A UNIQUE PHOTON BOMBARDMENT SYSTEM FOR SPACE APPLICATIONS.
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The innovative (patents pending) Electromagnetic Radiation Collection and Concentration System (EMRCCS) described here is the foundation for the development of a multiplicity of space and terrestrial system formats. The system capability allows its use in the visual, infrared, and ultraviolet ranges of the spectrum for EM collection, concentration, source/receptor tracking, and targeting.

The nonimaging modular optical system uses a physically static position aperture for EM radiation collection. Folded optics provide concentration in windowing and targeting applications. Other system design formats provide power generation and thermal processes for heating and absorption cooling.

Fixed portable and mobile (space and terrestrial) applications include designs that incorporate a phased RF and/or the system array for purposes of radiation source acquisition/tracking and data derivation. The data is utilized in source acquisition (array capture angle of 75° in the orthogonal E and H planes), source autotracking in the same angular intervals, and, subsequent to source and receptor acquisition, control of direction and magnitude of the output concentrated radiation at a given target range. In addition, the phased array can provide EM channel voice or data capability.

AN INTEGRATED XRF/XRDTNSTRUMENT FOR MARS EXOBIOLOGY AND GEOLOGY EXPERIMENTS.
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By employing an integrated X-ray instrument on a future Mars mission, data obtained will greatly augment those returned by Viking; details characterizing the past and present environment on Mars and those relevant to the possibility of the origin and evolution of life will be acquired. A combined XRF/XRD instrument has been breadboarded and demonstrated to accommodate important exobiology and geology experiment objectives outlined for MESUR and future Mars missions. Among others, primary objectives for the exploration of Mars include the intense study of local areas on Mars to "establish the chemical, mineralogical, and petrological character of different components of the surface material; to determine the distribution, abundance, and sources and sinks of volatile materials, including an assessment of the biologic potential, now and during past epochs; and to establish the global chemical and physical characteristics of the martian surface" [1].

The XRF/XRD breadboarding instrument identifies and quantifies soil surface elemental, mineralogical, and petrological characteristics and acquires data necessary to address questions on volatile abundance and distribution. Additionally, the breadboard is able to...
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: XRF 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.


REMOTE MEASUREMENT OF PLANETARY MAGNETIC FIELDS BY THE HANLE EFFECT. C. K. Kumar1,2, L. Klein1,2, and M. Giraud3, 1Department of Physics and Astronomy, Howard University, Washington DC 20059, USA, 2Center for the Study of Terrestrial and Extra-Terrestrial Atmospheres, Howard University, Washington DC20059, USA, 3Département 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 (NOγ 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. J. B. Kumer, J. N. Aubrun, W. J. Rosenberg, and A. E. Roche, Lockheed Palo Alto Research Laboratory, Palo Alto CA 94304, USA.

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.

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.