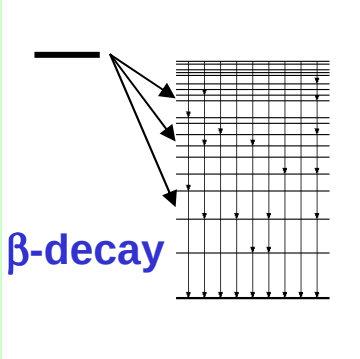
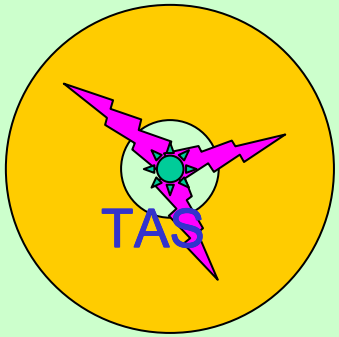
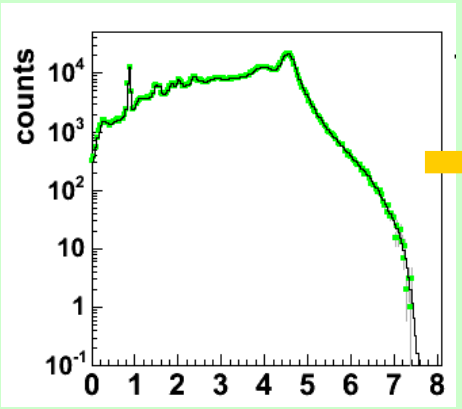
A Total Absorption Spectrometer for DESIR

- Total Absorption Spectroscopy is the best method to measure beta strengths in β-decay for complex decay schemes
- The highest possible efficiency and energy resolution of the spectrometer are important to minimize systematic errors in the de-convolution process
- The main source of systematic error is contamination/background signals



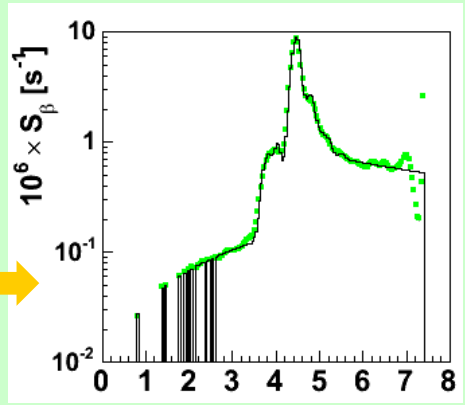




$$\text{"}\mathbf{f} = \mathbf{R}^{-1}\cdot\mathbf{d}\text{"}$$

$$\mathbf{R}'_j = \sum_{k=0}^{j-1} b_{jk}\mathbf{g}_{jk} \otimes \mathbf{R}'_k$$

$$\mathbf{R}_j = \boldsymbol{\beta}_j \otimes \mathbf{R}'_J$$



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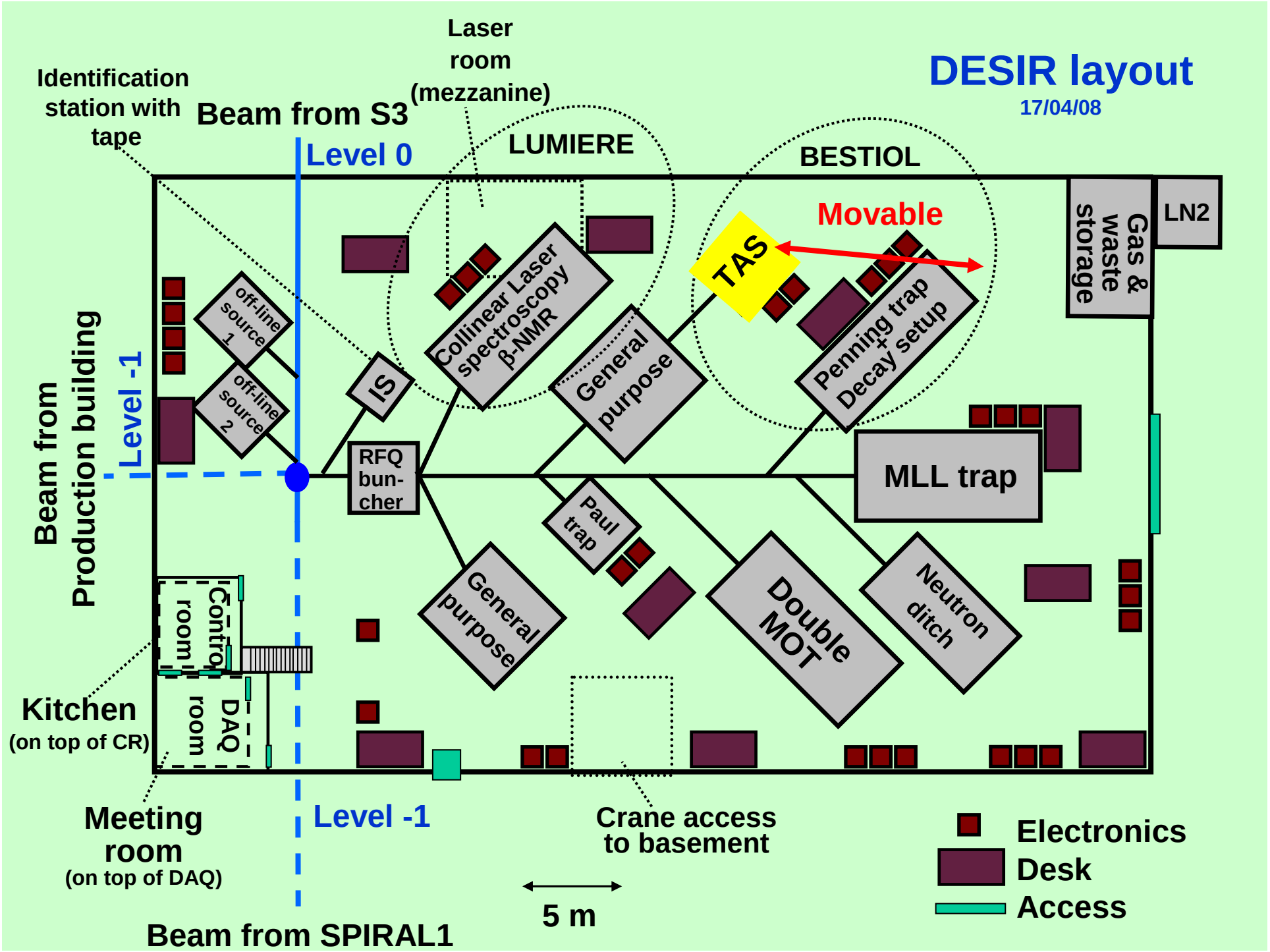
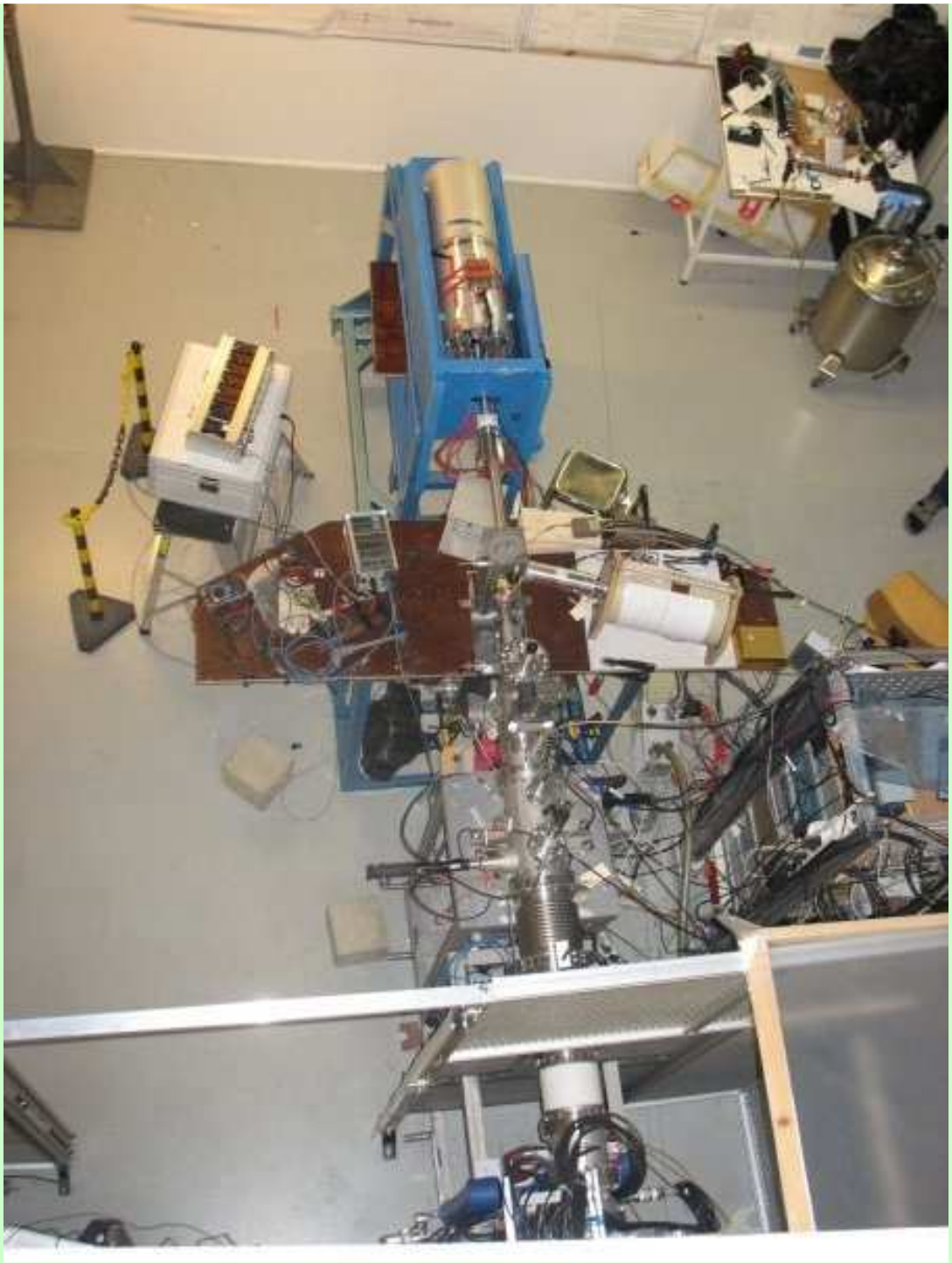

DESIR layout
17/04/08
Identification station with tape
Beam from S3
Level 0
Laser room (mezzanine)
LUMIERE
BESTIOL
Movable
TAS
Gas & waste storage
LN2
Collinear Laser spectroscopy β-NMR
General purpose
Penning trap Decay setup
off-line source 1
off-line source 2
IS
RFQ bun-cher
MLL trap
Paul trap
General purpose
Double MOT
Neutron ditch
Control room
DAQ room
Kitchen
(on top of CR)
Meeting room
(on top of DAQ)
Beam from Production building
Level -1
Level -1
Crane access to basement
5 m
Beam from SPIRAL1
Electronics
Desk
Access

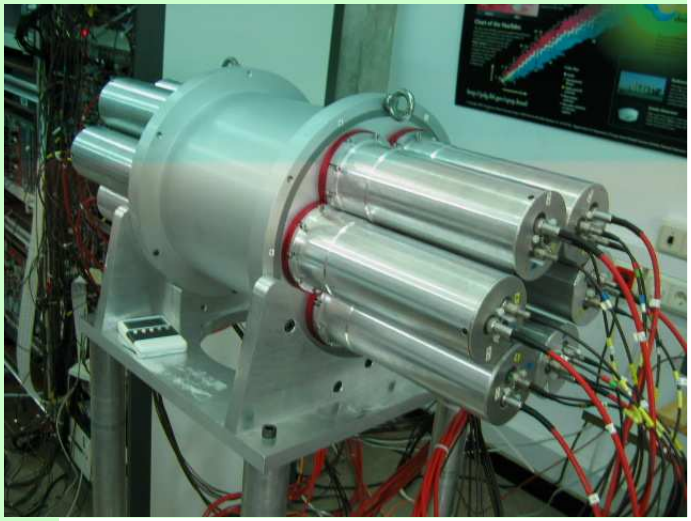
TAS after Penning trap at JYFL

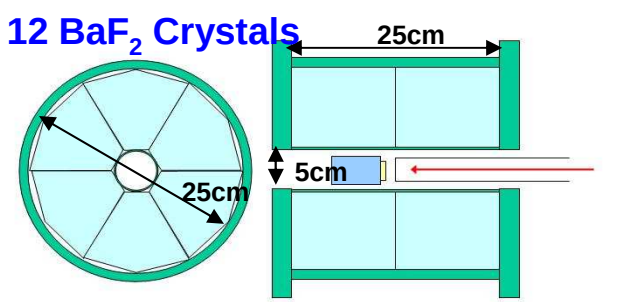


The Surrey-Valencia TAS

Detector:
•external dimensions: ∅: 32.5cm, L: 76cm
• hole: ∅:5cm
• weight: 80kg
Lead shielding (5cm):
• external dimensions: □: 50cm, L: 80cm
• weight: 820kg
Support:
• dimensions: W: 60cm, L: 150cm, H: ~100cm

Detector or/and shielding on sliding support on top of a movable table

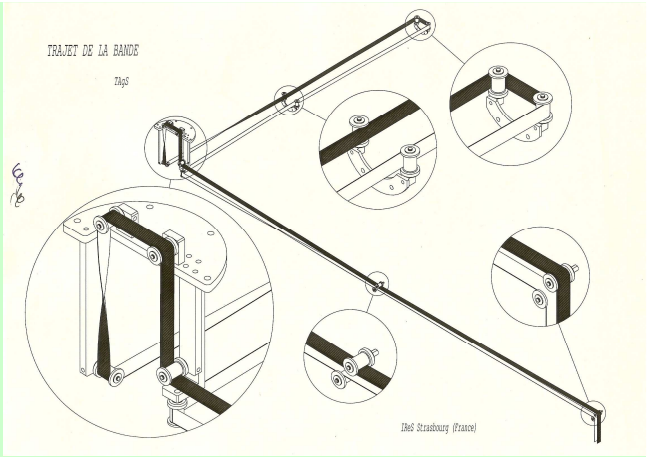


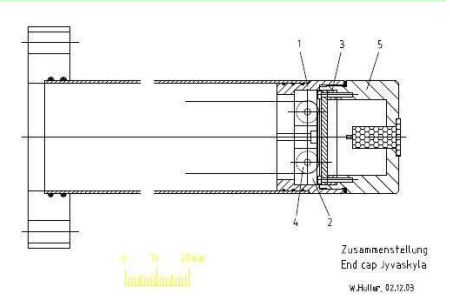


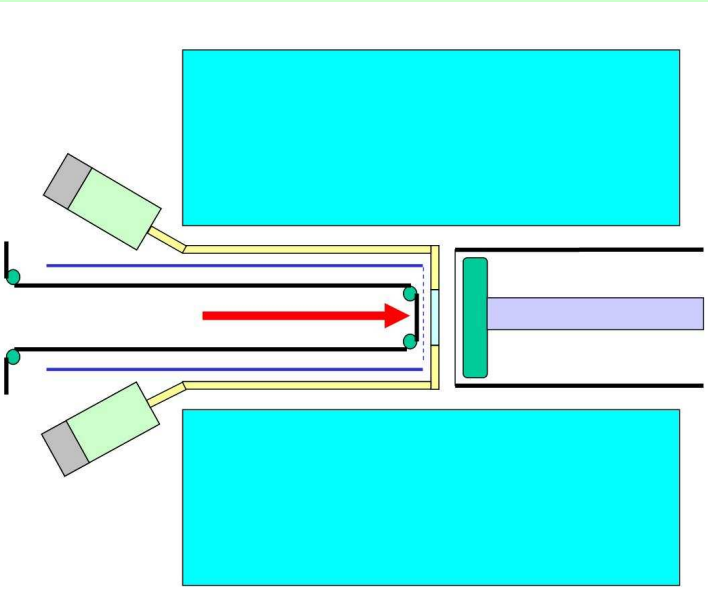
Source tape transport system:
- implanting outside - positioning inside
- implanting inside – removing outside

Vacuum tube:
- to fit inside (∅:~36mm)
- end cap with thin window
- end cap with detector mounting

Ancillary detectors:
- beta detectors: silicon / plastic scintillators
- X-ray detector: germanium / Si(Li)



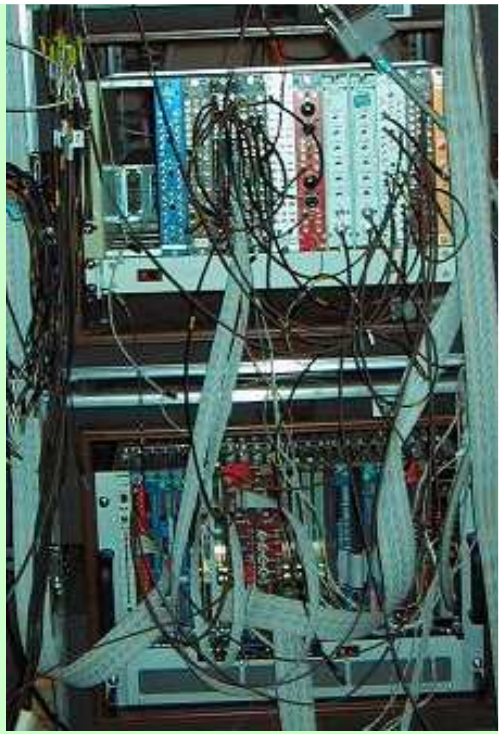


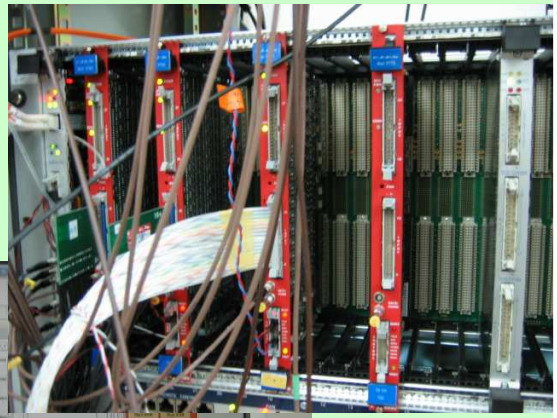


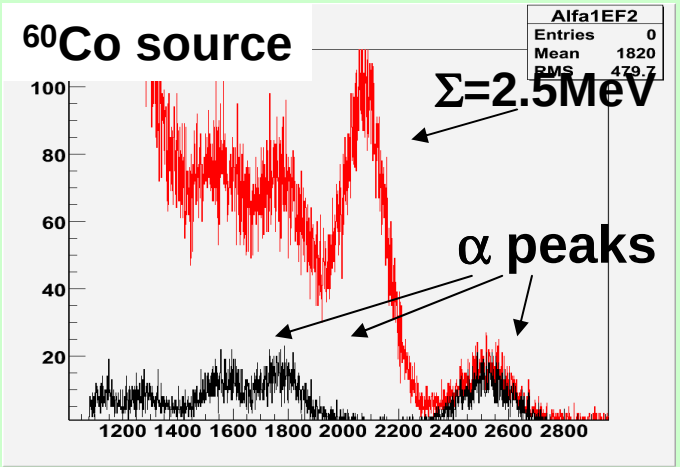
Electronics:
- conventional NIM electronics

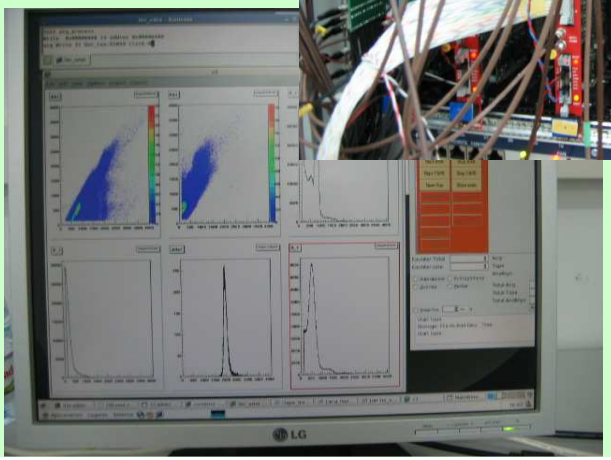
Data acquisition system:
- VME based (ADC, QDC, TDC)
- interface with CAMAC-FERA
- PMT gain stabilization (contaminant α-peaks)

- FADC digital system under development









Budget:

- Investment:
  - Total absorption spectrometer: **185 k€** ⩾
  - Ancillary detectors:
    - X-ray detector: 15 k€
    - Beta detector: **3 k€** ⩾
  - Electronics: **55 k€** ⩾
  - Data acquisition system: **52 k€** ⩾
  - Lead shielding and assembly support: 15 k€
  - Tape transport system and vacuum beam pipe: 100 k€

  TOTAL: **425 k€**

- Manpower cost:
  - personnel: 1 person-year 30 k€

- Travel and running costs: 15 k€

Time schedule:

- TAS, electronics, DACQ: **ready**, first in-beam test @ JYFL in 2009
- Mechanical support: under design, **ready for 2009**
- Shielding
- X-ray detector
- **Tape system and vacuum tube**

} **resources not available**

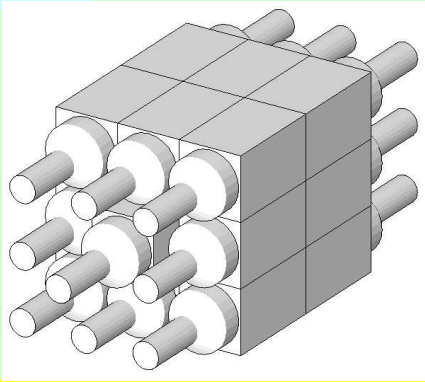
Partners:

- CIEMAT Madrid
- IEM Madrid
- **IFIC Valencia**
- INR Debrecen
- PNPI S. Petersburg
- Univ. Surrey
- (Subatech Nantes, …)

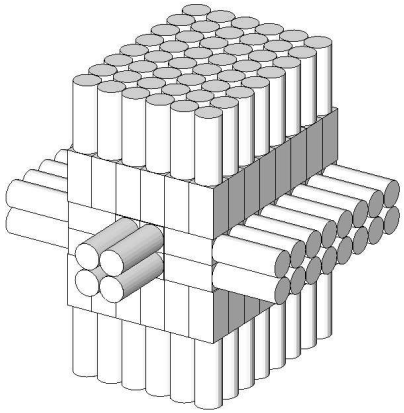
DESPEC design choices

16 + 1 modules:
15×15×25 cm^3 **NaI(Tl)**
+ 5” PMT (50% light col.)
V= 95 L, M= 351 kg

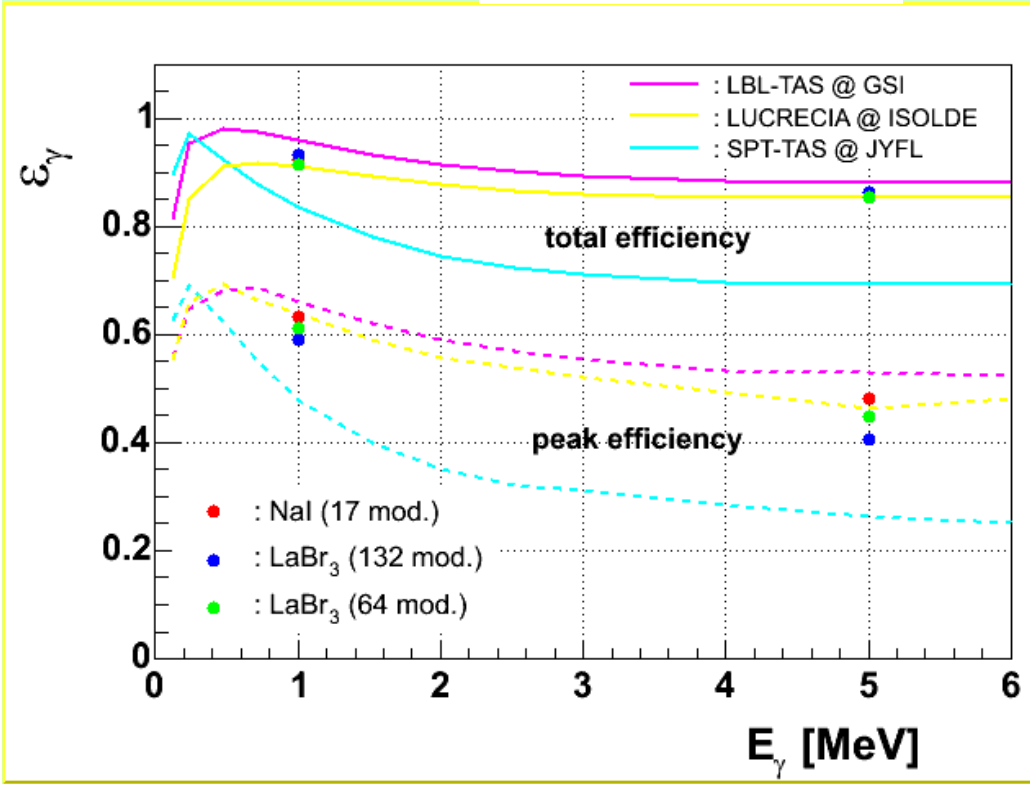
ΔE/E ~ 5%
(@1.3MeV)
Δt ~ 2 ns
τ ~ 230ns



128 + 4 modules:
5.5×5.5×11 cm^3 **$LaBr_3$:Ce**
+ 2” PMT (60% light col.)
V= 44 L, M= 223 kg



ΔE/E ~ 2%?
(@1.3MeV)
Δt ≤1 ns
τ ~ 26/160ns



Eventually the DESPEC TAS could be also used at DESIR