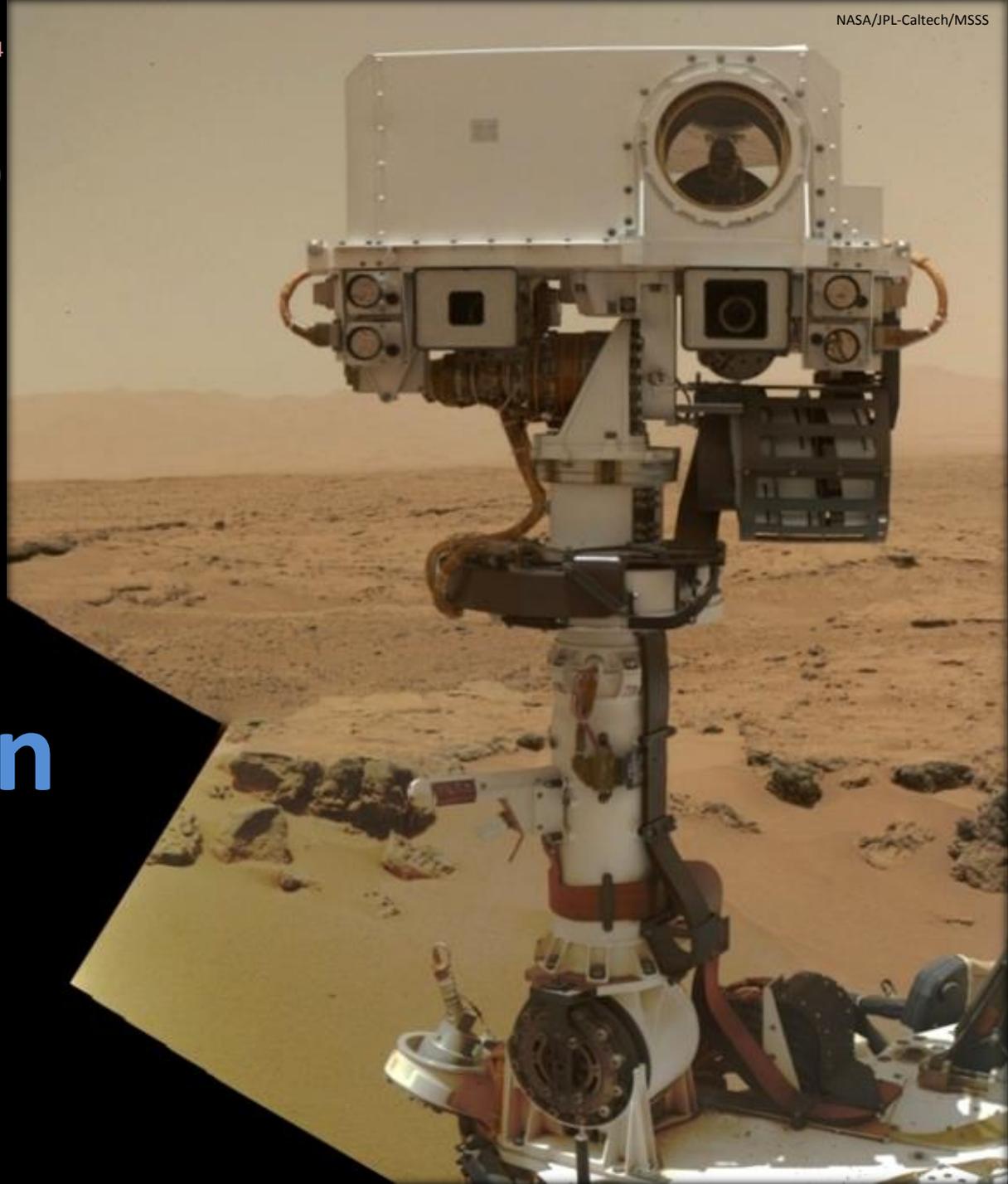Lunar and Planetary Science Conference, March 16th, 2014

COMMUNITY USER WORKSHOP ON PLANETARY LIBS (CHEMCAM) DATA

Introduction

Roger Wiens
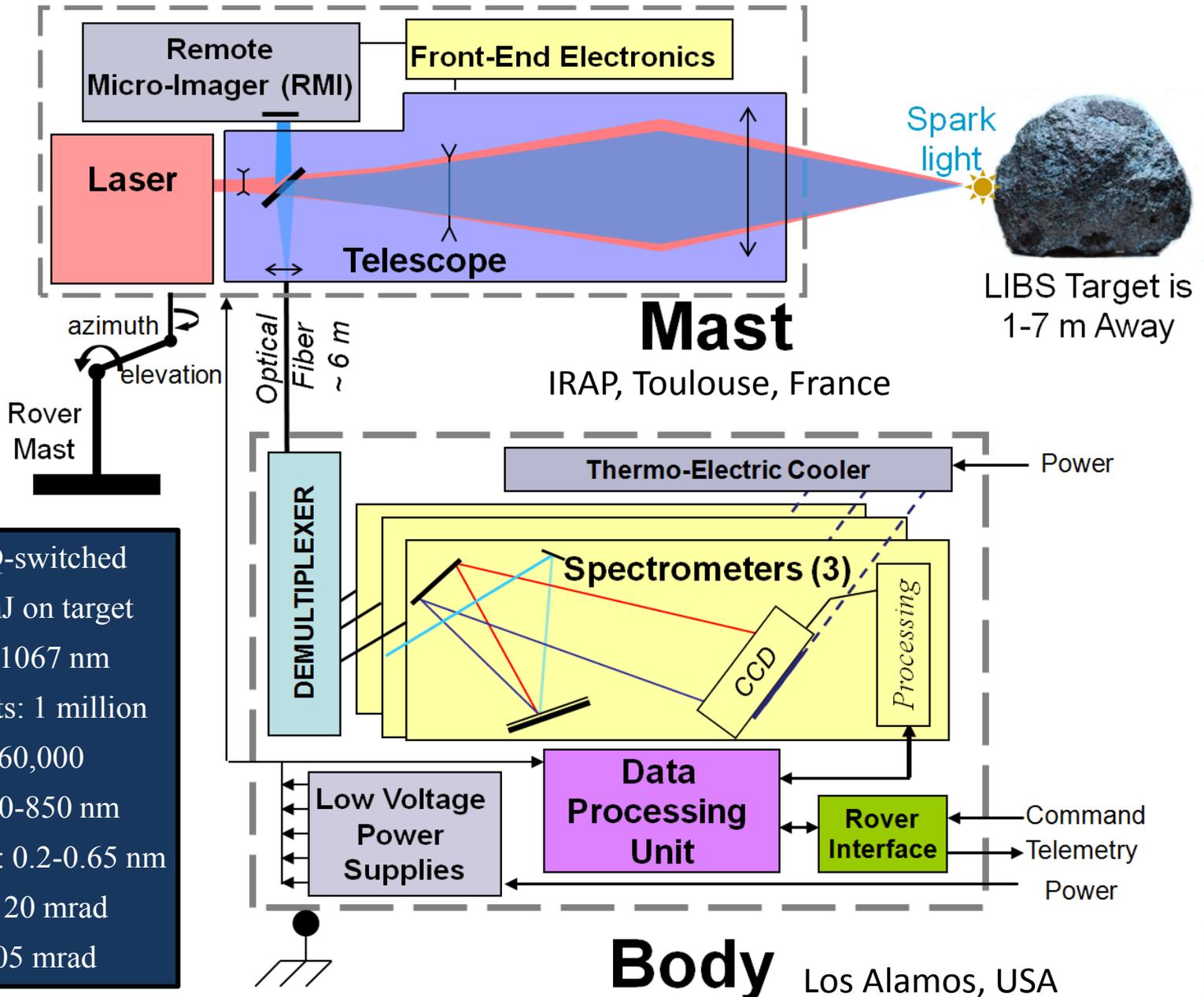
and the ChemCam team

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
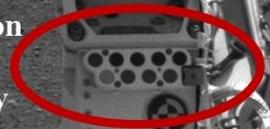
Meeting Agenda

	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) Level 2	Jeremie Lasue, IRAP	20
	c) Advanced	Ryan Anderson, USGS	10
4	C-Quest Emission Line Tool	Agnes Cousin, LANL	10
5	Remote Micro-Imager (RMI)	Olivier Gasnault, IRAP	10
6	Data Currently Available, Access	Nina Lanza, LANL	15
7	Analyst Notebook Demo	Tom Stein, PDS	20
8	Past and Current Investigations	Diana Blaney, JPL	10
9	Collaborating with ChemCam	Roger Wiens, LANL	10

ChemCam Instrument Schematic

Remote Micro-Imager (RMI)

Front-End Electronics

Laser

Telescope

Spark light

LIBS Target is 1-7 m Away

azimuth

elevation

Rover Mast

Optical Fiber ~ 6 m

Mast

IRAP, Toulouse, France

Thermo-Electric Cooler

Power

DEMULTIPLEXER

Spectrometers (3)

Processing

CCD

Data Processing Unit

Low Voltage Power Supplies

Rover Interface

Command

Telemetry

Power

Body Los Alamos, USA

Laser: Nd:KGW, Q-switched

Laser energy: 14 mJ on target

Laser wavelength: 1067 nm

Expected laser shots: 1 million

Laser shots so far: 60,000

Spectrometer λ: 240-850 nm

Spectral resolution: 0.2-0.65 nm

RMI field of view: 20 mrad

RMI resolution: 0.05 mrad

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

ChemCam Calibration Target Assembly

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

Depth Profile
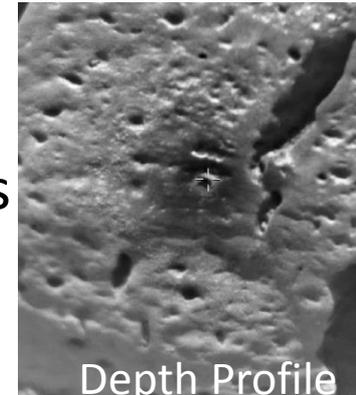
# Nomenclature—Other

- 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.

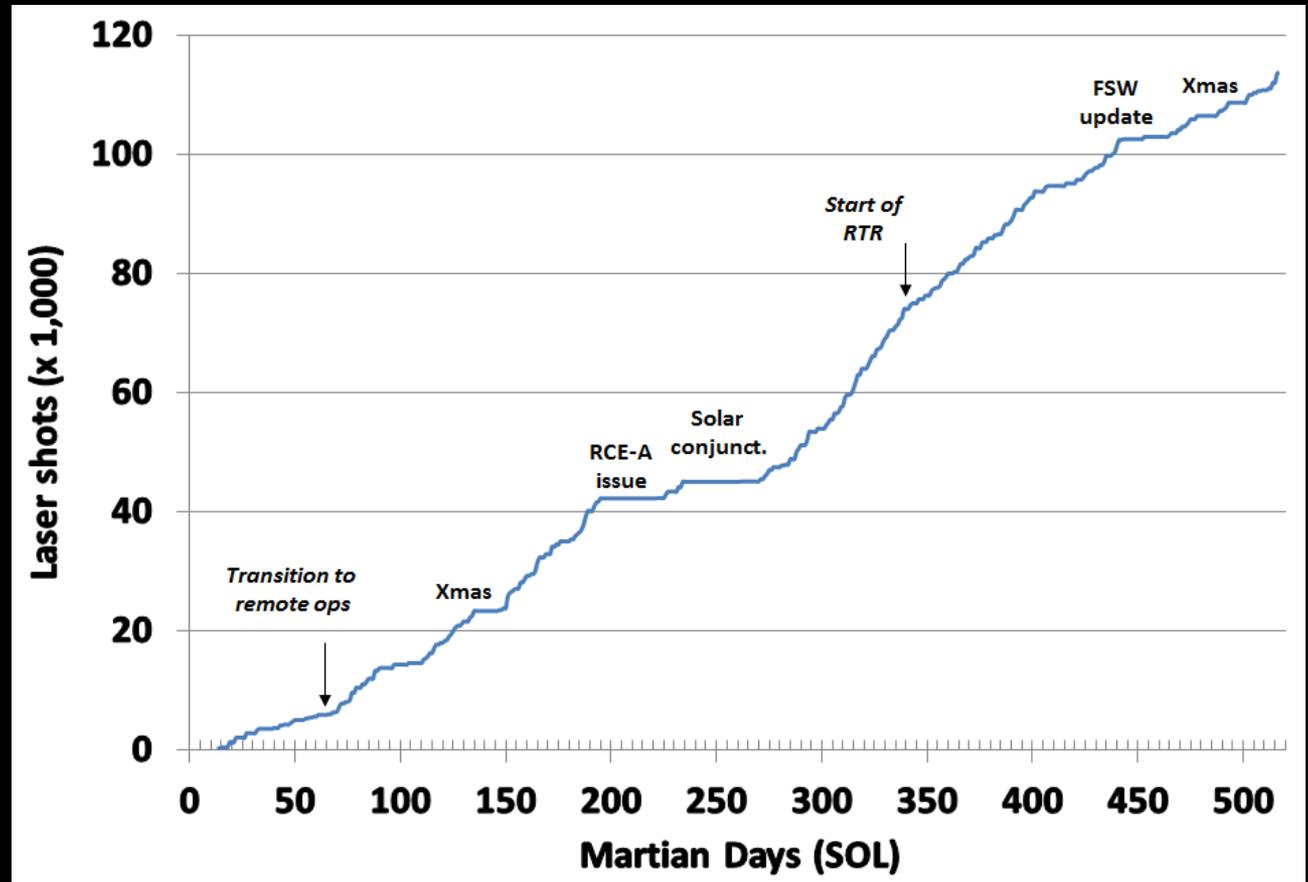- For RMI images, processed results are labeled PRC (partial radiometrically corrected)

5mm

10
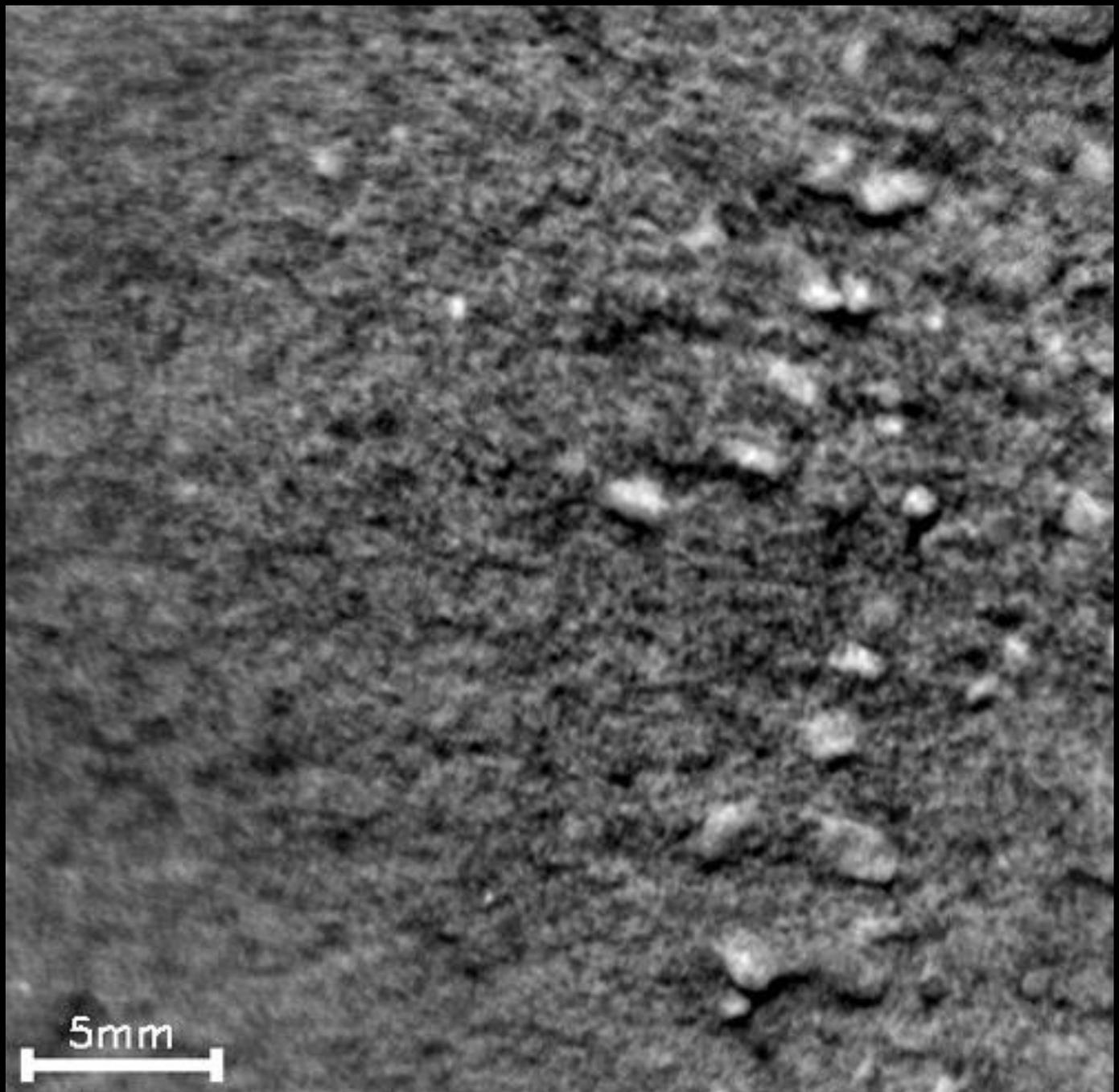
Instrument Status

ChemCam is doing great!

Number of Mars spectra: 120,000+

As of SOL : 517

sequences : 666

working sols : 252

Mars targets : 452

LIBS points : 3162

Images : 1585

Chart: Laser shots (x 1,000) vs Martian Days (SOL), with annotations: Transition to remote ops, Xmas, RCE-A issue, Solar conjunct., Start of RTR, FSW update, Xmas.

Locations of Targets

BEDDED FRACTURED

YELLOW-KNIFE BAY

BRADBURY LANDING

GLENELG

CRATERED SURFACE

~30k spectra before Yellowknife Bay

>30k spectra in Yellowknife Bay

~50k post Yellowknife Bay

HUMMOCKY PLAINS

Map shows target locations
since leaving Yellowknife Bay
To sol 494

METERS

0   200   400   600   800   1000

● Blind CHEMCAM Target

△ CHEMCAM Target

Vasavada et al 2014