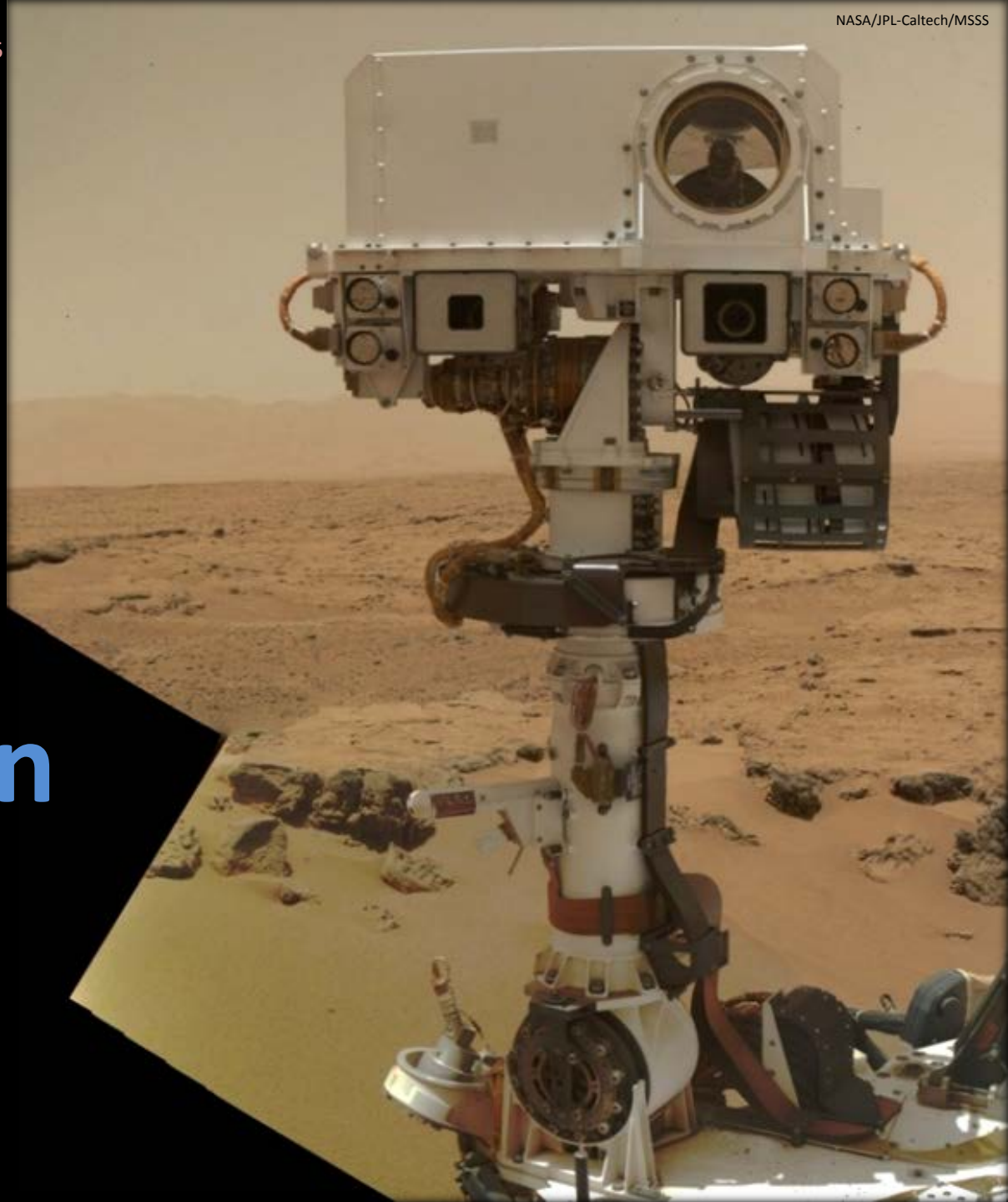
Lunar and Planetary Science Conference, March 18th, 2015

COMMUNITY USER WORKSHOP ON PLANETARY LIBS (CHEMCAM) DATA

Introduction

Roger Wiens

and the ChemCam team



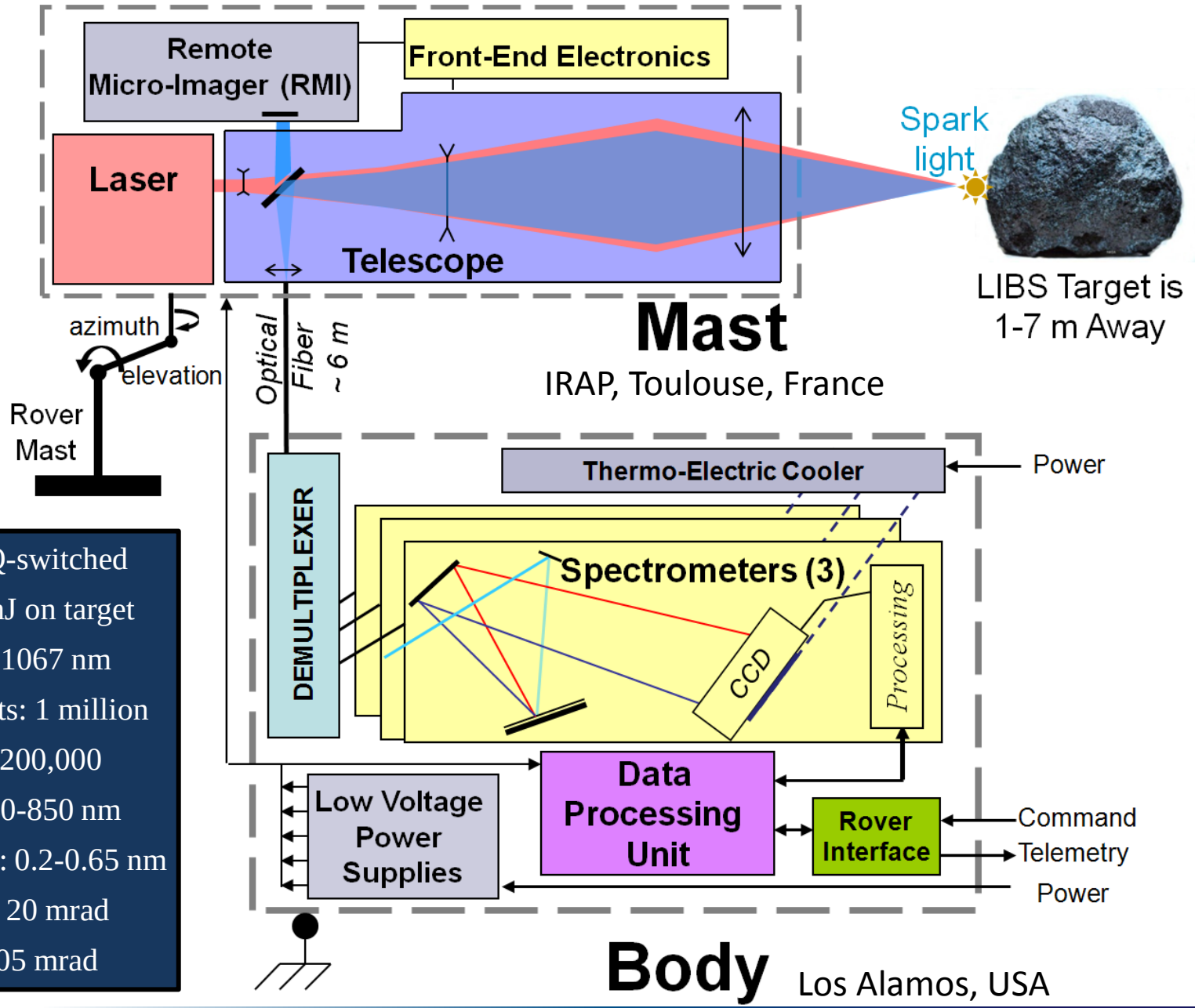
Purposes

- To inform scientists in the community how to access ChemCam data and how to use it
- To inform about past and present work, as this will inspire ideas for future applications
- To foster greater collaboration with the ChemCam data. The ChemCam team will help researchers who are starting to use the data, and the investigations benefit greatly from the collaboration

Meeting Agenda

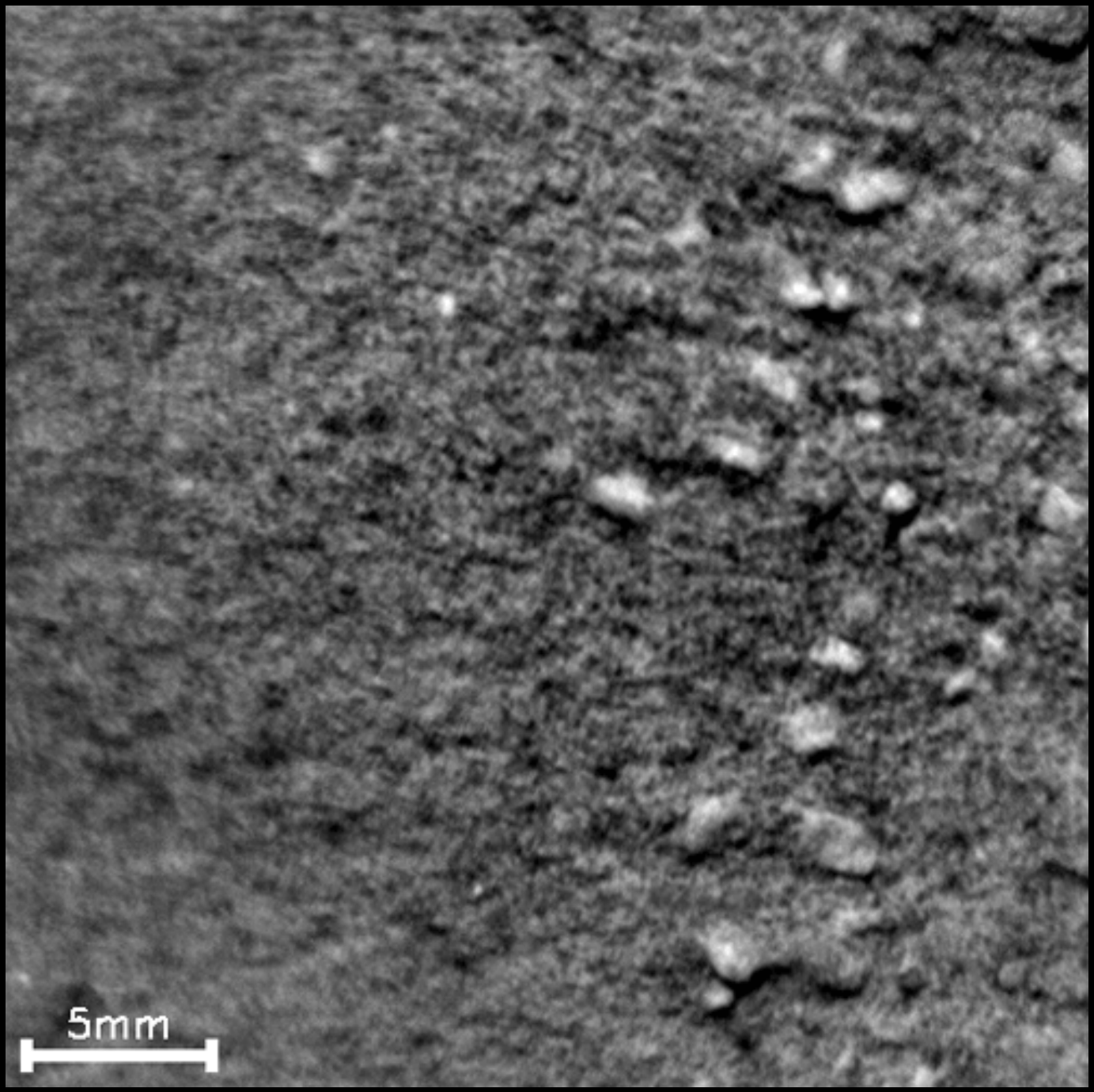
	TOPIC	PRESENTER	DURATION
1	Welcome, Introduction, ChemCam Description	Roger Wiens, LANL	15 min.
2	Introduction to LIBS	Sam Clegg, LANL	20
3	LIBS data processing		
	a) Level 1	Olivier Forni, IRAP	15
	b) Advanced	Jeremie Lasue, IRAP	15
	c) Quantitative	Ryan Anderson, USGS	15
4	C-Quest Emission Line Tool	Agnes Cousin, IRAP	10
5	Remote Micro-Imager (RMI)	Olivier Gasnault, IRAP	10
6	Data Currently Available, Access	Dot Delapp, LANL	15
7	Analyst Notebook Demo	Tom Stein, PDS, Wash U	20
8	Past and Current Investigations	Diana Blaney, JPL	10
9	Collaborating with ChemCam	Roger Wiens, LANL	10

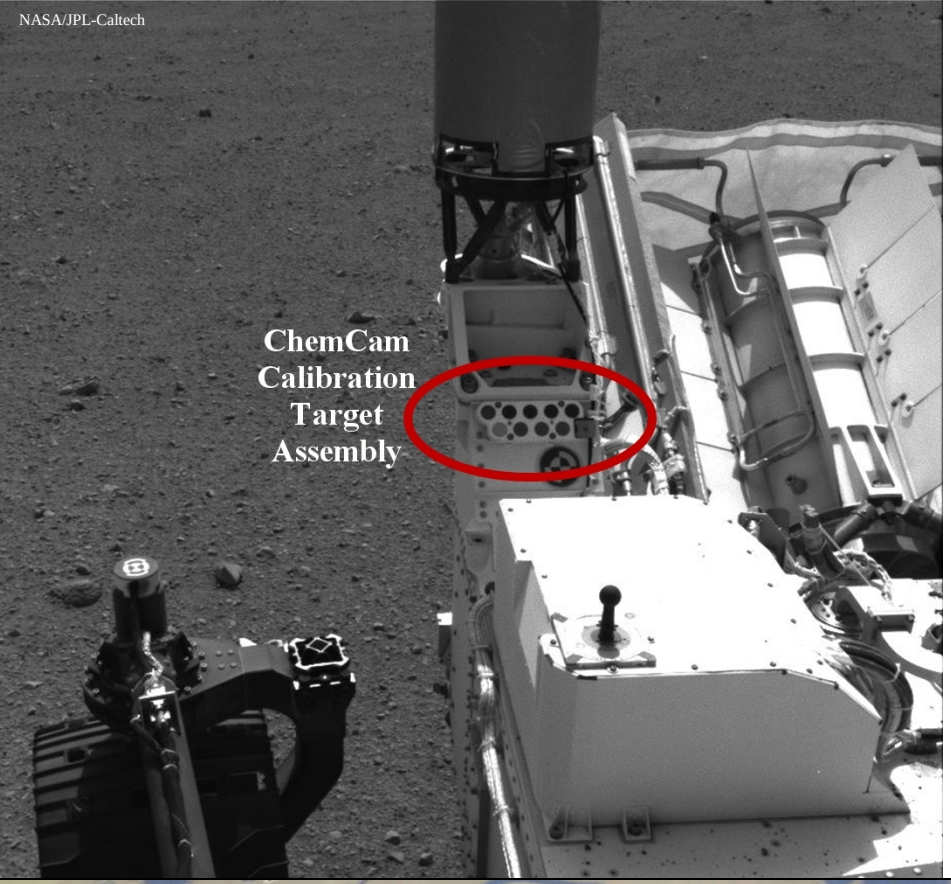
ChemCam Instrument Schematic



- Laser: Nd:KGW, Q-switched
- Laser energy: 14 mJ on target
- Laser wavelength: 1067 nm
- Expected laser shots: 1 million
- Laser shots so far: 200,000
- Spectrometer λ: 240-850 nm
- Spectral resolution: 0.2-0.65 nm
- RMI field of view: 20 mrad
- RMI resolution: 0.05 mrad

NASA/JPL-Caltech/LANL/IRAP/IAS

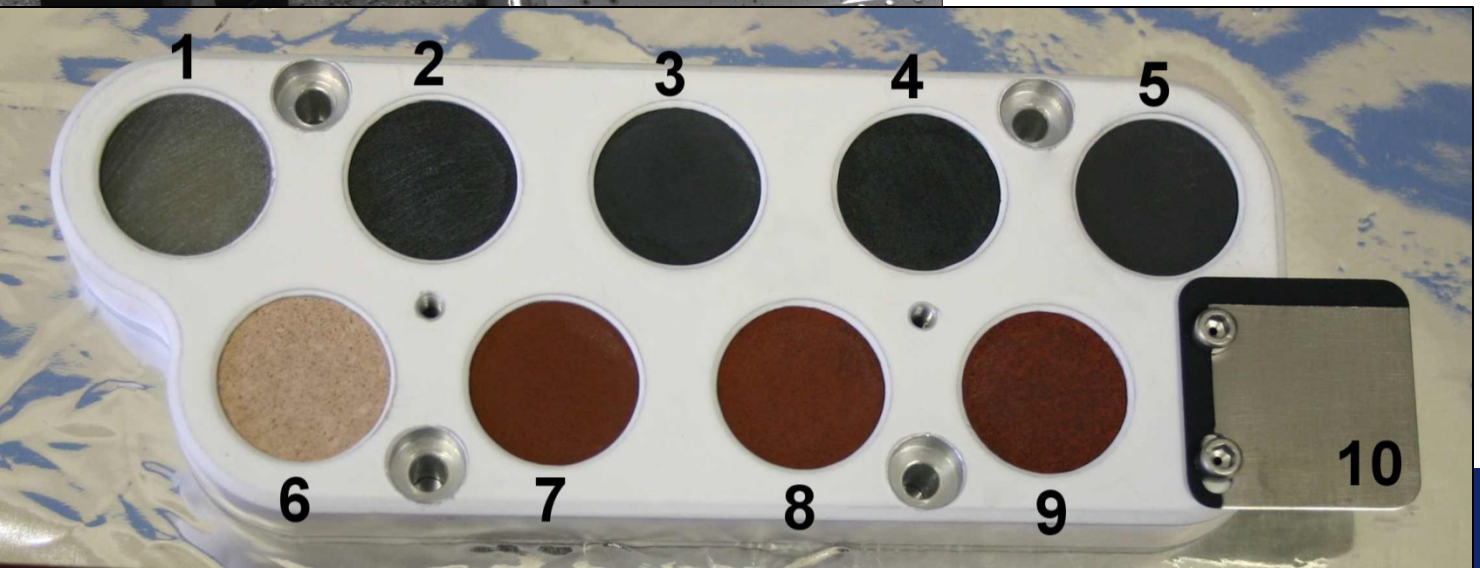




ChemCam Mars Calibration

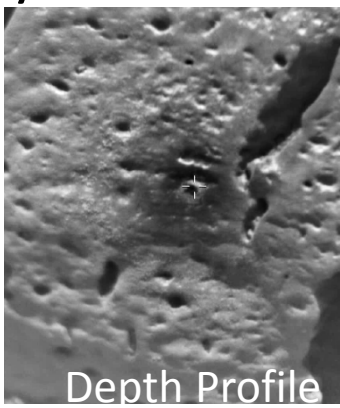
1. Macusanite volcanic glass
2. Norite synthetic glass
3. Picrite synthetic glass
4. Shergottite synthetic glass
5. Graphite (C calibration)
6. Kaolinite-based ceramic
7. Nontronite-based ceramic
8. Nontronite-based ceramic
9. Nontronite-based ceramic
10. Titanium plate (diagnostics)

References:1-4: Fabre et al., 2011
6-9: Vaniman et al., 2012



Nomenclature—LIBS

- LIBS = laser-induced breakdown spectroscopy
- Shot = single laser pulse; the plasma signal is recorded with a spectrum from each shot
- Observation point = location; the place where the laser fired at a single point. Almost all location analyses consist of 30 spectra
- Raster = series of locations sampled by ChemCam. Usually these are 1x5, 1x10, 2x2, 3x3, 4x3, or 5x5



- Depth profile: > 50 laser shots in the same location, to investigate compositional variations at greater depths
- "Dark" = non-laser background exposure of the same duration used for the LIBS
- Sequence = single set of commands that includes a raster, before & after RMI images, and darks
- Spectral ranges: UV = ultraviolet, VIO/VIS = violet / visible, VNIR = visible & near infrared

Nomenclature—Other

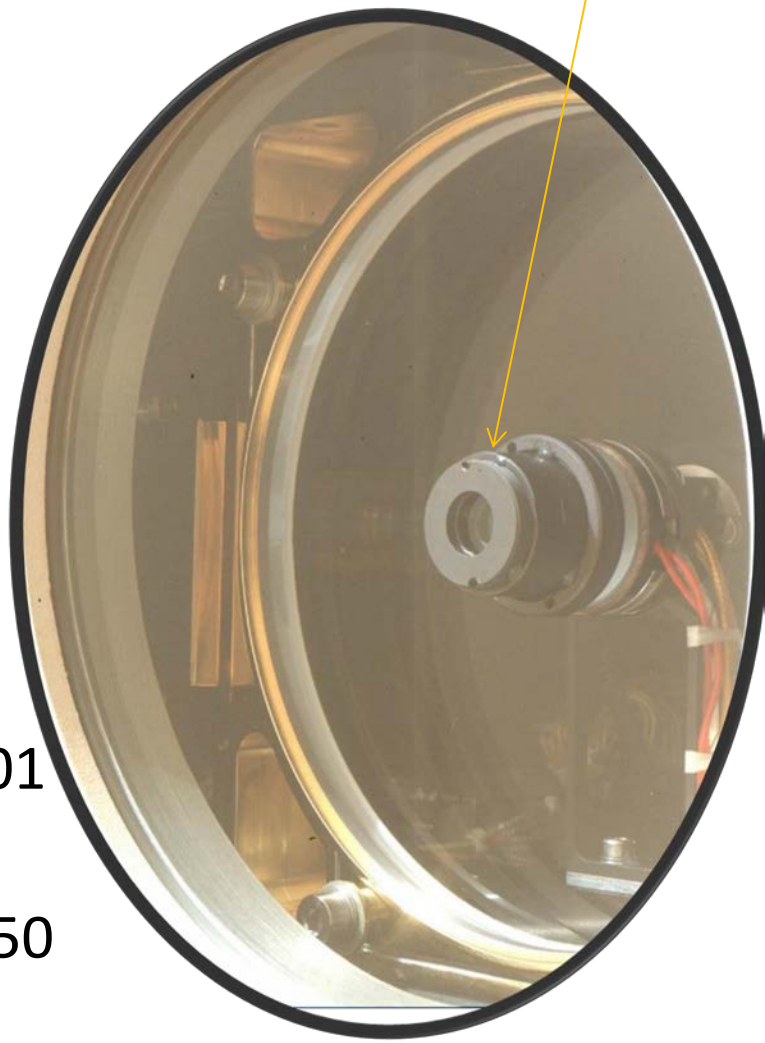
- RMI = Remote Micro-Image
- Autofocus = automatic focusing, used at < 18 m
- Manual focus = used > 18 m
- Z-stack = series of co-boresighted images at slightly different focus; used when exact focus is not well known, e.g., between 18 m & 1 km (infinity)
- Passive spectra = non-laser spectra. These may be the same as the “darks”, which yield reflectance spectral information, or they can be longer exposures.
- CCCT = ChemCam on-board Calibration Targets
- Blind Targets = observations on random surfaces @ 3 m distance, to the right of the rover

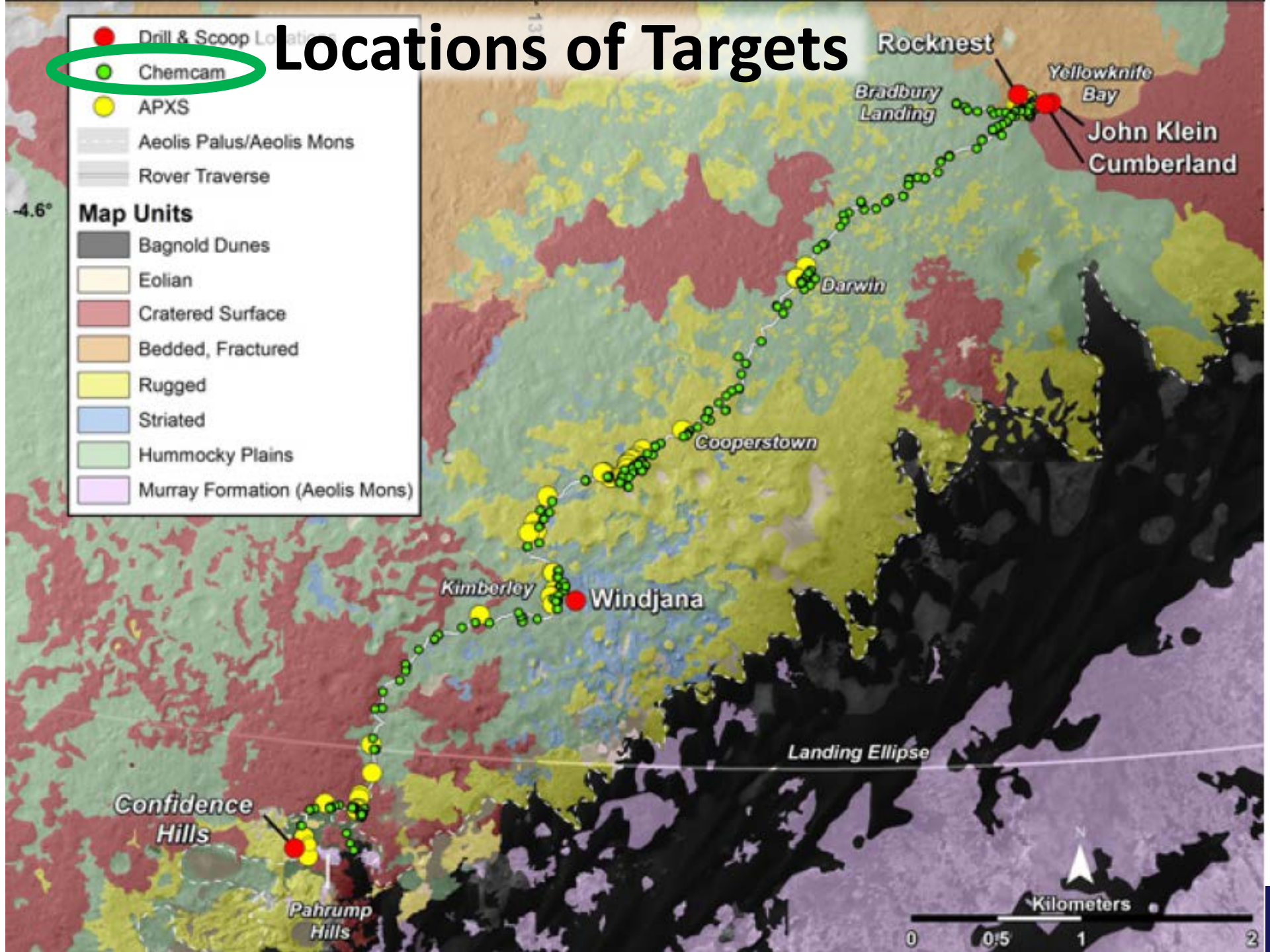
PDS Data Nomenclature

- RDR = reduced data record, level 1a, without instrument response correction. In units of counts (DN) per channel
- CCS = clean calibrated spectra, level 1b, in units of photons per channel
- MOC = multivariate oxide compositions, level 2, in weight %, e.g., for SiO_2, Al_2O_3, etc.
- For RMI images, processed results are labeled PRC (partial radiometrically corrected)

Autofocus Anomaly

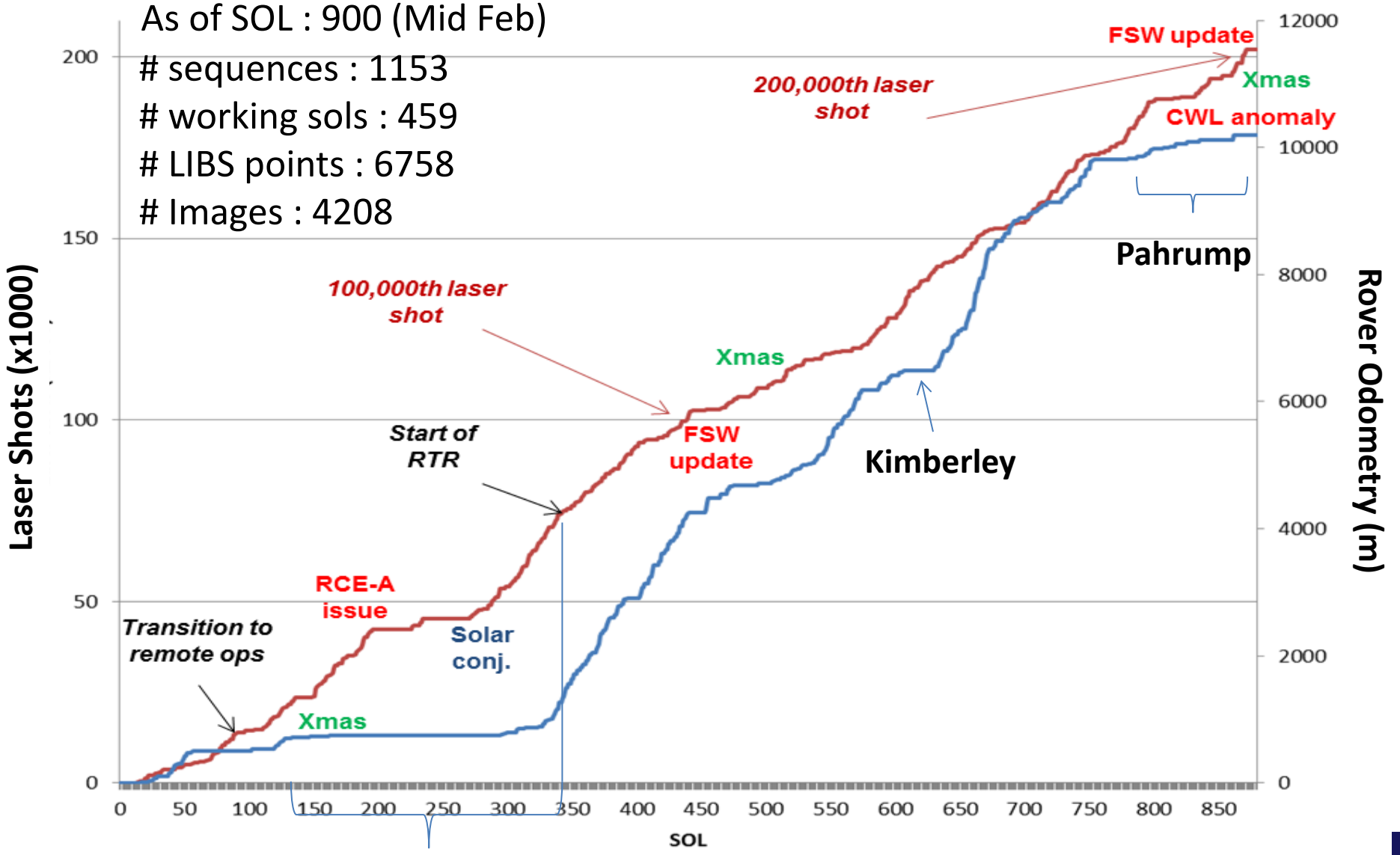
- In early November 2014 (sol 801) ChemCam's CW laser failed
- ChemCam lost the ability to focus
- Since then we have taken data @ 9 different focus planes (inefficient!)
- We are developing an RMI-based autofocus, planning upload in April
- Nomenclature:
  - Season 1 = pre-autofocus failure, < 801
  - Season 2 = intermediate period
  - Season 3 = RMI-based autofocus, ~ 950




Locations of Targets
Drill & Scoop Locations
Chemcam
APXS
Aeolis Palus/Aeolis Mons
Rover Traverse
Map Units
Bagnold Dunes
Eolian
Cratered Surface
Bedded, Fractured
Rugged
Striated
Hummocky Plains
Murray Formation (Aeolis Mons)
-4.6°
Rocknest
Yellowknife Bay
Bradbury Landing
John Klein
Cumberland
Darwin
Cooperstown
Kimberley
Windjana
Landing Ellipse
Confidence Hills
Pahrump Hills
N
Kilometers
0
0.5
1
2

Observation Statistics

Number of Mars laser spectra: > 210,000



LIBS Calibration Updates

- 1st update completed September 2013, initiated in PDS November 2013
- 2nd update is being completed; should be submitted to PDS June 2015, available on the PDS August 2015; new values available upon request when re-calibration is complete