From Kiel to Mars – Mars Science Laboratory

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for the MSL/RAD Team:

RIGHT UP THERE FOR 350 YEARS

Christian-Albrechts-Universität zu Kiel

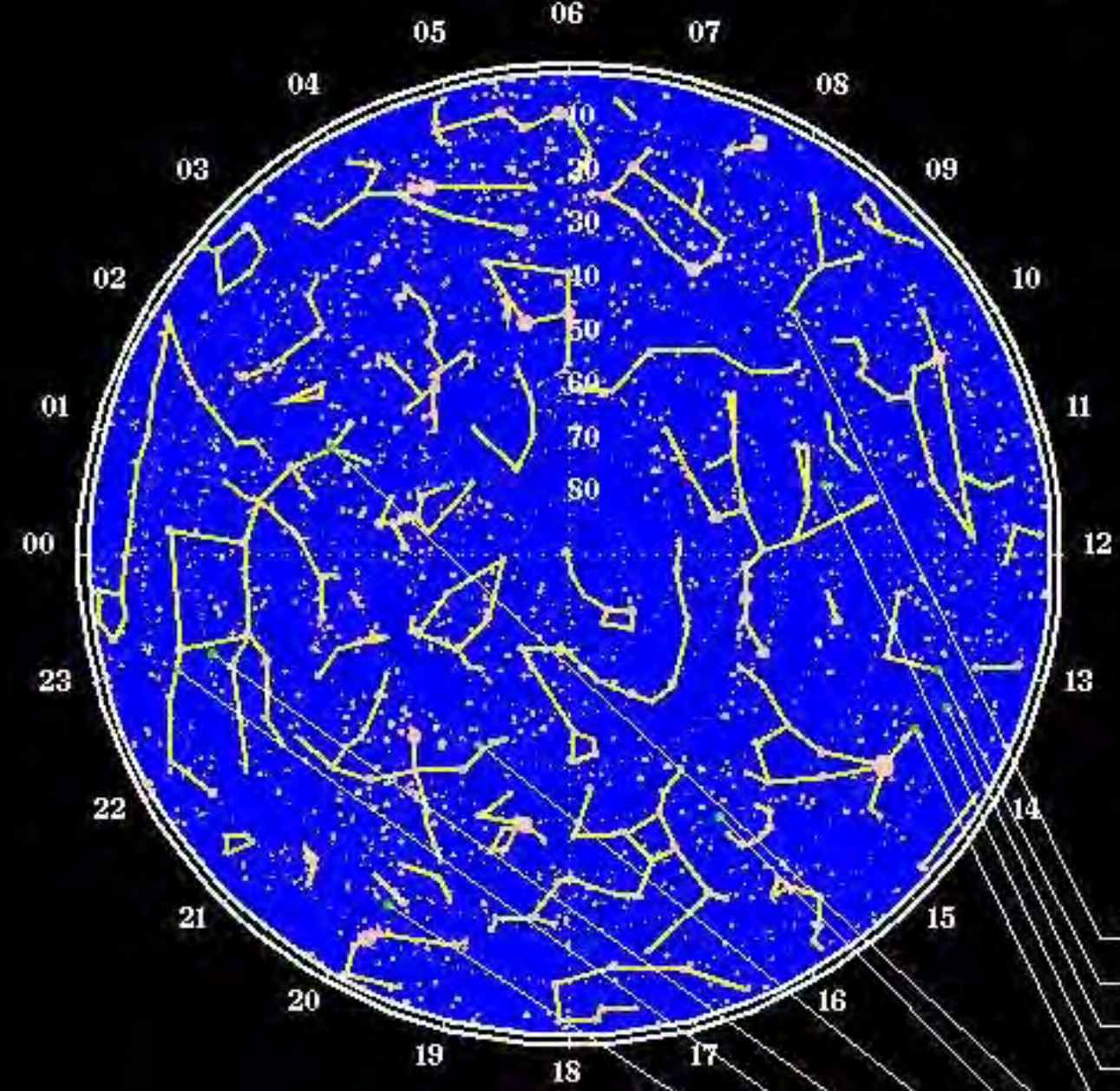
Contents:

- Why Mars and why Gale crater?
- Mars Science Laboratory and the Kiel Radiation Assessment Detector RAD
- The Landing – Seven minutes of pure terror!
- Selected Resultats

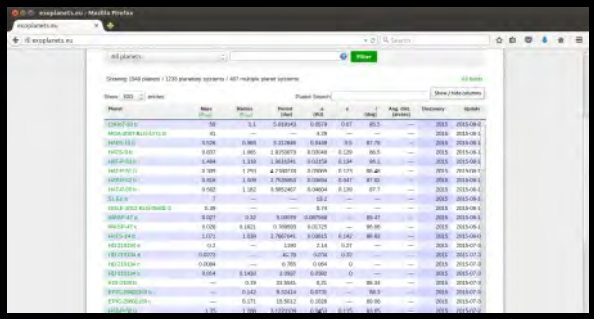
Mission: Mars Science Laboratory

Rover: Curiosity

Habitability: „Fit for life“



Yes, there are planets everywhere!



55 Cancri
HD 114762
70 Virginis
47 Ursae Majoris
τ Bootis
υ Andromedae
ρ Coronae Borealis
16 Cygni B
51 Pegasi
Gliese 876
14 Hercules

May 10 12:51

exoplanet.eu/catalog

133% Search

rted CAU missions institut projects ET tools python electronics teaching

Exoplanet.eu

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Catalog

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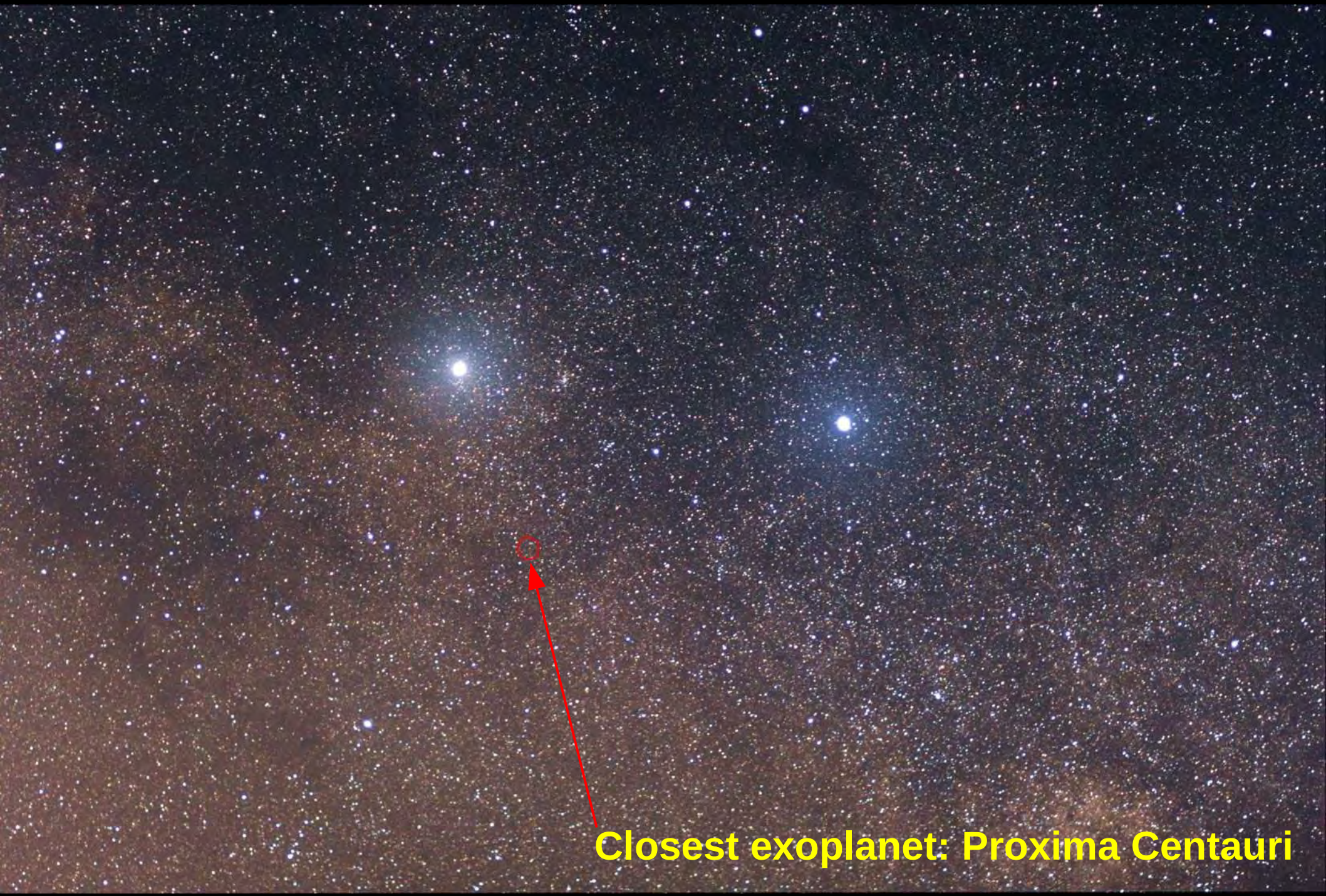
Status | Detection | Filter

Showing 5370 planets / 3966 planetary systems / 856 multiple planet systems

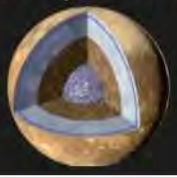
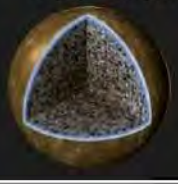
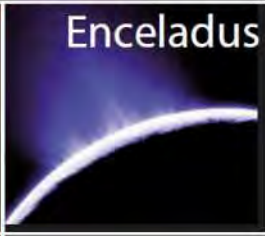
All fields

Show 100 entries | Planet Search | Show / hide columns

Planet	Mass (M_{Jup})	Radius (R_{Jup})	Period (day)	*a* (AU)	*e*	*i* (deg)	Ang. dist. (arcsec)	Discovery	Update
HD 31221 b	12	1.32	4.66632	—	—	84.86	—	2023	2023-05-09
TOI-2641 b	0.366	1.615	4.880974	0.0607	0	83.75	—	2023	2023-05-08
TOI-622 b	0.303	0.824	6.402513	0.0708	0	86.62	—	2023	2023-05-08
TOI-615 b	0.435	1.693	4.66155983	0.0678	0	86.73	—	2023	2023-05-08
WASP-48 b	0.98	1.67	2.143634	0.03444	0	80.09	—	2011	2023-05-05
GJ 3470 b	0.03958	0.373807429400	3.336649	0.03557	0.114	88.3	—	2012	2023-05-05
GJ 486 b	0.00887	0.11643	1.467119	0.01734	0.05	88.4	—	2021	2023-05-02
TOI-519 b	0.463	0.75	1.2652328	0.012	0.06	88.9	—	2021	2023-05-01
KELT-9 b	2.88	1.84	1.4811235	0.03368	—	87.2	—	2017	2023-04-27
TOI-3082 b	0.0410483	0.326713	1.926907	0.027	—	87.63	—	2019	2023-04-26
HATS-15 b	2.17	1.105	1.74748753	0.02712	0	87.13	—	2014	2023-04-26


Closest exoplanet: Proxima Centauri

Habitability and accessibility of solar system bodies

	SURFACE HABITATS		DEEP HABITATS				
	Shallow water		Trapped oceans			Top oceans	
	The Earth	Mars	Ganymede	Callisto	Titan	Europa	Enceladus
							
Liquid Water	●	●	●	●	●	●	●
Stable Environ-ment	●	●	●	●	●	●	●
Essential elements	●	●	●	●	●	●	●
Chemical Energy	●	●	●	●	●	●	●

Earth

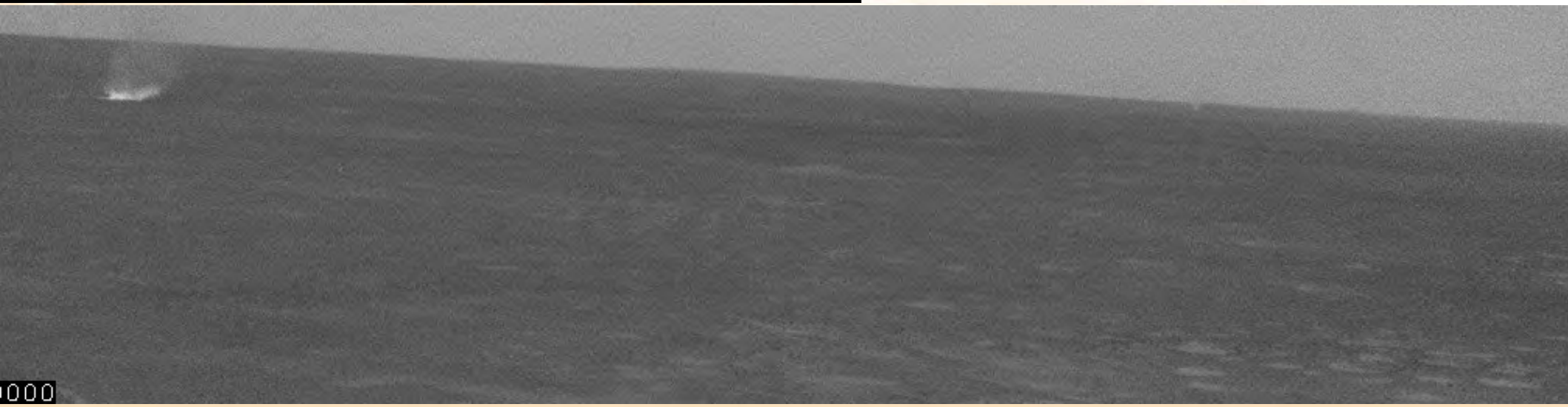
Mars

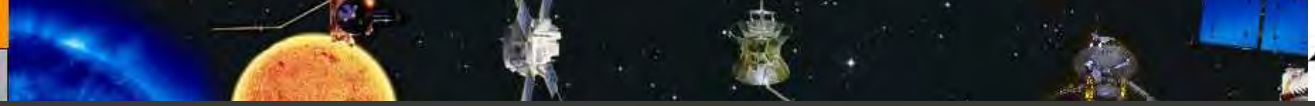
Earth:
6.378 km
1 g

Mars:
3.397 km
0.375 g

Dust storms on Mars can be global and cover the planet entirely!

'Everything is dusty!'





www.google.com/mars

Search

untains Plains
nyons Ridges
nes Craters

gale crater

Search

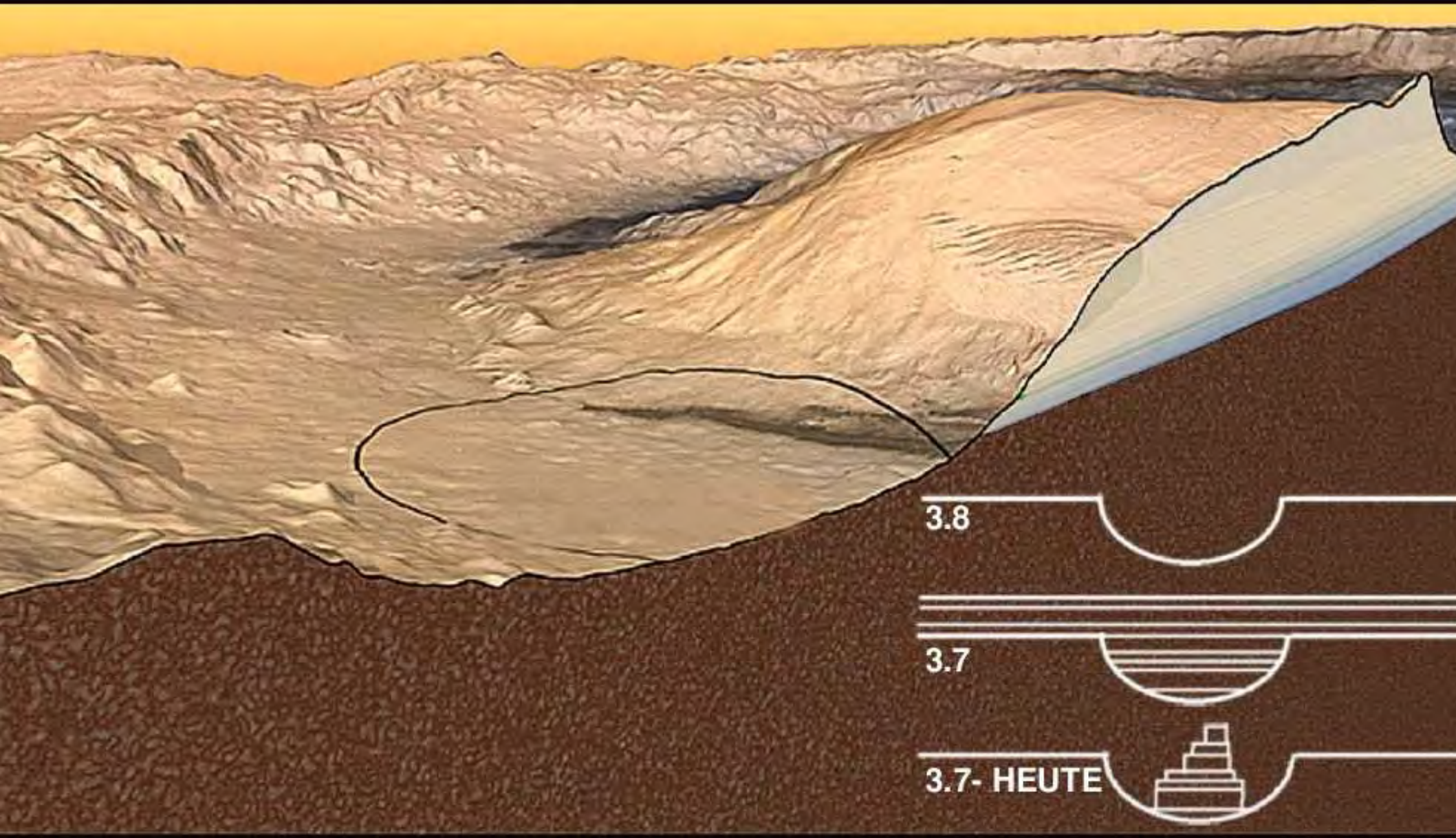
Link this view

View Mars
Google Ear

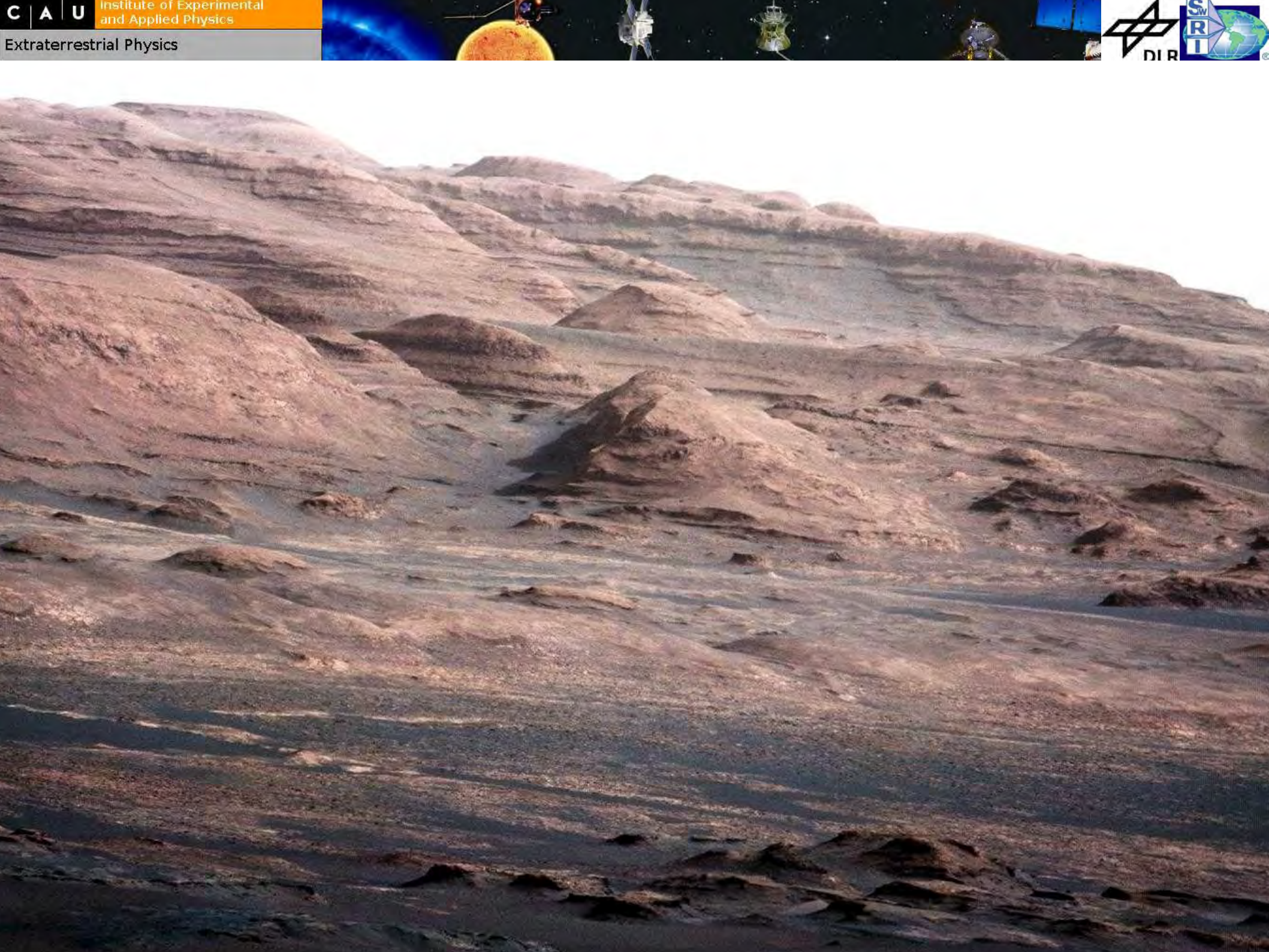
Elevation

Elevation
21 km
18 km
15 km
12 km
9 km
6 km
3 km
0 km
-3 km
-6 km
-9 km

Importance of Gale crater

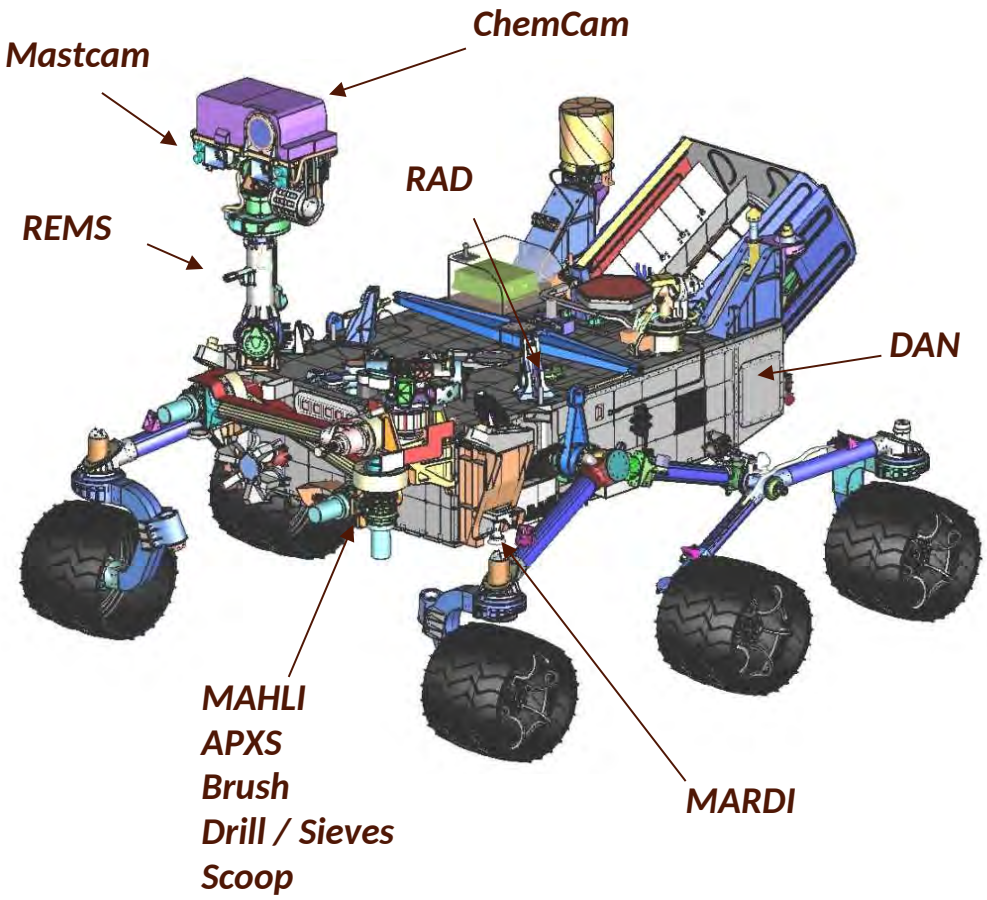


Sediments reflect hydrological evolution of Mars
(Lowest layer very old (3.7 Gy), formation influenced by water)




EXIT

Scientific Payload of Curiosity (MSL)



Wheelbase:	**2.8 m**
Deck height:	**1.1 m**
Ground clearance:	**0.66 m**
Mast:	**2.2 m**
Mass:	**899 kg**

REMOTE SENSING

Mastcam (M. Malin, MSSS) - Color and telephoto imaging, video, atmospheric opacity

ChemCam (R. Wiens, LANL/CNES) – Chemical composition; remote micro-imaging

CONTACT INSTRUMENTS (ARM)

MAHLI (K. Edgett, MSSS) – Hand-lens color imaging

APXS (R. Gellert, U. Guelph, Canada) - Chemical composition

ANALYTICAL LABORATORY (ROVER BODY)

SAM (P. Mahaffy, GSFC/CNES) - Chemical and isotopic composition, including organics

CheMin (D. Blake, ARC) - Mineralogy

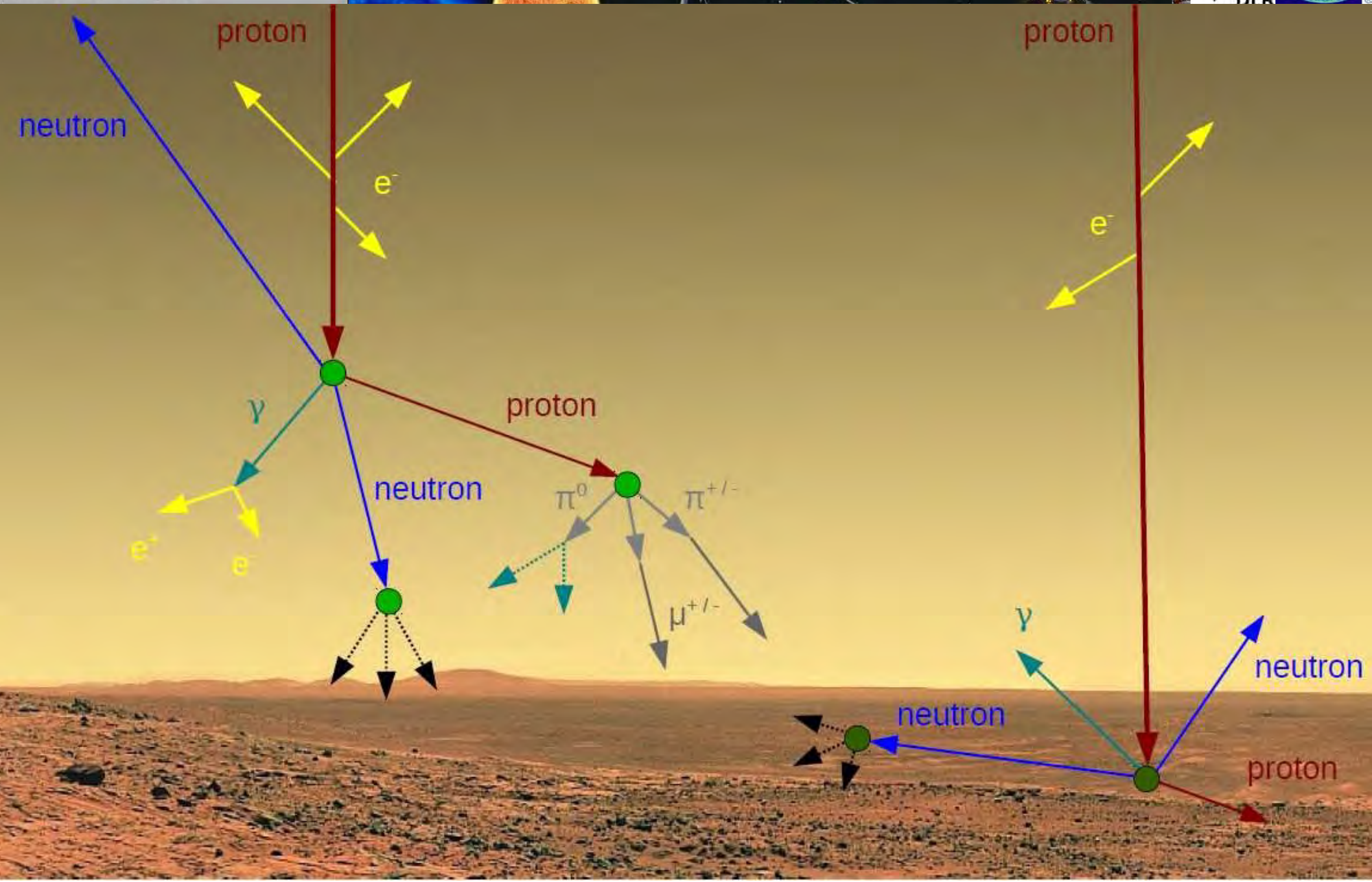
ENVIRONMENTAL CHARACTERIZATION

MARDI (M. Malin, MSSS) - Descent imaging

REMS (J. Gómez-Elvira, CAB, Spain) - Meteorology / UV

RAD (D. Hassler, SwRI) - High-energy radiation

DAN (I. Mitrofanov, IKI, Russia) - Subsurface hydrogen

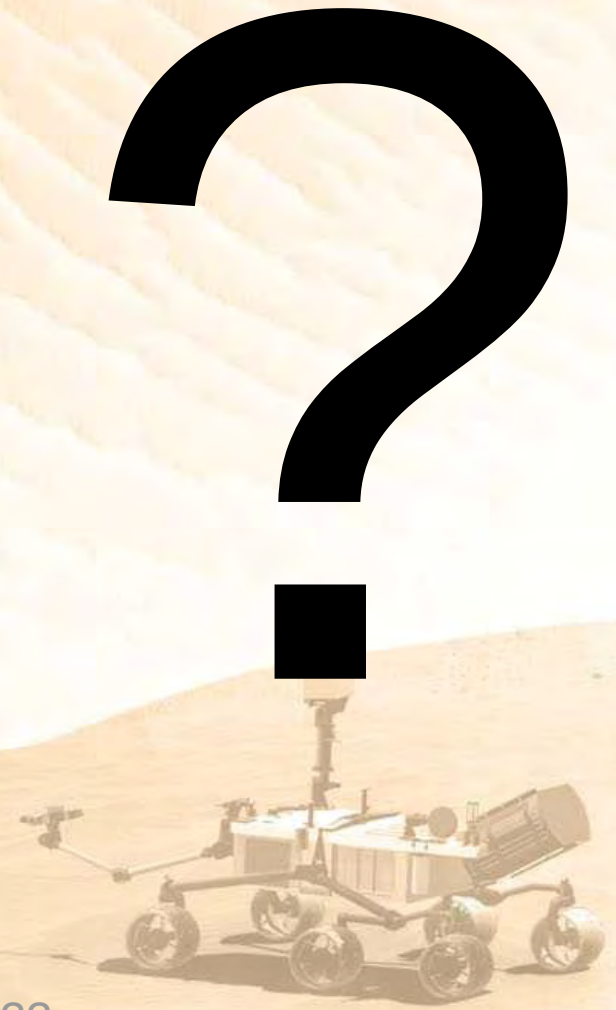


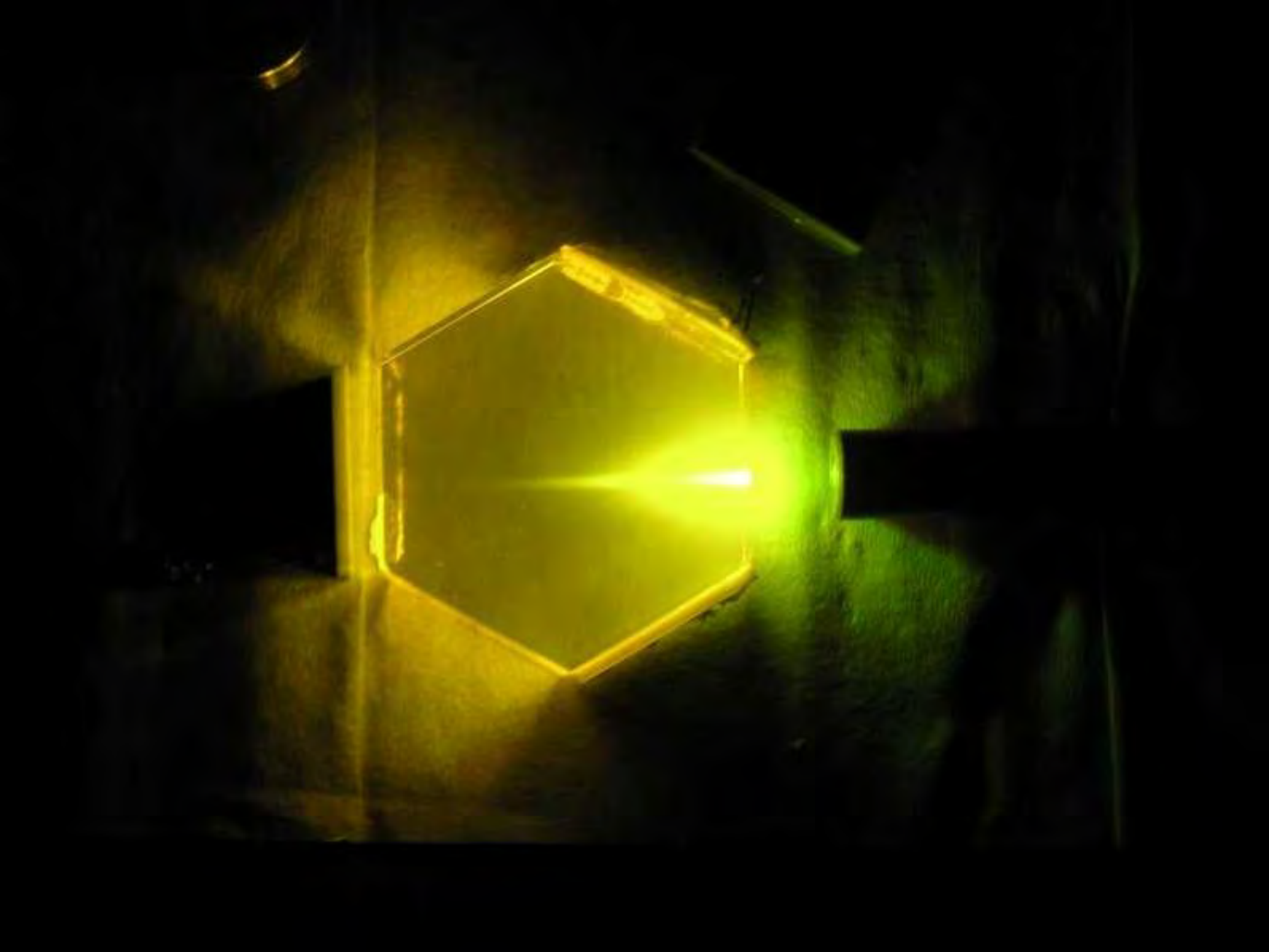
Radiation (neutral!) plays a crucial role in preserving biosignatures!


Maximum of secondary production
is at the Martian surface...
esa

Requirements on RAD:

- Charged particles ($1 \leq Z < 27$) up to 100 MeV/nuc
- Neutral particles (n, γ) up to 100 MeV
- LET
- Composition
- Time series
- Autonomous operation

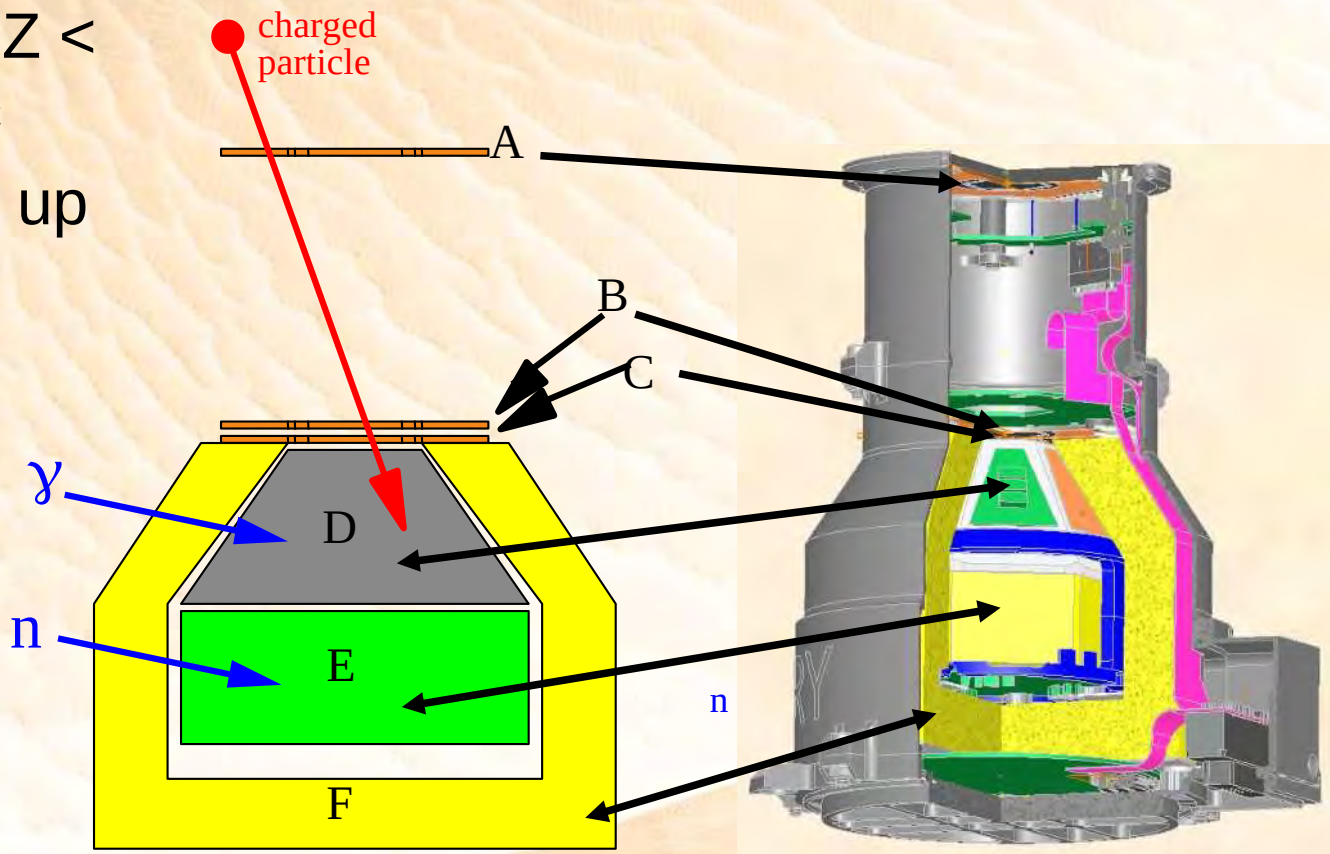


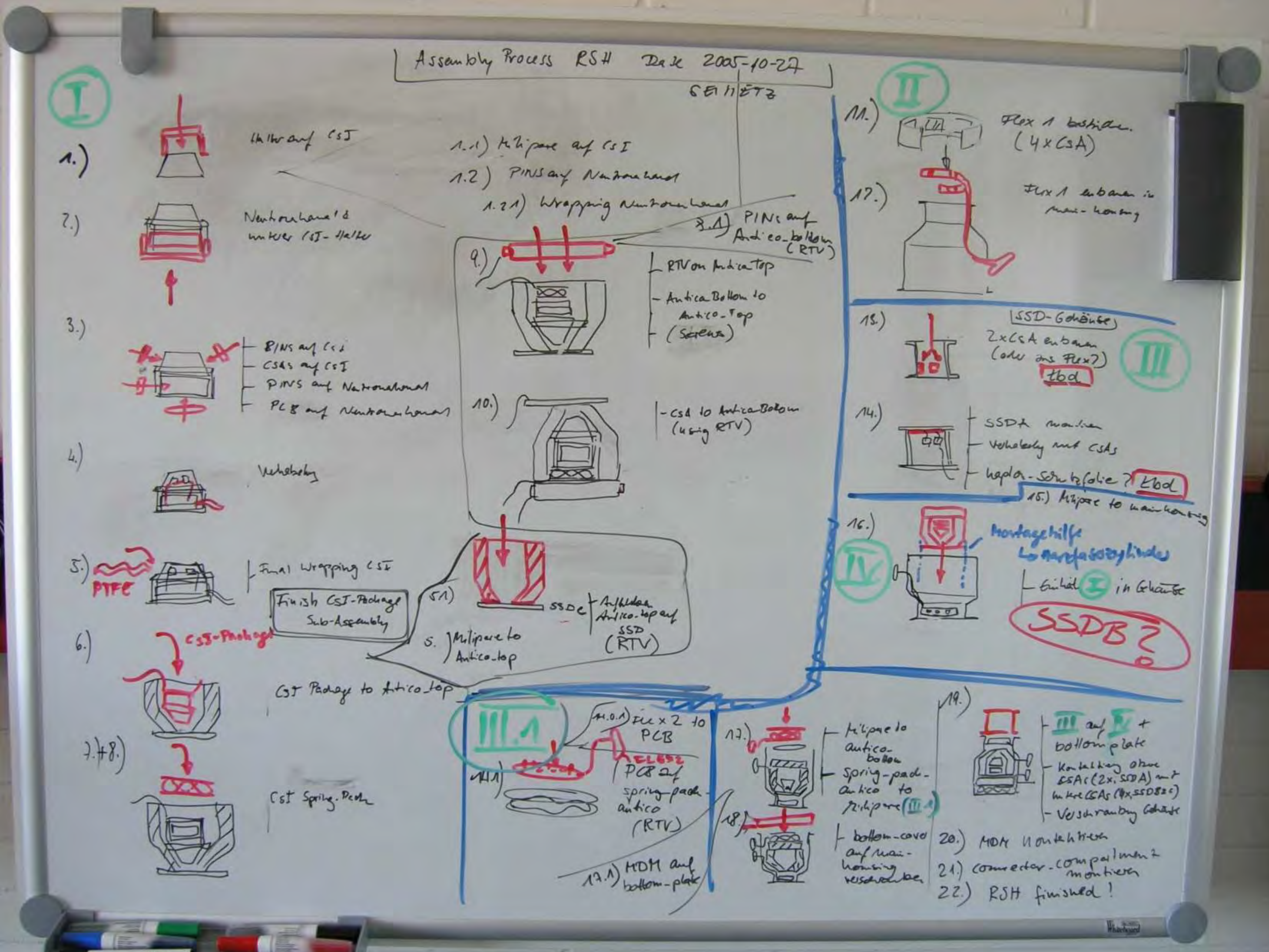


Requirements:

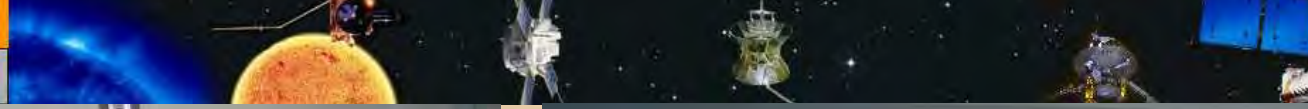
- Charged particles (1 ≤ Z < 27) up to 100 MeV/nuc
- Neutral paritcles (n, γ) up to 100 MeV
- LET
- Composition
- Time series
- Autonomous operation

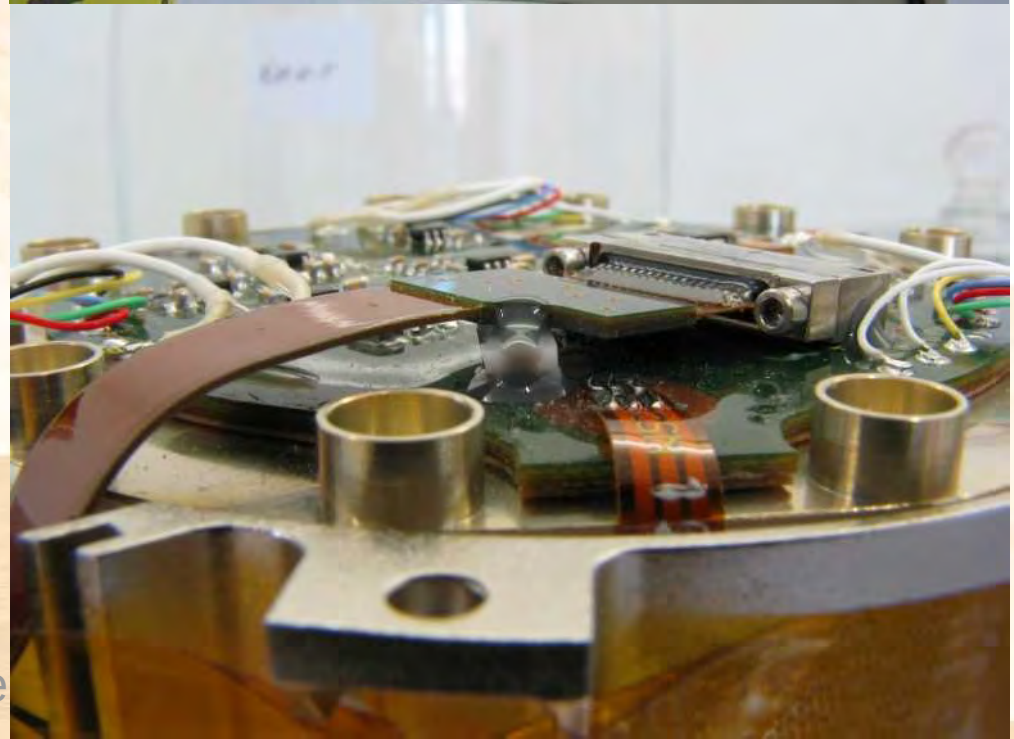
How it works:

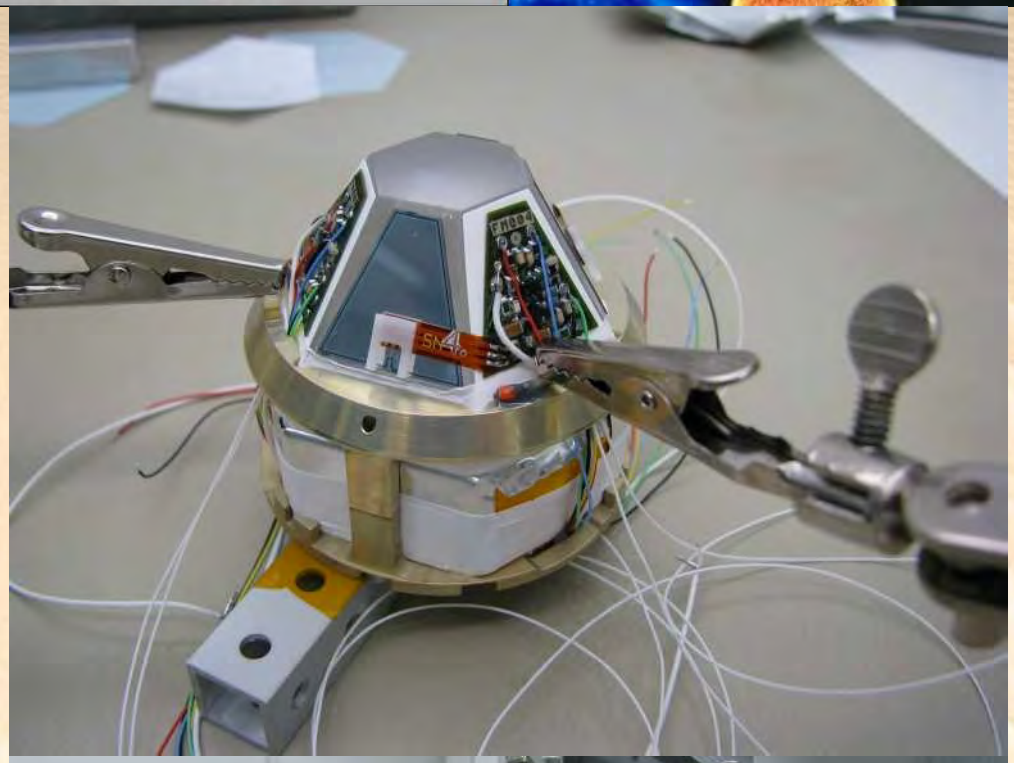


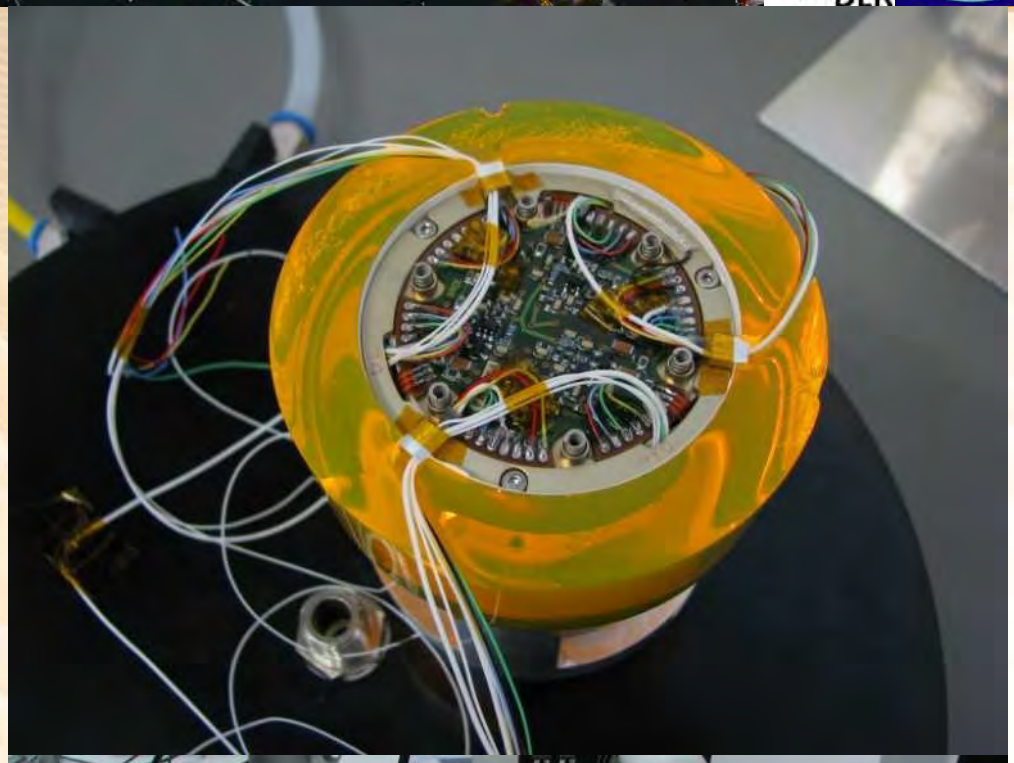


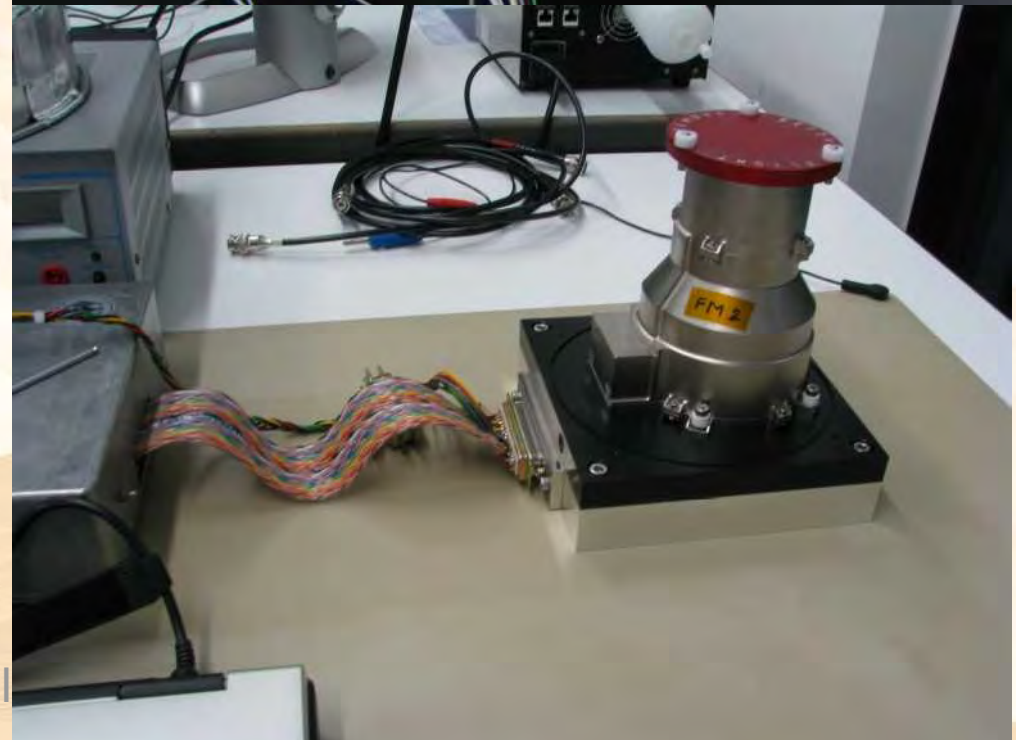
Assembly Process RSH Date 2005-10-27
I
1.)
1.1) Milipore auf CsI
1.2) PINS auf Neutronenwand
1.2.1) Wrapping Neutronenwand
2.)
Neutronenwand unter CsJ-Halter
3.)
PINS auf CsI
CSAs auf CsI
PINS auf Neutronenwand
PCB auf Neutronenwand
4.)
5.)
PTFE
Final Wrapping CsI
Finish CsJ-Package Sub-Assembly
6.)
CsJ-Package
CsJ Package to Antico_top
7.)+8.)
CsJ Spring-Pack
9.)
PINs auf Antico-bottom (RTV)
RTV on Antico-Top
Antico Bottom to Antico-Top (Screws)
10.)
CSA to Antico-Bottom (using RTV)
5.1)
SSD
Aufkleben Antico-top auf SSD (RTV)
5.) Milipore to Antico_top
II
11.)
Flex 1 bestücken (4 x CSA)
12.)
Flex 1 einbauen in main-housing
13.)
SSD-Gehäuse
2xCSA einbauen (oder ans Flex?)
tbd
III
14.)
SSDA montieren
Verkabelung mit CSAs
Kapton-Schutzfolie? tbd
15.) Milipore to main housing
16.)
Montagehilfe
IV
SSDB?
III.1
11.0.1) Flex x 2 to PCB
11.1)
PCB auf Spring-pack antico (RTV)
17.)
Milipore to antico-bottom
Spring-pack-antico to Milipore (III.1)
18.)
bottom-cover auf main-housing
17.1) MDM auf bottom-plate
19.)
III auf IV + bottom plate
Verschraubung Gehäuse
20.) MDM montieren
21.) connector-compartment montieren
22.) RSH finished!

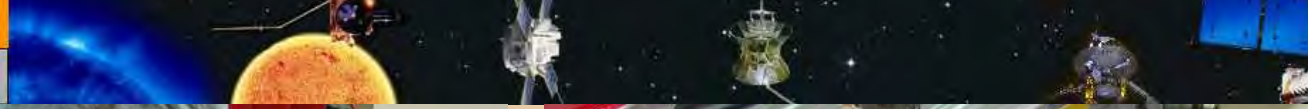


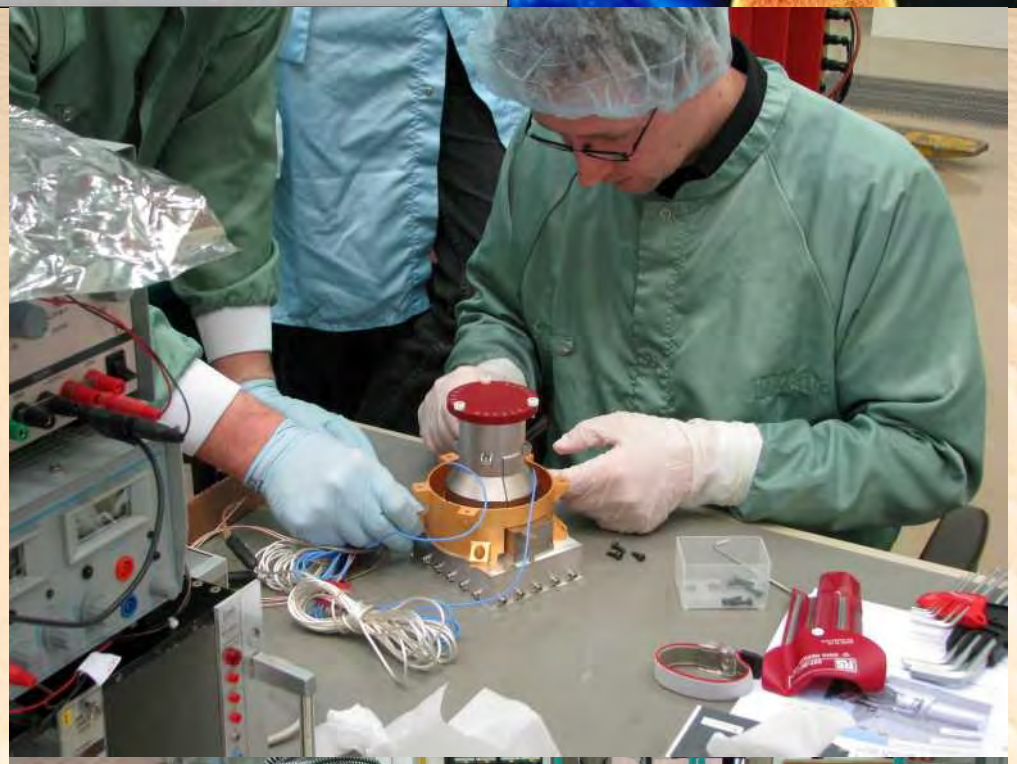


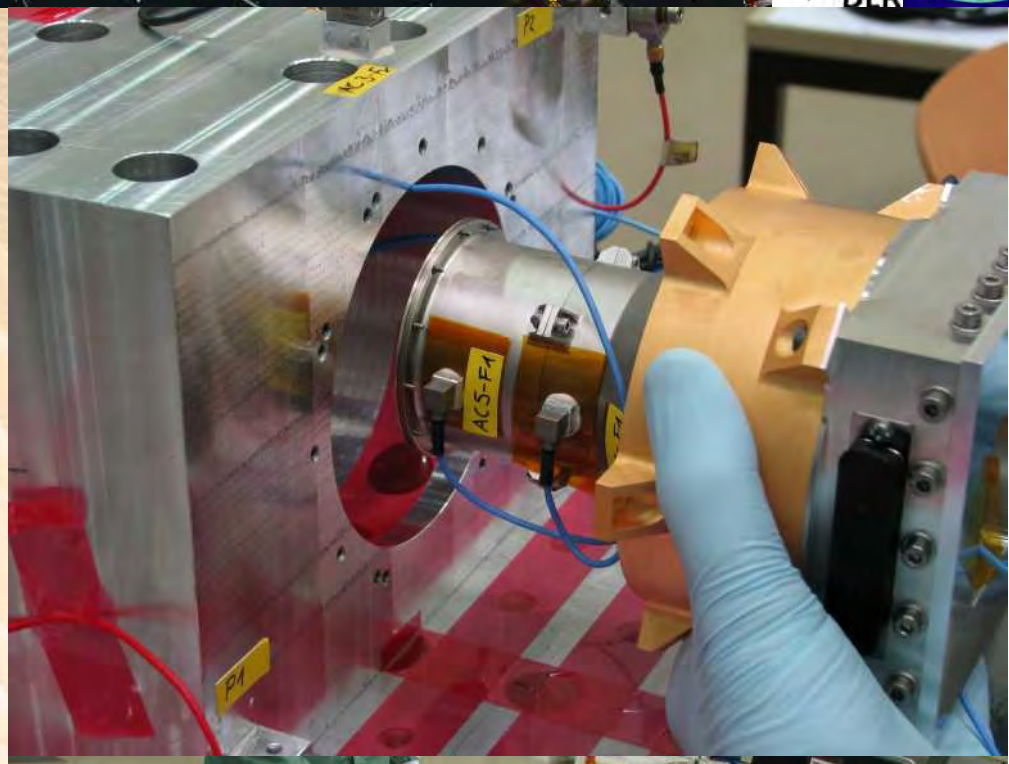





FM 2



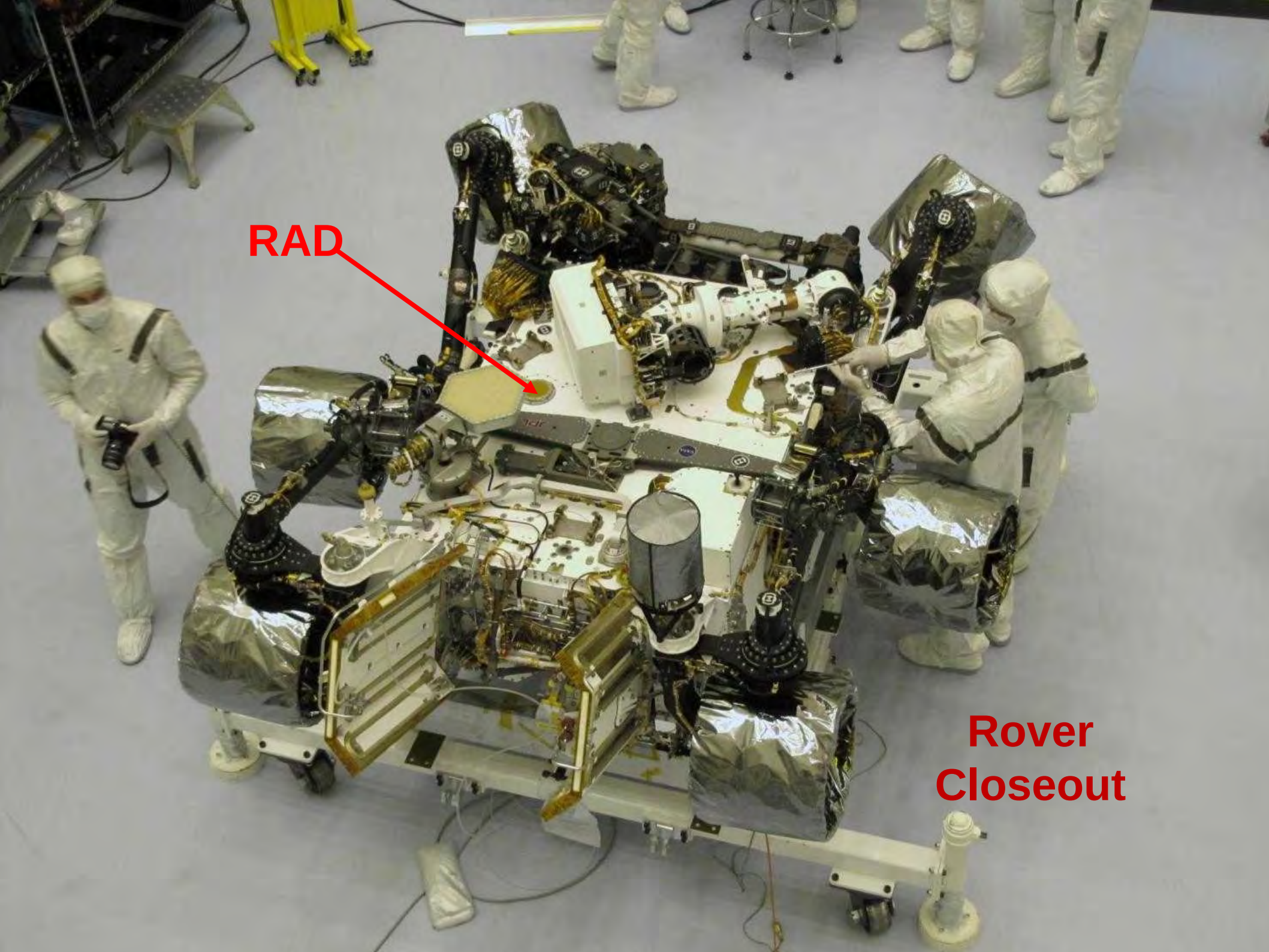



ACS-F1
P1

RAD:

- Mass: 1,56 kg
- Power: 4,2 W
- Telemetry: 10 bps
- RSH: FM & FS


"DANGER"
"KEEP OUT"
3-3053
CAUTION
DANGER

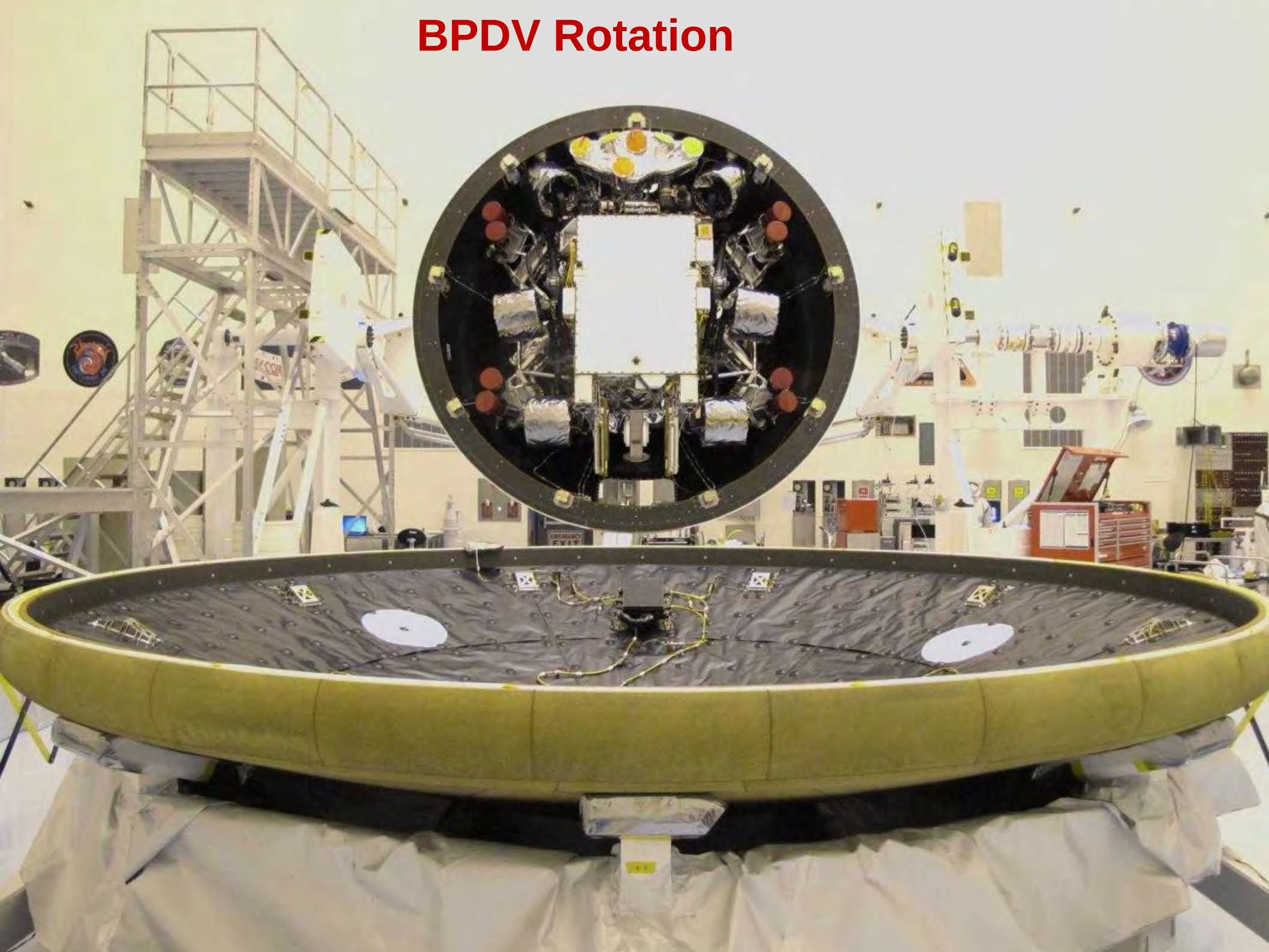

RAD
Rover
Closeout

Rover on Spin Table For Mass Property Measurements


Powered
Descent
Vehicle
Mate


1025740R-001-308
CAUTION

BPDV Rotation



MSL Stacked Spacecraft – Final Rotation