powers up to 3.5 W at 200 K. Self-induced vibration measurements indicate that the cooler can be balanced to reduce vibration forces below 0.02 newtons from 0 to 500 Hz.

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p, 1

ENVIRONMENTAL MONITORS IN THE MIDCOURSE SPACE EXPERIMENTS (MSX).

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The Midcourse Space Experiment(MSX) is an SDIO-sponsored spacebased sensor experiment with a full complement of optical sensors. Because of the possible deleterious effect of both molecular and particulate contamination on these sensors, a suite of environmental monitoring instruments are also being flown with the spacecraft. These instruments are the Total Pressure Sensor based on the cold-cathode gauge, a quadrupole mass spectrometer, a Bennett-type ion mass spectrometer, a cryogenic quartz crystal microbalance (QCM), four temperature-controlled QCMs, and a Xenon and Krypton Flash Lamp Experiment. These instruments have been fully space-qualified, are compact and low cost, and are possible candidate sensors for near-term planetary and atmospheric monitoring. The philosophy of adopted during design and fabrication, calibration and ground testing, and modeling will be discussed.

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p, 1

ULTRAVIOLET IMAGING SPECTROMETER.

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Wide-field imaging systems equipped with objective prisms or gratings have had a long history of utility in groundbased observations of meteors [1] and comets [2]. Deployment of similar instruments from low Earth orbit would allow the first UV observations of meteors. This instrument can be used for comets and Lyman alpha coronae of Earth-orbit-crossing asteroids. A CaF_2 prism imaging spectrograph designed for stellar observations was used aboard Skylab to observe Comet Kohoutek (1973f), but its 1300-Å cut-off precluded Lyman alpha images and it was not used for observation of meteors [3]. Because the observation of the UV spectrum of a meteor has never been attempted, researchers are denied the opportunity to obtain composition information from spectra at those wavelengths. We propose construction of a flight instrument functioning in the 1100–3200-Å spectral range that is suitable for a dedicated satellite ("QuickStar") or as a space-station-attached payload. It can also be an autonomous package in the space shuttle cargo bay.

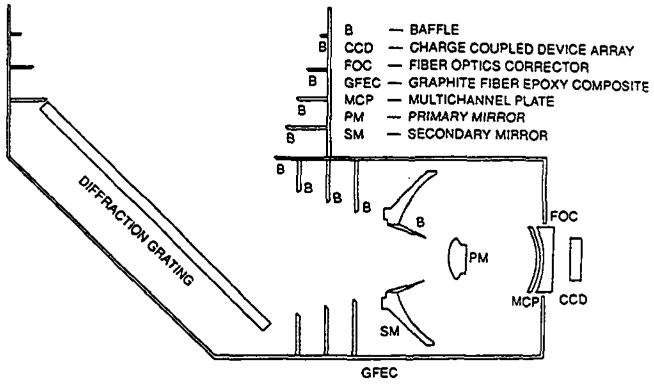

Fig. 1.

The instrument structure is of graphite fiber epoxy composite, and has an objective diffraction grating, low expansion optics, multichannel plate electro-optics, and event discrimination capability through processing of video data. It would either have a field-of-view (fov) of 12° and f number of 0.75 or a wider fov of 20°–25° and f number of 1. The instrument has a heritage from the UV auroral imager of the Swedish Viking spacecraft [4].

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p, 1

DEVELOPMENT OF MINIATURIZED OPTIMIZED SMART SENSORS (MOSS) FOR SPACE PLASMAS.

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The cost of space plasma sensors is high for several reasons: (1) Most are one-of-a-kind and state-of-the-art, (2) the cost of launch to orbit is high, (3) ruggedness and reliability requirements lead to costly development and test programs, and (4) overhead is added by overly elaborate or generalized spacecraft interface requirements. Possible approaches to reducing costs include development of small "sensors" (defined as including all necessary optics, detectors, and related electronics) that will ultimately lead to cheaper missions by reducing (2), improving (3), and, through work with spacecraft designers, reducing (4). Despite this logical approach, there is no guarantee that smaller sensors are necessarily either better or cheaper. We have previously [1] advocated applying analytical "quality factors" to plasma sensors (and spacecraft) and have begun to develop miniaturized particle optical systems by applying quantitative optimization criteria. We are currently designing a Miniaturized Optimized Smart Sensor (MOSS) in which miniaturized electronics (e.g., employing new power supply topology and extensive use of gate arrays and hybrid circuits) are fully integrated with newly developed particle optics to give significant savings in volume and mass. The goal of the SwRI MOSS program is development of a fully self-contained and functional plasma sensor weighing ~1 lb and requiring ~1 W. MOSS will require only a typical spacecraft DC power source (e.g., 30 V) and command/data interfaces in order to be fully functional, and will provide measurement capabilities comparable in most ways to current sensors.

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X-RAY, FAR, AND EXTREME ULTRAVIOLET COATINGS FOR SPACE APPLICATIONS.

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The improved FUV filters that we have designed and fabricated were made as combinations of three reflection and one transmission filter. Narrowband filtering with a bandwidths of 5 nm and a throughput at the central wavelength of more than 20% is achieved, for example, at 130.4 nm and 135.6 nm with the average blocking of out-of-band wavelengths of better than 4×10^{-4}%. In the case of broadband filters a multiple reflector centered at 150 and 170 nm combined with corresponding transmission filters had a bandwidth of more than 11 nm and transmittance greater than 60%. The average blocking of out-of-band wavelengths is better than 4×10^{-4}% with less than 10^{-5}% transmittance at 121.6 nm [1–5]. The idea of utilizing the multiple reflections from Π multilayer reflectors constitutes the basis of the design approach used for the narrowband and broadband filters. The multiple reflector combinations provide spectral performance for narrow- and broadband filters superior to what was previously available [6–9].

The idea of utilizing imaging mirrors as narrowband filters constitutes the basis of the design of extreme ultraviolet imagers operating at 58.4 nm and 83.4 nm. The net throughput of both imaging-filtering systems is better than 20%. The superiority of the EUV self-filtering camera/telescope becomes apparent when compared to previously theoretically designed 83.4-nm filtering-imaging systems, which yielded transmissions of less than a few percent [10] and therefore less than 0.1% throughput when combined with at least two imaging mirrors. Utilizing the self-filtering approach, instruments with similar performances are possible for imaging at other EUV wavelengths, such as 30.4 nm [11–12].

The self-filtering concept is extended to the X-ray region where its application can result in the new generation of X-ray telescopes, which could replace current designs based on large and heavy collimators. The calculated reflectance for an 80° angle of incidence shows a reflectance peak value of 35.8% at 0.73 nm (2.621 KeV) with the bandwidth of the reflector less than 0.01 nm. The in-band to out-band ratio is more than 3000, with an instrument monochromatic sensitivity factor $T[\%]\Delta\lambda$ [nm] > 3600. At an 85° angle of incidence the peak reflectance is more than 65% at 0.44 nm with a bandwidth of less than 0.006 nm providing the ratio $T[\%]\,\Delta\,\lambda$ [nm] > 10,000.

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