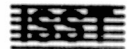


**ORBITAL DEBRIS
ENVIRONMENT MONITOR
ODEM**

**Dr. John P. Oliver
Institute for Space Science and Technology,
Gainesville, Florida**

**Presented at the Flight Experiments
Technical Interchange Meeting, Monterey, California
5-9 October, 1992**

Institute for Space Science and Technology © 1992



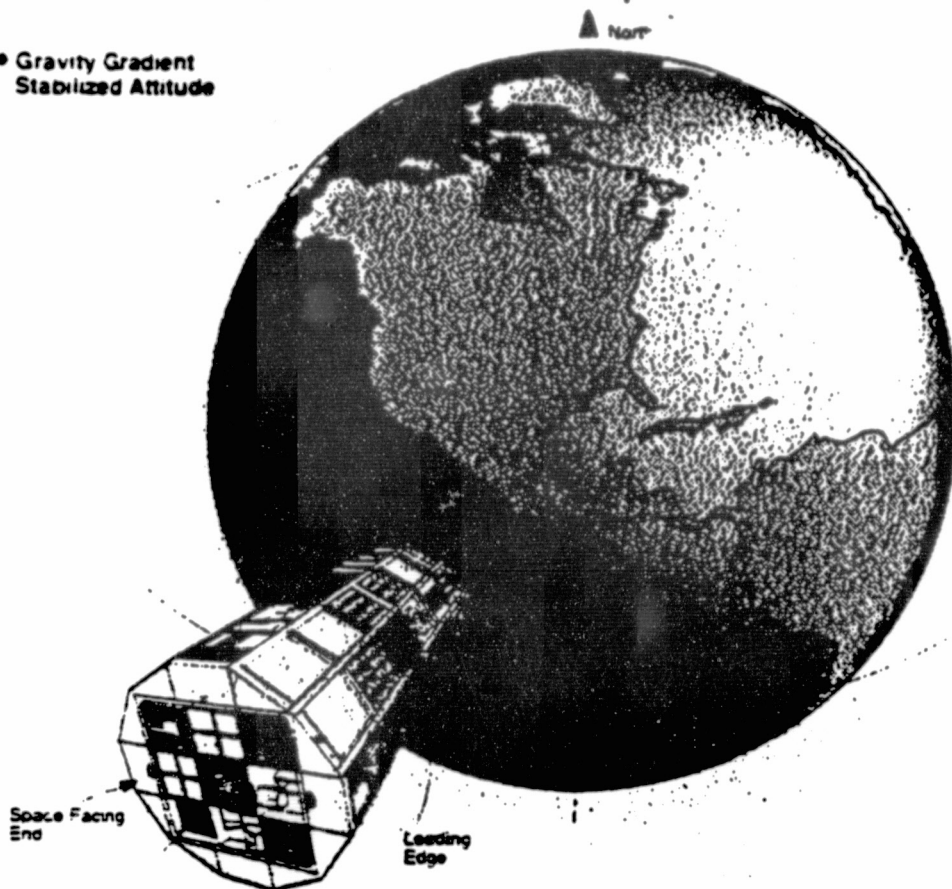
N93-28735

2
p. 16
30/159241

Institute for Space Science and Technology, 1810 NW 6th Street, Gainesville, Florida 32609 © 1992

LDEF Orbital Flight Orientation

● Gravity Gradient Stabilized Attitude



NASA

L-00-10710

LDEF Long Duration Exposure Facility

Orbital Attitude: Gravity Gradient Stabilized
(Schematic)

Deployed: April 7, 1984, at 250 nmi (463 km)

Retrieved: January 12, 1990, at 178 nmi (330 km)

Total Duration in Orbit: 70 months (5.8 yr)

Atomic Oxygen Fluence (atoms/sq cm): $\approx 10^{22}$

Orbital Ram Velocity: ≈ 8 km/s

LDEF Structure:

Material: 6061-T6, Aluminum

Coating: (Interior) Chemglaze Z306 (Flat Black)

Size: (12-Sided Cylinder)

Length: 30 ft (≈ 9 m)

Diameter: 14 ft (≈ 4 m)

Weight: (With Experiments) 21,393 lb (9,704 kg)

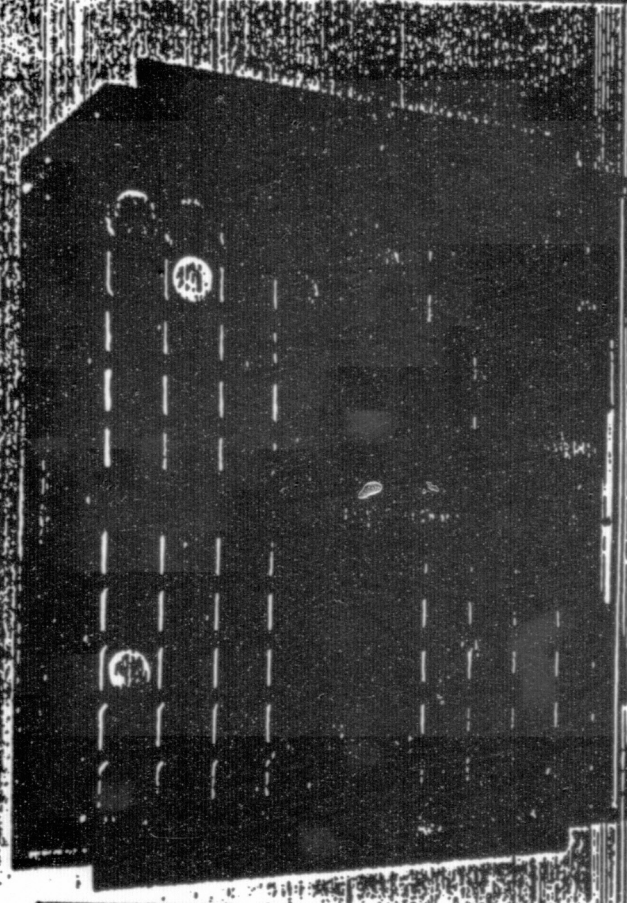
Number of Experiments: 57

Number of Investigators: >200

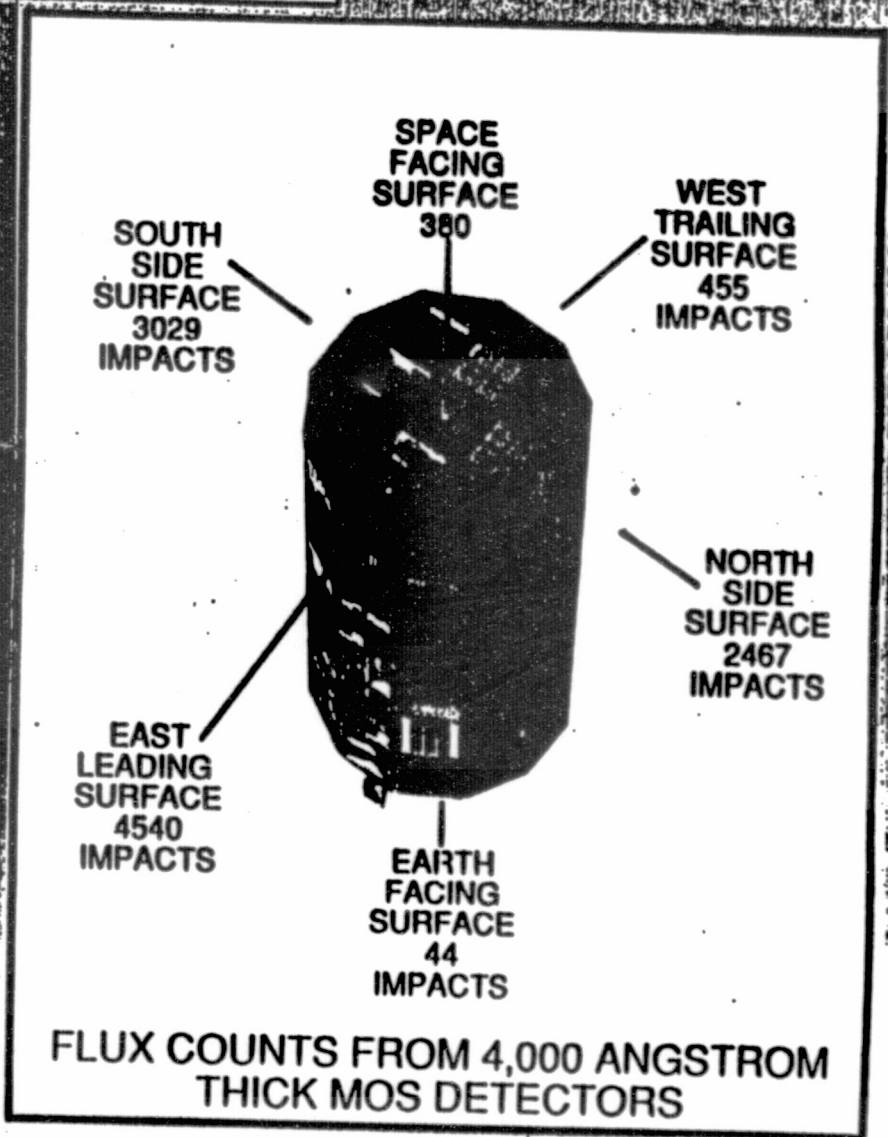
6-10

INTERPLANETARY DUST EXPERIMENT

• Detector Arrays Mounted on 6 Sides of LDEF



DETECTOR ARRAY MOUNTED ON EARTH SIDE OF LDEF



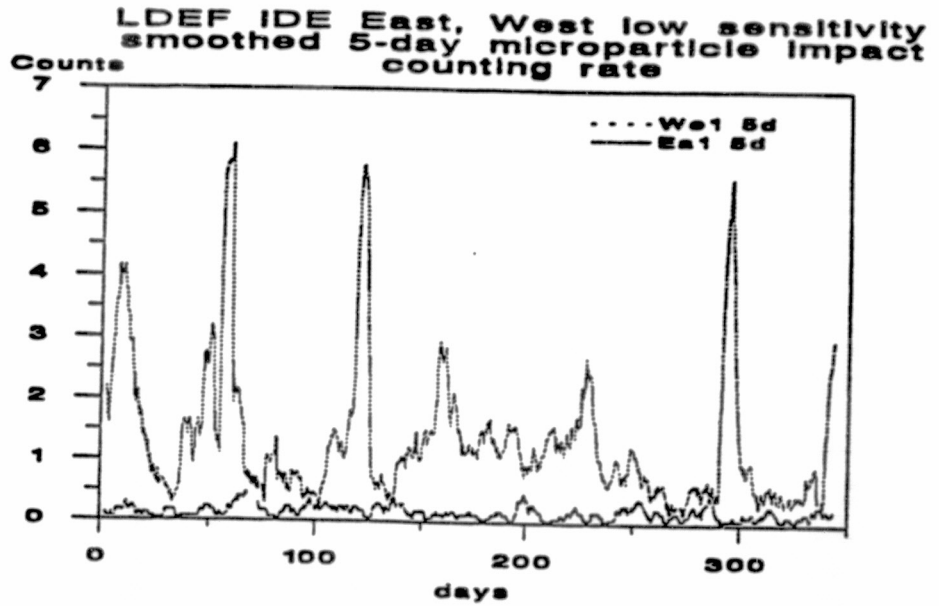


Figure 2a. Five day smoothed flux on the East and West low sensitivity IDE sensors as a function of time.

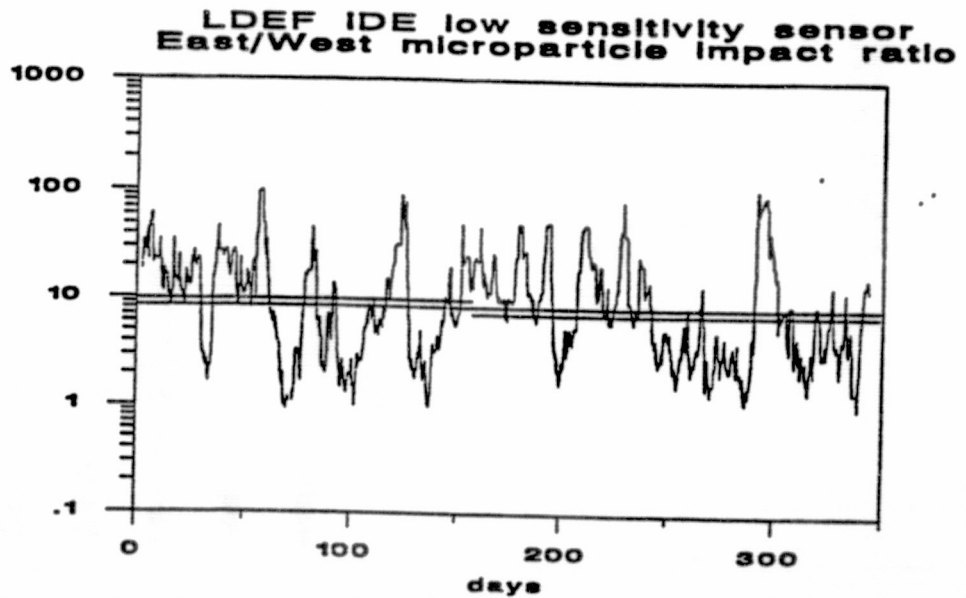
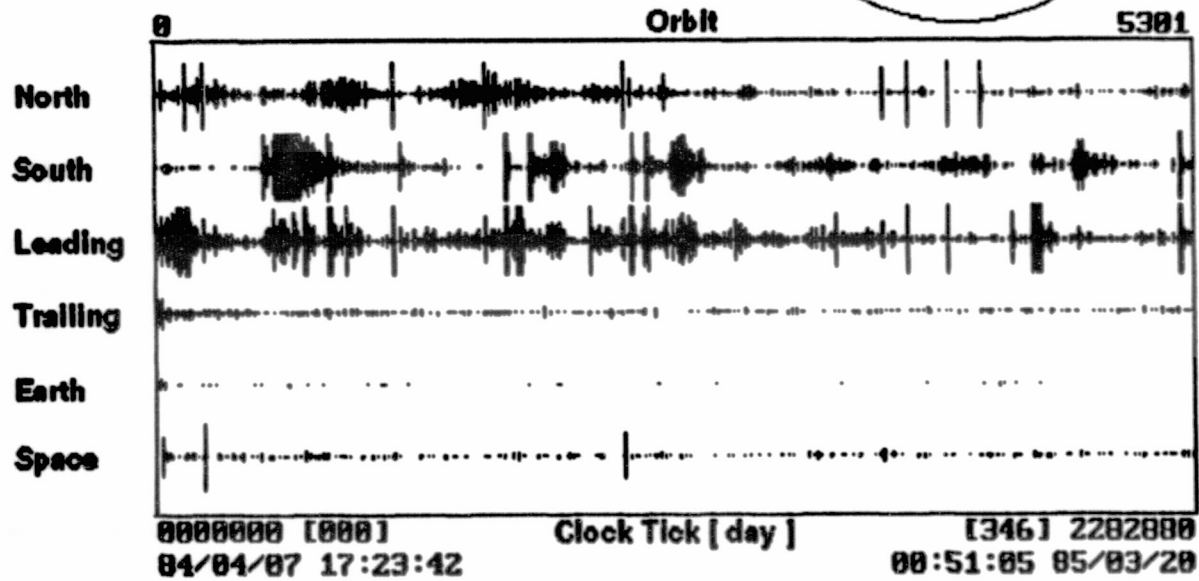
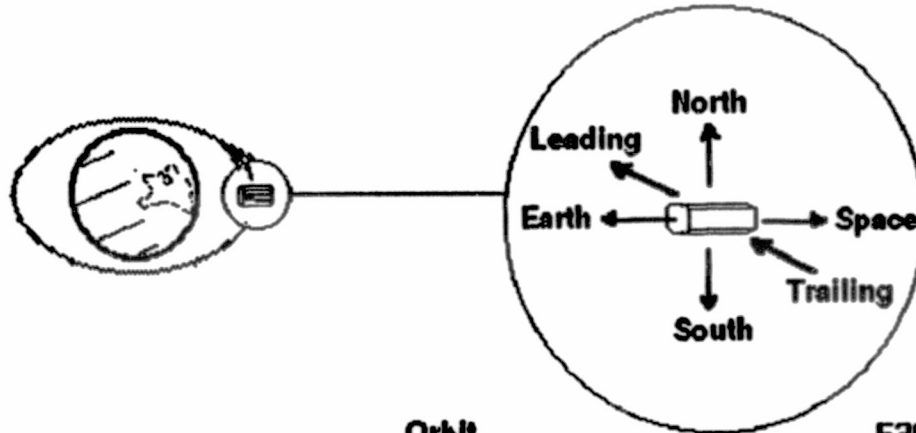


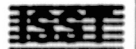
Figure 2b. Five day smoothed ratio of East and West low sensitivity sensor microparticle impact fluxes as a function of time. Horizontal lines mark mean values of full data set and the first and second halves of the data set..



"Seismograph" Plot



Institute for Space Science and Technology © 1992



IDE active mission = 346 days

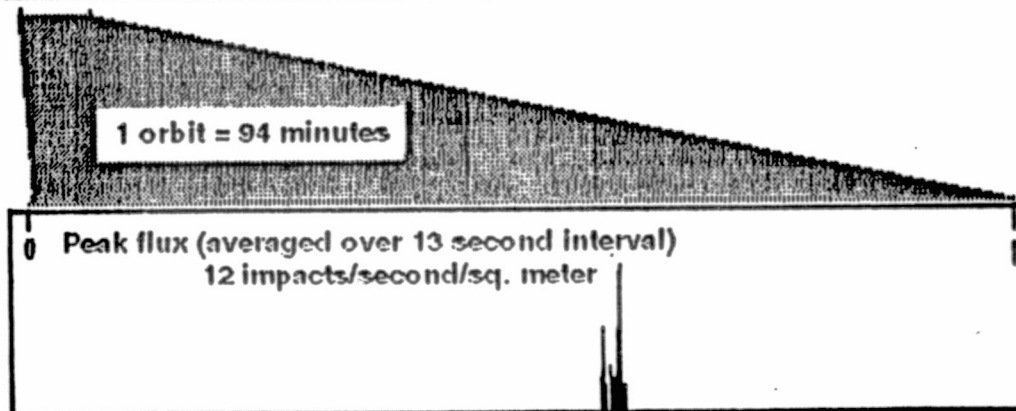
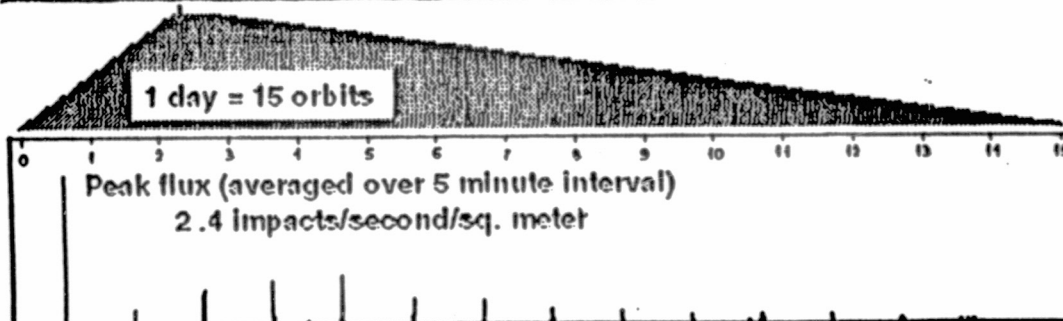
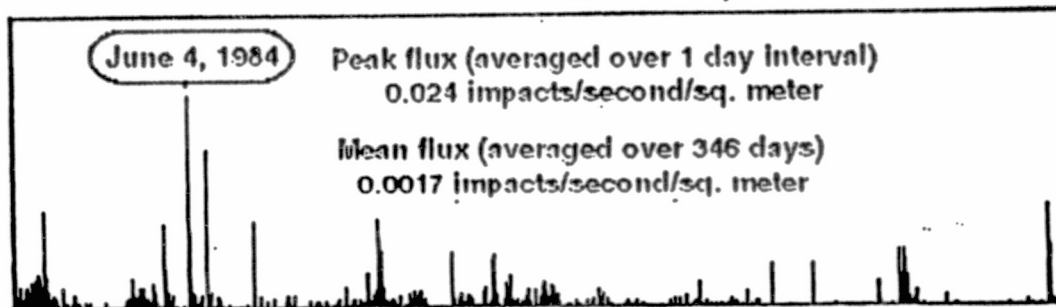
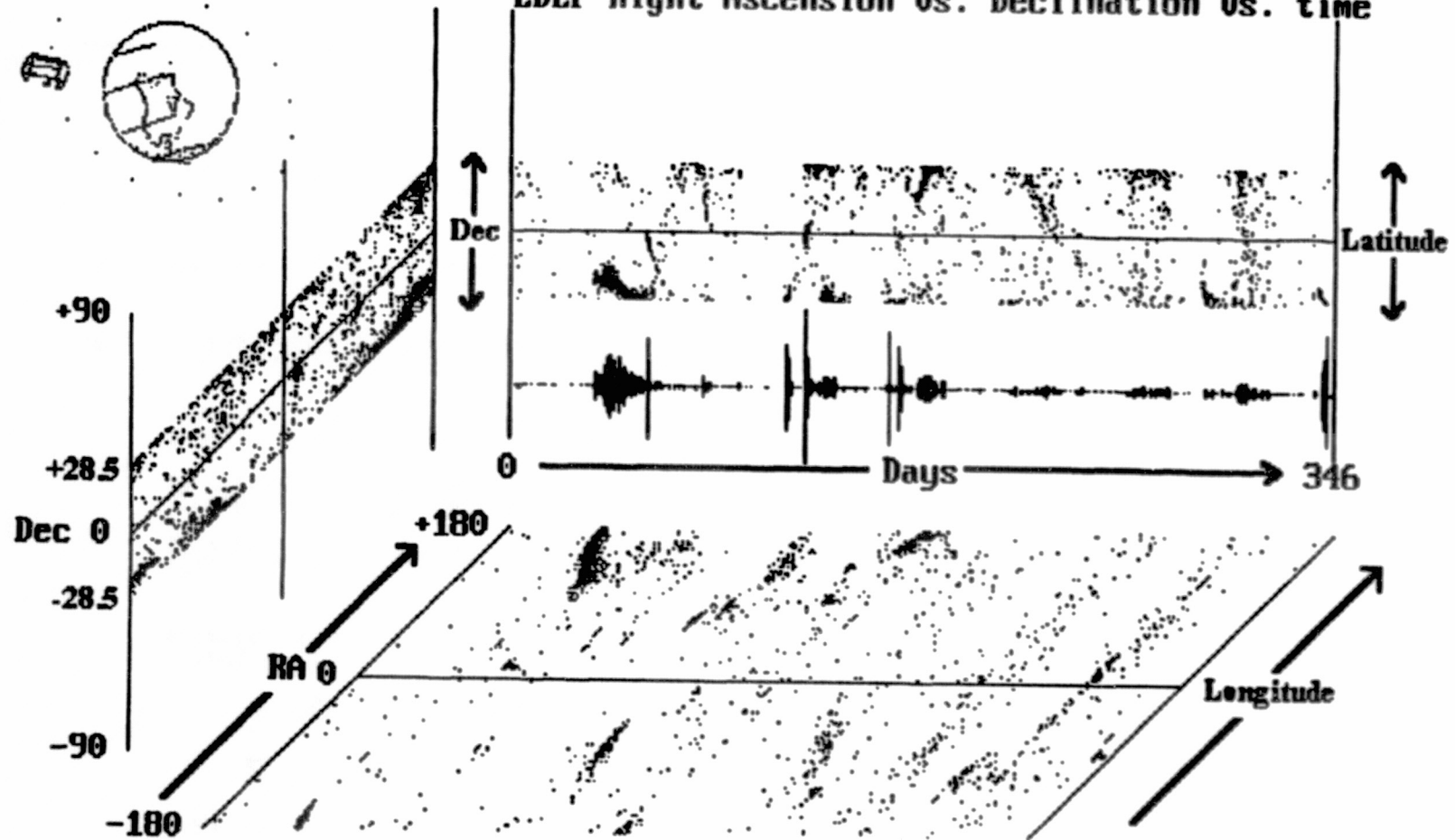


Figure 2. Observed activity on the leading (ram) edge of LDEF as recorded by the 0.4 μm thickness detectors of IDE.

ISST



LDEF IDE Data: South 0.4 I data
LDEF Right Ascension vs. Declination vs. time



Institute for Space Science and Technology © 1992



Orbital Debris Clouds

- **Greatly Increased Impact Rates Localized In Time and Space**
 - Events Occur Every 94.1 Minutes**
 - Typical Event Duration; 3 to 5 Minutes (1500 to 2500 Km)**
- **Events Occur in Same Place Each Orbit**
 - Relative Activity on Differing Surfaces**
 - May Yield Apparent Source Direction**
- **Precession Allows Mapping In Space**
- **May 13th Swarm . . . $\approx 30^\circ$ Orbital Inclination**
- **June 4th B Event . . . $\approx 65^\circ$ Orbital Inclination**



ISST

**institute for
Space
Science and
Technology**

**1810 NW 6th Street
Gainesville, FL
32609**



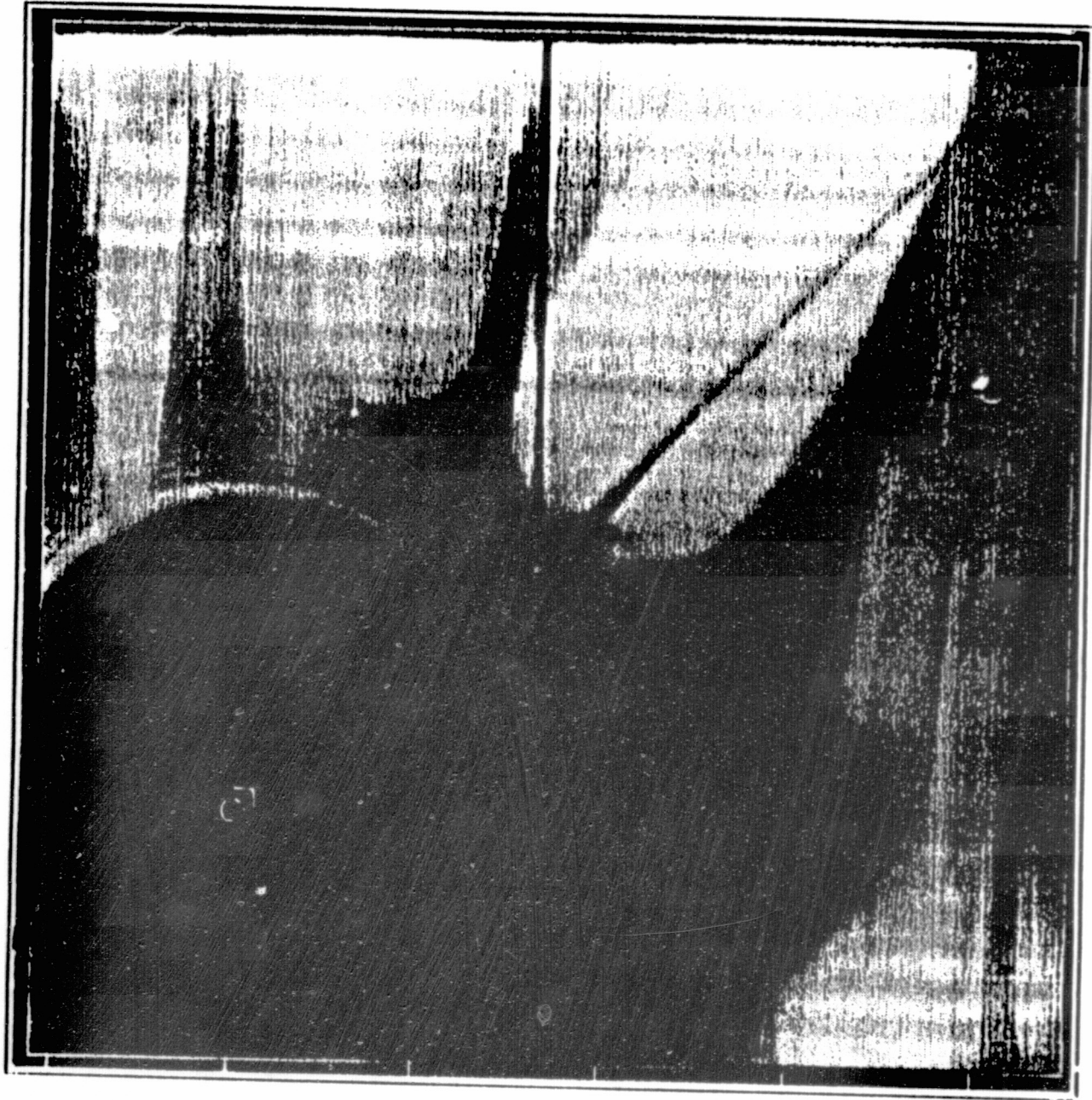
Mapping and Modeling of Orbital Debris Clouds

- **Exploit the Unique IDE Spatio-Temporal Dataset**
- **Identify and Categorize Cloud Events**
- **Relate Cloud Events to Sources**
 - Launches to LEO**
 - LEO to GEO Insertion**
 - Accidental Disruption**
 - Deliberate Disruption**
- **Analyze Cloud Evolution and Dispersion**
- **Predictive Modeling of Clouds - Space Weather Prediction**
- **Statistical Prediction of Total LEO Debris Environment**



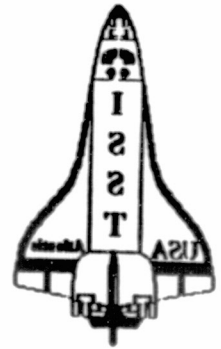
Solar Maximum Mission Spacecraft

- **In same orbital plane, 15 km "above" LDEF at LDEF release**
- **HAO Coronagraph images showed near-field particles and particle clouds**
- **Although originally attributed to local contamination, statistical analysis suggests some were orbital debris particles**
- **Correlation of LDEF IDE data with SMM Coronagraph data taken during 1984-1985 can confirm orbital debris origin**
- **SMM Coronagraph data available for period from 1980 through 1989; allowing assessment of changes in**



IST

Institute for
Space
Science and
Technology
1810 NW 6th Street
Gainesville, FL
32609



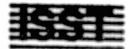
SynMOD (precursor to ODEM)

- ***Synoptic Monitoring of Orbital Debris***
- **High time-resolution monitoring of near-Earth small particle impacts**
- **Uses proven MTS/Explorer 46/IDE sensors**
- **Selected for Eureka-2**

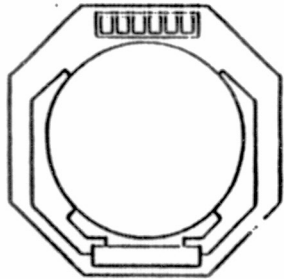
ODEM

- ***Orbital Debris Environment Monitor***
- **Adds impact energy/size/mass discrimination to SynMOD**
- **Standardized, Modular system**
- **Can easily mount on any Bus**

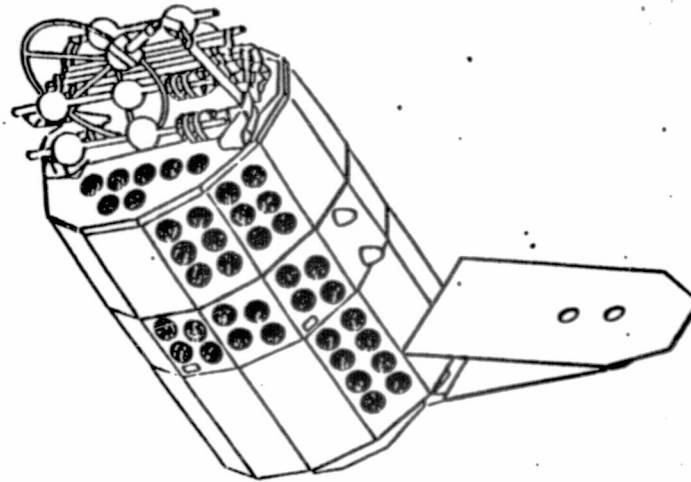
Institute for Space Science and Technology © 1992



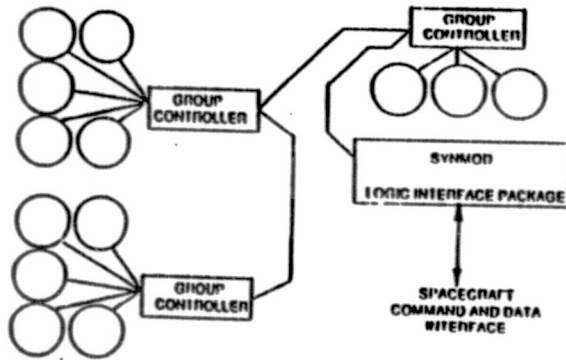
22. PICTORIAL



Individual Detector Element



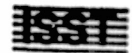
Possible Configuration Options



System Architecture

DD FORM 1721 AUGUST 1990
PREVIOUS EDITIONS ARE OBSOLETE

Security Classification (When data entered)



RESOURCE REQUIREMENTS

	SynMOD	ODEM
Command and Data Uplink:	none	none
Telemetry Downlink:	< 250 Kbits/day	same
Power:	nominal 2 watts	same
Mass (per module):	< 0.75 kg	same
Mass (electronics):	< 1.0 kg	same
Volume (per module):	.3 x .3 x .003 m	same
Stabilization Required:	none	none
Desired Configuration:	12 modules	same

Institute for Space Science and Technology © 1992

