EURECA: Towards high resolution X-ray spectroscopy

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EURECA (EURopean JapanEse Calorimeter Array) is a multinational European-Japanese project that aims to demonstrate technical readiness for a Transition-Edge-Sensor (TES) based X-ray Imaging spectrometer by the end of 2007. EURECA aims at becoming a demonstrator for a high resolution non-dispersive X-ray Imaging Spectrometer that could fly on board a large throughput X-ray mission within ESA's Cosmic Vision 2020 programme, such as XEUS. Spain is taking an active role on various aspects of this prototype.

1 XEUS

XEUS is an ESA-JAXA X-ray observatory mission proposal for ESA's Cosmic Vision 2015-2025, and its three main scientific goals could be summarized as:

- Study matter under extreme conditions (strong gravity, high densities)
- The assembly of barions (first groups and clusters and their evolution, the intergalactic medium, chemical enrichment)
- The evolving violent Universe (birth and growth of massive black holes, feedback, their relation to galaxy formation)

The mission will be composed of two spacecrafts separated 35 m flying in formation in a L2 halo orbit, and the baseline payload will include a Wide Field Imager (FOV of 7' diameter) to perform low resolution (150 eV @ 6 keV) spectroscopy and a Cryogenic Imaging Spectrometer (FOV of 45" diameter) for high resolution (1-2 eV @ 1 keV) imaging spectroscopy. The total energy range covered by the instruments will be 0.1 to 15 keV.
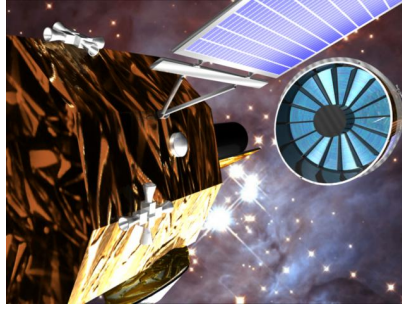
Fig. 1. Credit: ESA; XEUS mission artist view

2 EURECA Technical Description

The EURECA instrument comprises a 5 x 5 Transition Edge Sensor (TES) array that will be read-out by four SQUID-based amplifier chains making use of Frequency Domain Multiplexing (FDM). The TES array and SQUID amplifiers will be cooled down to $\sim$ 50 mK making use of a space-qualified Adiabatic Demagnetization Refrigerator (ADR) developed under ESA contract. The spectral resolution will be 1-2 eV @ 1keV for the dynamic range of the instrument (0.1-3 keV).
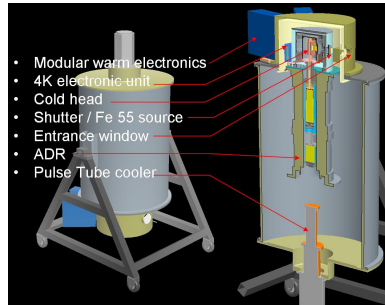

Fig. 2. Credit: SRON; EURECA concept assembly explained

2.1 EURECA Collaboration

The institutes collaborating in this project (under coordination of Piet de Korte from SRON) are:

- SRON (Netherlands)
- U. of Heidelberg (Germany)
- Alcatel Alenia Spazio (Italy)

- U. of Helsinki (Finland)
- IFCA (Spain)
- ICMAB (Spain)
- ICMA (Spain)
- INA (Spain)
- IMM (Spain)
- ESA ESTEC (Netherlands)
- ISDC (Switzerland)
- PSI (Switzerland)
- U. of Leicester (UK)
- VTT (Finland)
- MSSL/UCL (UK)
- JAXA (Japan)

3 Spanish contributions

Spain is involved in this project under three main work lines: new TES fabrication, LC filters and characterisation software.

New TESs

Three institutes collaborates in the fabrication of new Mo superconducting layers and Mo/Au bilayers: the Instituto de Microelectrónica de Madrid, Institut de Ciència de Materials de Barcelona and the Instituto de Ciencia de Materiales de Aragón. Their work also covers the study and possible reduction of excess noise, the stresses and structural characterisation, the I-V curves (sharp edges), the absorber deposition and the device characterisation.

LC filters

The work involving LC filters needed for signal filtering between neighbouring columns is being developed by two institutes: the Instituto de Nanociencia de Aragón and the Instituto de Ciencia de Materiales de Aragón. They focus on cryogenic tests of capacitors and existing filters and the development of new LC filters needed for larger arrays.

Software

The IFCA (J.Bussons) is the overall coordinator of the EURECA characterisation and configuration software, including interface with electronics. It is responsible for provision of quick look and data analysis packages, study of non-linearities and cross-talk correction as well as version control, software repository and task interconnectivity.