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A GEOSTATIONARY IMAGING SPECTROMETER TOMS INSTRUMENT

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The requirements for a geostationary TOMS include 50 km or better spatial resolution, three to five wavelength bands, time resolution of 30 to 60 minutes, in-orbit measurement of incident and backscattered sunlight, minimum signal-to-noise ratio of 30 at 312.5 nm at the terminator (solar zenith angle = 84 degrees), and 1 nm spectral bandpass to allow discrimination of SO2 from ozone. These requirements can be met with some difficulty with a mechanically scanned multiwavelength spectrometer similar to the current polar orbiting TOMS design. Alternate designs need to be considered in a pre-Phase A study.

One design with many desirable features is an imaging spectrometer. This type of instrument is now feasible for ozone and sulfur dioxide mapping because of the development of uv sensitive CCD array detectors. A preliminary study makes use of a 0.25 m Czerny-Turner spectrometer with which the earth is imaged on a CCD in dispersed light. The wavelength is determined by a movable grating which can be set arbitrarily by ground control. The signal integration time depends on wavelength but this system allows arbitrary timing by command. Normally a preprogrammed wavelength-integration time sequence would be executed. However, special circumstances, such as a requirement to track a low-lying sulfur dioxide cloud or a need to discriminate high level ozone from total ozone at midlatitudes, could be obtained by adding a particular wavelength to the sequence.

The incident solar irradiance is measured by deploying a diffuser plate in the field of view, similar to the procedure developed with the SBUV/TOMS instruments. This has an added advantage of establishing the calibration of individual pixels in the CCD array. It should be noted that the TOMS technique, in general, makes use of signal ratios to cancel any dependence on absolute calibration. In the proposed design, individual detector elements correspond to scene elements in which the several wavelengths are serially sampled and the earth radiance is compared to the incident sunlight. Thus the problem of uncorrelated drift of multiple detectors is removed.

This suggested design is illustrated in an attached sketch. It appears to meet all of the measurement requirements outlined in previous discussions during the meeting.

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GEOTOMS - TOTAL OZONE MAPPING SPECTROMETER FOR GEOSTATIONARY SATELLITE

IMAGING CZERNY-TURNER SPECTROMETER (1/4M) WITH FIXED SLITS. IFOV (TOTAL EARTH COVERAGE) SCANNED WITH GRATING FOR SELECTED WAVELENGTHS.

WAVELENGTH RANGE: UV-200 TO 400nM (SELECTABLE); APPROX. 9Kg; 4 WATTS

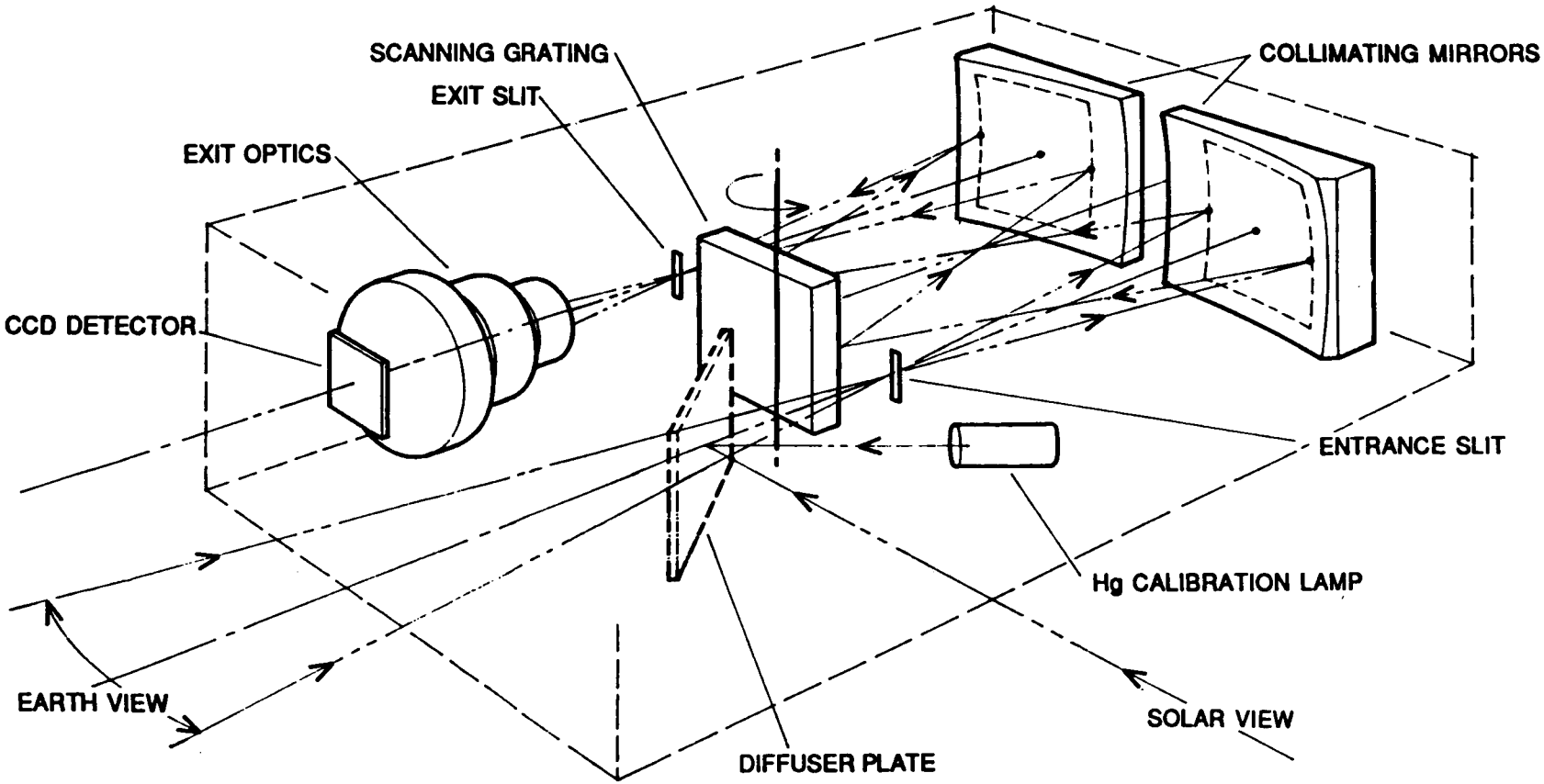

Figure 1.