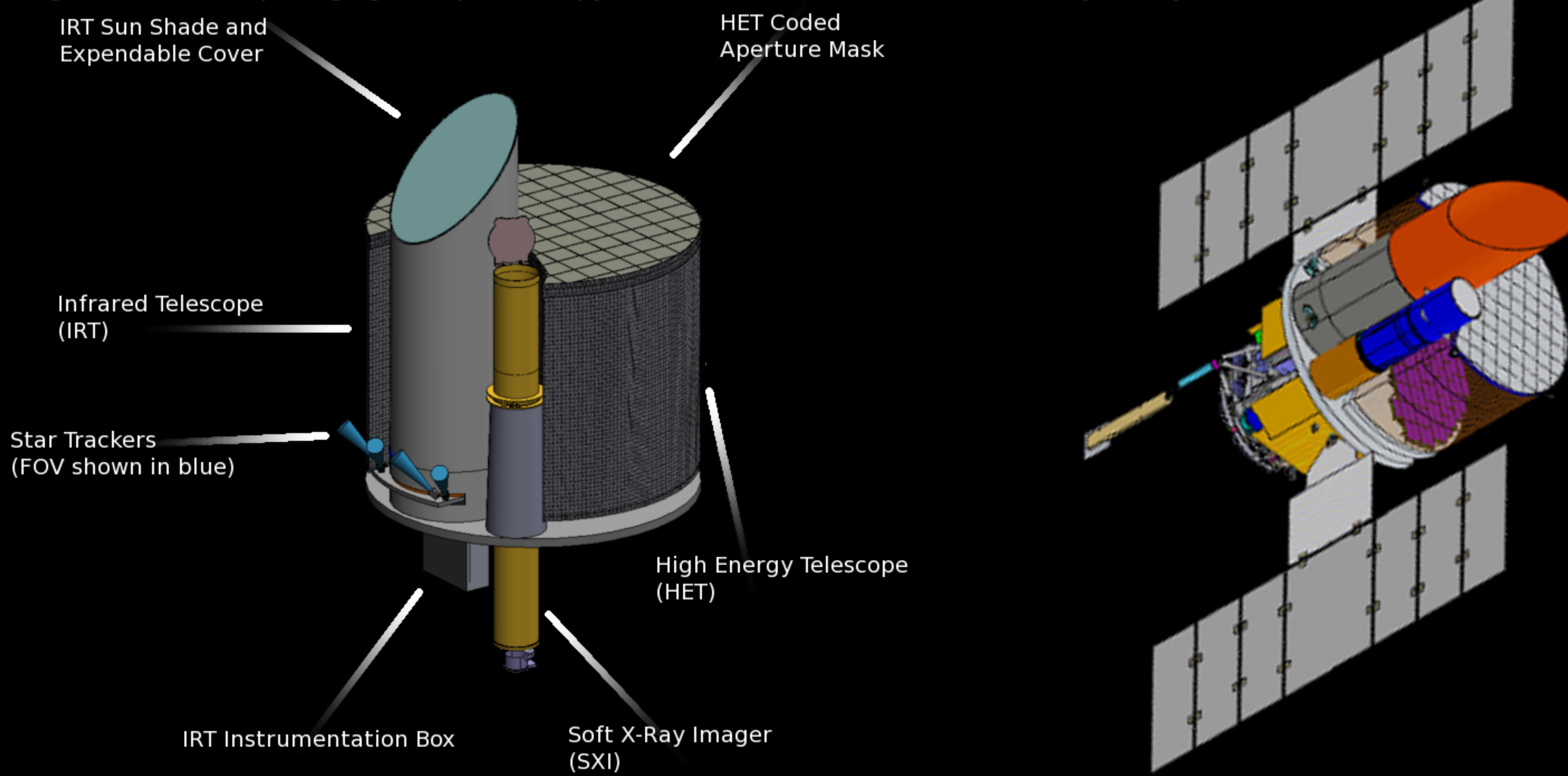


EXIST: Surveying the birth and evolution of Black Holes

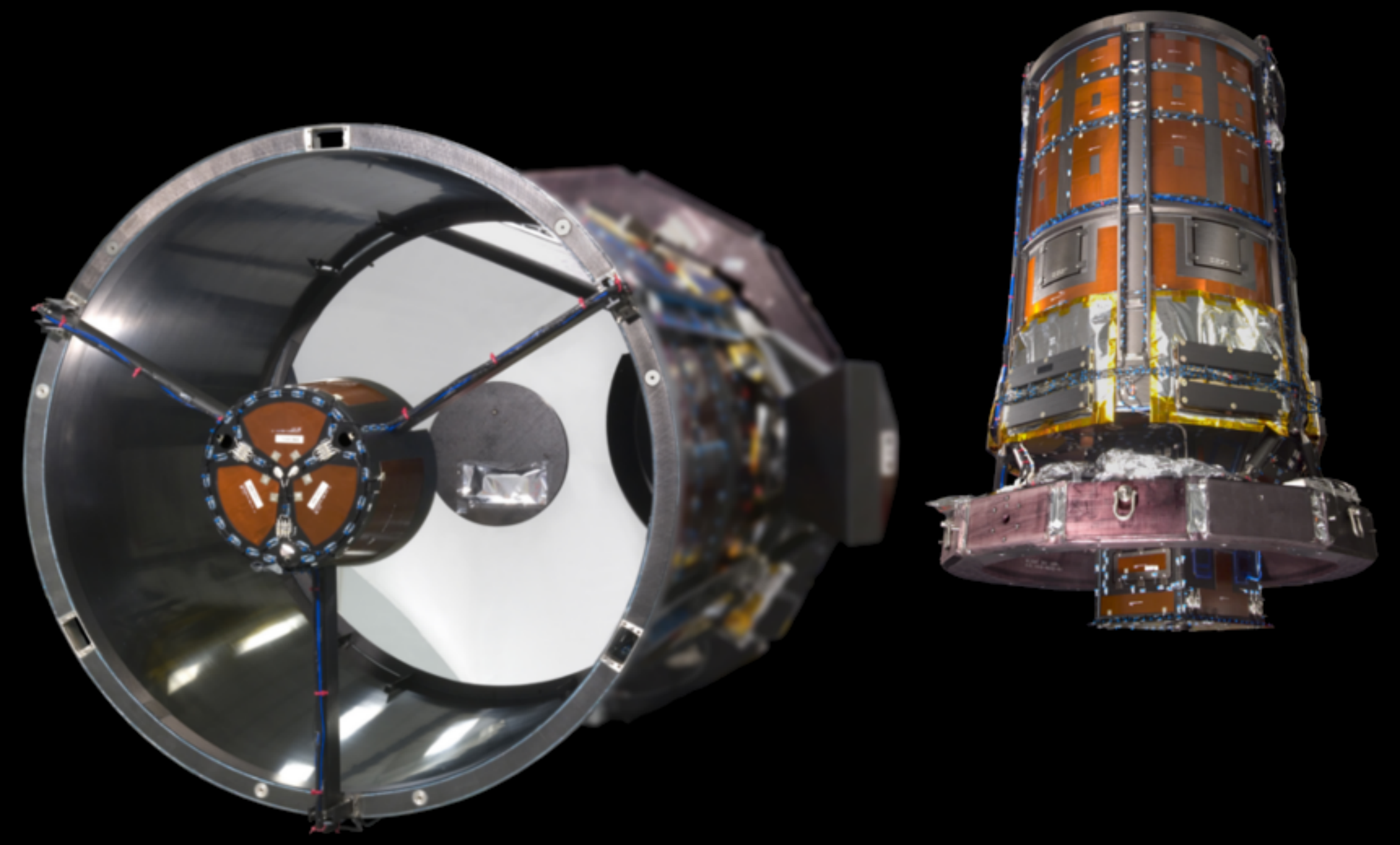
The EXIST IRT (Optical Infrared Telescope)

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The EXIST IRT has been integrated into the EXIST concept for the determination of GRB redshifts on orbit and to perform follow-up source identification and studies following the detection of a GRB or other transient event by the HET (High Energy Telescope) or any other targeted source during the pointed phase of the mission. The IRT design has been inherited from the ITT NextView program which was originally conceived for the collection of geospatial data. An exemplar was launched on board the GeoEye-1 satellite and has been in operation since September of 2008. After reconfiguration for astrophysical observations the IRT will operate with a 3.75'x4.25' field of view with an angular resolution of 0.15" and be sensitive between 0.3 and 2.2 μm with passive cooling of the primary, secondary and tertiary mirrors. The EXIST IRT will rapidly slew to 2 GRB's per day (mean expected rate) for follow up imaging and redshift spectroscopy over 2 orbits (typically) throughout the 5 year mission. After the 2 year scanning all sky survey, the IRT (and HET and SXI) will then be targeted for followup imaging and spectroscopy of ~10000 AGN's discovered in the sky survey.



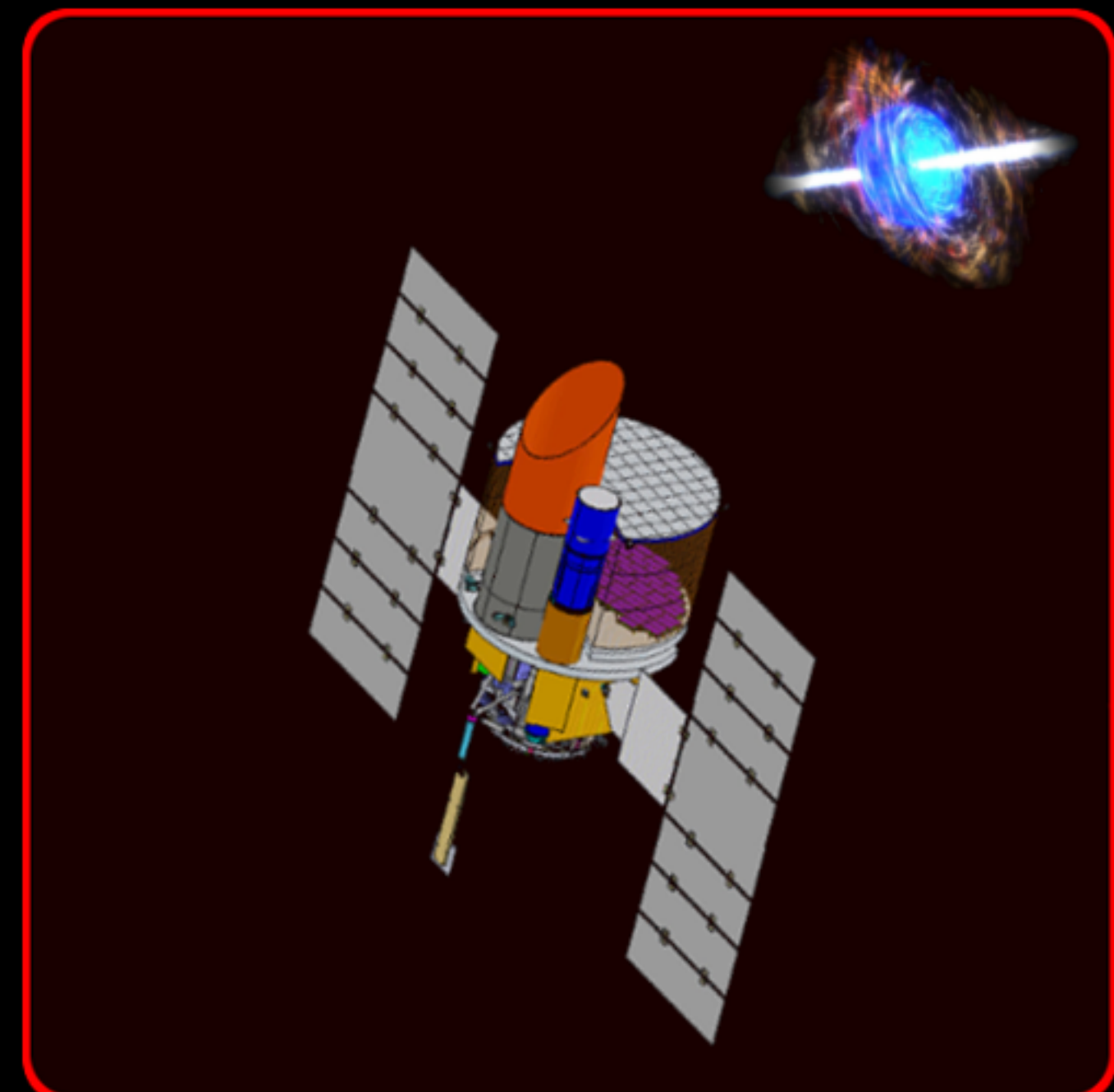
The EXIST instrument package consists of 3 primary instruments: the High Energy Telescope (HET), the Infrared Telescope (IRT), and the soft X-Ray imager (SXI). The SXI is a contributed instrument from the Italian space agency (ASI). The detailed layout for the instrument package is shown to the left and the fully integrated mission is displayed to the right.



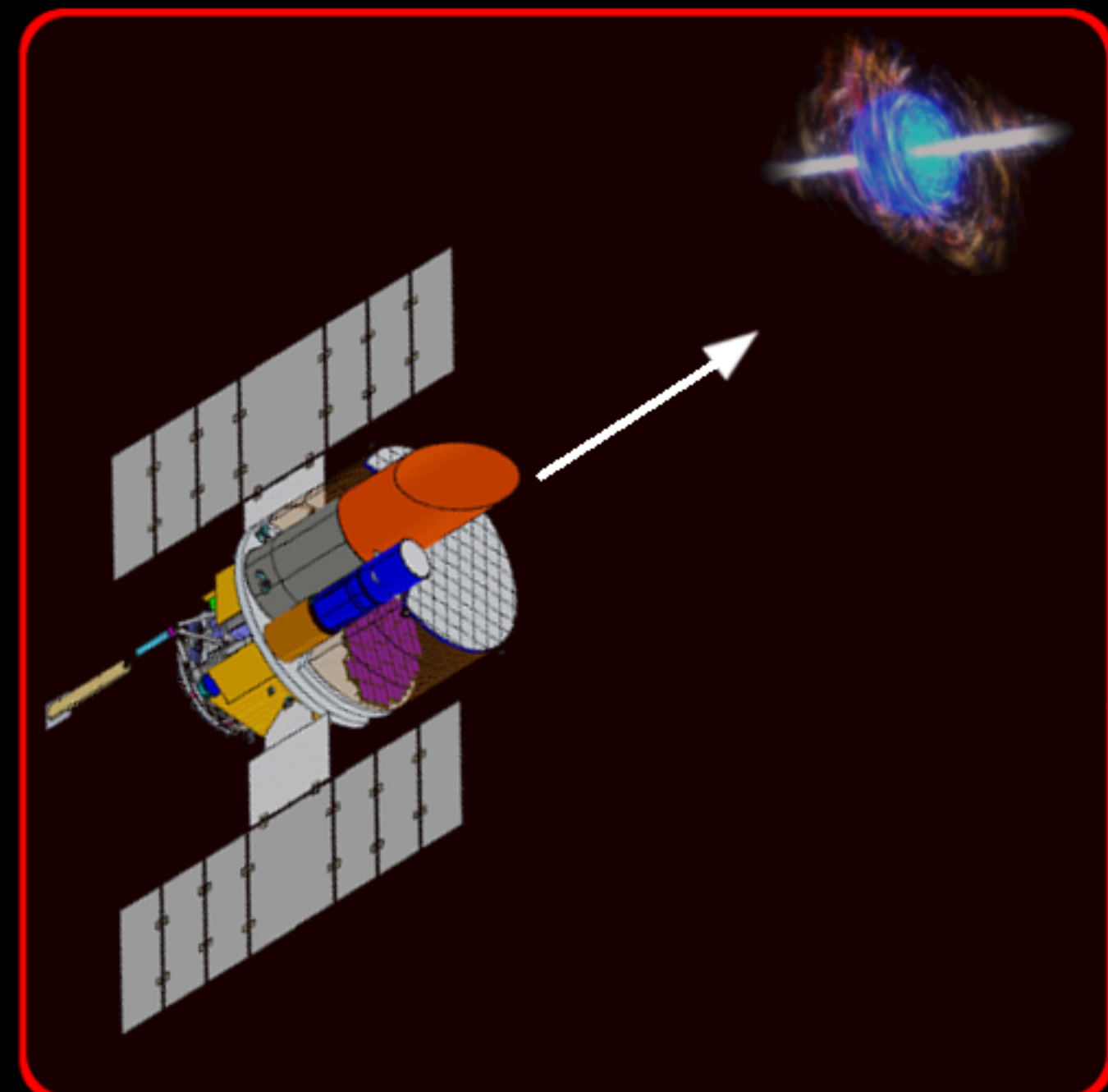
A duplicate of the ITT NextView Telescope (shown above) will be integrated into the EXIST instrument package with minimal modification for follow-up observations of GRB afterglows, on board redshift determination, and the study of any targeted object after the survey phase of EXIST is completed. Currently a NextView telescope is in operation aboard GeoEye-1 (below).



GeoEye-1 (lower right and left) was launched in September of 2008 for the acquisition of geospatial data and has been in operation since October 2008. The top image was obtained using GeoEye-1 during the 44th annual "Head of the Charles" regatta at a resolution of 0.5 m showing racers passing under the Anderson Memorial Bridge and past the Weld boathouse on the Charles River just south of the Harvard campus in Cambridge, MA.



During the first 2 years of the mission EXIST will operate in a survey mode. During this time the entire sky is scanned once every two orbits by the HET. When a GRB or other transient is detected within the HET field of view the object is initially localized on-board with the HET to within 20° (See the EXIST HET poster, 453.04, for details).



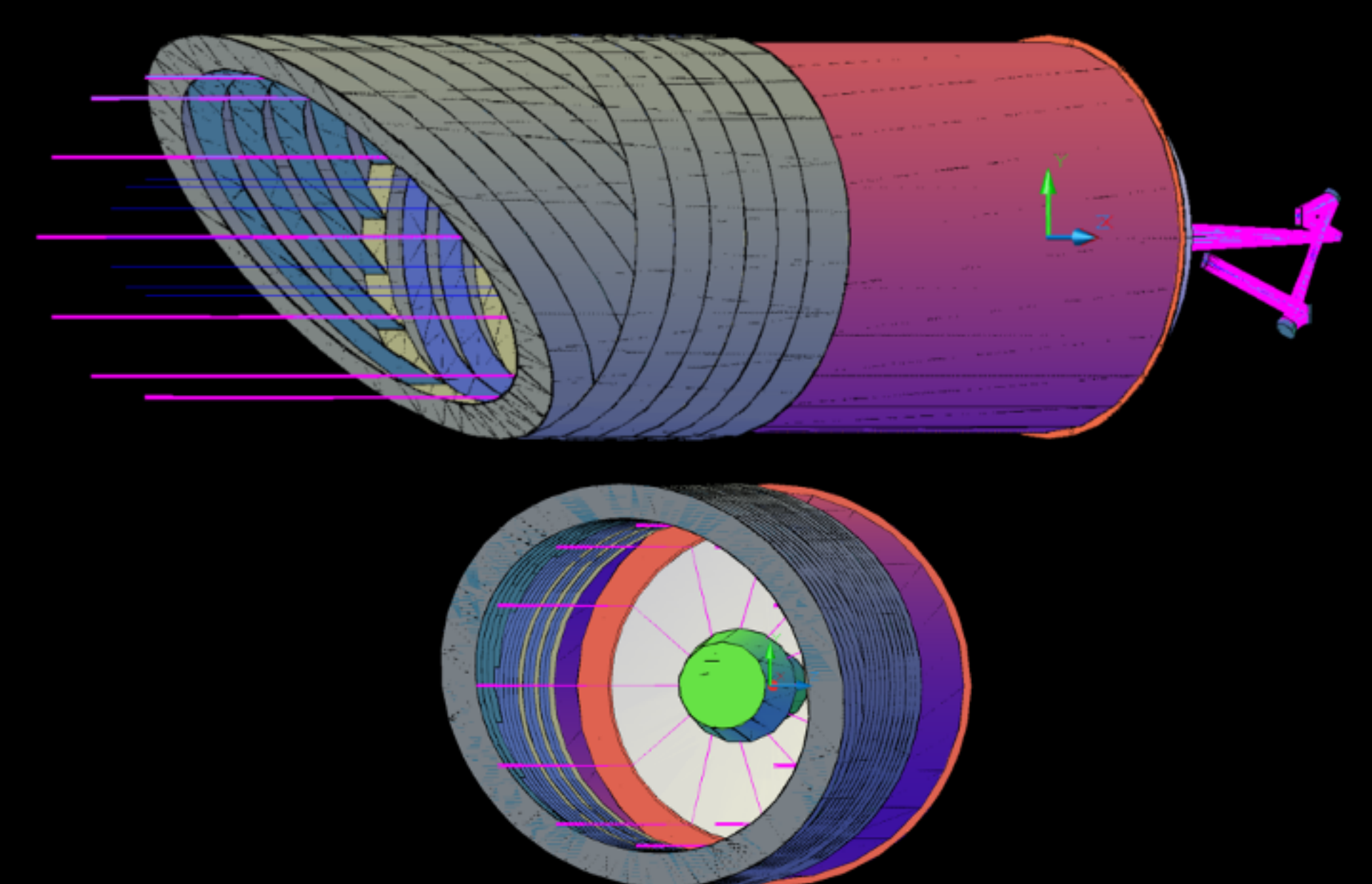
Within ~10 s the observatory slews (~100 s) and accurately points for an acquisition image (~100 s) by the SXI and IRT. The SXI source position (<2" contingent on the support of ASI) allows IRT source identification and follow-up objective prism (R=30) spectra or long slit (R=3000) spectra, depending on the magnitude, for the measurement of GRB redshifts up to z~20.



Pictured above are the Denmark Technical University (DTU) star trackers.



Pictured above is a mirror with a similar configuration as that intended for the IRT primary mirror.

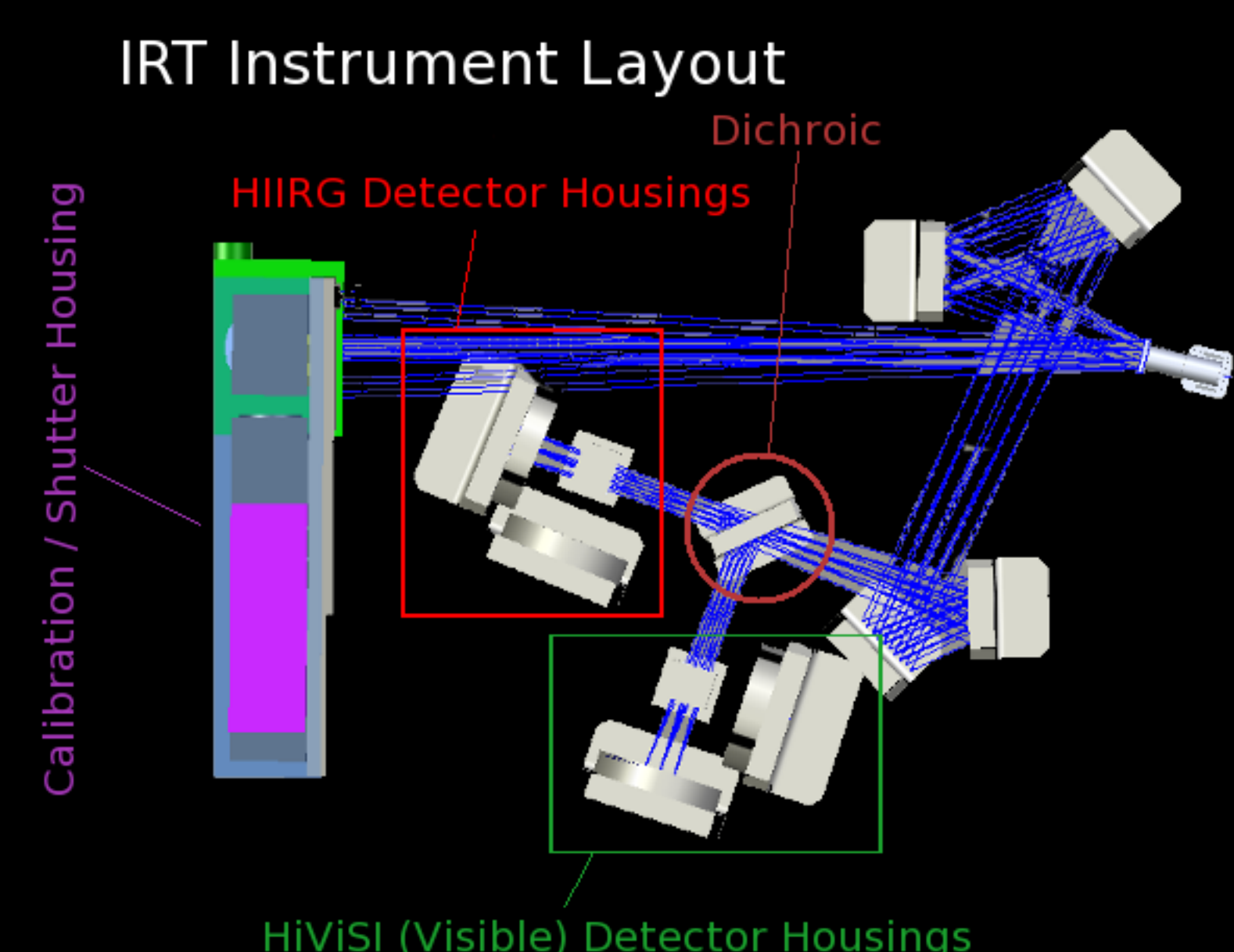


In order to ease pointing constraints and to eliminate the presence of scattered light due to the earth limb, sun, and moon the addition of a baffle will be necessary for optimal operation and to achieve zodiacal background limits. A 45° sunshade is utilized to keep sunlight out of the baffle entrance aperture (solar avoidance >45°). The interior baffle vanes eliminate scattered light and allow the primary and secondary mirrors to radiatively cool to 243 K. This temperature is maintained by a thermal shroud. The detectors themselves are cooled by a cryocooler (see IRT Optical Assembly Specifications).

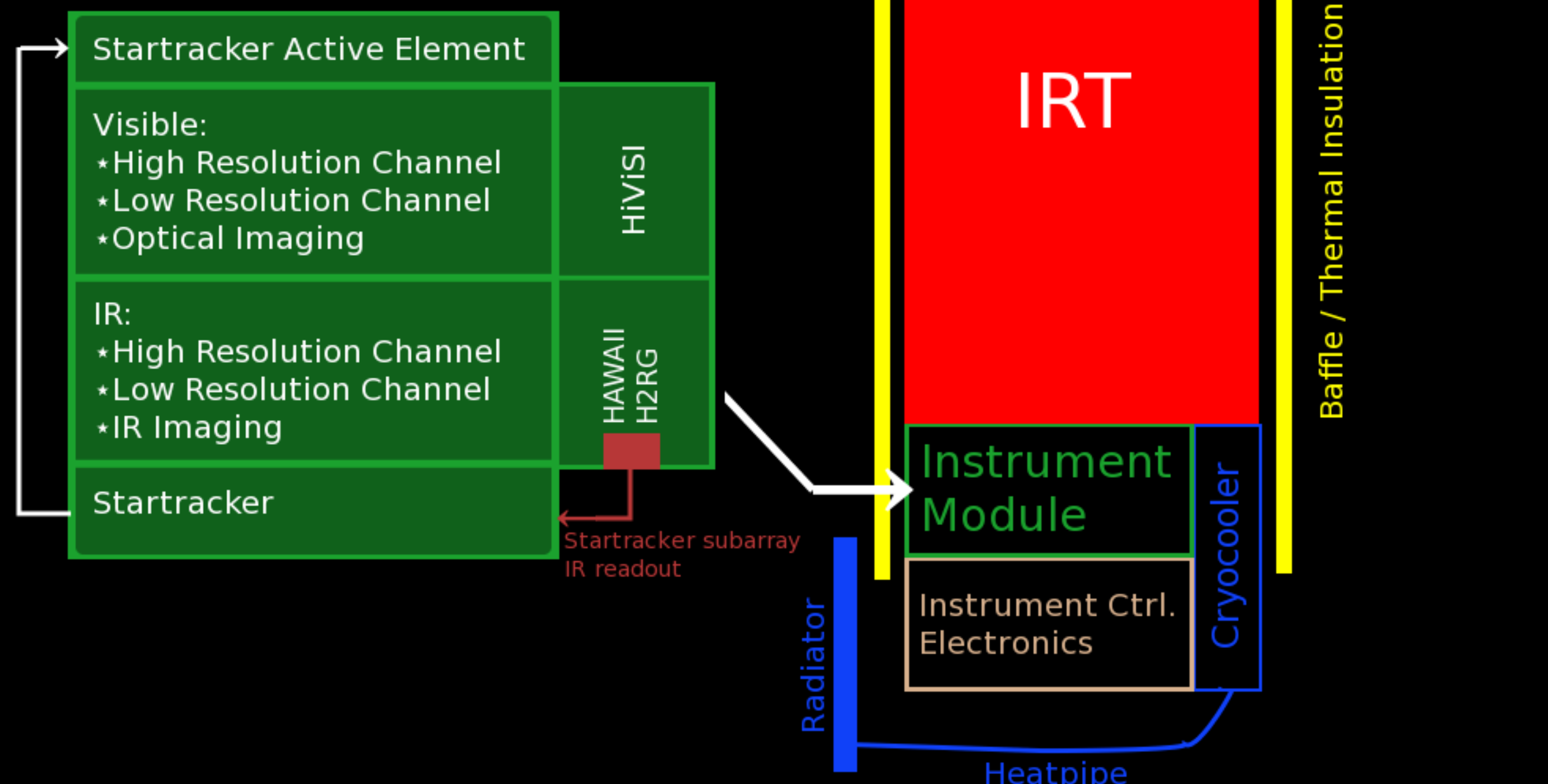
IRT Camera / Imaging Spectrometer	
• 4 Band Instantaneous Imaging (FOV 3.75'x4.25')	
• JWST NIRCAM HIIRG	
→ 0.9 - 1.38 μm	
→ 1.38 - 2.2 μm	
• HiViSI	
→ 0.3 - 0.52 μm	
→ 0.52 - 0.9 μm	
• Spectroscopy from 0.3 μm to 2.2 μm	
• Low res. slitless R~30 (FOV 3.75'x0.75')	
• High res. R~3000 (Single object and spatial res. along the slit)	

Pointing and Stability	
Active Image Stabilization	Tip-Tilt Mirror
Transverse Pointing Accuracy	10"
Abs. Pointing Knowledge	2"
Pointing Stability	1" / 100s
Star Trackers	4 DTU
Slew Rate	0.5° per sec.

IRT Optical Assembly Specifications	
Telescope Design	Ritchey-Chrétien
Primary Mirror diameter	1.1 m
Secondary Mirror Diameter	0.31 m
Mass	250 kg
Instrumentation Mass	70 kg
Main Telescope Assembly	243 K
HgCdTe HIIRG Operating Temperature	73 K
CMOS (HiViSI) Operating Temperature	170 K



The basic layout for the EXIST IRT camera. Two channels are simultaneously observed at IR and visible wavelengths. A safety shutter has been installed for use during calibration and to protect the camera in the unlikely event of attitude control loss. (See the Camera and Spectrometer Poster (453.07) for more details)



Summary

- The addition of the IRT to EXIST provides the unique capability for immediate on board observations of GRB afterglows as well as follow-up survey sources for measurement of redshifts and source properties.
- The 1.1 m NextView telescope allows diffraction-limited imaging with proven technology. HIIRG arrays (JWST NIRCAM heritage) are the best performance space qualified detectors current available.
- Integration of a NextView telescope with a minimum of modification makes this possible without the overhead costs for design and development.