**Introduction:** Raman spectroscopy provides a powerful tool for *in situ* mineralogy, petrology, and detection of water and carbon [1,2,4,5]. The Athena Raman spectrometer is a microbeam instrument intended for close-up analyses of targets (rock or soils) selected by the Athena Pancam and Mini-TES. It will take 100 Raman spectra along a linear traverse of ~1 cm (point-counting procedure) in one to four hours during the Mars’ night. From these spectra, the following information about the target will be extracted: the identities of major, minor, and trace mineral phases, organic species (e.g., PAH or kerogen-like polymers), reduced inorganic carbon, and water-bearing phases; chemical features (e.g., Mg/Fe ratio) of major minerals [6]; rock textural features (e.g., mineral clusters, amygdu- lar filling and veins). Part of the Athena payload, the miniaturized Raman spectrometer has been under development in a highly interactive collaboration of a science team at Washington University and the University of Alabama at Birmingham, and an engineering team at the Jet Propulsion Laboratory. The development has completed the brassboard stage and has produced the design for the engineering model.

**Instrument characteristics** The miniaturized Raman spectrometer consists mainly of two parts: a probe deployed by a robotic arm, and a source-spectrograph unit consisting of the laser, detector, electronics, and microprocessor, all located within the warm electronic box of the rover. The excitation laser beam and collected Raman signal are transmitted via optical fibers. The Raman probe has a scanning mechanism to enable linear traverses. The 532 nm line of a diode-pumped solid state laser is used as the excitation source. The laser delivers a condensed, ~10 mW beam (~25 µm in diameter) onto the sample. The spectrograph covers two spectral regions: 200-1700 cm\(^{-1}\) (for oxides, oxyanions, and carbonate materials) and 2500-4000 cm\(^{-1}\) (for hydrogen bonded to O, C, N, S). It has a spectral resolution of 6-7 cm\(^{-1}\) and a peak position accuracy of ~1 cm\(^{-1}\). A point-counting measurement procedure was designed to take spectra from original surfaces of rocks or soils and from the distal ends of samples obtained by coring. As the target surface will be uneven, the sampling objective has an 8 mm working distance. The instrument needs no auto-focusing mechanism, because the optical design [3] enables a depth-of-sampling range for strong Raman scatters of ≥2.5 mm. The total mass of the system is ~2.5 kg, of which the probe is ~220 g. A maximum of 36 Watt-hours is required per set of 100 Raman spectra. The size of the brassboard is ~5.5 × 7.5 × 7.7 cm for the probe, and ~16.4 × 15.9 × 7.7 cm for the spectrograph.

**Brassboard models performances:** Extensive performance tests have been done on all breadboard and brassboard models. Overall, they have proved highly successful, demonstrating that a Raman spectrometer can be built that is suitably miniaturized and low enough in power for use as an on-surface planetary instrument, yet retains high detection sensitivity and yields laboratory quality spectral resolution over a broad wavelength range. These features are essential to provide accurate mineral characterization.

Raman spectra obtained by using brassboard 1b on three common igneous minerals are shown in Fig. 2. Reduced carbon of probable organic origin is readily identified from the spectra of two ancient cherts (Fig. 3). The detection of carbonate and sulfate minerals is especially important, since they are potentially important indicators of ancient Mars environments and evidence of past water activity. Raman spectra of some natural carbonate and sulfate minerals obtained using brassboard 1d appear in Fig. 4. These spectra demonstrate that mineral classification (i.e., silicate, carbonates, sulfates) can often be achieved by mere inspection of raw spectra, and that chemical features of individual mineral species are revealed by detailed Raman parameters such as peak positions.
Figure 2. Raman spectra obtained by brassboard 1b from common igneous minerals

Figure 3. Raman spectra obtained by brassboard 1b from two ancient cherts

The sensitivity of the brassboard 1d model was tested briefly at low laser power and untweaked alignment by a 20-point traverse across the surface of a terrestrial basalt. Figure 5 shows three of the Raman spectra obtained. Of 20 spectra taken from this random sampling, 15 yielded identifiable peaks. Further detailed tests of the brassboard are planned.