ANAIS STATUS REPORT

TAUP 2009

3 July 2009

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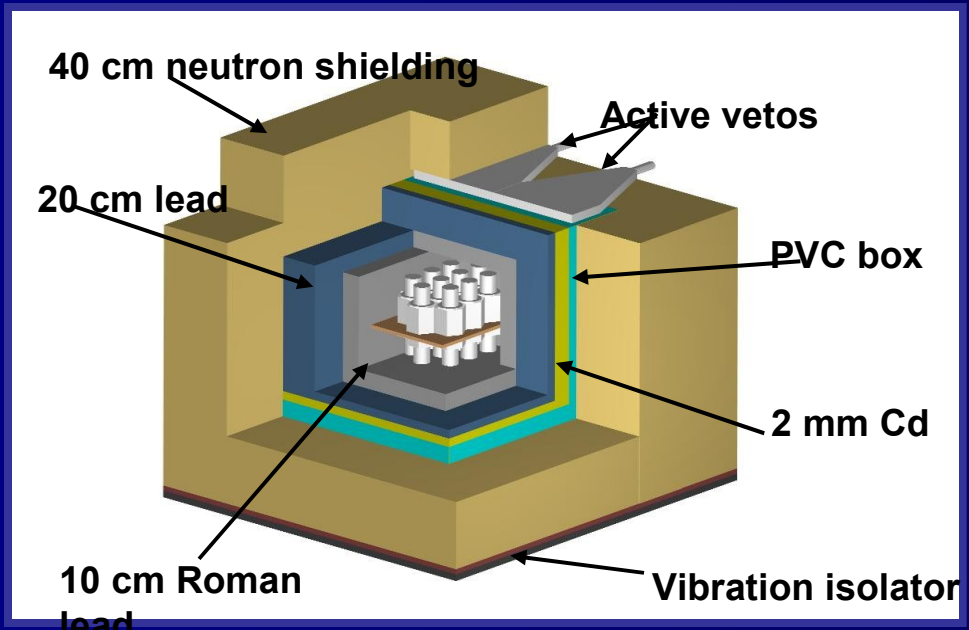
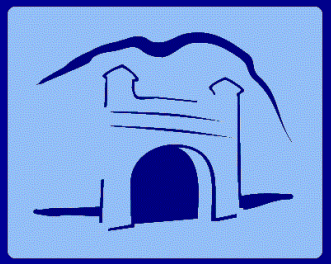
OUTLINE

- ANAIS: WHAT and WHY
- K40 Characterization of NaI(Tl) crystals
- Threshold and Linearity
- ANAIS-0 Module
- Conclusions and Next Steps

ANAIS: WHAT AND WHY

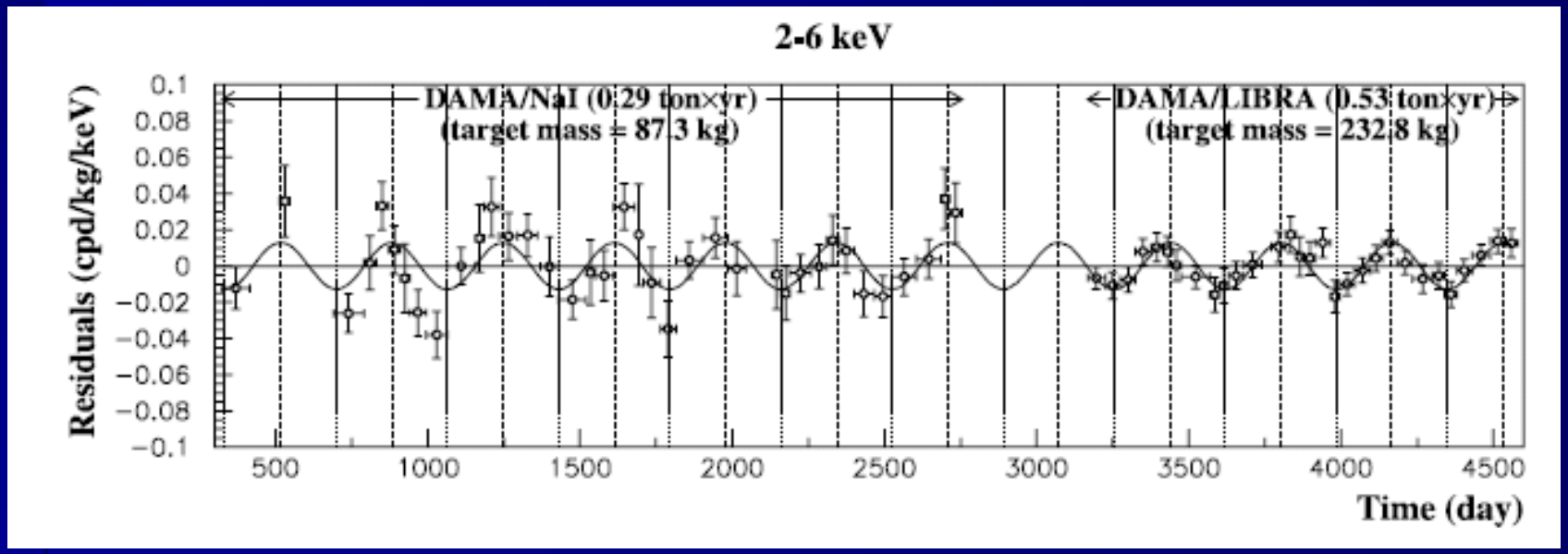
- ANAIS: Direct search for WIMPs through annual modulation on NaI(Tl) scintillating crystals at LSC.
- ANAIS: uses same target as DAMA





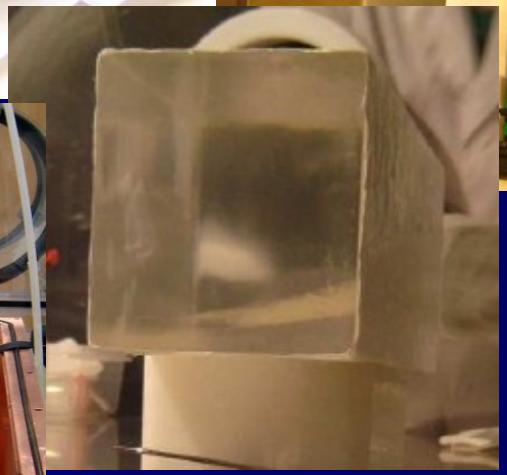
ANAIS: WHAT AND WHY

- DAMA annual modulation observed
- Rate=Wimp*Nuclear*Halo uncertainties



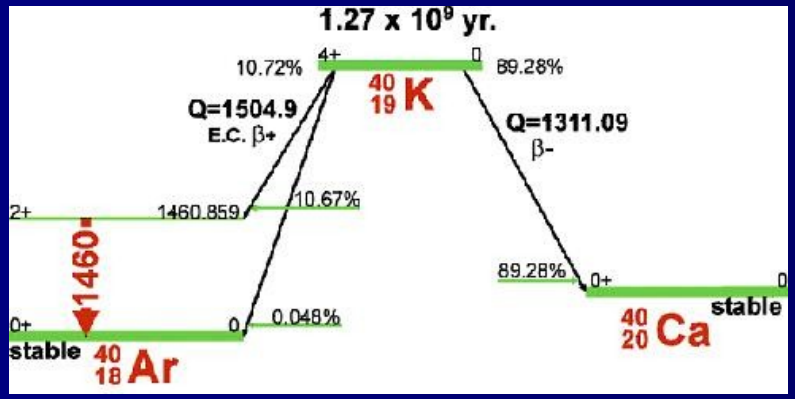
ANAIS

- 14 hexagonal crystals stored underground from 1988. 10.7kg each
- 1 crystal St Gobain. Prism 9.7kg
- Various Prototypes developed by GIFNA at Zaragoza and numerous runs at LSC. Goal: optimize Threshold and Background



K40 Characterization

- Dedicated Set-ups at old LSC to estimate internal K40 Background
- Measurement of 3.2KeV in Coincidence with 1460KeV
- Estimation of K40 internal contamination and calibration in energy and trigger efficiency

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G4DecayTable:  K40[0.0]
0:  BR:  0.8928  [Phase Space]   :   e- Ca40[0.0] anti_nu_e
1:  BR:  0.080325729  [Phase Space]   :   nu_e Ar40[1460.9]
2:  BR:  0.022006024  [Phase Space]   :   nu_e Ar40[1460.9]
3:  BR:  0.0028845003  [Phase Space]   :   nu_e Ar40[1460.9]
4:  BR:  0.001774271  [Phase Space]   :   nu_e Ar40[0.0]
5:  BR:  0.00017397588  [Phase Space]   :   nu_e Ar40[0.0]
6:  BR:  2.5499654e-05  [Phase Space]   :   nu_e Ar40[0.0]
7:  BR:  9.87e-06  [Phase Space]   :   e+ Ar40[0.0] nu_e
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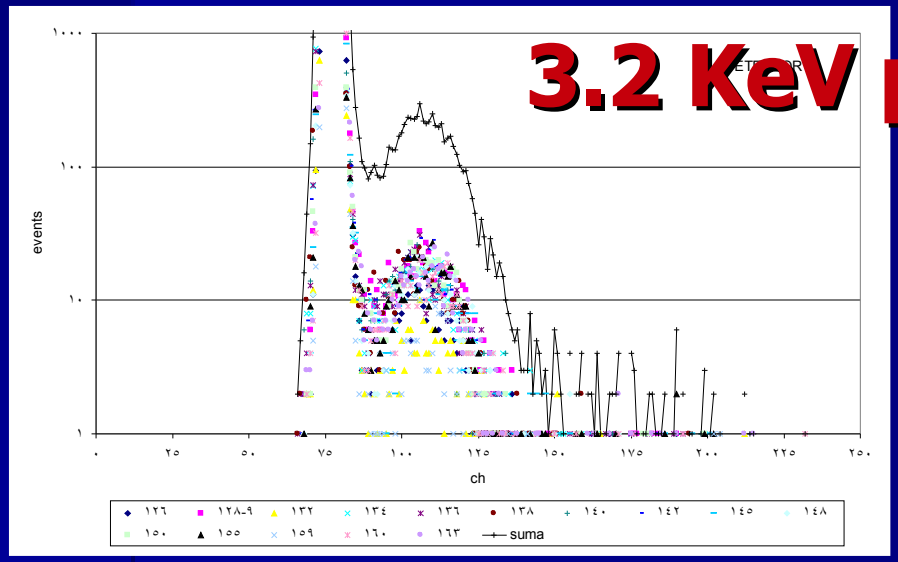
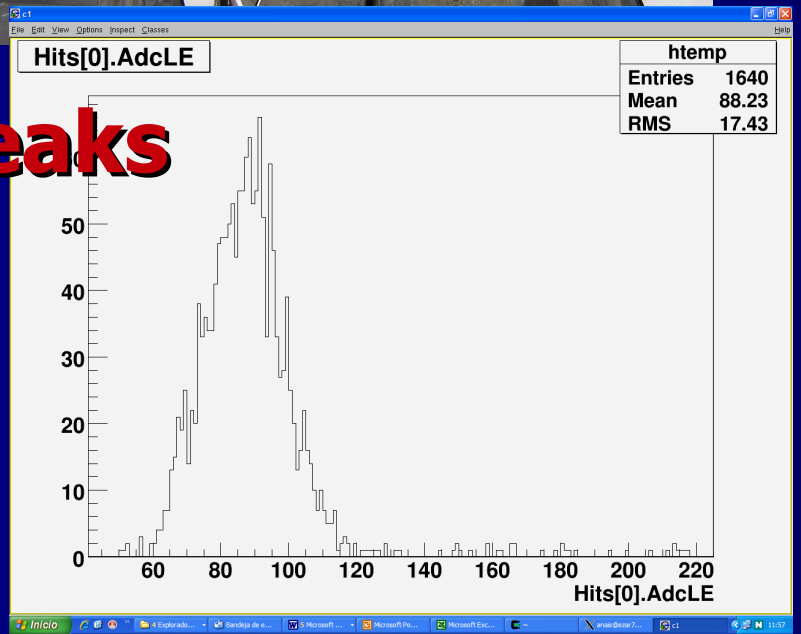
K40 Characterization



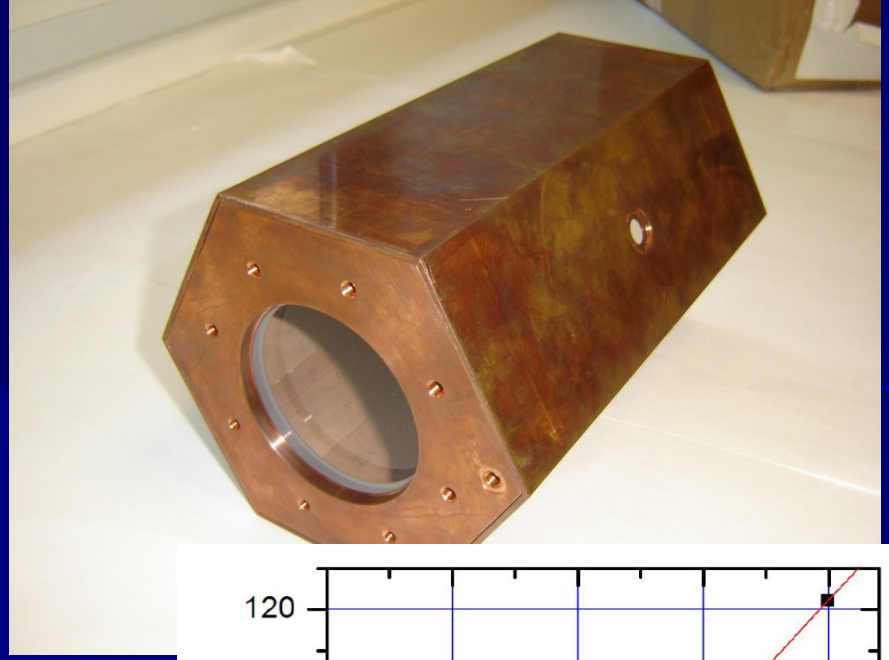


K40 Characterization of old crystals

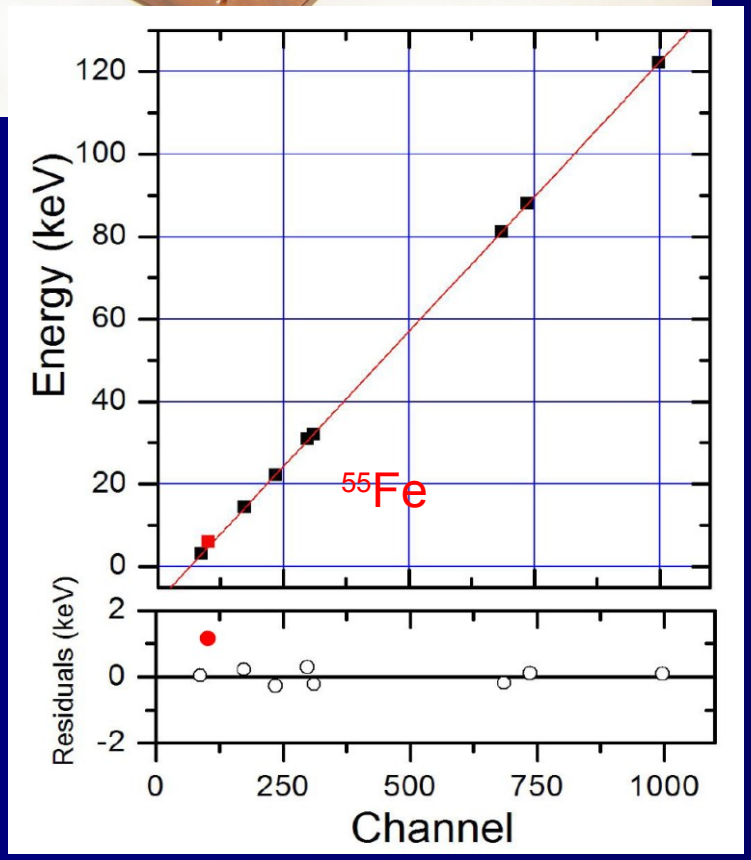
- Mean contamination 10-20 mBq/Kg in K40
- ANAIS needs cleaner crystals to achieve 1mBq/Kg or less in K40.

Detector	^{40}K Activity (mBq/kg)
EL603	14.5±0.2
EP508	16.2±0.3
EP509	16.6±0.2
EP055	15.2±0.1
EP056	18.8±0.2
EL214	17.9±0.4
EP057	20.9±0.4
EM301	21.2±0.4
EP604	16.5±0.3
EP054	13.7±0.3
PIII	15.7±0.5

LINEARITY

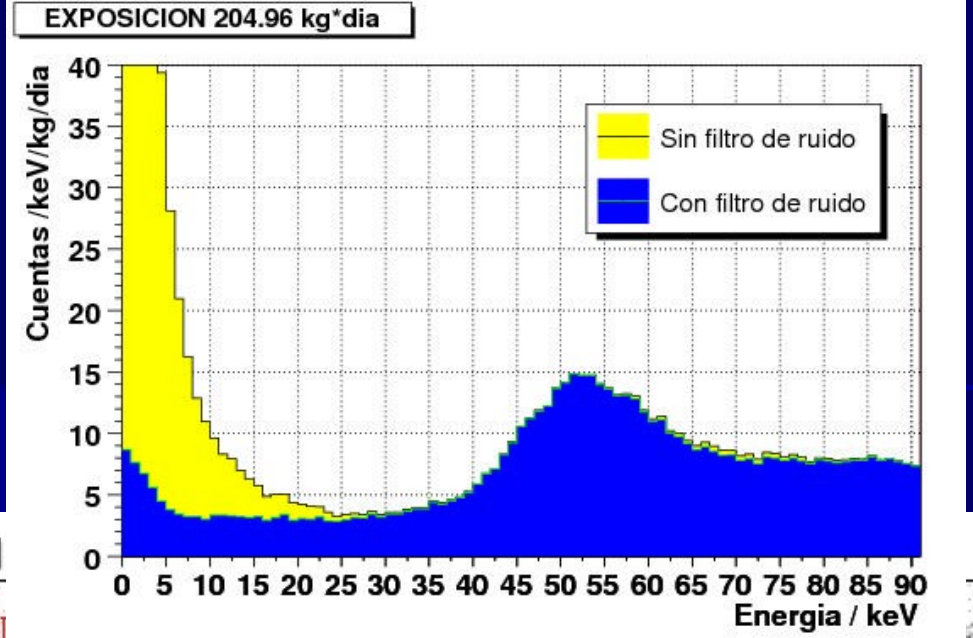


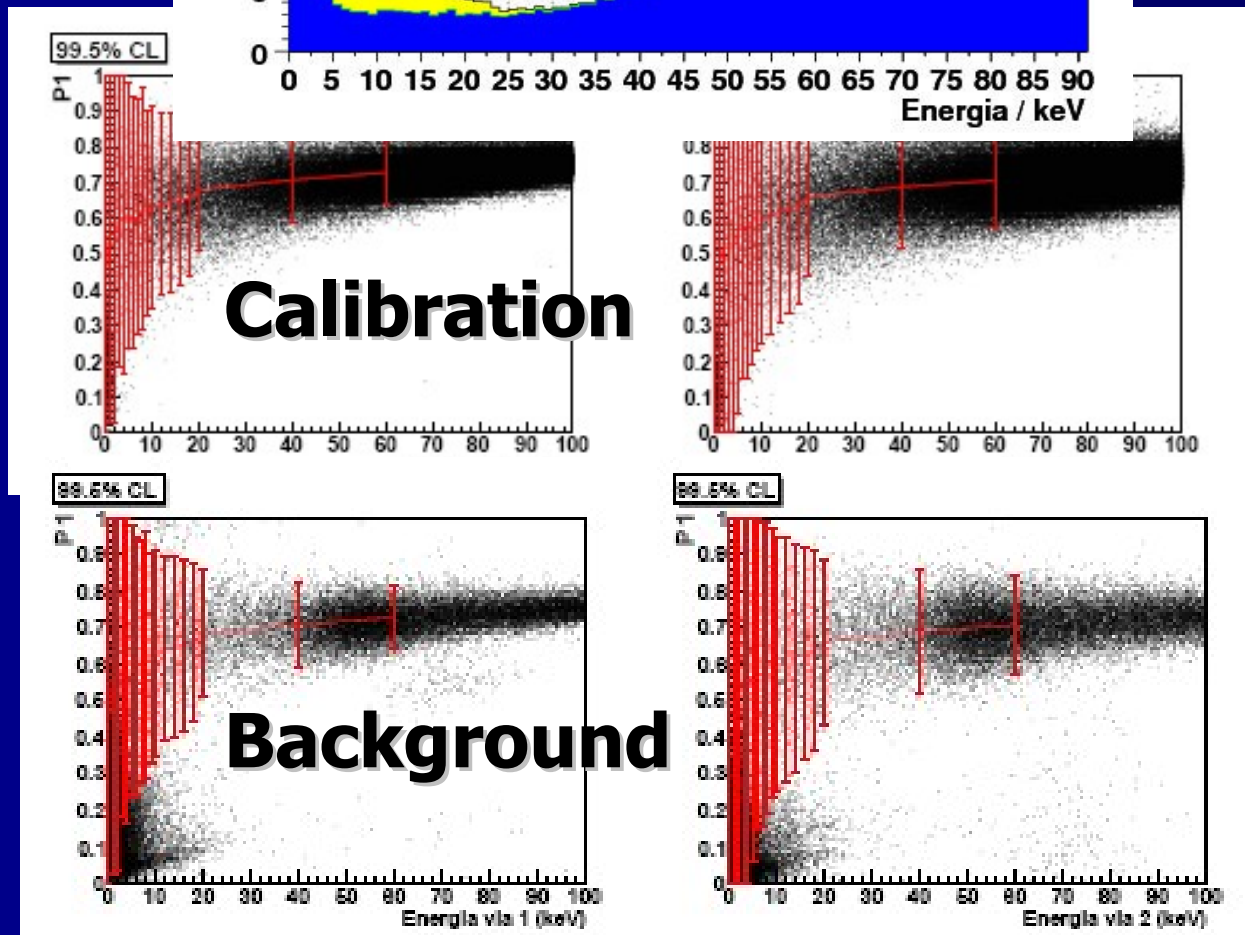
- Prototype III: new encapsulation with mylar window
- Calibration with K40 internal contamination and Fe-55, Cd-109, Ba-133, Co-57, Cs-137
- Linearity down to 3KeVee
- surface effect for Fe-55 X-ray line



Threshold

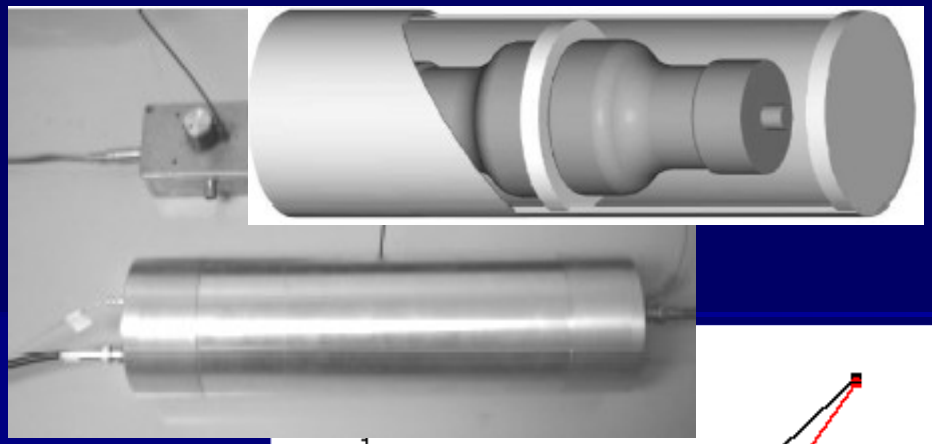
- Hardware threshold at photoelectron level
- Analysis threshold extended down to 2KeVee
- Further developments to improve light collection and noise rejection

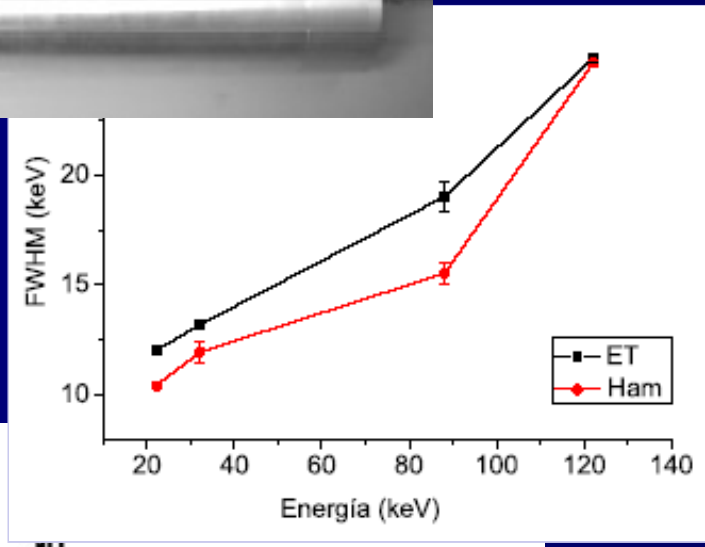


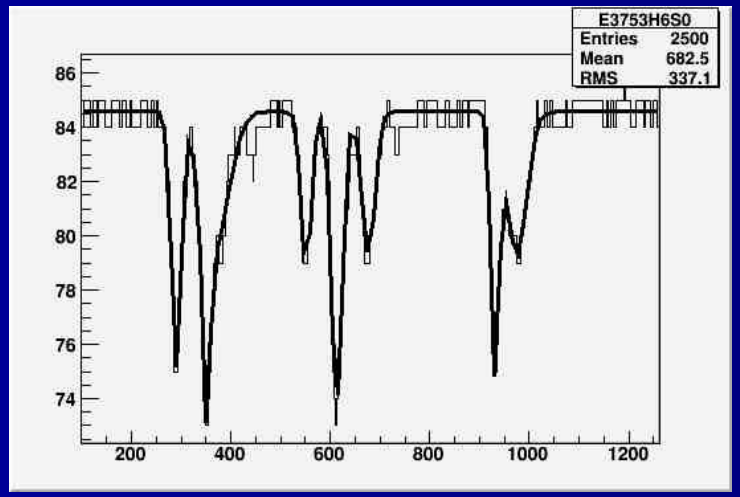


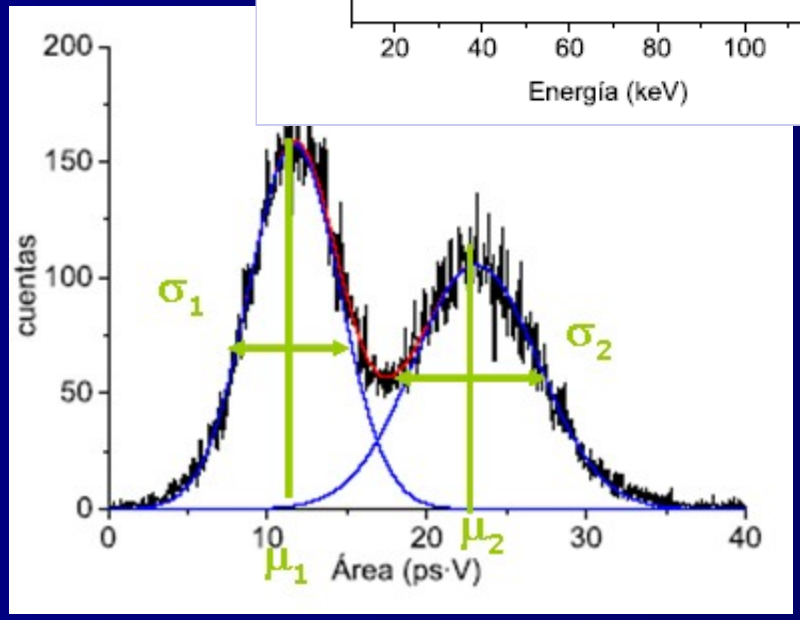
Threshold and PMTs

- Test Bench at Zaragoza
- Pulse Shape Analysis at LE









PMTs Radiopurities

	ET 9302B	HAM High QE R6233-100	HAM Low Bkg* R6233-100
^{40}K	(420 ± 50) mBq/PMT	(19.5 ± 0.1) Bq/PMT	0.4 Bq/PMT
^{232}Th	(24 ± 4) mBq/PMT	(0.42 ± 0.04) Bq/PMT	0.3 Bq/PMT
^{238}U	(220 ± 12) mBq/PMT	(0.513 ± 0.03) Bq/PMT	0.2 Bq/PMT

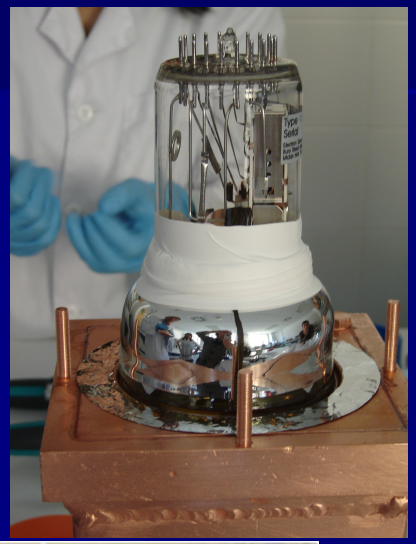
- Background measurements at LSC with High purity Ge detector
- HAM High QE good resolution, but high BKG
- Contacts to try both High QE and Low BKG

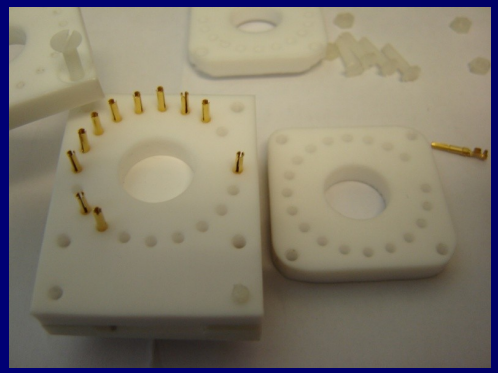
* Stated by provider. Measurements at LSC ongoing

ANAIS-0

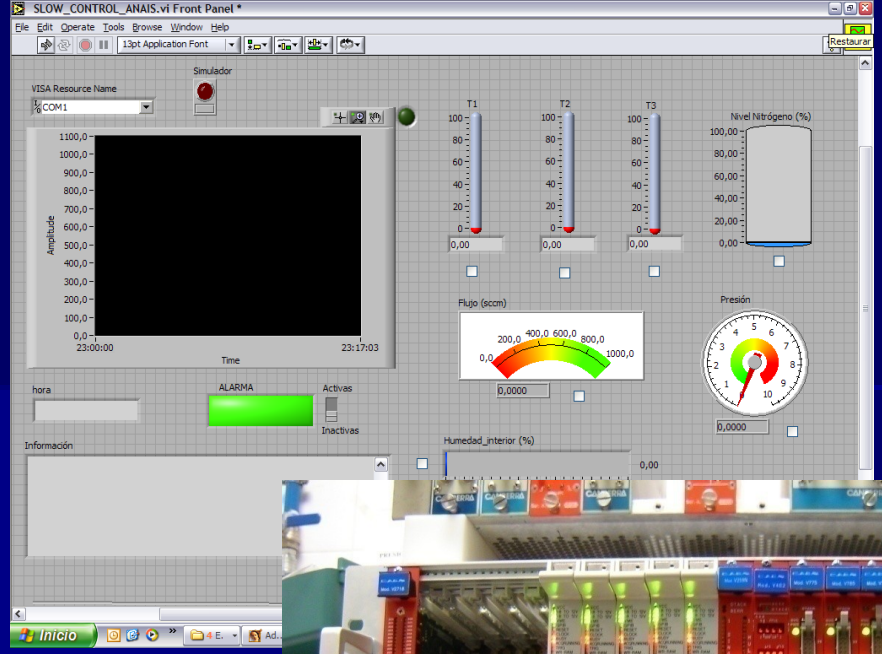
- Design and Cu electroforming of PMTs encapsulation. 9.7kg crystal.
- Radiopurity measurement of windows, coupling gels, etc. at LSC
- Design of new electronic bases for the PMTs with Teflon, SMD components and new thin cable for HV supply.
- Module assembled in Zaragoza and installed at Canfranc. First tests ongoing

9.7kg Module



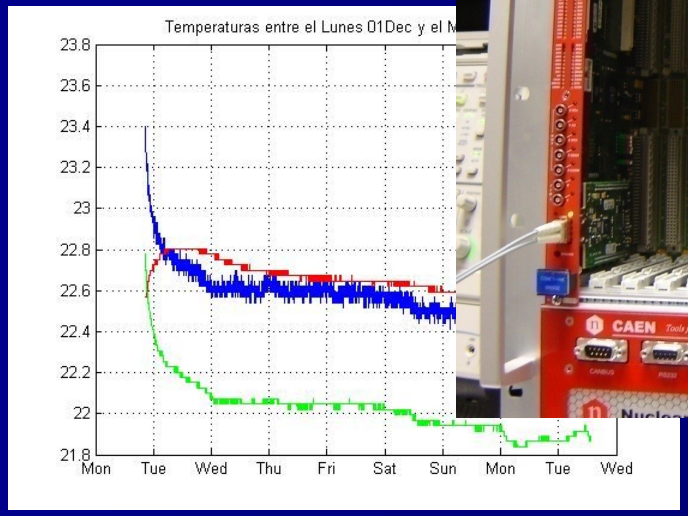


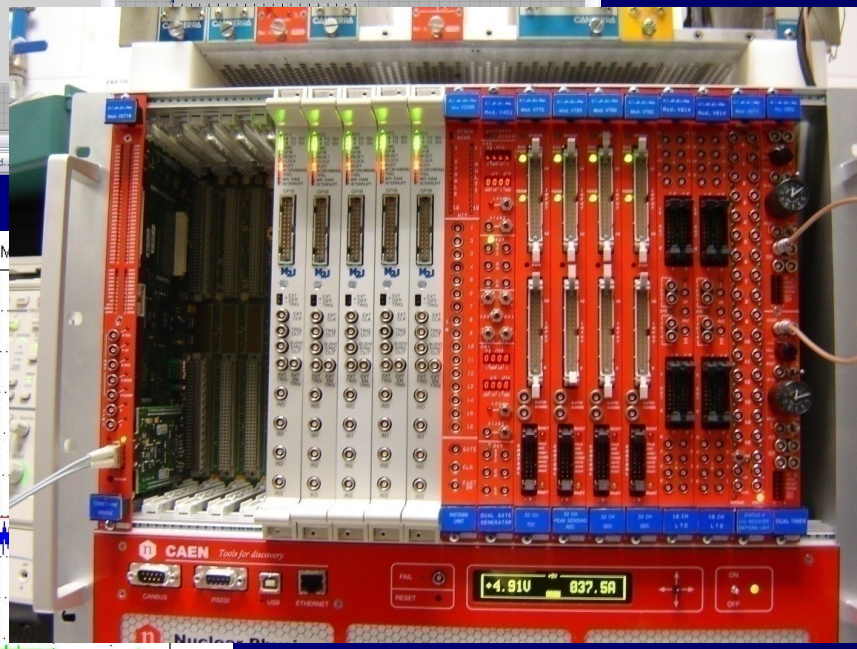
ANAIS-0



- In parallel, development of new acquisition system VME based ongoing

- Monitorization of Lab conditions (T, P, Rn, etc)





Objetive: mount ANAIS-0 module in old Canfranc Laboratory with optimized shielding and stability control

Conclusions and Next Steps

- Linearity shown down to 3 keV and analysis threshold at 2keVee. Works ongoing to further improve.
- Set-up for Crystal K40 characterization. Old crystals characterised, 9.7 kg module ongoing.
- Crystals:

  - NaI powder bought at ppm level in K40. Measured at LSC

  - Purification methods and analysis under investigation. Objective less than 30ppb in Knat.

  - Continue contacts with providers.

  - Will be checked at LSC.
- Mount ANAIS-0 module at old LSC with stability control and optimized shielding.

THANK YOU