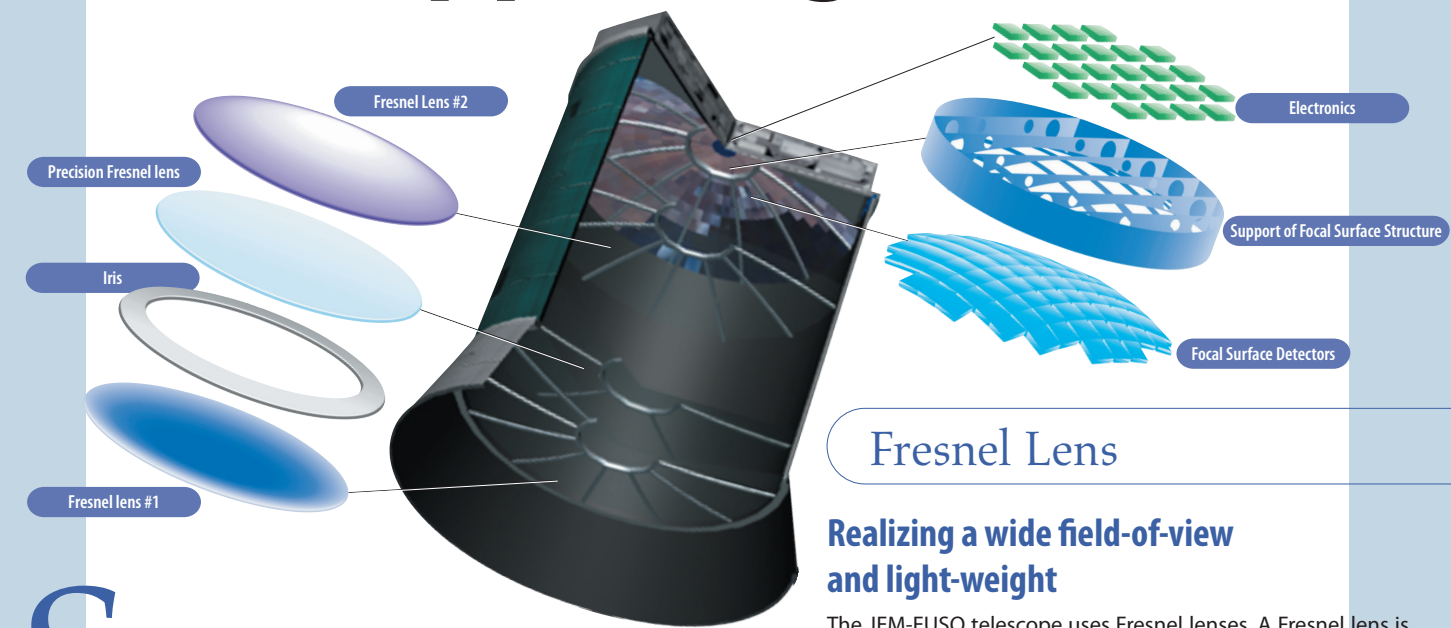


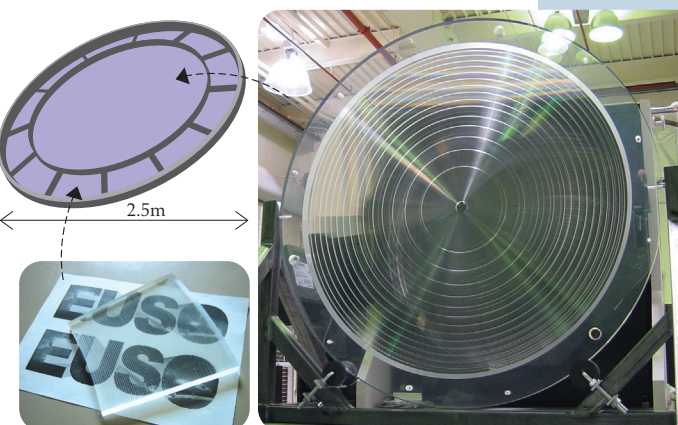
High Technologies are Supporting JEM-EUSO



Fresnel Lens

Realizing a wide field-of-view and light-weight

The JEM-EUSO telescope uses Fresnel lenses. A Fresnel lens is a semi-flat lens having circular grooves that eliminate the large mass of a standard convex or concave lens. A thin and light Fresnel lens is necessary for use in space, performing the optical functions in the same way as a thick and heavy lens. JEM-EUSO uses two curved double-sided Fresnel lenses of UV-transmitting plastic and one micro-grating Fresnel lens. This design allows the best efficiency for the widest field-of-view. The size of the triple-lens is 2.5-m diameter, composed of the central 1.5-m part and the circular outer annular lenses.



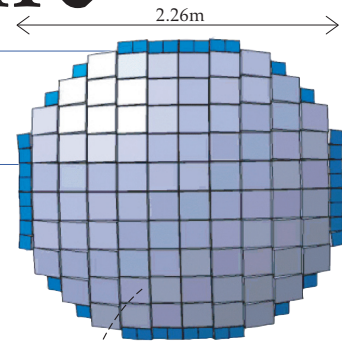
▲ Central lens and annular lenses configuration enable a lens size larger than can be manufactured on a single machine.

Structure

Focal Surface Detectors

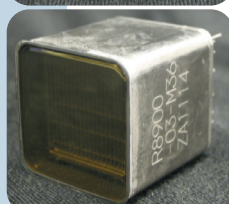
6,000 photomultipliers

The focal surface is curved with a diameter of 2.26m. About 6,000 1-inch square multianode photomultiplier tubes (PMTs) detect the light from the different locations in the earth's atmosphere. Earlier PMTs had a limited photo-sensitive area of only 45%. JEM-EUSO and Hamamatsu Photonics jointly developed PMTs to have a higher effective area of 85%.



▲ Focal Surface
It consists of 164 modules, and the total number of PMTs is 5,904.

▲ Light-sensing module
Covering a focal surface of 2.26m diameter with 5,904 PMTs, each PMT having 6 × 6 = 36 photo-sensitive units.

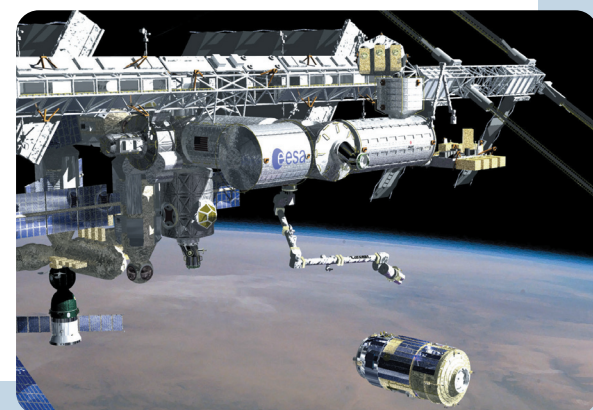


▲ Photomultipliers
The PMT surface has 85% active area, having 6 × 6 pixels with a total area of 26.2 mm square.

Launch

JAXA's Space Station Transfer Vehicle (HTV) carries JEM-EUSO

HTV will be launched by a H-IIB rocket (JAXA) and autonomously carry JEM-EUSO to ISS. Robotic arms of ISS will deploy JEM-EUSO at JEM module of "Kibo."



▲ Space Station Transfer Vehicle (HTV) approaching ISS ©JAXA

Comparison of JEM-EUSO with the largest ground observatories

	AGASA	HiRes	Auger	Telescope Array	JEM-EUSO
Organization	University of Tokyo	University of Utah	International Consortium	University of Tokyo and University of Utah	International Consortium
Location	Yamanashi, Japan	Utah, USA	Argentina	Utah, USA	International Space Station
Type of Detectors	Ground Array	Fluorescence Ground Telescope	Ground Array + Fluorescence Ground Telescope	Ground Array + Fluorescence Ground Telescope	Fluorescence Space Telescope
Period of operations	1990–2004	1997–2006	2005–	2007–	launch expected in 2013
Effective aperture (km ² ·sr)	150	500	~7,000	760	125,000
Yield of EHE events (No./year)	1, experiments terminated	observed less than 1, experiments terminated	50 (expected), 3 (observed)	10 (expected)	350 – 1,700 (expected)

Mission Operation of JEM-EUSO

Altitude	about 400km	Number of pixels of the focal surface	about 0.2 million
Observation latitude and longitude	N51°– S51° × all longitudes	Resolution of the ground	about 0.8km
Filed of view	60°	Duty cycle	12–25%
Aperture (ground area size)	0.2 million km ²	Mission duration	3 (+2) years
Diameter of telescope	2.5m	Total mass	~1.9 ton
Optical system	Two double-sided Fresnel lens and a high-precision Fresnel lens	Power usage	< 1kW

International Partners

Japan	RIKEN Konan Univ. Fukui Tech. Univ. Aoyama Gakuin Univ. Saitama Univ. NIRS Univ. Tokyo Tohoku Univ. ICRR, Univ. Tokyo KEK Chiba Univ. NAOJ ISAS/JAXA Kanazawa Univ. Nagoya Univ. STE Lab., Nagoya Univ. Yukawa Inst., Kyoto Univ. Kyoto Univ. Kobe Univ. Kinki Univ. Hiroshima Univ. Hokkaido Univ. Tokyo Inst. Tech.
USA	NASA/MSFC UAH LBL,UCB UCLA Vanderbilt Univ. Univ. Arizona.
France	APC-Paris 7 LAL, IN2P3-CNRS
Germany	MPI Munich Univ. Tuebingen MPI Bonn Univ. Erlangen LMU&MPQ
Italy	Univ. Florence Univ. Naples Univ. Palermo Univ. Rome "Tor Vergata" Univ. Turin INOA/CNR IASF-PA/INAF IFSI-TO/INAF INFN
Mexico	ICN-UNAM BUAP UMSNH
Republic of Korea	Ehwa W. Univ. Yonsei Univ.
Russia	SINP MSU Dubna JINR
Switzerland	Neuchatel, CSEM IACETH
Spain	Univ. Alcalá
Poland	IPJ Podlasie Univ. Kielce Univ. Jagiellonian Univ.
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New Astronomy using Earth's Atmosphere as a Gigantic Observatory
Extreme Universe Space Observatory onboard Japanese Experiment Module

JEM-EUSO

