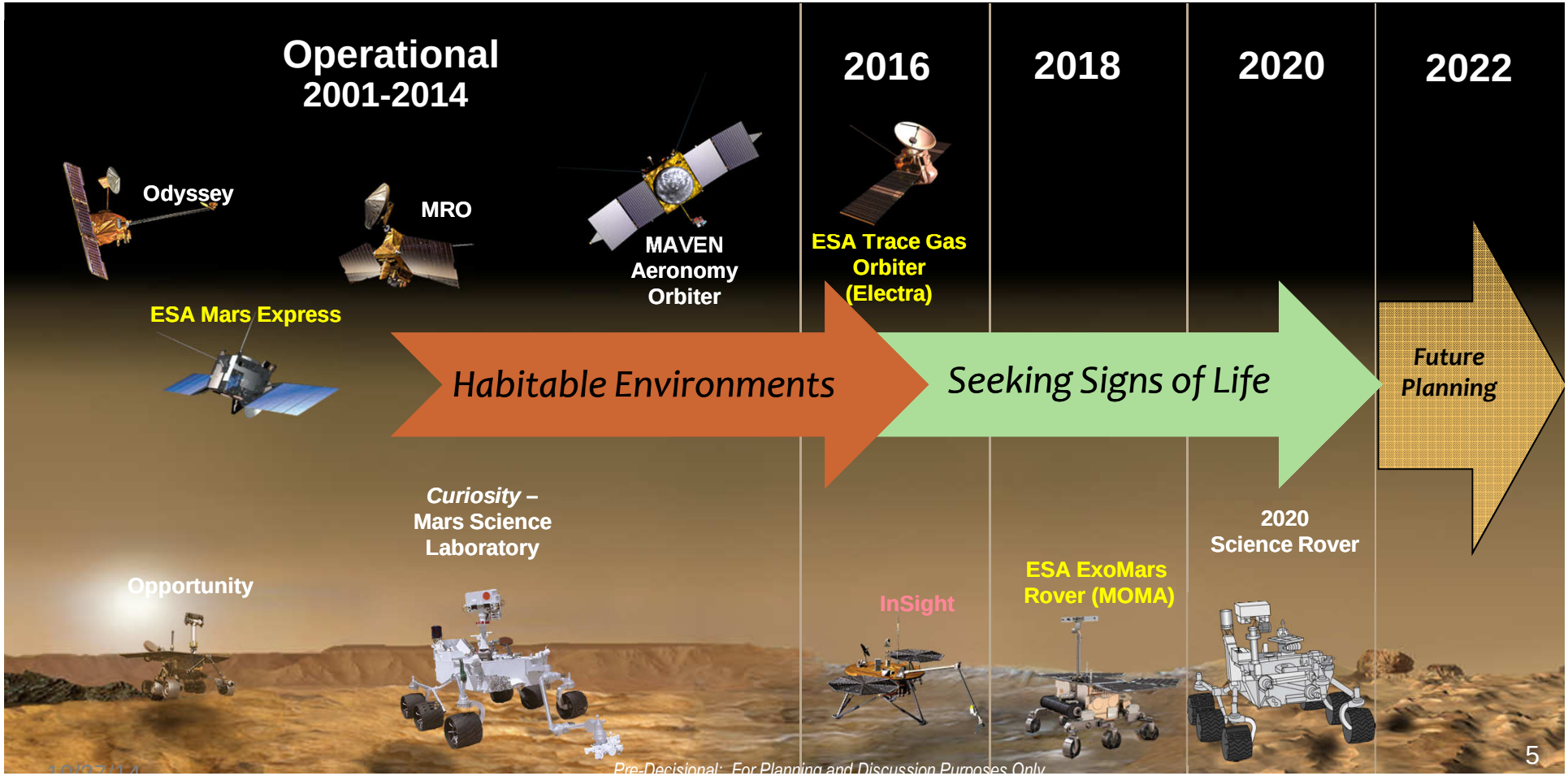
Chronology SRR/MDR => PDR

- 28-29 Oct 2014 - System Requirements Review/Mission Definition Review
- Jan 2015 - Instrument Accommodation Reviews
- Mar 2015 - Payload System Review
- Mar-Apr 2015 - CMC/DPMC/APMC (KDP-B)
- May 2015 - Flight System Baseline Workshop
- Jul 2015 - 2nd Landing Site Workshop
- Jul/Aug 2015 - EDL/SCS/Ops/Cost/etc. Pre-Reviews
- Sept 2015 - PDR 1
- Nov 2015 - PDR 2 (payload & related elements)
- Nov/Dec 2015 - CMC/DPMC/APMC (KDP-C)

Mars Exploration in This Decade

Baseline Mars 2020 mission:

- Leverages MSL design, residual hardware, and experienced team
- Builds on MSL/Curiosity results by investigating bio-signature preservation in geologic context
- Provides opportunities for HEOMD and STMD contribution
- Provides opportunities for international collaboration



Mars 2020 Scientific Objectives

A. Geologic History

Carry out an integrated set of context, contact, and spatially-coordinated measurements to characterize the geology of the landing site

B. *In Situ* Astrobiology

Find and characterize ancient habitable environments, identify rocks with the highest chance of preserving signs of ancient Martian life if it were present, and within those environments, seek the signs of life

C. Sample Return

Place rigorously documented and selected samples in a returnable sample cache for possible future return to Earth

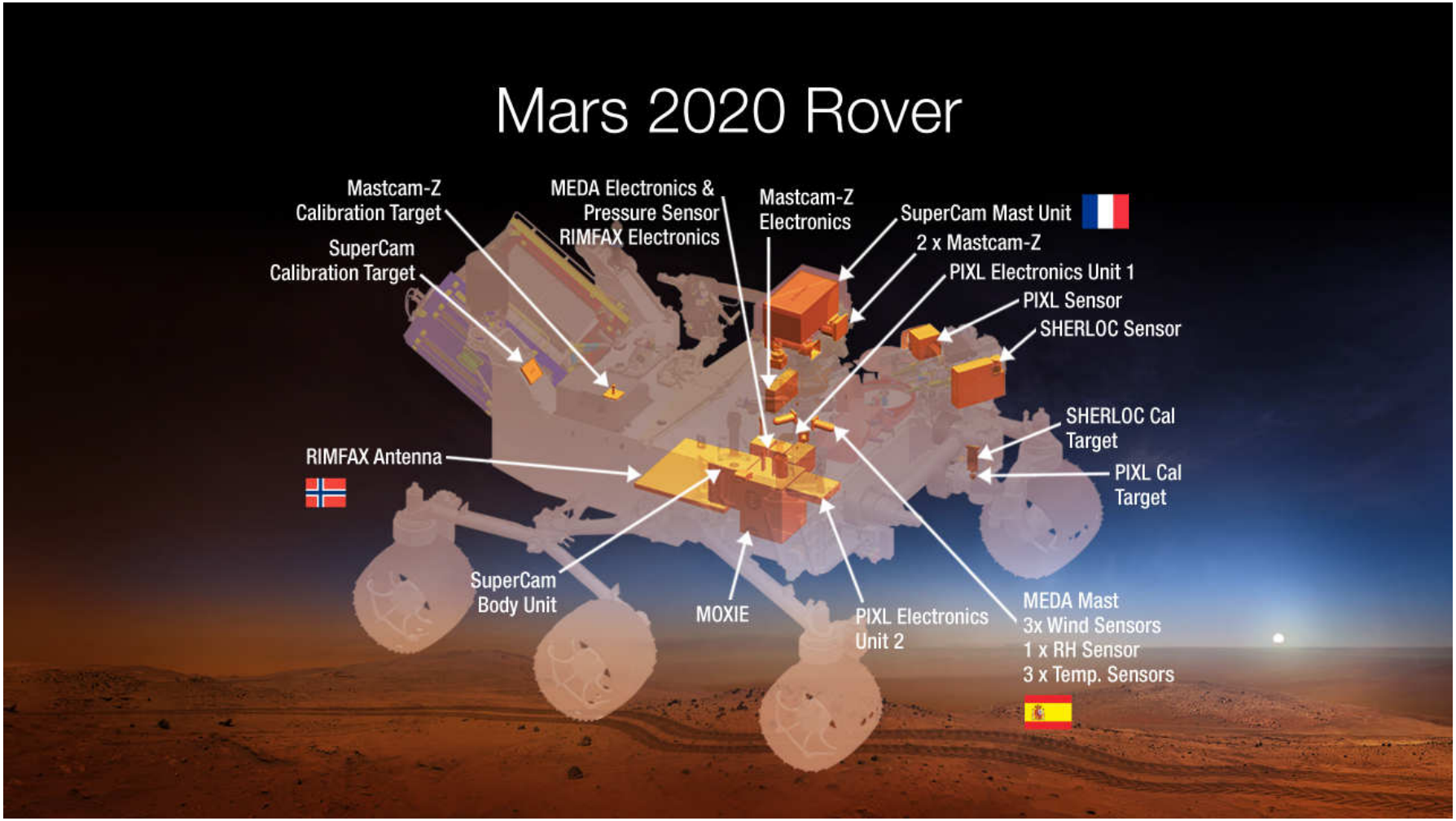
Mars 2020 Objectives (2)

D. Additional objectives related to future exploration of Mars

- Demonstrate in situ resource utilization and possibly other new technologies

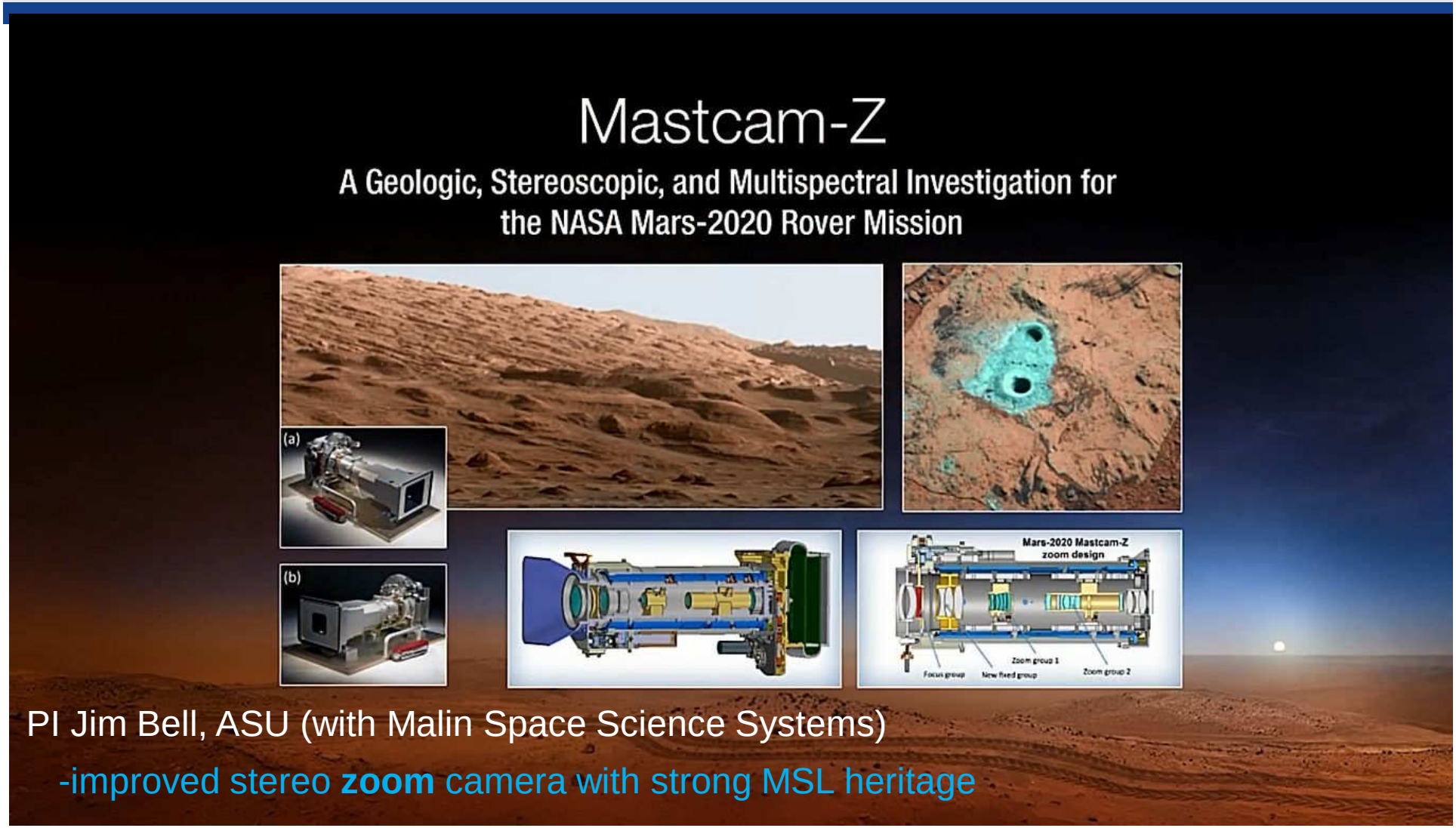
The Mars 2020 mission fulfills the high priority Decadal Survey objective to initiate the first step in the multi-mission campaign to (potentially) return a collection of fully scientifically documented martian samples to Earth

Instrument Payload



The payload consists of turret, mast, deck, and belly-pan mounted instruments, as well as the ISRU device inside the rover (*no "analytical laboratory" and no sample delivery*)

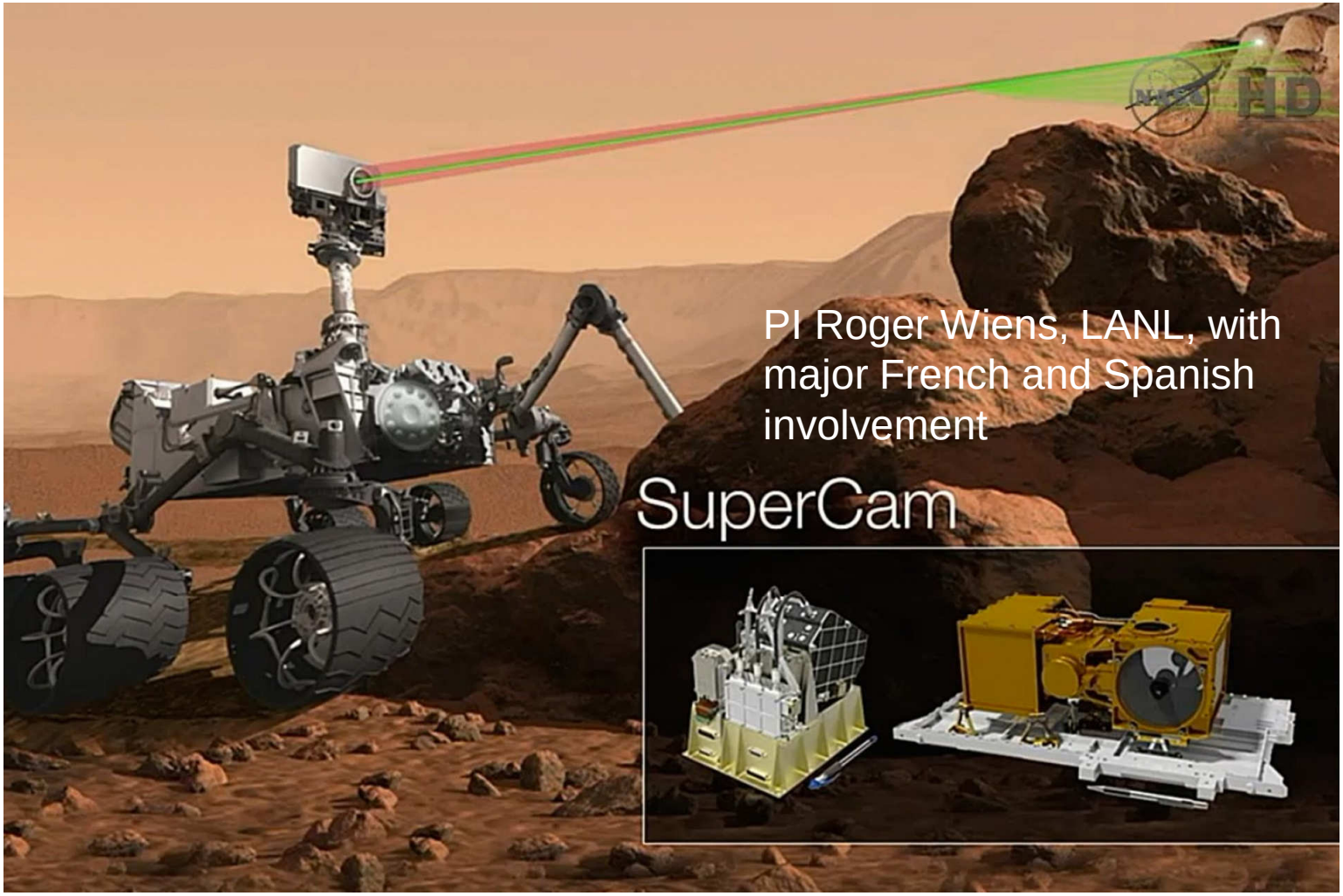
Remote Visual/Textural Imaging



PI Jim Bell, ASU (with Malin Space Science Systems)

-improved stereo **zoom** camera with strong MSL heritage

Remote Chemistry, Mineralogy, and Imaging

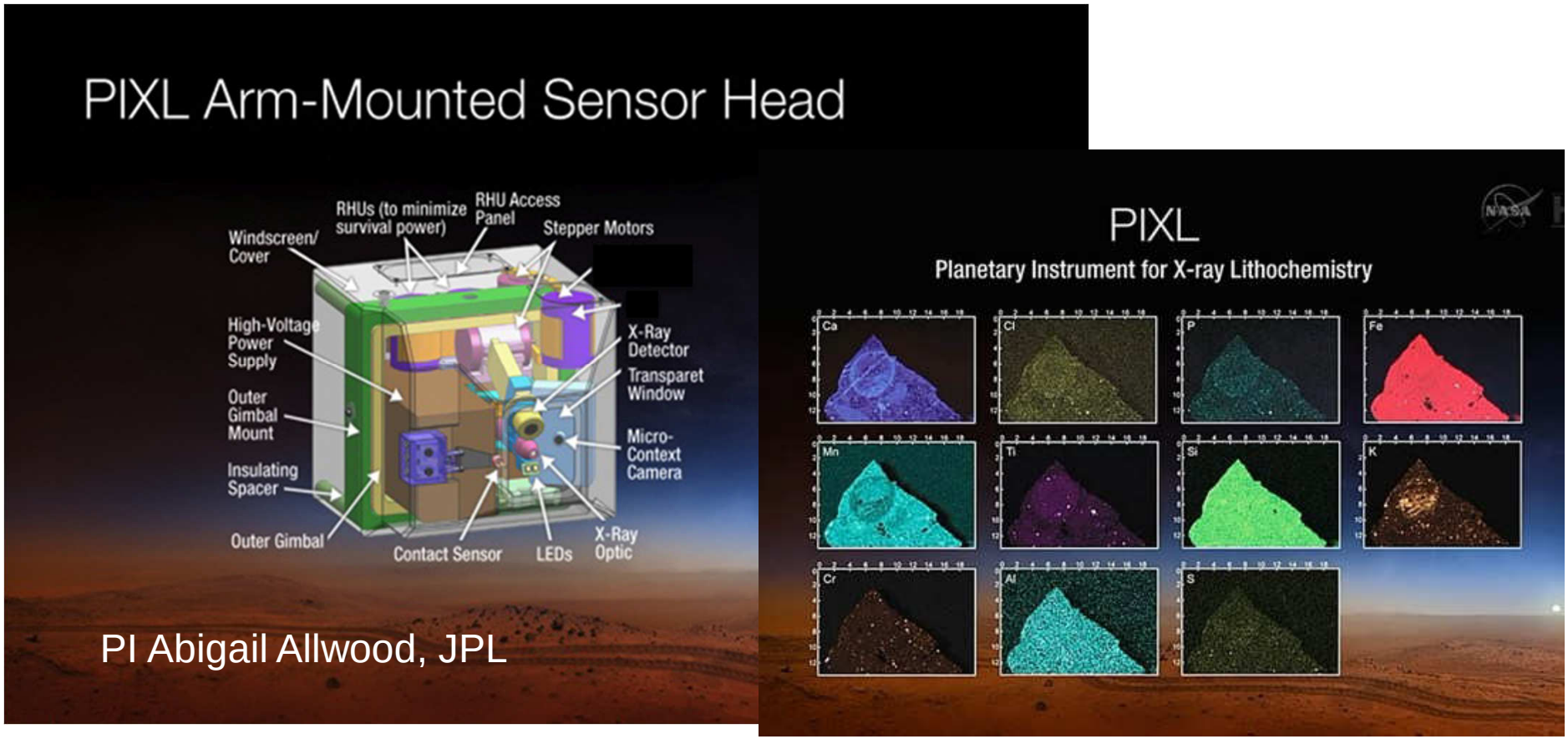


Laser induced breakdown spectroscopy (LIBS) + remote Raman and fluorescence spectroscopy + visible and infrared spectroscopy + remote micro-imaging ("telescope").

Fine Scale Organic Mapping

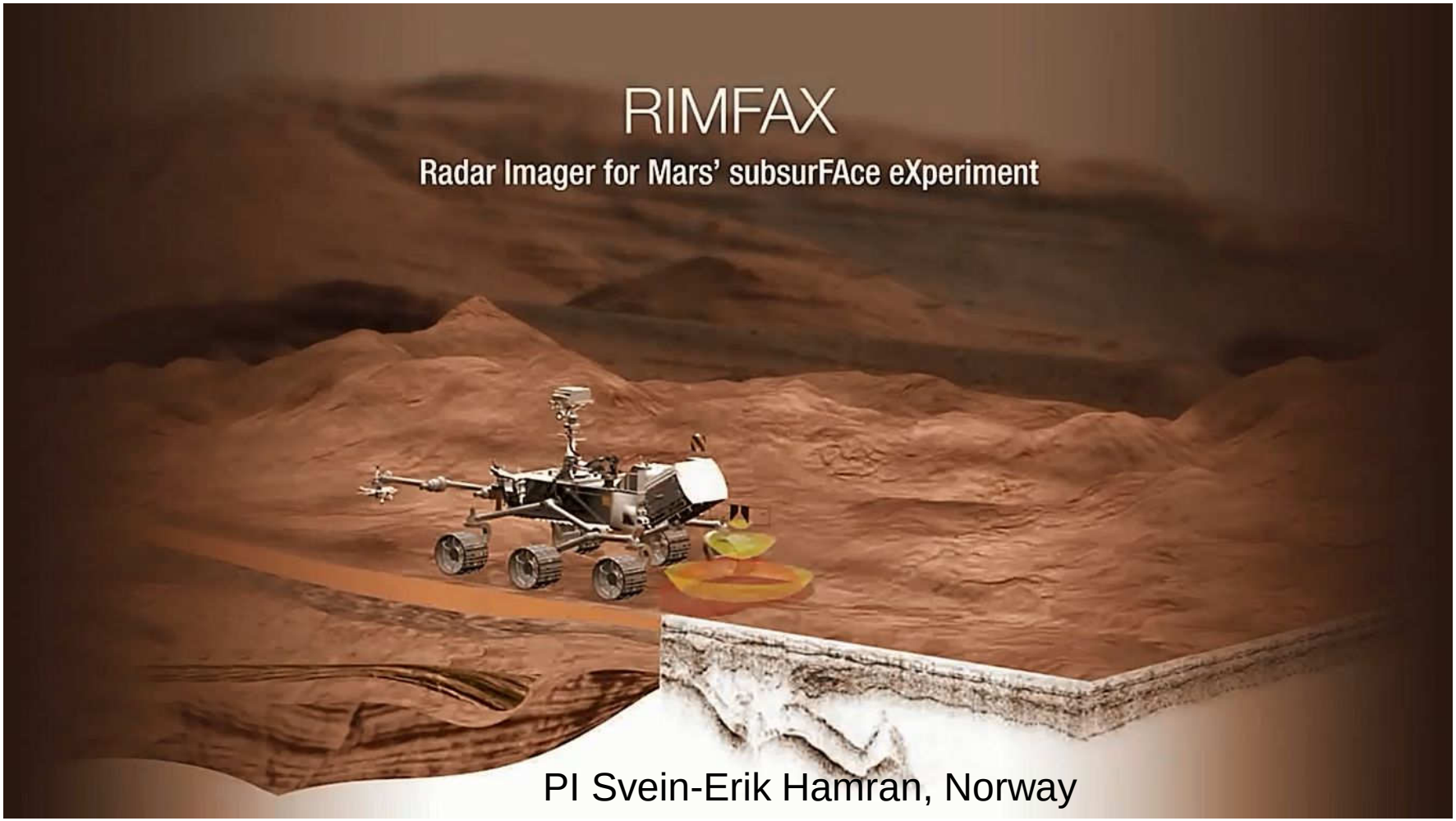
Laser induced fluorescence and Raman spectroscopy to identify organic molecules at the thin-section scale; high spatial resolution (~50 um).

Fine Scale Chemistry



X-ray fluorescence technique to map rock chemical composition (major and minor elements) at the ~50 um scale.

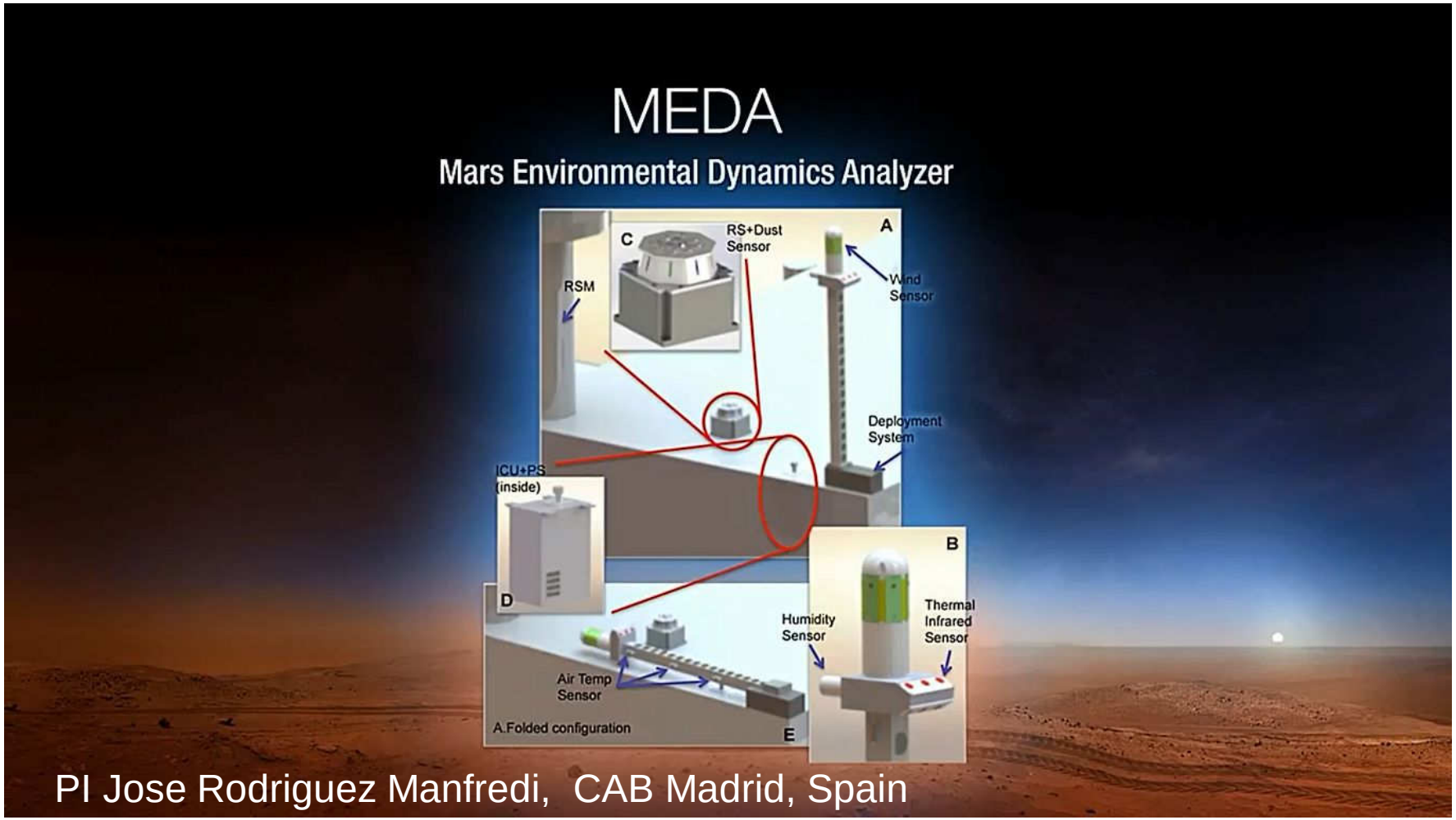
Geologic Characterization



PI Svein-Erik Hamran, Norway

Ground penetrating radar to map sub-surface geologic structure down to 500 m depth

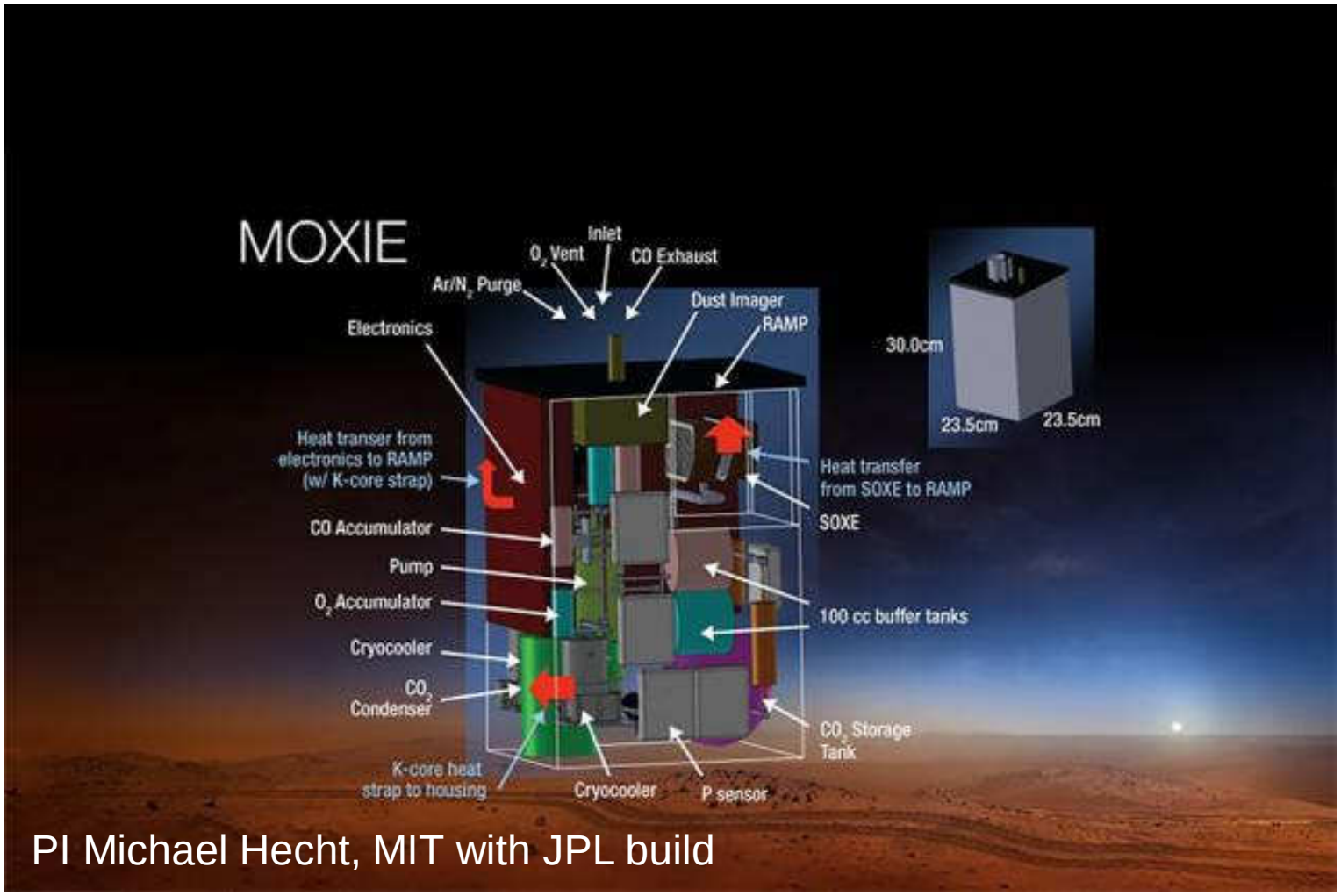
Environmental Monitoring



PI Jose Rodriguez Manfredi, CAB Madrid, Spain

Temperature, humidity, wind, solar radiation, and dust analyzer

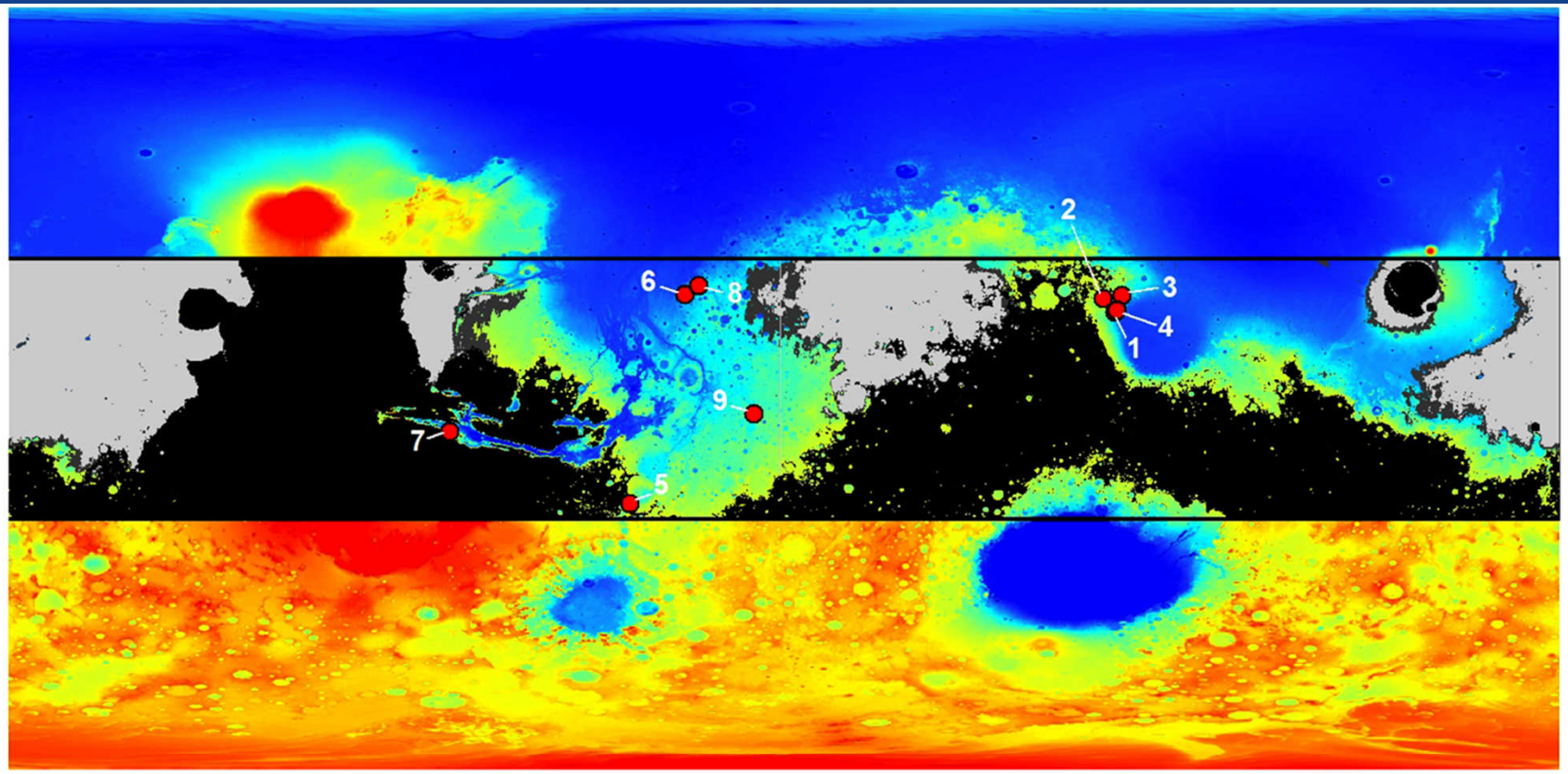
In Situ Resource Utilization



PI Michael Hecht, MIT with JPL build

Converts CO_2 to O_2 as possible future resource (oxidant)

Candidate Landing Sites



1: NE Syrtis Major
2: Nili Fossae Trough
3: Nili Carbonate
4: Jezero Crater
5: Holden Crater Fan
6: McLaughlin Crater
7: SW Melas Chasma
8: Mawrth Valles
9: E. Margaritifer Terra

Elevation above MOLA Geoid (m)

High : 4000 — Low : -5000

Black elevation mask > 0.5 km
Thermal inertia masks:
< 150 = Dark Gray
< 100 = Light Gray

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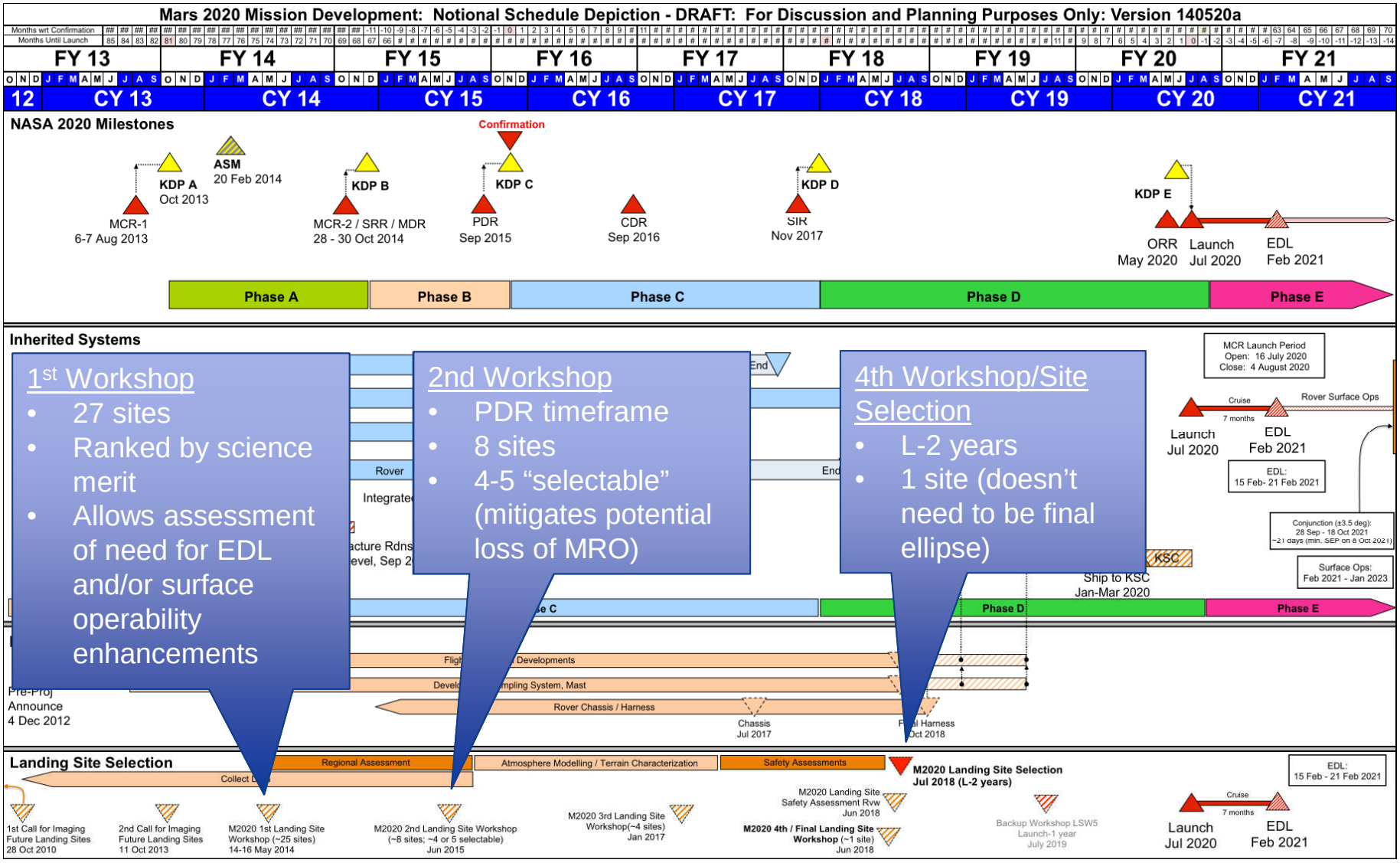
Landing Site Selection Schedule



1st Workshop
- 27 sites
- Ranked by science merit
- Allows assessment of need for EDL and/or surface operability enhancements

2nd Workshop
- PDR timeframe
- 8 sites
- 4-5 "selectable" (mitigates potential loss of MRO)

4th Workshop/Site Selection
- L-2 years
- 1 site (doesn't need to be final ellipse)

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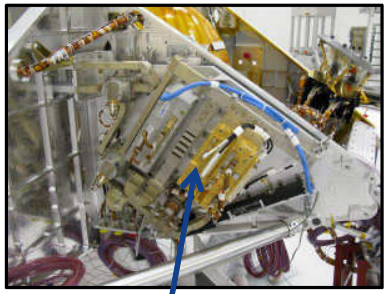
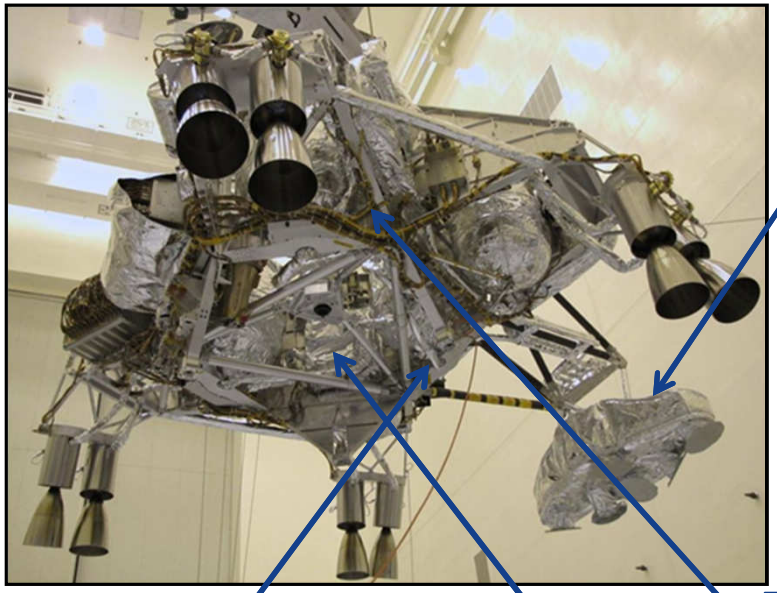
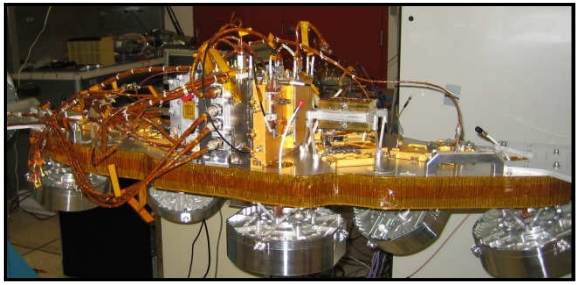
Descent Stage

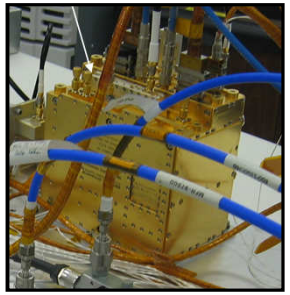




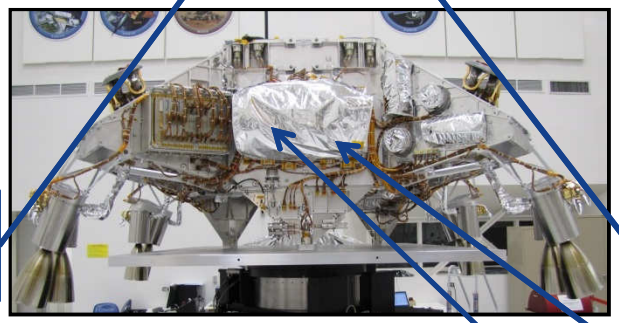
X-band Radio
- Under contract

Radar
- Flight Antennas
  - In negotiation
- Transmit/Receive Modules
  - Residual HW (under test)



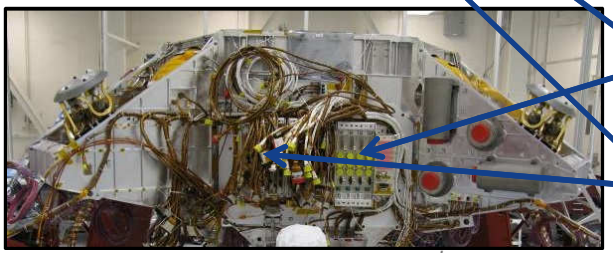


Primary Structure
- Residual



Inertial Measurement Unit
- Contract in negotiation

Descent Stage Brake
- Contract in negotiation



Descent Power Assembly
- Residual flight HW

Descent Power Analog Modules
- Parts Procured, build start in FY14

Project Organization

Mars 2020 Project
Project Manager: John McNamee
Deputy Project Manager: Matt Wallace
Project Scientist: Ken Farley
Deputy Project Scientist: Ken Williford

Mission Assurance
Randy Blue – MAM
Cate Harris - Dep. MAM
Mark Underwood - PPAL

Project System Engineering & Sampling Chief Engineer
Doug Bernard – PSE
Rick Welch – Dep. PSE
Adam Steltzner – SCS CE

Project Science Team

Business Management
Todd Cetti - Bus. Mgr.
Genny Lopez- PRA
Tim Clark - PSA

Mission System Development
Mike Wilson - Acting

Flight System Development
Howard Eisen - FS Mgr.
Jeff Srinivasan - Dep. FS Mgr.
Dave Gruel – Asst. FS Mgr.
Anne Devereaux - FSSE
Allen Chen - EDL Lead

Payload Development
Soren Madsen – Manager
Art Thompson – Deputy
Ann Devereaux - PSSE

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Level 1 Requirements: Organic Contamination and Planetary Protection

#	Requirement
15	The Mars 2020 Project shall comply with requirements for a Planetary Protection Category IVb implemented at subsystem level, as defined in NPR 8020.12 and in the categorization letter.
16	The Mars 2020 project shall design, clean, verify, and maintain elements of the sampling chain such that the returned sample meets the organic cleanliness standards required by the nature and sensitivity of the return sample experiments. The acceptable return sample contamination levels at the point of cache separation from the rover are: • Any Tier 1 compound (organic compounds deemed as essential analytes for mission success): 1 ppb: • Any Tier 2 compound (organic compounds not categorized as Tier 1): 10 ppb • Total Organic Compounds: 10 ppb Baseline (TBC), 40 ppb Threshold
17	The project shall identify, quantify, document, and archive potential pre-launch terrestrial contamination sources, both organic compounds and organisms, and provide mechanisms to support characterization of round-trip terrestrial contamination.
18	The Mars 2020 project shall design, clean, verify, and maintain elements of the sampling chain such that each sample in the returned sample set has less than 1 viable organism (TBC)

Summary

- Project is continuing through it's key milestones:
  - Heritage Hardware Build
  - Landing Site Work
  - Sampling System Architecture
  - Payload Selection and Accommodation

- Targeting confirmation activities in late fall / early winter of 2015/16.