TWO SPACE UV PROJECTS IN KOREA

Yong-Ik Byun
Yonsei University

GALEX

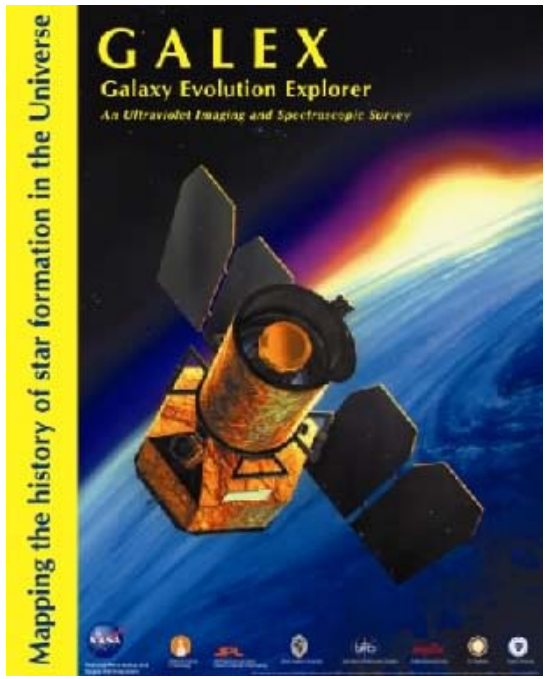
FIMS

Center for Space Astrophysics at Yonsei University
延世大學校 紫外線宇宙望遠鏡研究所

Korea Astronomy Observatory
韓國天文研究院

The Galaxy Evolution Explorer

GALEX, the Galaxy Evolution Explorer, is a NASA UV imaging and spectroscopic survey mission designed to map the global history and probe the causes of star formation and its evolution over the redshift range 0<z<2.



CSA Center for Space Astrophysics

Center for Space Astrophysics at Yonsei University
延世大學校 紫外線宇宙望遠鏡研究所
Y.W. Lee & Y.I. Byun

Galex Partners and roles

Summary

	CSA/Yonsei Univ	SODA, Science Calibration & Test, Archive
	NASA	Overall Project
	Caltech/JPL	Project Management
	Orbital	Spacecraft Integration and Test, Launch Vehicle
	JHU	Archive
	UC Berkeley	Detectors and Front-end Electronics
	LAS	Optical Design

Galex Project Summary

- **Science**: History of star formation over 0<z<2, 80% of history of universe, when galaxies & gas evolve dramatically. Z=0 UV investigation.
- **Technical**: UV 1350-3000Å 50 cm telescope, 2 Microchannel plate detectors, Rotating grism
- **Mission**: Launch May, 2002. Pegasus XL, 28 month mission, 3-axis S/C, nighttime exposures, all-sky survey, deep surveys, 28 deg/690 km orbit, X-band ground station
- **Data Release**: 2003-2004

Galex Instrument

Design Summary

Telescope Aperture : 50 cm

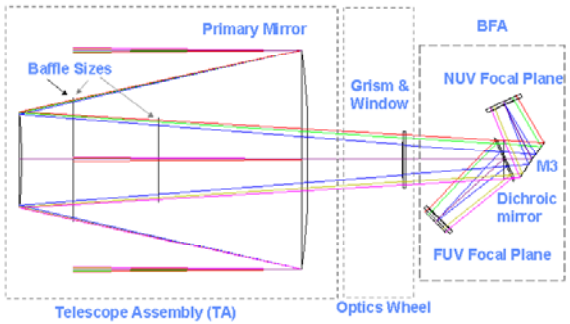
Optical Design : Modified Ritchey-Chretien
with Aspheric corrected

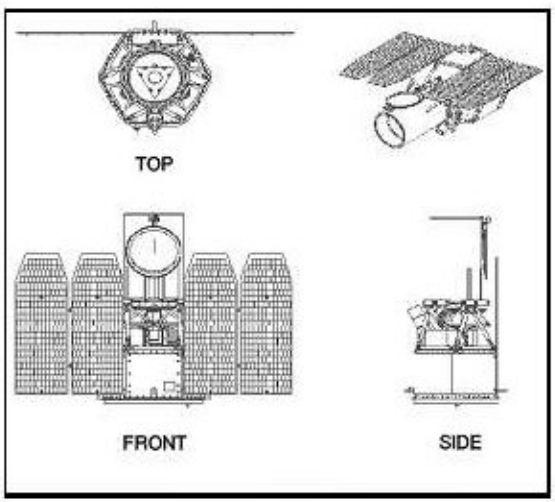
Field of View : 1.2 degrees, circular

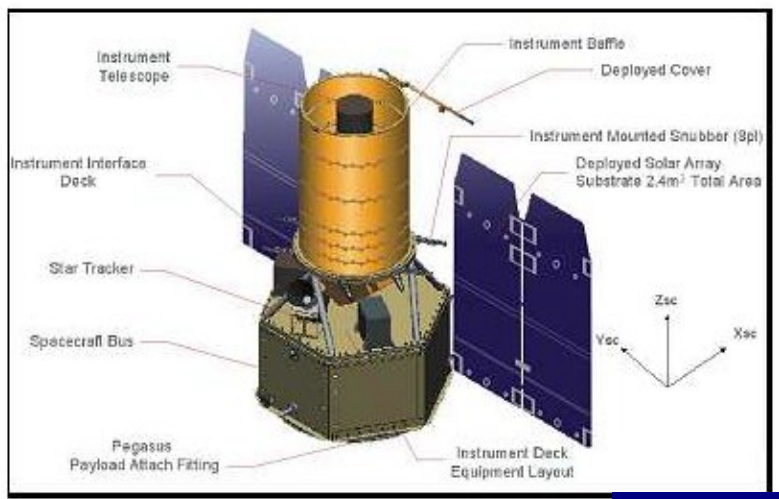
Focal Length : 3 m

Telescope coatings : Al+MgF2

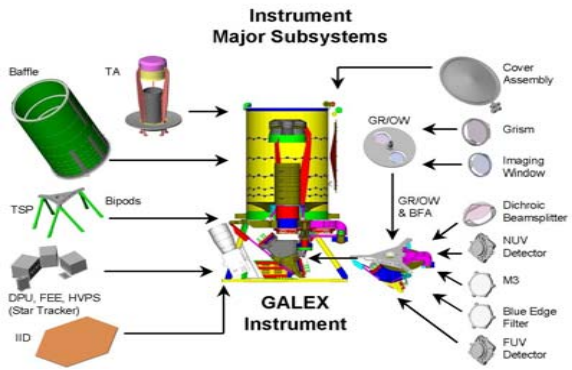
Imaging/Grism Modes

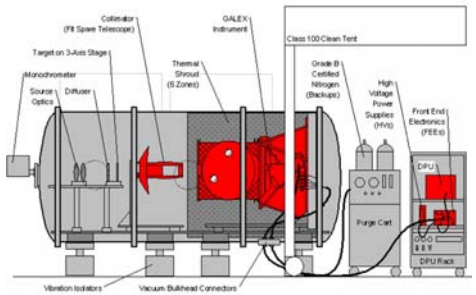


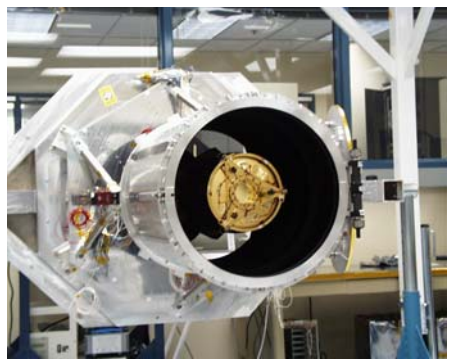




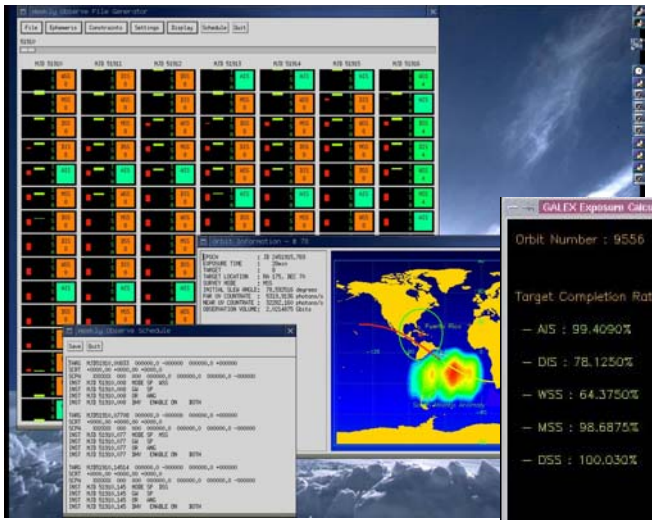
Integration and Test, Calibration



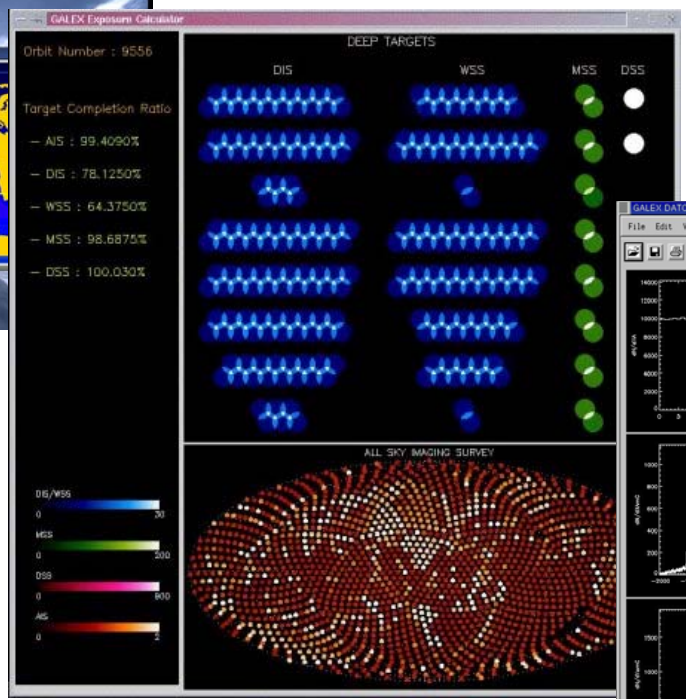




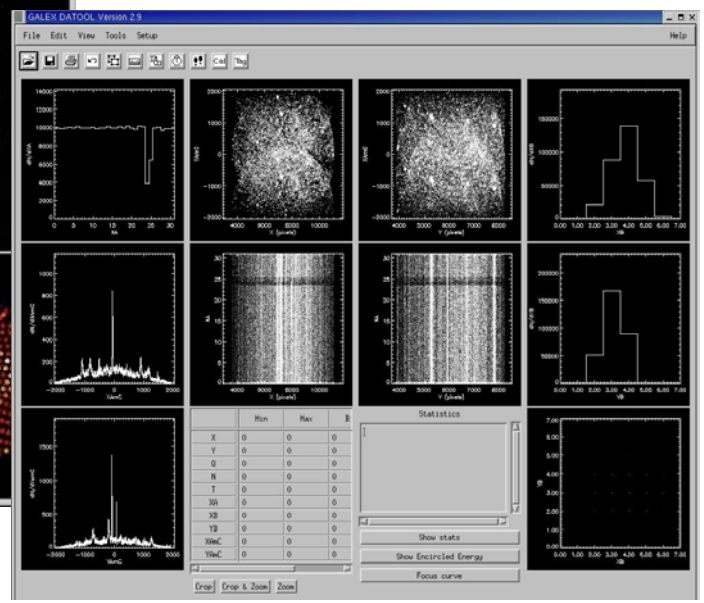
Software Developement



Plan File Generator



Sky Exposure Map



Data Analysis Tool

Mission/Spacecraft characteristics

Launch vehicle, location: Pegasus XL , Kennedy Space Center

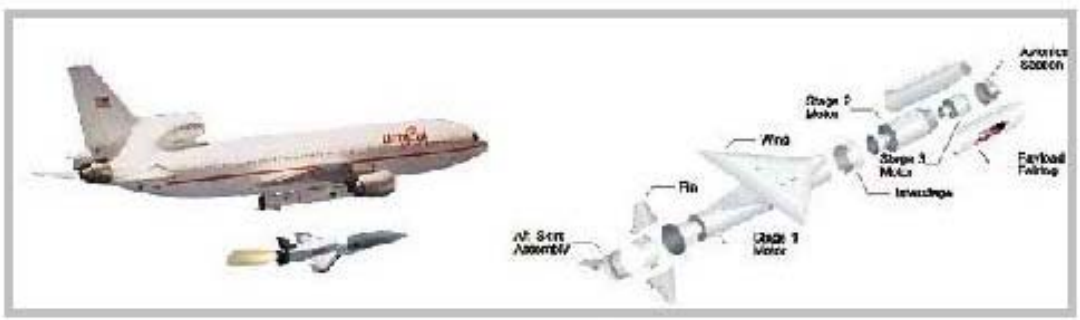
Orbit : 670 km, 28.5 deg inclination

Mission duration : 28 months + 1 month IOC

Telemetry system : X-band science downlink, 28 Mbps

S-band command/HSK link, 2 kbps

Ground stations: Hawaii, Perth



Pegasus Rocket

Kennedy Space Center

GALEX Science

Goals

The primary goals of GALEX are to address these questions:

1. What are the UV properties of local galaxies, and how do rest UV properties, measured at high redshift by HST and NGST in their search for galaxy origins relate to star formation rate (SFR), extinction, metallicity, and burst history?
2. What is the star formation and metal production history of galaxies over the redshift range $0<z<2$? When and where did stars and elements we see today have their origins? And does this history explain the dramatic evolution suggested in previous surveys?
3. What global (galaxy-wide) factors drive star formation and its evolution in galaxies?

Methods

GALEX addresses these goals with a set of focussed objectives:

1. Imaging: Two imaging surveys in a Far UV band (1350-1800 Å) and Near UV band (1800-3000 Å) with 3-5 arcsecond resolution (FWHM) and better than 1 arcsecond astrometry, and a cosmic UV background map.

[AIS:] An All-sky Survey to 20-21m (AB), netting ~10,000 galaxies within 70 Mpc and an unbiased local calibration of UV galaxy morphology, SFR, and extinction.

[DIS:] A Deep Imaging Survey over 100 square degrees to 25.5m (AB) to provide photometric redshifts, extinction and SFR for the faintest and most distant galaxies.

[UIS:] An Ultra-deep Imaging Survey over 10 square degrees to 26.5m (AB)

Methods

2. Spectroscopy: Three overlapping slitless-grism Spectroscopic Surveys over the 1350-3000 Å band with l/Dl~100, resulting in greater than 100,000 galaxies with redshifts (0<z<2), extinction, and SFR, with no follow-up required.

[WSS:] A Wide-field Spectroscopic Survey to 20m (AB) over 100 square degrees to calibrate the global UV/SFR/Extinction relations and find the rarest and most luminous star-forming galaxies.

[MSS:] A Medium-deep Spectroscopic Survey to 21.5-23m (AB) over 10 square degrees to find star forming galaxies of intermediate SFR and redshift.

[DSS:] A Deep Spectroscopic Survey to 22.5-24.3m (AB) over 2 square degrees to find thegalaxies with the lowest SFR and highest z, overlapping the deepest ground-based surveys.

Yonsei SAPs

A. Leading Sciences

- UV Evolution of Ellipticals and Spiral Bulges
- UV colors of globular clusters in the galaxies outside the Local Group: Clue to the galaxy formation theory
- UV colors of globular clusters in Local Group galaxies: Formation of Local Group galaxies
- UV color gradients within nearby ellipticals and spiral bulges
- UV observations of old hot HB stars in the Galactic halo field
- UV observations of hot stars in Galactic globular clusters
- UV observations of LMC
- Luminous blue compact galaxies (LBCG)

B. Participate and Contribute

- Classification and Cataloguing
- Dust Modeling for UV integrated light from Galaxies
- Population Synthesis Models for Galaxies

Galex is Satellite!

Far-ultraviolet Imaging Spectrograph : FIMS

Collaborative work with
Korea Advanced Institute for Science & Technology
and University of California at Berkeley

FIMS Science Objectives

- Energy flows through the hot ($10^{4.5\text{-}6}$ K) plasmas found on scales ranging from SN bubbles to galaxies and galactic corona, and the state and history of this energetic gas
- Morphology of the local and global cooling structures formed by the injection of energy into galaxies by interstellar shocks
- The nature, distribution, and life cycle of galactic structures, and their effect on energy exchange in the ISM and observation of extra-galactic background sources

Mission Objectives: Pointed Spectroscopy

- Imaging spectroscopy of at least 300 fields, covering 150 square degrees
  - Primary emission lines : C III, CIV, Si IV, He II, O IV
  - Spectral resolution : 1.5A (900-1175A), 2.3A (1335-1750A)
  - Emission line sensitivity : 300LU (C IV), 500LU (O VI)
  - Continuum sensitivity in long wavelength band : 30 ph/cm^2/s/A

$\Rightarrow$ Thermal and ionization equilibrium state and abundance of hot galactic plasmas

$\Rightarrow$ Optical properties and spatial distribution of dust

$\Rightarrow$ Formation/destruction cycle and distribution of H_2 in the Galaxy

Mission Objectives: All-Sky Mapping

- **One-year all-sky survey**
  - **Median sensitivity for 3°x3° bin : 1000LU (C IV), 1500LU (O IV)**

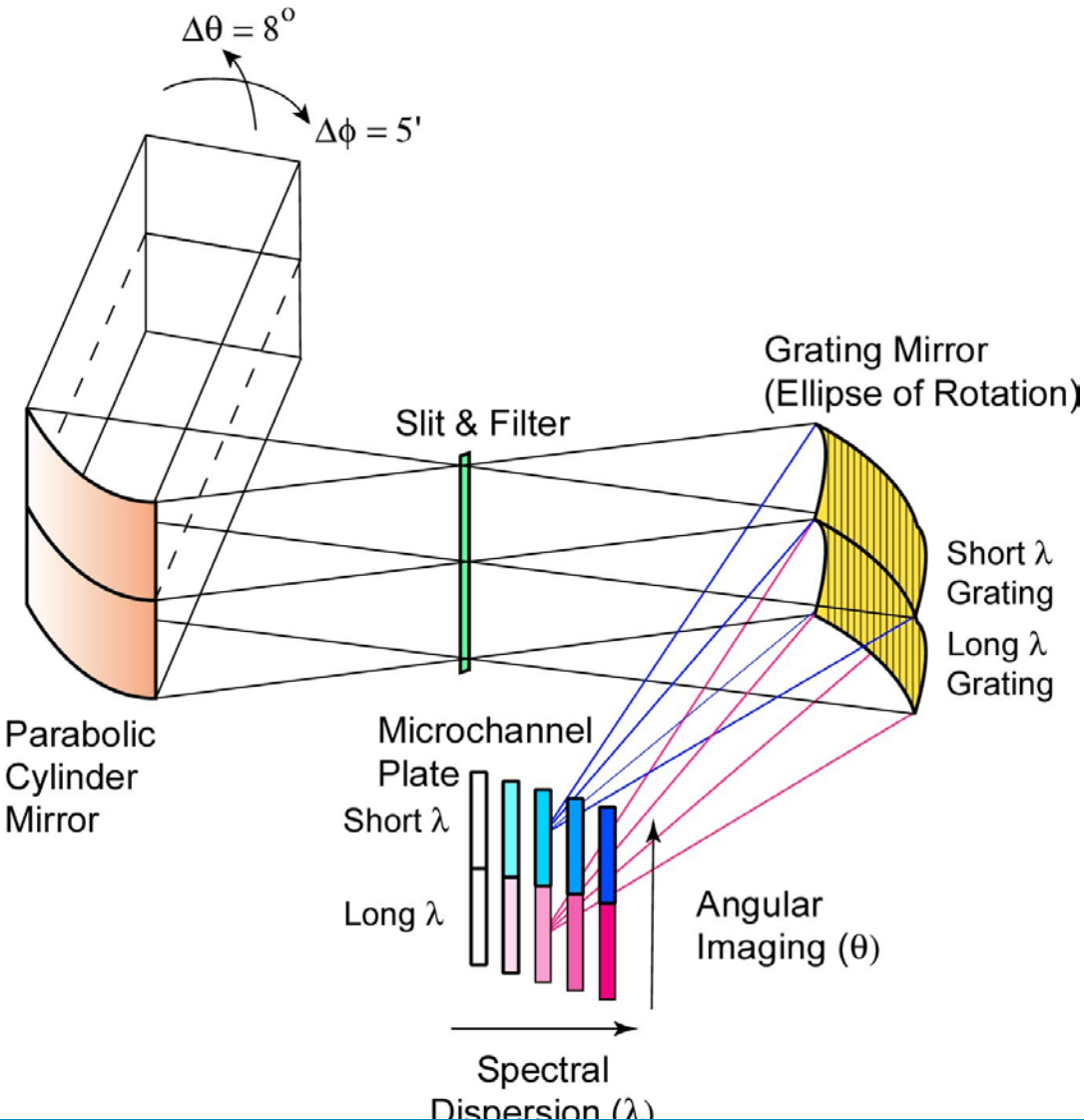
⇒ **Diffuse sky map of emission from important hot plasma cooling lines such as C IV and O VI**

Sky Map	Bin Exposure	1550 Å	1035 Å	3x3 sky bins 1 year sky map (LU unit)	Global IS Model H2 Distirbution IS Dust Distrib.
	Minimum	360	1150		
	Average	330	1000		
	Ecliptic Lat. <30°	260	800		

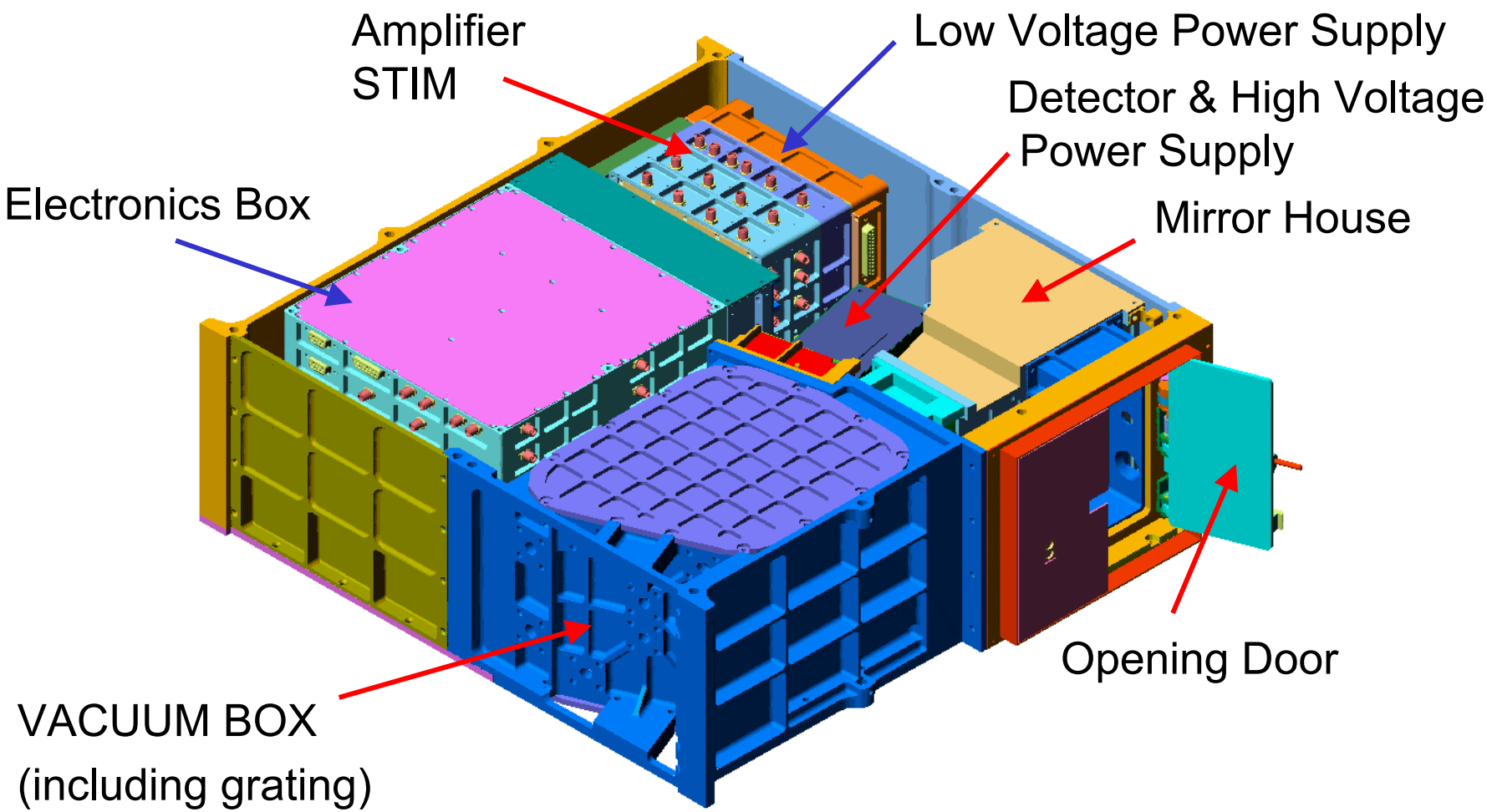
FIMS Optical System Specification

Specification	Short (O_{VI})	Long (C_{IV})
Band	900 – 1175 Å	1335 – 1750 Å
Spectral Res.	1.4 Å ($\lambda/\delta\lambda$~750)	2.2 Å ($\lambda/\delta\lambda$~750)
Grasp	0.6×10^{-4} cm^2 sr	1.25×10^{-4} cm^2 sr
FOV	$4^\circ \times 5'$ ($4^\circ \times 5'$ for background)	$8^\circ \times 5'$
Angular Res.	5′ – 10′	5′ – 10′

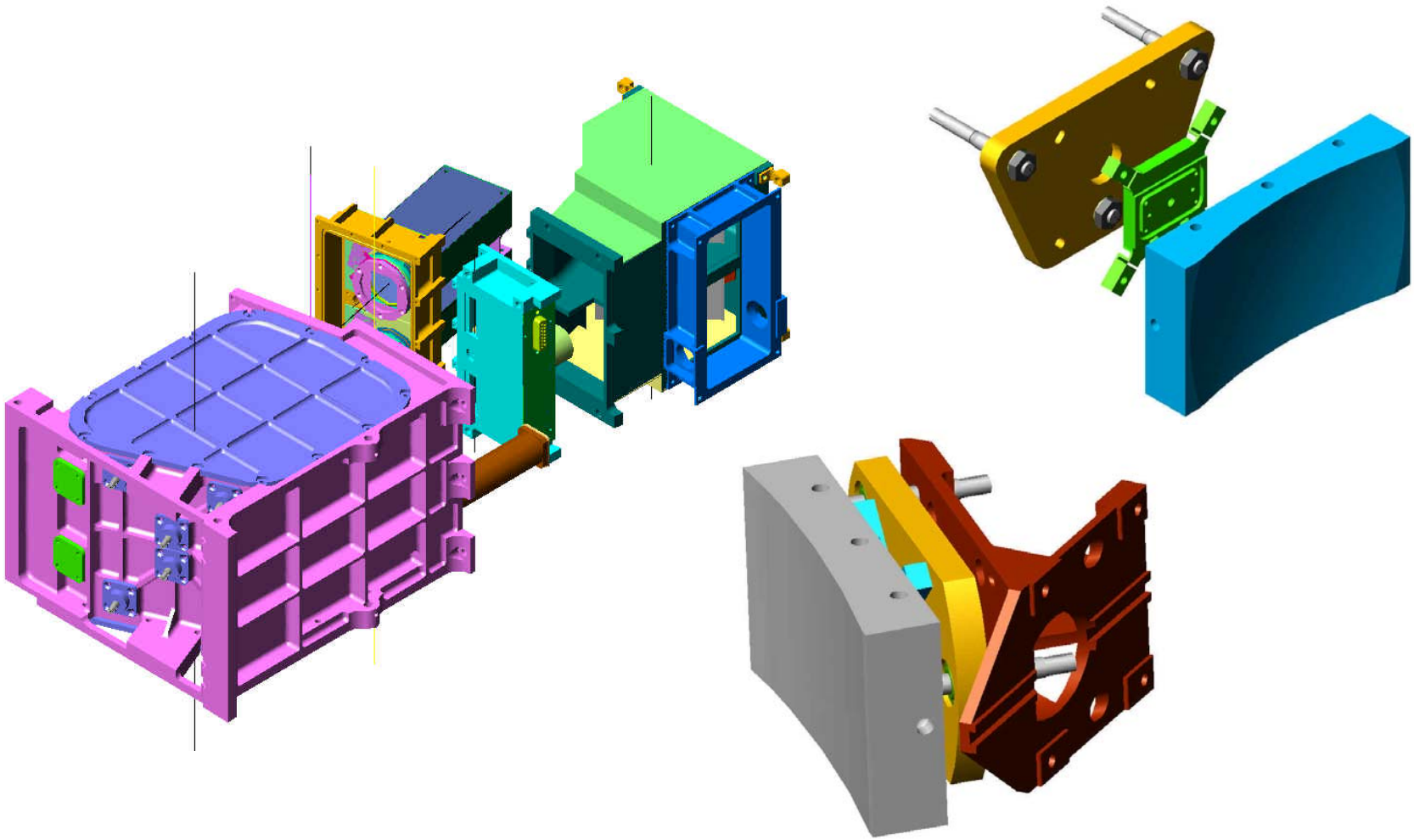
FIMS Optics Layout



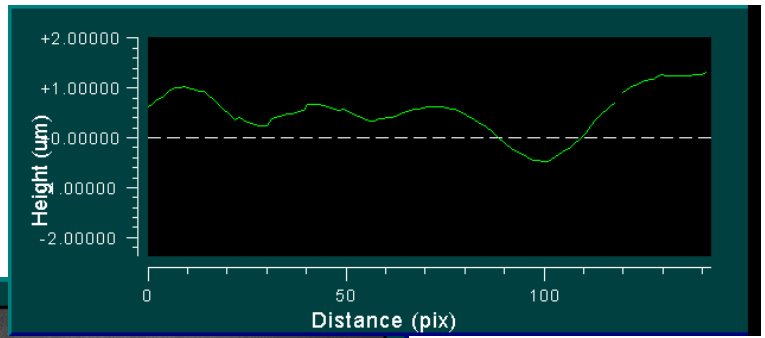
FIMS 3D View

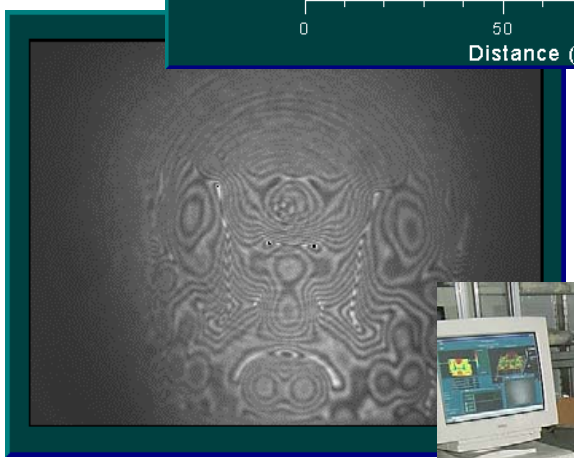

Amplifier
STIM
Low Voltage Power Supply
Detector & High Voltage
Power Supply
Electronics Box
Mirror House
Opening Door
VACUUM BOX
(including grating)

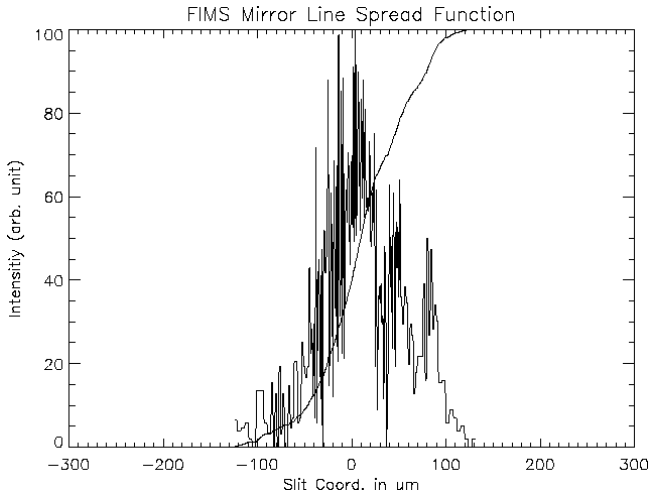
FIMS 3D View - Optics

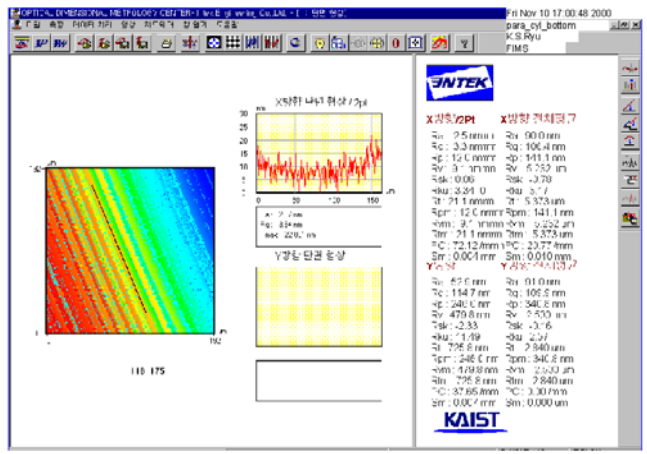


FIMS Mirror Testing

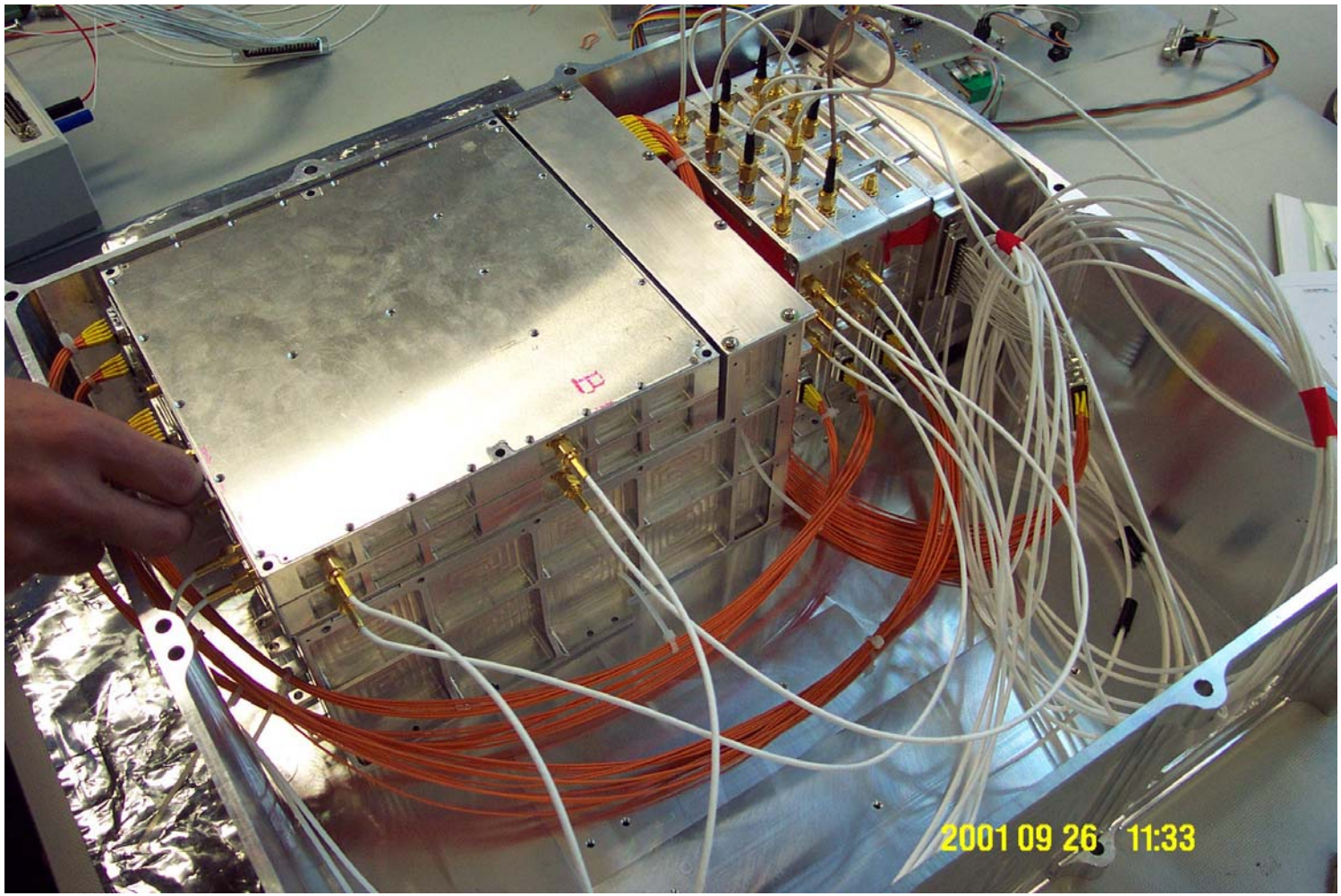




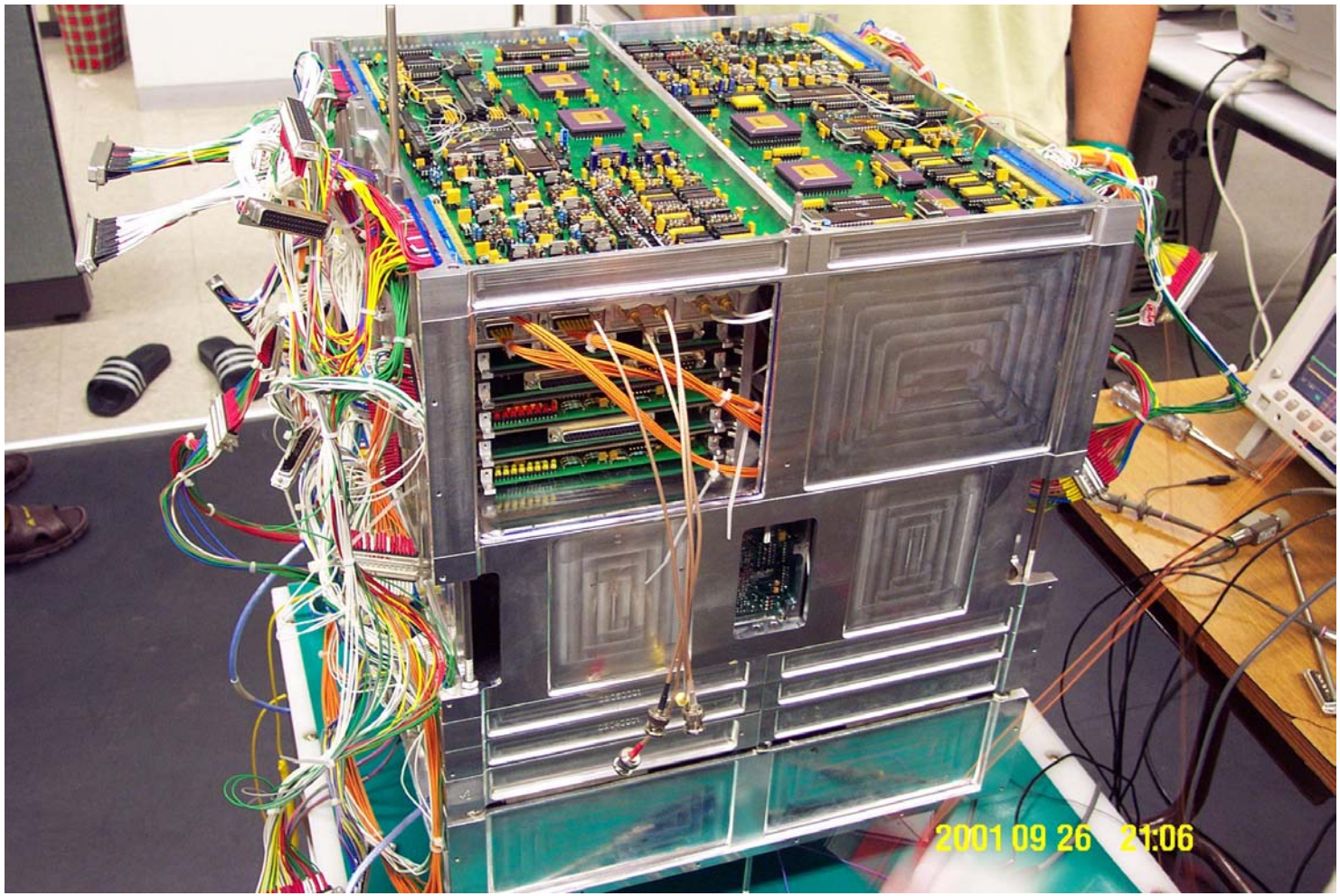




FIMS QM Function Test



QM Function Test with Spacecraft



FIMS Schedule Summary

- QM Function Test : completed
- QM AIT (2001.11 ~ 2002.1)
- Detector Tuning : until FM completion
- Optics Parts : 2~3 months delayed

- Launcher : under negotiation
  - (Russian COSMOS: early 2003)
- FM Delivery : 2002.5
- FM AIT : 2002.9 ~ 2002.12

TWO SPACE UV PROJECTS IN KOREA

Yong-Ik Byun
Yonsei University

GALEX

FIMS

Center for Space Astrophysics at Yonsei University
延世大學校 紫外線宇宙望遠鏡研究所

Korea Astronomy Observatory
韓國天文研究院