



EDGE: Explorer of Diffuse Emission and GRB Explosions

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on behalf of a large collaboration (<http://projects.iasf-roma.inaf.it/edge/EdgeOverview.htm>)

Abstract: We present a new high-energy astrophysics mission designed to study the role of the baryons in the Universe from the early epochs, through Gamma-Ray Burst (GRB) explosions, via the period of cluster formation, down to very low redshifts. EDGE (Explorer of Diffuse Emission and Gamma-ray burst Explosions) has been submitted to ESA as a M class mission in response to the Cosmic Vision 2015-2025 Call for Proposals

Methods and uniqueness: EDGE is specifically designed to exploit the X-ray bandpass to investigate:

- Large scale, low density baryonic structures, including the WHIM and the outskirts of clusters of galaxies, which are visible only in X-rays. EDGE is uniquely positioned to observe them by high resolution spectroscopy and imaging. It will use GRBs as bright backlight beacons.
- The early populations of massive stars that ignited in the Universe and cannot be observed individually by any planned facility. EDGE will observe their explosive death and reconstruct the exact epoch of the first significant Fe enrichment, which is expected to signal the very first massive star explosions.

Science goals

One of the fundamental issues in astrophysical cosmology is to understand the formation and evolution of structures on various scales from the early Universe up to present time. EDGE will trace the cosmic history of the baryons, by measuring three tracers of cosmic structures:

Cosmic filaments

- Detect the largest reservoir of baryons from $z \sim 1$ to the present time, predicted to reside in the Warm-Hot Intergalactic Medium (WHIM) by measuring densities down to 10^{-5} cm^{-3} (~30 times smaller than currently probed within clusters of galaxies)
- Place constraints on the interplay between diffuse baryons and star formation

Clusters of galaxies

- Trace the evolution and physics of clusters out to their formation epoch ($z > 1$)
- Measure the thermodynamical and chemical properties of a fair sample out to the virial radius, a fundamental step to qualify clusters as cosmological probes and for constraining their evolution through the link with the WHIM

Gamma-Ray Bursts

- Study the evolution of massive star formation using GRBs to trace their explosions back to the early epochs of the Universe ($z > 6$)
- Measure the metals in the host galaxies of GRBs and the explosive enrichment in their close environment out to $z > 6$

The unique capabilities of EDGE are illustrated in Fig. 1

Science instruments

Wide Field Spectrometer (WFS): effective area 1000 cm^2 , 3 eV resolution, $0.7 \times 0.7 \text{ deg}^2$ Field of View (FoV), optics with 2/4 reflections and TES calorimeter as detector

Wide Field Imager (WFI): effective area 1000 cm^2 , 15" angular resolution constant over the full 1.4° diameter FoV, CCD detectors.

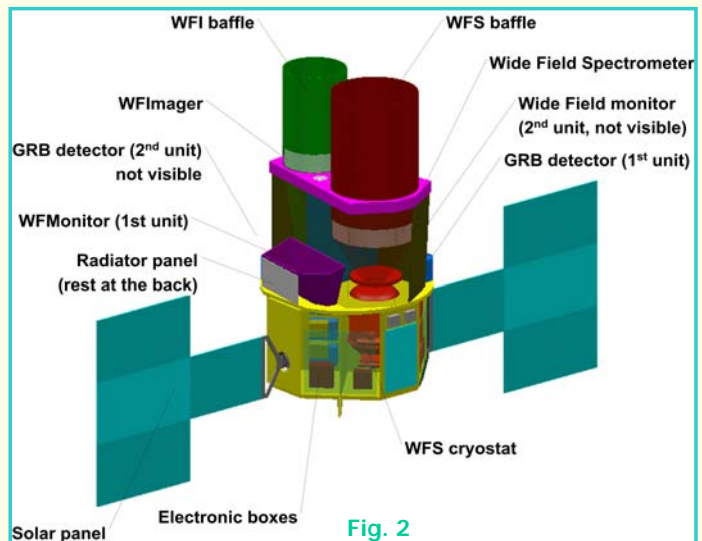
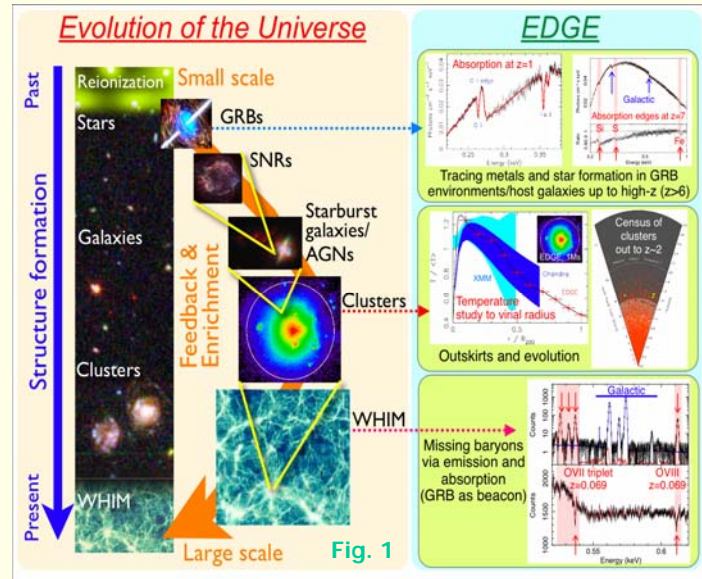
The WFIImager plus WFSpectrometer (see Fig. 2) will allow to perform high resolution spectroscopy with the lowest possible background

Wide Field Monitor (WFM): FoV $\frac{1}{4}$ of the sky, for detection and fast localization (a few arcmin) of 50% brightest GRBs

Gamma-Ray Burst Detector (GRBD): extension of energy range of the instruments to 3 MeV

The WFMonitor plus GRBDetector (see Fig. 2) will trigger the fast repointing of the satellite within 1 min

Mission profile: fast repointing (1 deg/s) requires a compact satellite with a densely packed payload, this is compatible with the VEGA launcher. The need for low background requires a low Earth equatorial orbit. A lifetime of 3 years is appropriate to realize the major goals of the mission with a modest guest observer program.



Instrument	A _{eff} [cm ²]	E-range [keV]	Angular resolution	Field of View [deg ²]	spectral resolution
Wide Field Spectrometer (WFS)	1000 @ 0.6 keV	0.2 – 2.2	3'	0.7 x 0.7	3 eV @ 0.5 keV
Wide Field Imager (WFI)	500 @ 1 keV	0.2 – 5	15"	1.4 ∅	80 eV @ 1 keV
Wide Field Monitor (WFM)	500 @ 50 keV ¹⁾	8 – 200	35' ²⁾	2.5 sr	3% @ 100 keV
Gamma-Ray Burst Detector (GRBD)	800 @ 600 keV	25-2500	n/a	3 sr	20% @ 100 keV

¹⁾ Averaged over 2 sr.

²⁾ More critical is the location accuracy of 4'

References:

All details on the EDGE mission can be found at <http://projects.iasf-roma.inaf.it/edge/>