



**EURECA:**  
Towards "high" spectral resolution in X-rays

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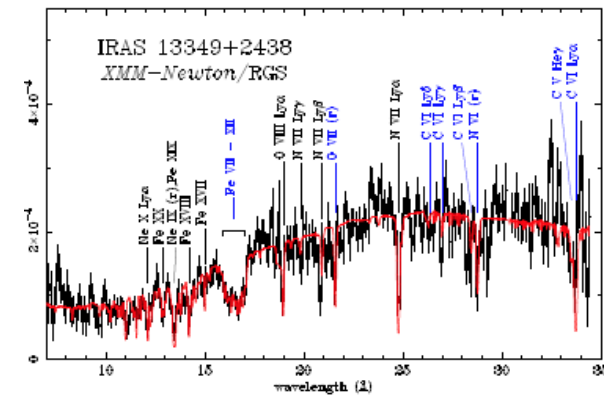
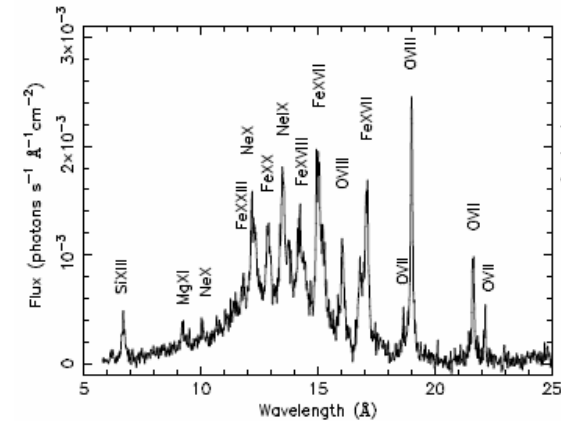


# EURECA

- The EUROpean-JapanEse Calorimeter Array EURECA is a multinational project that aims to demonstrate technical readiness for a Transition-Edge-Sensor (TES) based X-ray Imaging spectrometer.
- Goal: Construct and test a prototype by mid 2008.
- PI: Piet de Korte (SRON, NL)
- Partners:
  - Spain: ICMAB, ICMA, IMM, INA, IFCA
  - Germany: U Heidelberg
  - UK: MSSL, U Leicester
  - Netherlands: SRON, ESTEC (ESA)
  - Finland: VTT, U Helsinki
  - Japan: ISAS/JAXA
  - Switzerland: PSI, ISDC

# The need for high-resolution X-ray spectroscopy

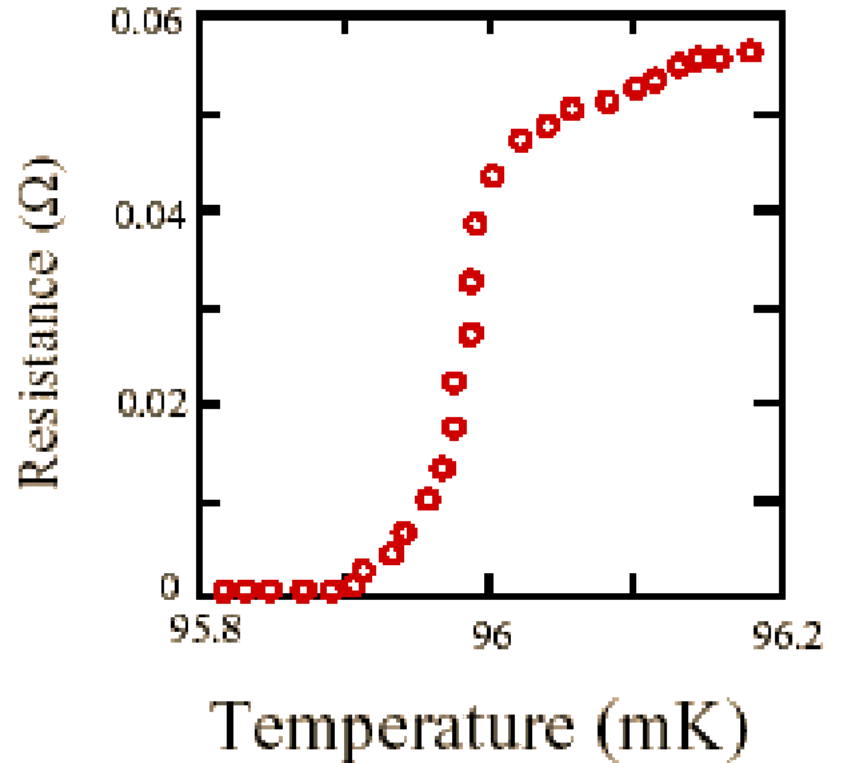
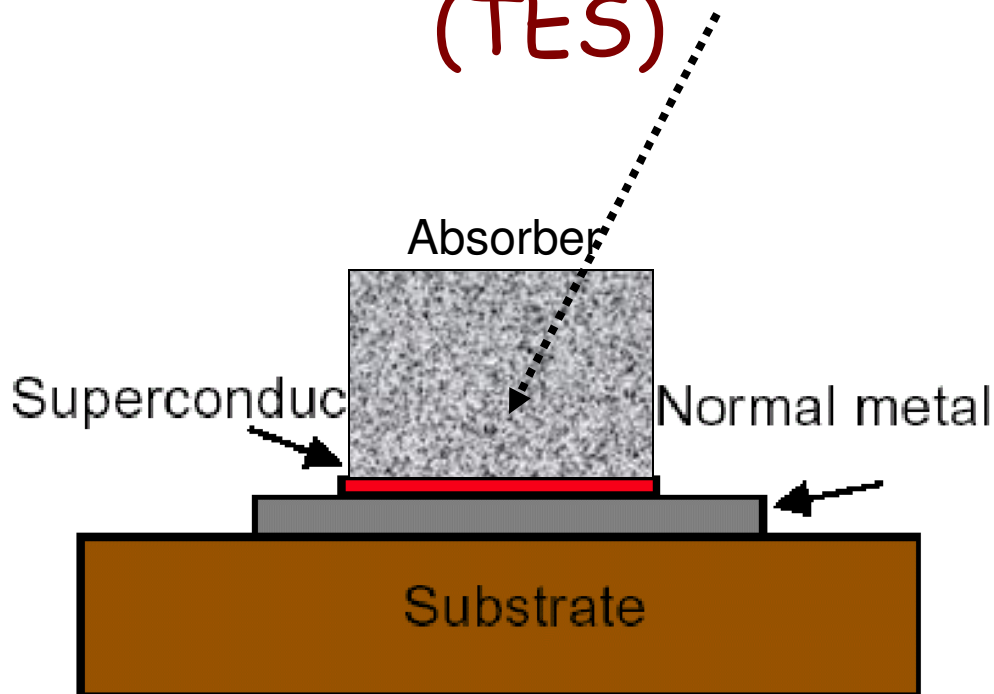
- Resolving individual emission lines from the Galactic background
- Metal abundances in AGN, SNRs, Clusters of galaxies, etc.
- Plasma diagnostics: resolve the He-like triplet of OVII
- Resolve the structure of the Fe K $\alpha$  emission line in AGN
- Detect resonant absorption lines



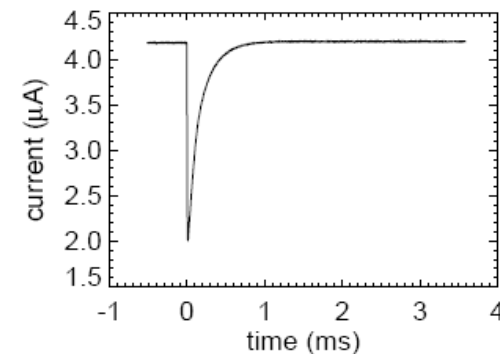
# EURECA specifications

- (Non-dispersive) spatially resolved spectroscopy
- 5 x 5 array, 500  $\mu\text{m}$  pixel size
- Spectral energy resolution  $\sim 1$  eV @ 1 keV, and 5 eV @ 6 keV, optimized at soft X-ray energies.
- Readout time 100  $\mu\text{s}$  or better
- Detection efficiency > 90% at 0.1-3 keV

# Transition Edge Sensors (TES)

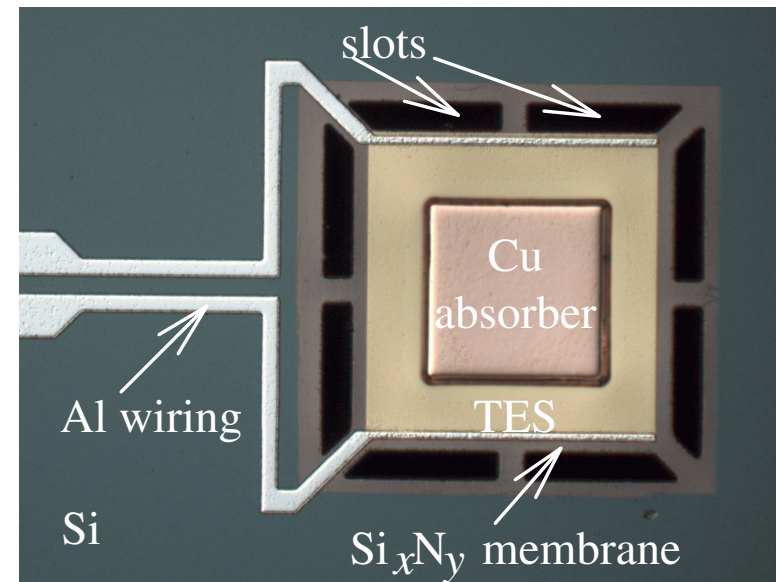


- Superconducting thin film operated close to  $T_{crit}$
- Spectral resolution a few eV, best at a few keV
- Low operating T (100 mK)



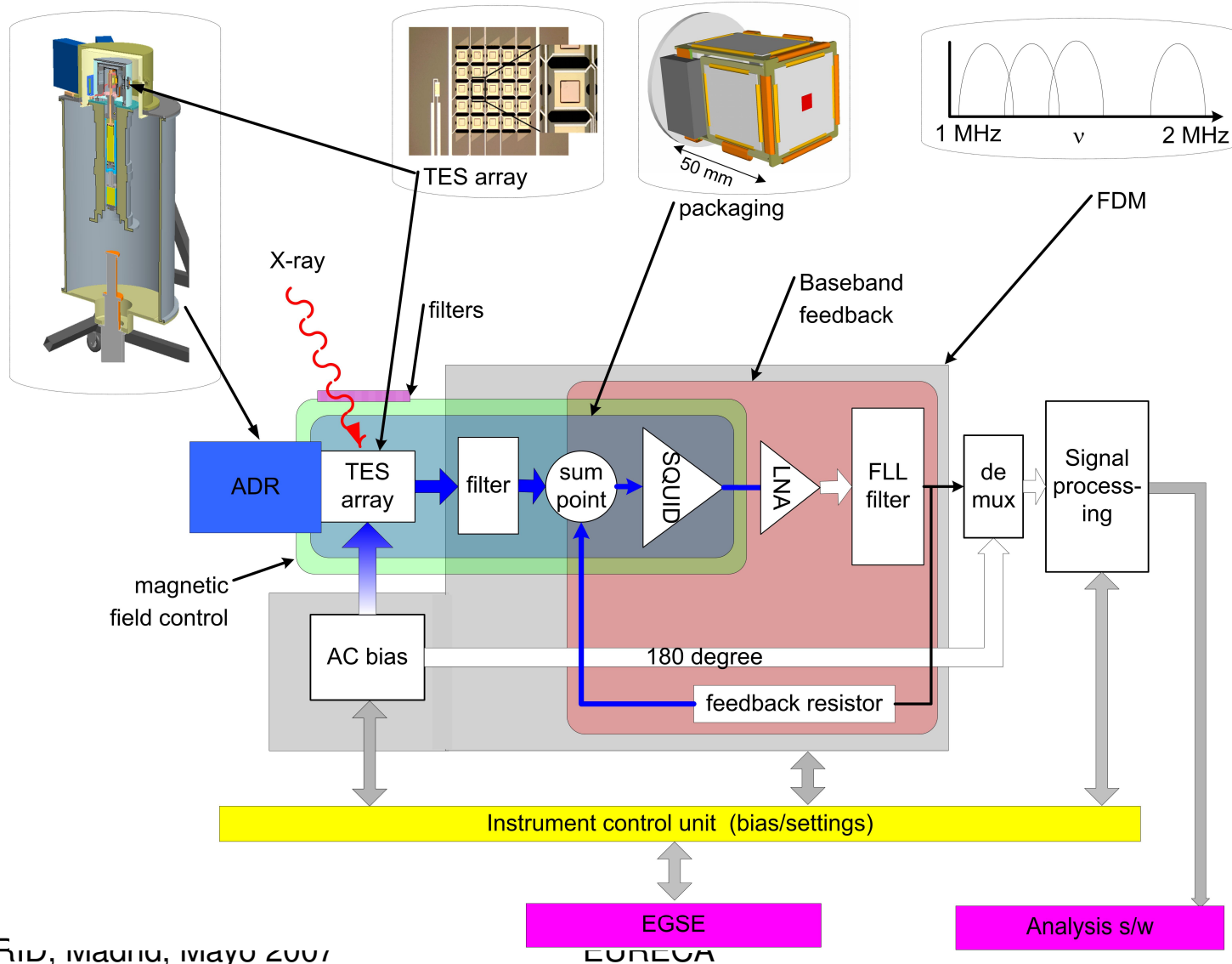
# Transition-Edge Sensors (TESs)

- Energy resolution of TES depends on:
  - Steepness of transition ( $\alpha$ )
  - Operational temperature
  - Capacitance (saturation energy)



$$\Delta E_{FWHM} = 2.36 \times 2 [\gamma n]^{0.25} \sqrt{k_B T^2 \frac{C}{\alpha}}$$

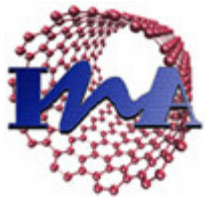
# The EURECA System



# EURECA @ Spain



ICMAB



- **Tasks:**

- Development & fabrication of new superconducting bi-layers (currently Mo/Au)
- Characterisation of LC filters
- Quick-look and Data Analysis Software (coordination & task development)

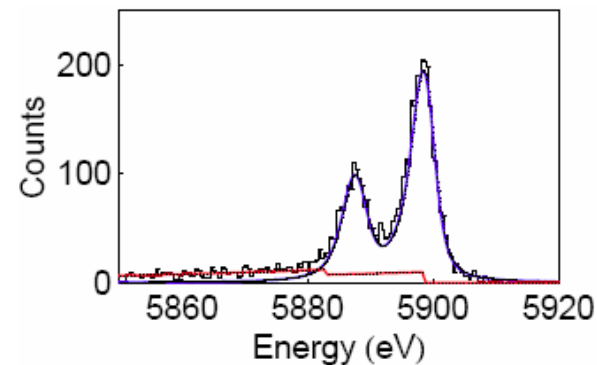
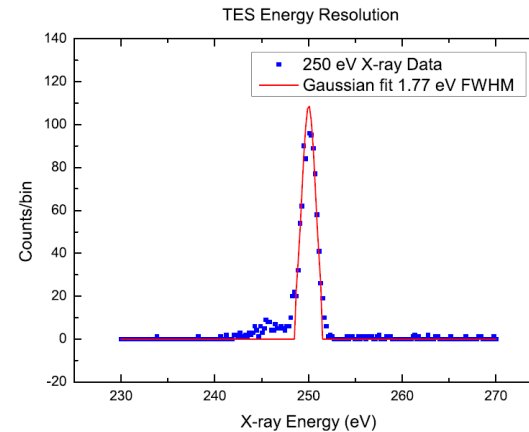
- **Funded by**

- ESP2004-21934-E (IP: L. Fàbrega, ICMAB CSIC)
- ESP2003-16308-C02 (Ips: X. Barcons, IFCA CSIC & L. Fàbrega ICMAB CSIC)
- MAT2005-02454 (IP: F. Bartolomé, ICMA CSIC)



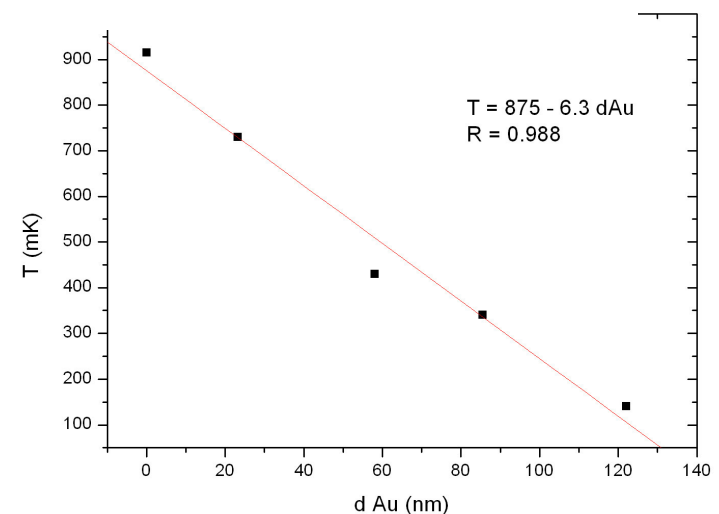
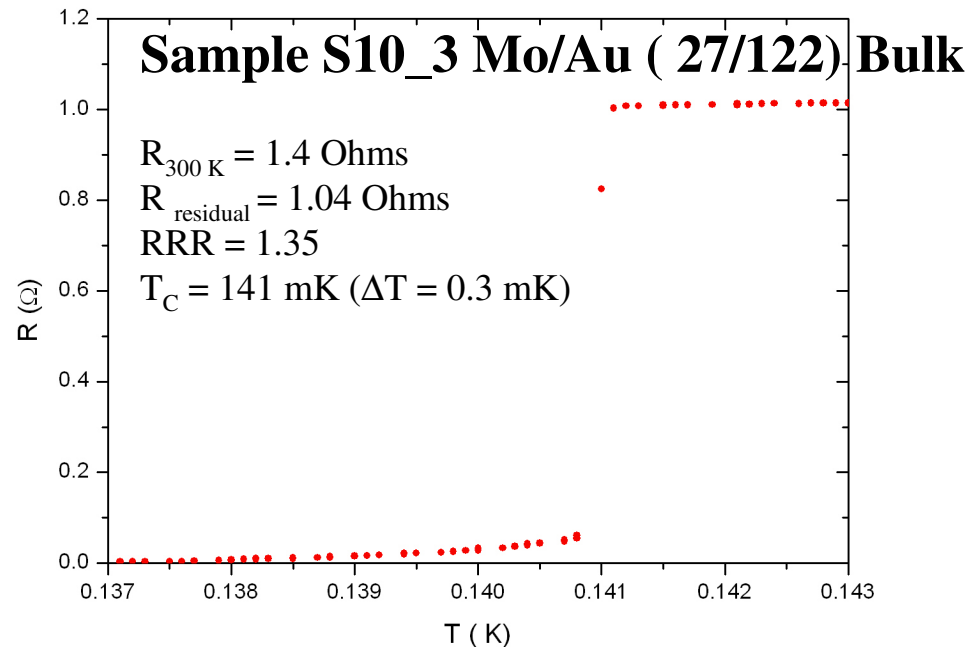
# EURECA: recent progress

- First measurements of single-pixel non-optimized cryo cooled device @ BESY, delivers energy resolution close to goal.
- Commercial LC filters
- EGSE (electronics) designed and on track
- Software designed and very advanced
- ADR being developed



# EURECA @ Spain: progress in new sensors

- Developing and characterising extremely good Mo/Au superconducting bilayers:
  - Sharpest transitions ever recorded
  - Transition temperature close to 100 mK

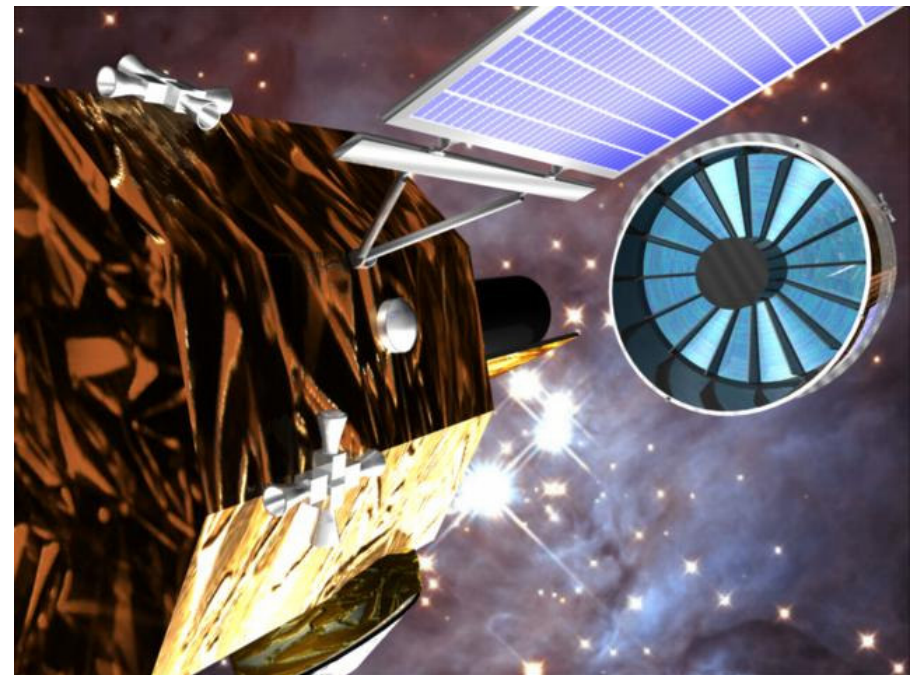
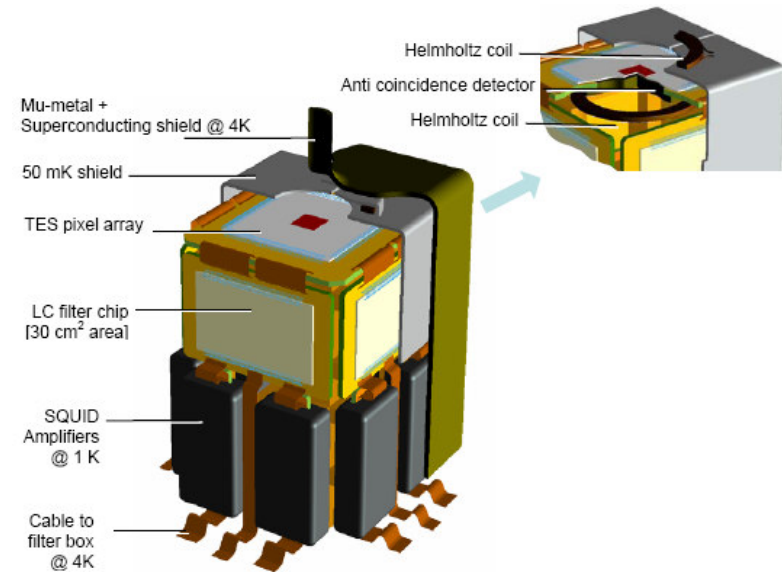


# EURECA @ Spain: Progress in Software

- Quick Look and Data Analysis Software team:
  - IFCA
  - ISDC
  - SRON
  - (MSSL)
  - (Leicester)
- Overall coordinator: Javier Bussons (IFCA, transiting to Univ of Murcia)
- Link to Hardware: Jan van der Kuur (SRON)
- Top requirements defined
- Version control repository
- Various tasks developed (now facing demultiplexing)
- Overall control & management of SW development and interface with HW

# Long-term goal

- Demonstrate that Europe & Japan can build a 32x32 array of TES calorimeters, with ~1 eV resolution
- Build up an international consortium bidding for the "High Spectral Resolution Instrument" on board the XEUS mission
- (more @ CDTI, next Monday 28)



# Conclusions

- EURECA is a consortium in the search for flight opportunities, but EURECA @ Spain is rather science-driven.
- Bringing most competent high-technology groups on board instrument design & development:
  - Difficult (busy people, many frontier projects)
  - Extremely rewarding: breaking new ground
- Now at R&D (pre-phase A) phase: lots of enthusiasm
- Will need to involve industry when going beyond the prototype phase

# Many thanks to all EURECA partners, especially:

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  - Wojtek Hajdas
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  - Noriko Yamasaki
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