**Raman/CHAMP – Camera, Handlens, And Microscope with Integrated Raman Laser Probe.** G. S. Mungas[1], K.R. Johnson[1], M.J. Pelletier[1], C. A. Sepulveda[1], J. Feldman[1], C. Lebow[1], J.E. Boynton[1], M. Deans[2], B. Pain[1], L. Beegle[1]. [1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena CA 91109, [2] NASA Ames Research Center, Moffett Field, CA 94035.

**Introduction:** Raman/CHAMP (Camera, Handlens And Microscope Probe) is a novel field imager/microscope with an internal scanning Raman laser probe. The field imaging system is capable of color imaging with continuously variable spatial resolutions from infinity imaging down to diffraction-limited microscopy (3 micron/pixel which can resolve >90% of lunar Apollo fines) – the closer the imager is placed to a target, the higher the resultant image resolution. At peak magnification (corresponding to a 18mm working distance), the 532nm Raman laser spot (<10 micron) can be scanned in 2D within the microscopic field of view of the instrument in order to interrogate surface features (Fig. 1).

CHAMP was originally developed through the 1998 Mars Instrument Development Program (MIDP). The Raman instrument was originally developed under the 1995 Planetary Instrument Definition and Development Program (PIDDP) and evolved into the Mars Microbeam Raman Spectrometer (MMRS) instrument development task in 1997 for the Athena Rover for the Mars 2001 Lander mission (eventually cancelled). The development and integration of these two instruments into a single remote sensing instrument suite is currently being funded as part of the Environmental and Regolith Physical Characterization (ERPC) experiment, a subset technology development for the RESOLVE ISRU lunar instrument suite. Robotic instrument operations support and precision arm placement is being conducted on the NASA Ames K9 rover. Imaging processing tools are being adapted from the MER MI (Micro-imager) toolkit and upgraded in a recently funded ASTEP (Astrobiology Science and Technology for Exploring Planets).

**Raman/CHAMP Integration:** Laser induced fluorescence of optical system glass elements can generate sufficient noise to swamp a Raman signature of a surface feature of interest. While fluorescence cross-sections can be many orders of magnitude greater than Raman cross-sections, the lambertian-like fluorescence emission pattern in transparent glasses has to be effectively imaged into a Raman collection aperture in order to produce a source of fluorescence noise. Zemax optical analysis of lambertian volumetric emitters placed in an upgraded CHAMP design's optical elements has demonstrated an effective geometric attenuation factor of $\sim 10^{-8}$. Experimental verification of this fluorescence attenuating effect has been demonstrated through an integration of the existing MMRS with the existing MIDP CHAMP instrument whereby low noise Raman measurements were acquired through the existing CHAMP optical design (Fig. 1B&C).

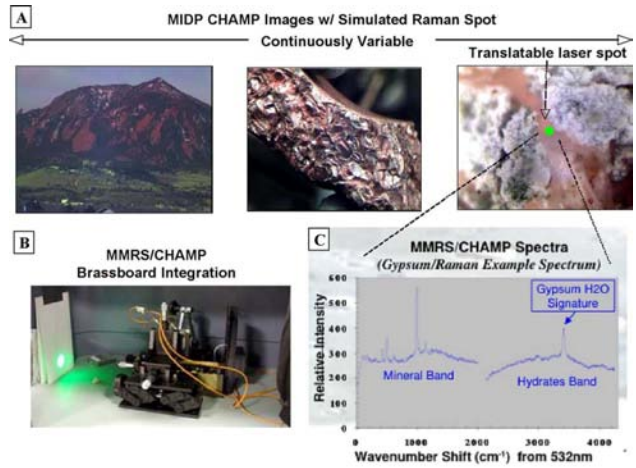


**Figure 1**. Measurements from an Integrated Raman/CHAMP Instrument. A) Continuously variable field-of-view of the MIDP CHAMP instrument from infinity to microscopy. B) Phase I successful demonstration of the integration of the MMRS with MIDP CHAMP. C) Acquired gypsum spectra from MMRS/MIDP CHAMP with a simulated scannable Raman spot (~10 micron) superimposed on MIDP CHAMP image.

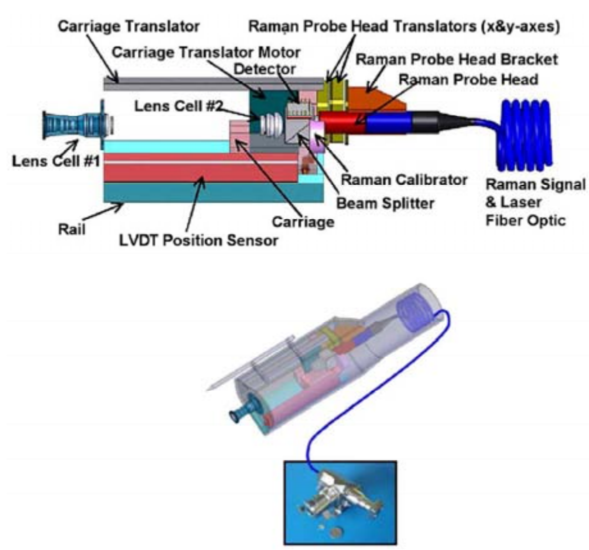


**Figure 2.** RESOLVE Raman/CHAMP instrument configuration.

While the original MMRS included a own 1D internal scanning probehead that could be used to determine bulk chemistry through statistical point-counting methods, a new instrument configuration (Fig. 2) has been developed to allow selective Raman analysis of visually identified features anywhere within CHAMP's microscopic field-of-view.

Viewing of unimproved, rough field surfaces is accomodated by the CHAMP variable focus mechanism. For imaging, focal plane merging of multiple image slices can be used to produce a single in-focus image over a very large depth of field as well as determine 3D surface topography (Fig. 3). This same focus mechanism and surface topographic map will subsequently be used to efficiently couple a small depth-of-field Raman laser probe into a target feature.

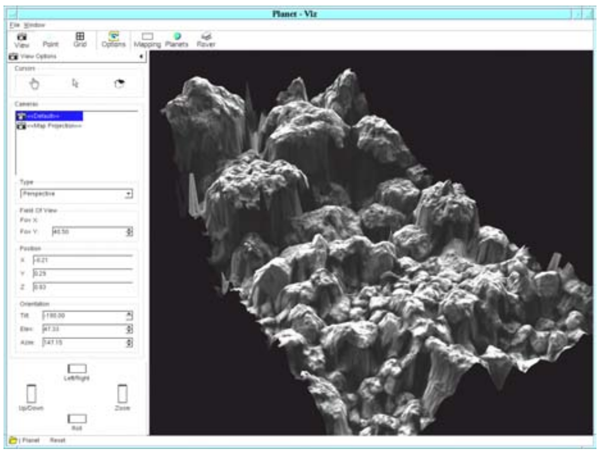


**Figure 3.** 3D surface topographic map produced from multiple microscopic image slices.

**Conclusions:** We have investigated the feasibility, analytically and experimentally, of integrating a Raman instrument into a CHAMP field microcope/imaging system. A new integrated Raman/CHAMP instrument configuration is subsequently in development for more refined future characterization of Raman measurements to be performed in conjunction with a field microscope.

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