characterize the biogenic element constituents of soil samples providing information on the biologic potential of the Mars environment. For example, experimental results employing the breadboard indicate that accurate and precise data including the detection, identification, and quantification of elements to trace levels (ppm) from carbon to zirconium ($6 < Z < 40$), as well as relative abundance of amorphous vs. crystalline minerals in Mars soil surface samples, can be obtained. The breadboard has been designed and built with regard to expected Mars environmental operating conditions, mission constraints, and technical requirements that include general instrument design considerations.

Preliminary XRF/XRD breadboard experiments have confirmed the fundamental instrument design approach and measurement performance. Experimental accomplishments and results include the following: XRD observation of the principal diffraction lines of montmorillonite; XRF measurement of aluminum, silicon, calcium, titanium, and iron abundances in palagonite powder samples commensurate with expectations; and calibration of a carbon-detecting XRF channel with detectability limits in the order of 0.01 wt%.

The breadboard experiments provided valuable confirmation of models used to simulate and optimize the instrument's performance and indicated practical improvements in its design.

References: [1] *COMPLEX* (1978) National Academy of Sciences, Washington, DC, 97 pp.

REMOTE MEASUREMENT OF PLANETARY MAGNETIC FIELDS BY THE HANLE EFFECT.   C. K. Kumar[1,2], L. Klein[1,2], and M. Giraud[3], [1]Department of Physics and Astronomy, Howard University, Washington DC 20059, USA, [2]Center for the Study of Terrestrial and Extra-Terrestrial Atmospheres, Howard University, Washington DC 20059, USA, [3]Departement de Physique, Université de Provence/St. Jerome, Marseilles, France.

Resonance fluorescence lines in the spectra of planetary atmospheres are polarized. They will be depolarized by magnetic fields in the scattering medium (Hanle effect). The amount of depolarization has been calculated for some atomic (FeI, CaI) lines and some molecular lines (NO γ bands) seen in the Earth's dayglow spectra. The results are presented and the potential advantages of LIDAR measurements for obtaining atmospheric magnetic fields are discussed. The depolarization of Na and Ca lines are suitable for measuring magnetic fields in and near Io.

RESOLUTION-ENHANCED MAPPING SPECTROMETER.
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A familiar mapping spectrometer implementation utilizes two-dimensional detector arrays with spectral dispersion along one direction and spatial along the other. Spectral images are formed by spatially scanning across the scene (i.e., push-broom scanning). For imaging grating and prism spectrometers the slit is perpendicular to the spatial scan direction. For spectrometers utilizing linearly variable focal-plane-mounted filters the spatial scan direction is perpendicular to the direction of spectral variation. These spectrometers share the common limitation that the number of spectral

resolution elements is given by the number of pixels along the spectral (or dispersive) direction. In this presentation we discuss resolution enhancement by first passing the light input to the spectrometer through a scanned etalon or Michelson. Thus, while a detector element is scanned through a spatial resolution element of the scene, it is also temporally sampled. For example, to enhance resolution by a factor of 4 in a given spectral element, one would design the etalon to have finesse 4 in that spectral region, scan the etalon through a free spectral range as the detector is spatially scanned through spatial resolution element, and take eight samples in the process. To plug numbers in a specific example, suppose the mapping spectrometer pixel at 1 μm had unenhanced resolution of 60 cm^{-1}, but 15 cm^{-1} resolution is desired. Further assume that 2 s is required to scan across a spatial element. An etalon with gap 83.33 μm would give it the required free spectral range of 60 cm^{-1}, reflectivity 46.5% would give it the required finesse ≈ 4, and a sample rate of eight per second while scanning the gap through 1/2 wavelength (i.e., 0.5 μm in this example, in order to scan through the 60 cm^{-1} free spectral range) in eight steps of 0.5 μm/8 would provide a spectrum of resolution of 15 cm^{-1} resolution within the order sorting 60 cm^{-1} provided by the unenhanced spectrometer. Our presentation will address the analysis for all the pixels in the dispersive direction. We will discuss several specific examples. We will also discuss the alternate use of a Michelson for the same enhancement purpose. Suitable for weight constrained deep space missions, we have developed hardware systems including actuators, sensors, and electronics such that low-resolution etalons with performance required for implementation (performance requirement typified by the example above) would weigh less than one pound.

PROPOSAL FOR A UNIVERSAL PARTICLE DETECTOR EXPERIMENT.   J. C. Lesho, R. P. Cain, and O. M. Uy, APL, Building 13-5377, Johns Hopkins University, Laurel MD 20723, USA.

The Universal Particle Detector Experiment (UPDE), which consists of parallel planes of two diode laser beams of different wavelengths and a large surface metal oxide semiconductor (MOS) impact detector, is proposed. It will be used to perform real-time monitoring of contamination particles and meteoroids impacting the spacecraft surface with high resolution of time, position, direction, and velocity. The UPDE will discriminate between contaminants
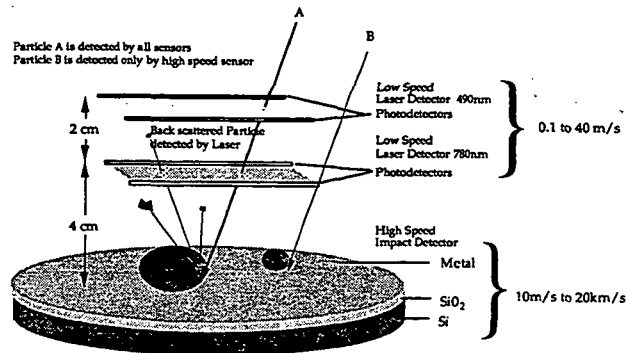

Fig 1.   UPDE sensor.