Smart Raman Instrument for Mars Science Laboratory

Bruce McIntosh,[1] Bonner Denton,[2] Robert Downs,[2] Doug Becker[1]
[1]Hamilton Sundstrand Sensor Systems, Pomona CA [2]University of Arizona, Tucson AZ

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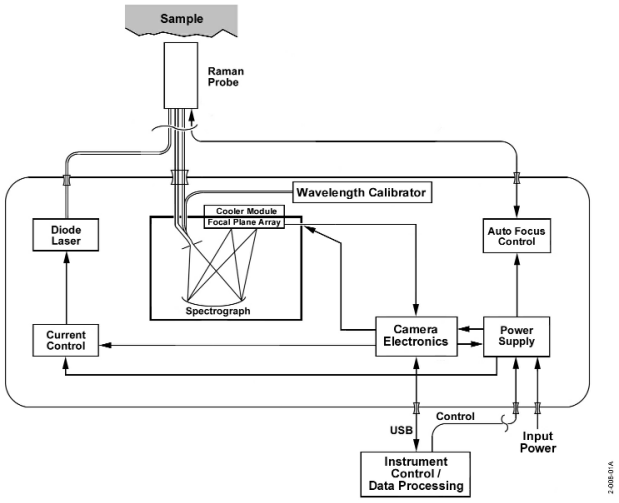
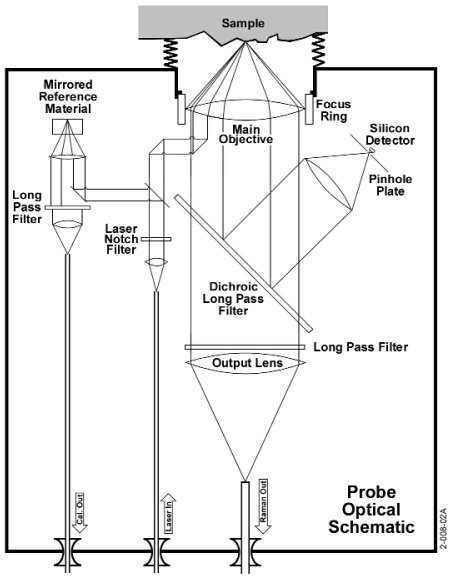
Smart Mars Raman Instrument Objective

- **Characterize in-situ Martian mineralogy**
- **Understand Martian geological evolution**
  - Analyze/quantify carbonates/sulfates
  - Detect presence of free/bound water and ice
  - Identify carbon-based organic functionalities
  - Provide andesite/basalt discrimination (ST1 vs ST2)
  - Identify magnetic materials hematite, magnetite, pyrrhotite
  - Characterize weathered mineral products and identify processes
- **Utilize Raman Effect**
  - Sample materials scatter photons inelastically with frequency shifts proportional to vibration modes
- **Analyze both surface rocks/dust and interior core samples**
  - Characterize sample makeup with spatial resolution of 50 um or better
  - Utilize Raman spectral libraries to identify mineral species
  - Utilize "smart" software to classify measured spectra and optimize instrument utilization

Instrument Configuration



Autofocus Probe Head

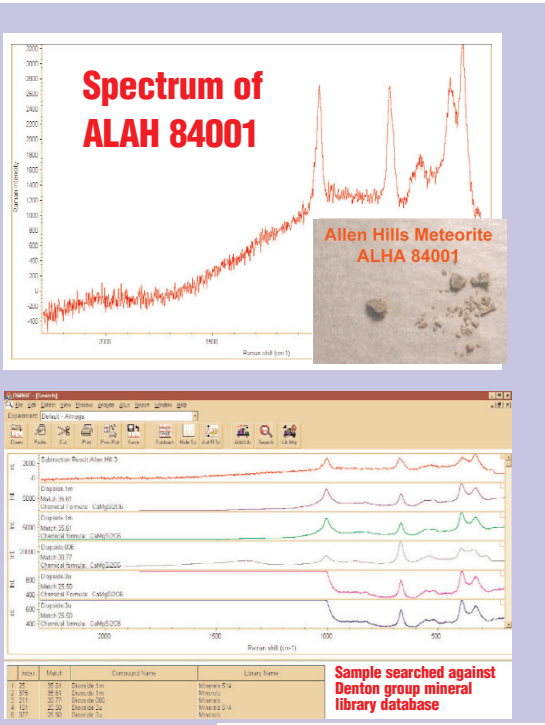


Key instrument Characteristics

- **Power-efficient optical and electrical design**
- **Long wavelength laser to reduce fluorescence**
- **Auto-focus probe for highest collection efficiency**
- **Automatic frequency and intensity scale correction of each spectrum**
- **Automated optimization of collection parameters**
- **Built in mineral library**
- **Automated baseline correction for better library search operation**

Smart Raman Instrument for Mars Science Laboratory

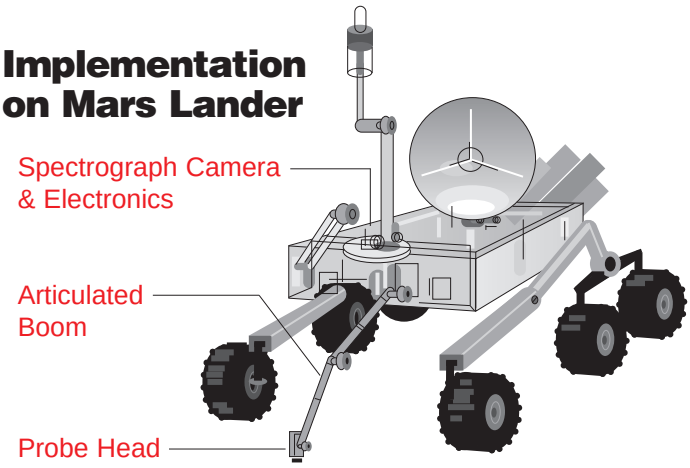
Raman Analysis of Allen Hills Meteorite

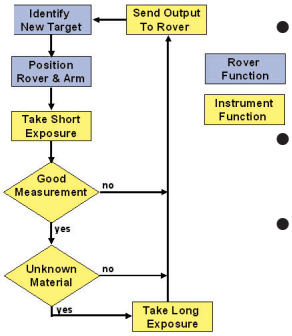


Data Acquisition/ Processing

- Frequency and intensity shifts distort spectral data
- Such shifts limit the usefulness of spectral library matching
- Frequency shifts result from spectrograph and laser temperature drift
- Frequency corrections utilize internal calibration and laser signals for each spectrum
- Measured intensities vary with filter and camera temperature drift
- Intensity corrections utilize response to internal reference material

Implementation on Mars Lander





- Brief exposure evaluates saturation and identifies "material of interest"
- New spectra can be added to library as desired
- Corrected data vector is compressed and downlinked

Raman Instrument Heritage