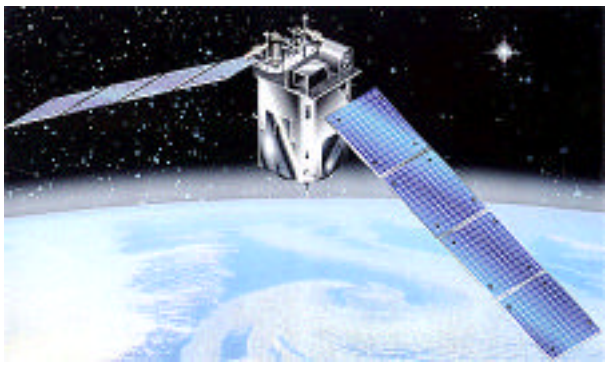
T I D I

TIMED Doppler Interferometer



Experiment Overview

The TIMED Doppler Interferometer (TIDI) will investigate the dynamics and energetics of the Earth's mesosphere and lower-thermosphere-ionosphere (MLTI) from an altitude of 60 to 300 km. TIDI measurements will allow us to obtain a global description of the vector wind and temperature fields, as well as important information on gravity waves, species densities, airglow and auroral emission rates, noctilucent clouds, and ion drifts. TIDI will provide basic information about global winds and temperatures. TIDI will also contribute to the study of MLTI energetics.

Science Objectives

The TIDI interferometer (or Profiler) primarily measures horizontal vector winds and neutral temperatures from 60 to 300 km, with a vertical resolution 2.5 km at the lower altitudes and with an accuracy that approaches ~3 m/sec and ~3 K, respectively, under optimum viewing conditions. The TIDI design allows for 100% duty cycle instrument operation during daytime, nighttime, and in auroral conditions. TIDI views emissions from OI 557.7 nm, OI 630.0 nm, OII 732.0 nm, O_2(0-0), O_2(0-1), Na D, OI 844.6 nm, and OH to determine Doppler wind and temperature throughout the TIMED altitude range. TIDI also makes spectral ratio observations to determine O_2 densities and rotational temperatures.

Key Spacecraft Characteristics

Orbital Altitude: 625 km Circular
Orbital Inclination: 74.1°
Total Spacecraft Weight: 660 kg
Spacecraft Size: Mid-Lite class
Launch Vehicle: Delta II 7920

Description and Specifications

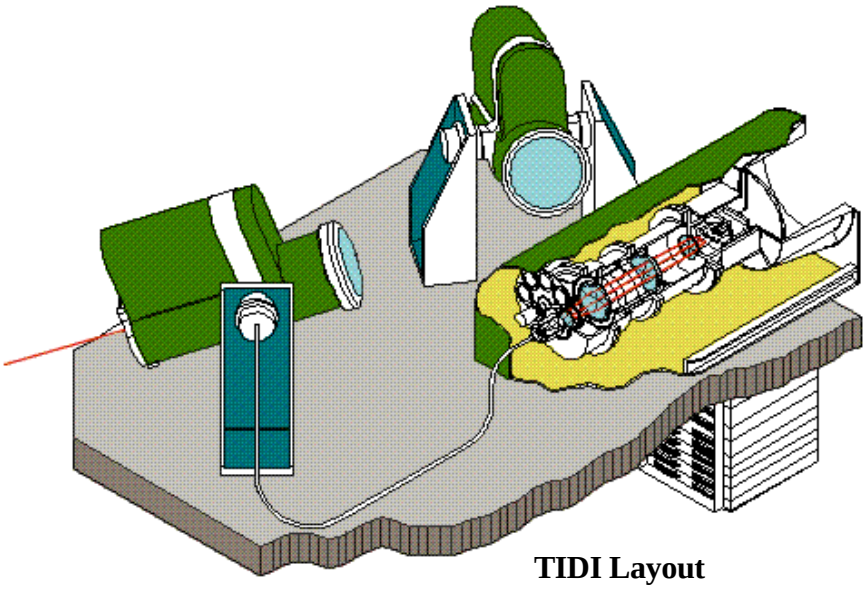
TIDI comprises three major subsystems: four identical telescopes, a Fabry-Perot interferometer with a CCD detector, and an electronics box. Light from the selected regions of the atmosphere is collected by the telescopes and fiber-optically coupled to the detection optics. The four fields of view are scrambled along with a calibration field input and converted to an array of five concentric circular wedges. This input then passes through a selected filter, then through a Fabry-Perot etalon, and is finally imaged onto a CCD via a circle to line imaging optic (CLIO) device.

TIDI System

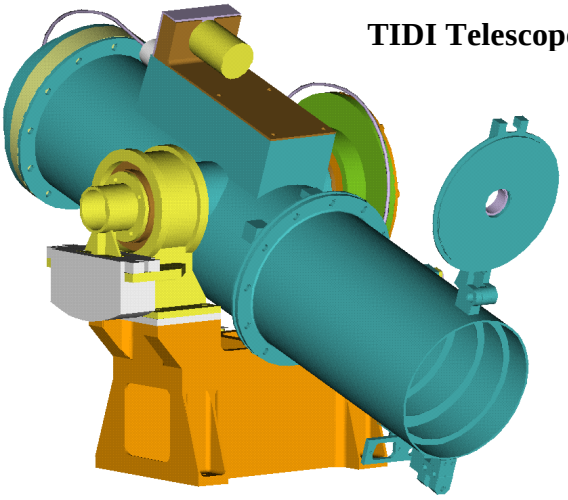
Mass:	41.8 kg
Electrical Power:	19.32 watts (orbit ave.)
Heater Power:	11.0 watts
Data Rate:	2494 bits/sec
Observations:	winds, temperatures, and density
Wind accuracy:	3 m/s (line of sight)
Altitude Resolution:	2.5 km
Spectral Range:	550 - 900 nm
Lifetime:	>2 years

Electronics System

Hybrid Power supply
80C51 (UTMC) Flight computer
Data acquisition
CCD controller
Filter wheel/ shutters/ PWM heaters
Telescope servo amp
Calibration lamp power supply



TIDI Layout
(showing two of four telescopes)

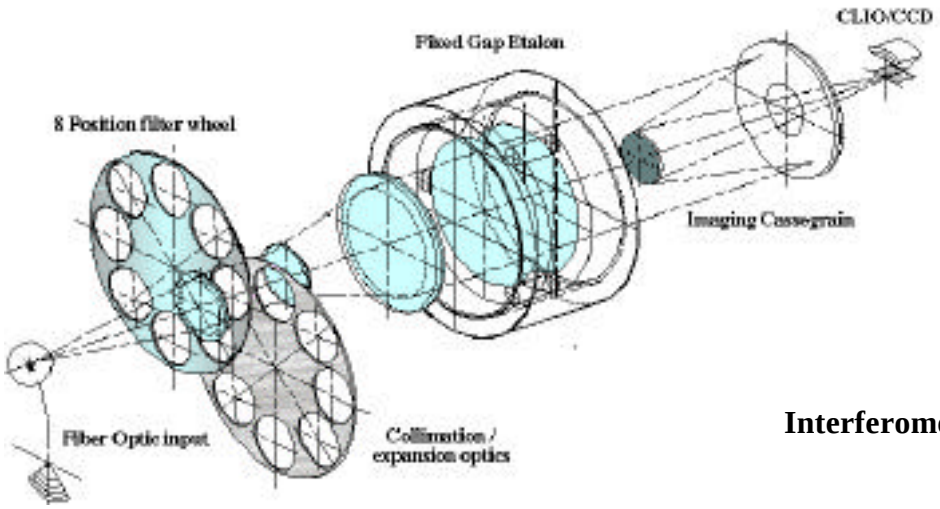


TIDI Telescope

Telescope Specifications

Off axis Gregorian
Low scatter optics and baffles
Zenith gimbal

Clear Aperture	7.5 cm
Area	44.2 cm^2
Angular FOV	2.5° horiz x 0.05° vert
F/number	2.2

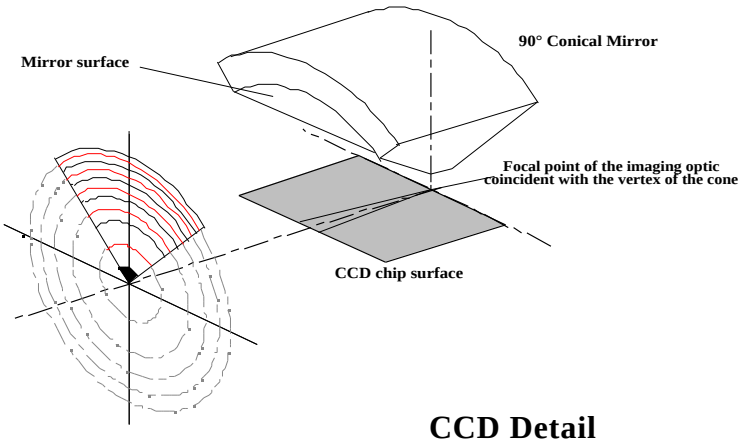


Interferometer Optics

Profiler Specifications

Fixed gap single etalon Fabry-Perot inferferometer
2 x 8 position filter wheel
Circle to line image converter (CLIO)
Passively Cooled CCD detector
5 x 32 Channels

Clear Aperture	7.5 cm
Plate Diameter	10.5 cm
Gap	2.2 cm
Finesse	8.1-8.9



CCD Detail

Principal Investigator

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TIDI Key Parameter Summary

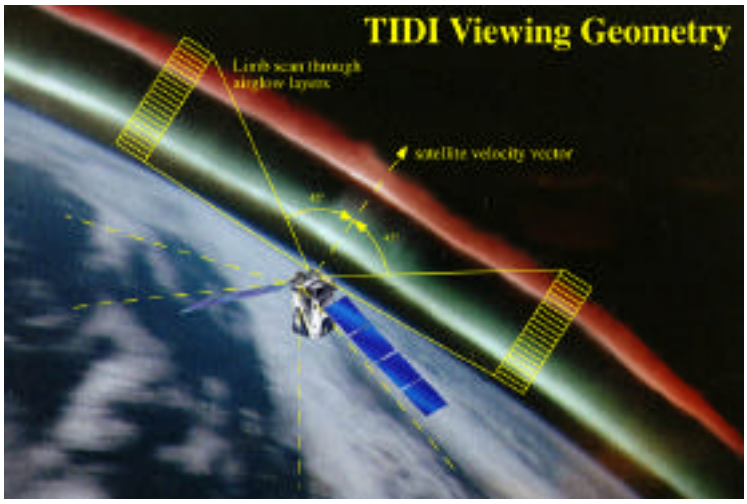
The filter wheels for TIDI contain a complement of fourteen interference filters carefully chosen to allow full daytime altitudinal coverage of neutral wind and temperature measurements throughout the MLTI. Setting the filter wheels to view the most appropriate emission within each altitude range optimizes the measurement. Altitudinal coverage during nocturnal periods is reduced since the terrestrial airglow exhibits a discrete layer behavior when sunlight is absent. Tables 1 and 2 summarize the TIDI measurements for dayside and nightside modes, respectively, by listing the altitude range over which it is possible to obtain useful measurements from each emission. In cases of overlap it has yet to be determined which emission will be viewed at a given altitude.

Dayside Science

Measurement	Feature	Altitude Range
Vector Wind	O_2 At (0-1) P11	60 - 85 km
	O_2 At (0-0) P9	85 - 120 km
	OI (5577Å)	90 - 250 km
	OI (6300Å)	200 - 300 km
	OII (7320Å)	170 - 300 km
Neutral Temperature	O_2 At (0-1) P11 and O_2 At (0-1) P7	60 - 85 km
	O_2 At (0-0) P9 and O_2 At (0-0) P15	85 - 120 km
	OI (5577Å)	100 - 150 km
	OI (6300Å)	200 - 300 km
O_2 Density	O_2 At (0-0) VER	~100 km
	O_2 At (0-1) and O_2 At (0-0)	60 - 90 km
O Density	OII (7320Å) and OI (8446Å)	150 - 300 km
O_3 and $O(^1D)$ density	O_2 At VER	70 - 95 km

Nightside Science

Measurement	Feature	Altitude Range
Vector Wind	OH Meinel (7-3)	80 - 90 km
	Na D	85 - 95 km
	O_2 At (0-0) P9	85 - 105 km
	OI (5577Å)	95 - 105 km
	OI (6300Å)	200 - 300 km
Neutral Temperature	OH Meinel (7-3)	80 - 90 km
	Na D	85 - 95 km
	O_2 At (0-0) P9 and O_2 At (0-0) P15	85 - 105 km
	OI (5577Å)	95 - 105 km
	OI (6300Å)	200 - 300 km
O Density	OH Meinel	80 - 95 km
	O_2 At	85 - 100 km
	OI (5577Å)	90 - 105 km



The TIDI telescopes perform limb scans through the terrestrial airglow layers throughout the satellite orbit. TIDI obtains these scans simultaneously in four orthogonal directions: two at 45° forward but on either side of the satellite's velocity vector and two at 45° rearward of the satellite. These four views provide the measurements necessary to construct the horizontally resolved vector winds as a function of altitude within the MLTI region along two parallel tracks, one on either side of the spacecraft. Each vertical scan consists of individual views 2.5° (horizontal, along the limb) by 0.05° (vertical, normal to the limb) in angular size. The vertical altitude resolution of the instrument is 2.5 km, but the altitude spacing between views will be adjusted to yield a measurement vertical resolution of half a scale height throughout the limb scan. The altitude step size will range from 2.5 km in the MLTI region to 25 km in the thermosphere. Each up/down acquisition cycle will take 100-200 seconds to complete, resulting in a nominal horizontal spacing between profiles of approximately 750 km along the orbit track. The exact time per vertical scan will depend on the mode being run and the integration or dwell time needed at each altitude step. Each up/down scan cycles through a sequence of filter tunings, selecting the optimal emissions to be viewed within each altitude range to allow rotational and/or Doppler temperatures as well as neutral winds to be retrieved.