Sounding of the Atmosphere using Broadband Emission Radiometry (SABER)

TIMED Mission Instrumentation

Scientific Goal

To explore the mesosphere and lower thermosphere globally and achieve a major improvement in our understanding of the fundamental processes governing the energetics, chemistry, dynamics, and transport of the atmospheric region extending from 60 to 180 km. SABER is one of four instruments on NASA's TIMED mission.

Scientific Objectives:

- Study the mesosphere and lower thermosphere structure, including its seasonal, latitudinal, and temporal variations.
- Investigate the energetics and distribution of radiatively active species in the non-LTE environment to understand the relative importance of radiative, chemical, and dynamic sources and sinks of energy.
- Analyze the O_y and HO_y chemistry and its coupling with energetics and dynamics.
- Conduct studies of dynamics and transport and their role in the energy budget.

Key Experiment Features

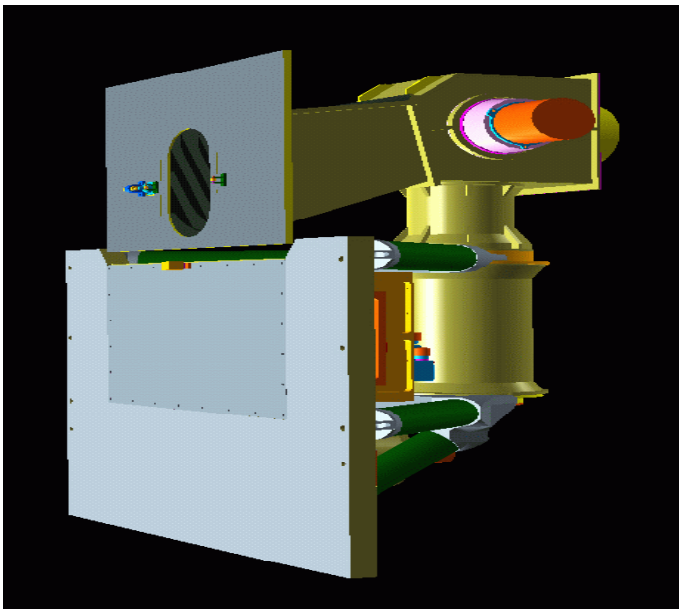
- Mathematical inversion of earthlimb emission vertical profiles measured by a multispectral radiometer operating in the near- to mid-infrared over the range 1.27 to 17 μm (7865 to 650 cm^{-1}) is the experimental approach.
- The capability to continuously sound the atmosphere both night and day is provided by limb emission sounding, permitting diurnal change and polar night studies to be conducted with daily global coverage.
- Autonomous pressure and altitude registration and automatic correction for spacecraft motion effects are performed using two wide-band and one narrow-band CO_2 channel centered in the 15-μm band.
- State-of-the-art mechanical cooling of the detector focal plane array is employed to achieve high radiometric sensitivity, operational flexibility, and long experiment life.
- The experiment builds on a rich spaceflight heritage of limb sounding beginning with the Nimbus-7 LIMS experiment and including SAMS, CIRRIS, ATMOS, HALOE, CLAES, ISAMS, and SME. The instrument design and experimental approach is based directly on the highly successful LIMS instrument and flight experience.

SABER Measurements and Applications

Parameter	Wavelength (μm)	Application	Altitude Range (km)
CO_2	14.9 & 15.2	T, density, IR cooling rates, P(z), non-LTE	10–130
O_3	9.6	O_3 conc., cooling rates, solar heating, chemistry and dynamics studies	15–100
$O_2(^1\Delta)$	1.27	O_3 conc. (day), inferred [O] at night, energy loss for solar heating efficiency	50–105
CO_2	4.3	CO_2 conc., mesosphere solar heating, tracer	85–150
OH (v)	2.0 & 1.6	HO_y chem., chemical heat source, dynamics, inference of [O] and [H], PMC studies	80–100
NO	5.3	Thermosphere cooling, NO_x chemistry	90–180
H_2O	6.9	HO_y source gas, dynamical tracer	15–80

Instrument Description

The SABER instrument is a 10-channel radiometer that will measure infrared earthlimb emissions. The instrument telescope is a Cassegrain design with a picket-fence tuning fork chopper at the first focus and a clam shell reimager to focus the image on the focal plane. The telescope has been designed to reject stray light from the Earth and atmosphere outside the instrument instantaneous field of view (IFOV). The baffle assembly contains a single axis scan mirror that permits the 2-km vertical IFOV of each detector to be scanned from the Earth to a 400-km tangent height. Accurate vertical registration of the tangent height of the data in the atmosphere is achieved by analysis of the 14.9- and 15.2-mm CO_2 channels. The telescope and baffle assembly are cooled to 240 K by a dedicated radiator. The focal plane assembly, consisting of a filter array, a detector array, and a Lyot stop, is cooled to 75 K by a miniature cryogenic refrigerator. The detector array contains discrete HgCdTe, InSb, and InGaAs detectors. The conductive heat load on the refrigerator is minimized by a Kevlar support system that thermally isolates the focal plane assembly from the telescope. The telescope is supported and thermally isolated from the instrument base plate by a glass composite structure. The cryogenic refrigerator and electronic heat load is dissipated to space by the plate radiator. Instrument responsivity drifts due to changes in telescope and focal plane base temperatures as well as other causes are corrected by an in-flight calibration system.



Mass: 61.7 kg
Power: 64 W
Data Rate: 4 kbps
Dimensions: 77 × 103 × 60 cm

SABER Science Team

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For additional information you may access the
JHU/APL Space Department home page at
http://sd-www.jhuapl.edu/TIMED

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