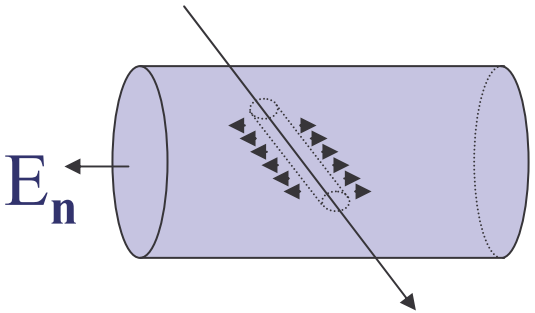
RAP-RD
Rivelazione Acustica di Particlle

Physical Motivation



The energy deposited by a particle is converted in a local increase of temperature

$\delta T = \delta E/(\rho C V)$; $\delta p = \gamma \cdot \delta E/V$;

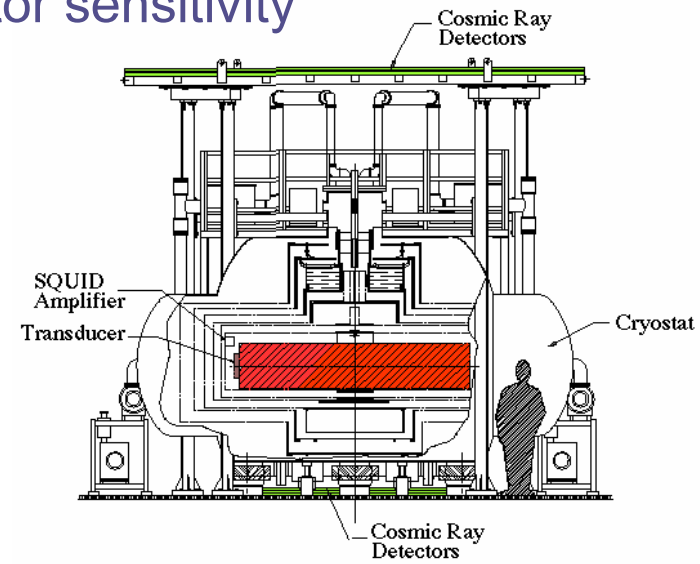
$\gamma = \alpha Y/(\rho C)$ γ = Grüneisen constant

$$E_n \propto \gamma^2 \cdot (dE/dx)^2 \cdot F^2_n$$

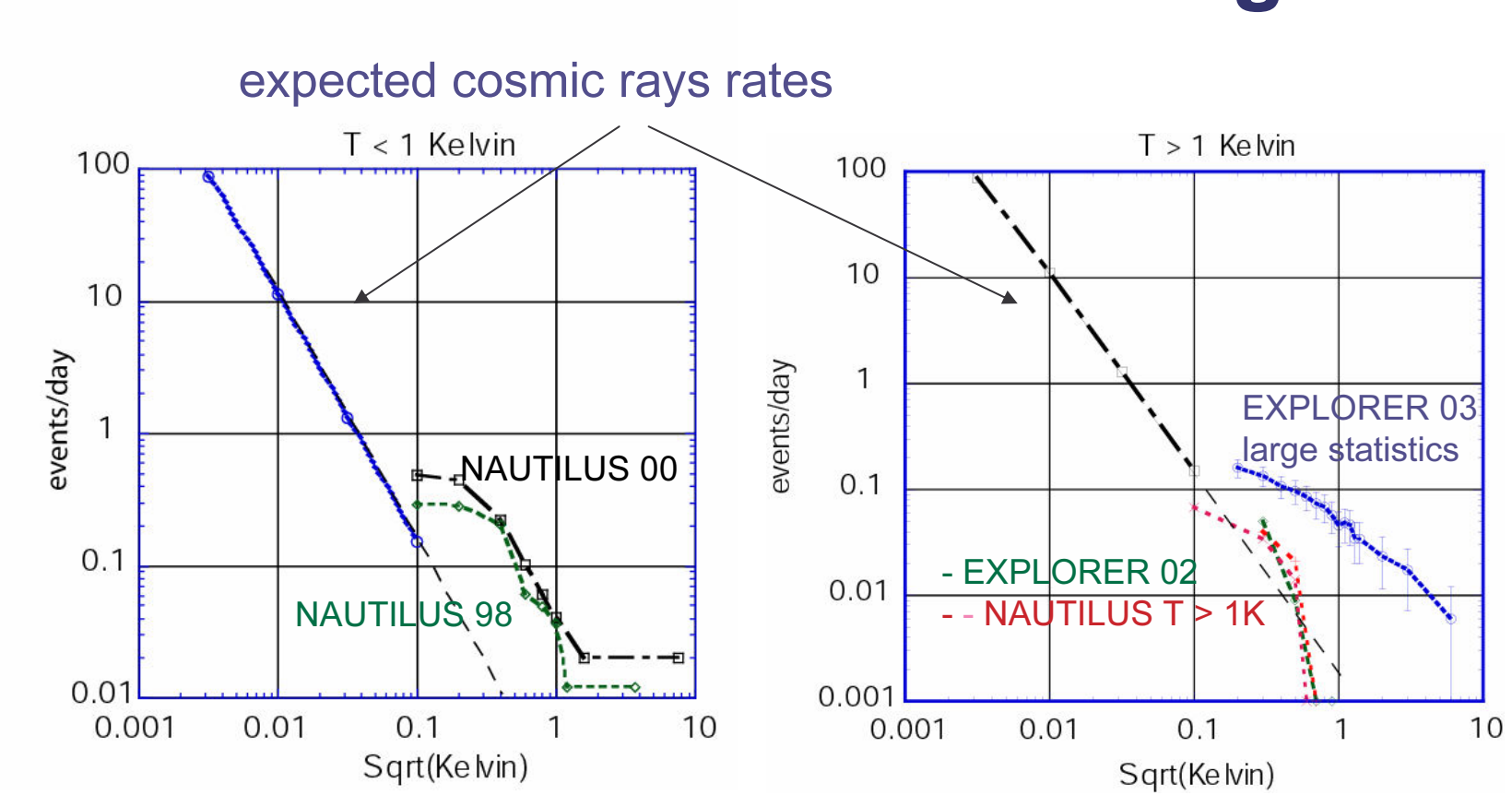
The Thermo Acoustic Model predicts very small signal for present resonant gravitational wave detector sensitivity

1992 NAUTILUS was equipped with a cosmic ray veto system (LST) Nucl.Instrum.Meth.A355:624-631,1995

2001 EXPLORER was also equipped with a veto system (scintillators)



unexpected cosmic rays noise non super-conducting state

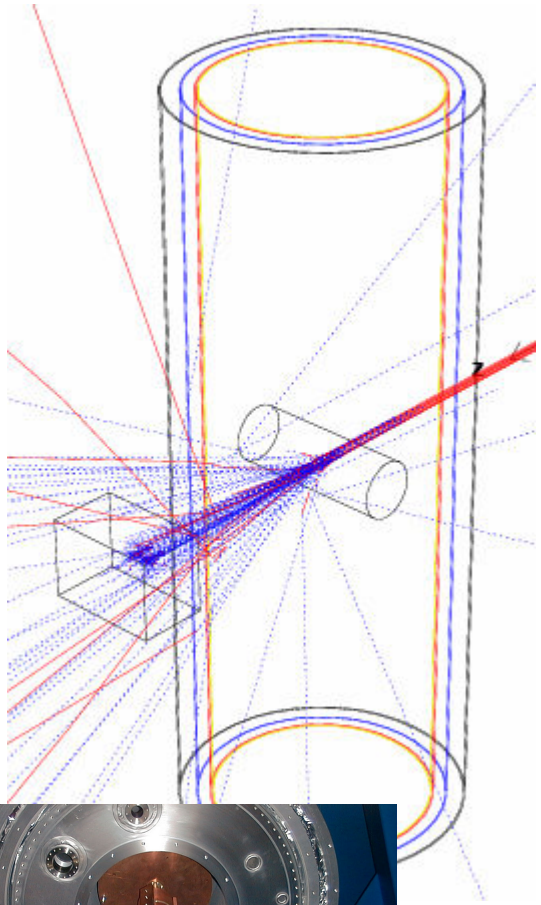


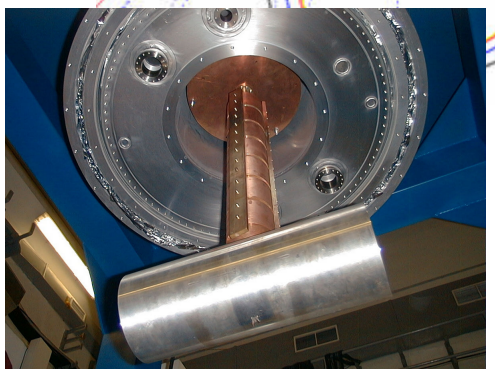
2003 EXPLORER data are in disagreement with the NAUTILUS data when detectors are in non super-conducting state

The RAP Experiment

thermal and mechanical | energy lost | Geometric factor

$$E_n \propto \gamma^2 \cdot (dE/dx)^2 \cdot F^2_n$$





In order to understand:

γ enhancement of Grüneisen factor in super-conducting or low temperature state

(dE/dx) enhancement of energy conversion in super-conducting or low temperature state

(dE/dx) exotic component of cosmic rays (nuclearites, monopoles)

…

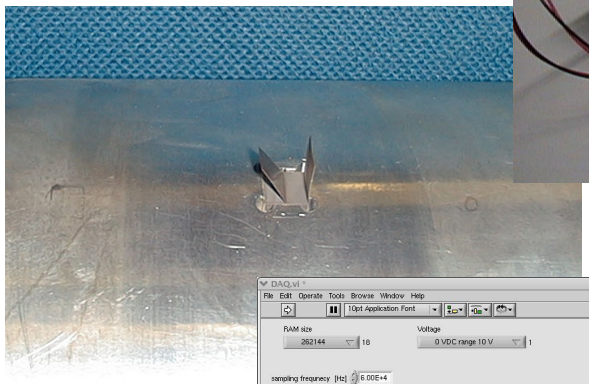
The thermo-acoustic model has been proven effective at room temperature by previous experiments

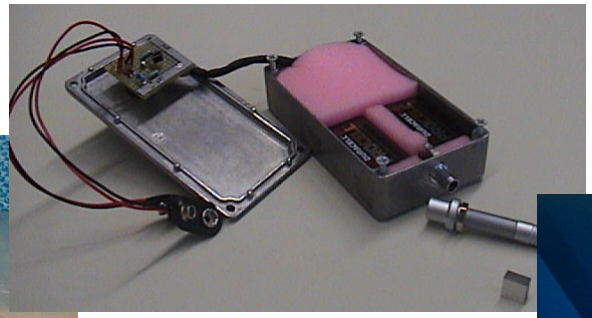
Rev.Sci.Instrum.71:1345-1354, 2000 and pervious papers

Phase 1: 300K test

installation and test of full detector at room temperature: suspension, electronics, DAQ, mechanical structure ready first measurement at room temperature

2 piezo-electric ceramics (PZT24, 1cm^{2}x0.5cm) embedded in the test mass



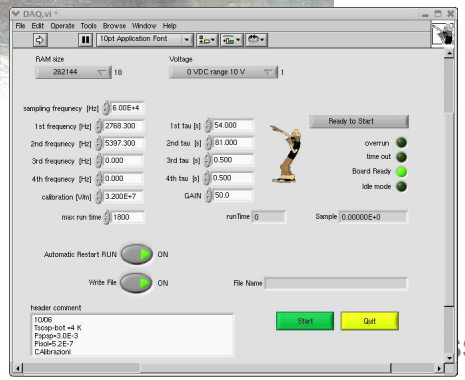


JFET amplifier
1nVHz$^{-1/2}$@ 5KHz
bandwidth 25KHz

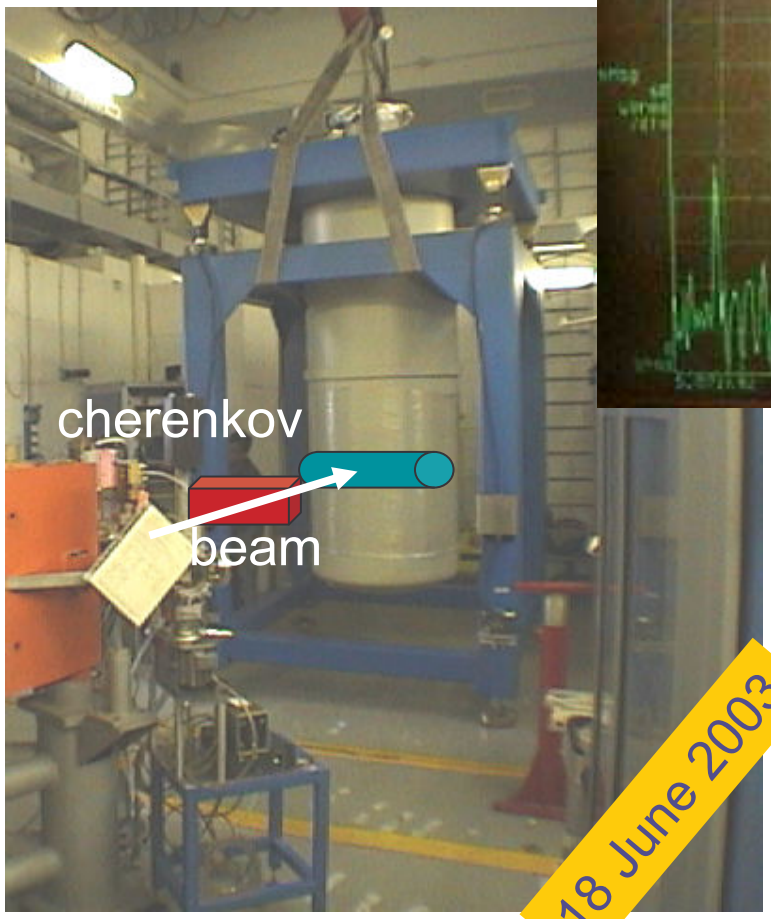
Suspension:
7 OFHC copper masses
1 OFHC copper tube
Attenuation: –200db@ 5KHz

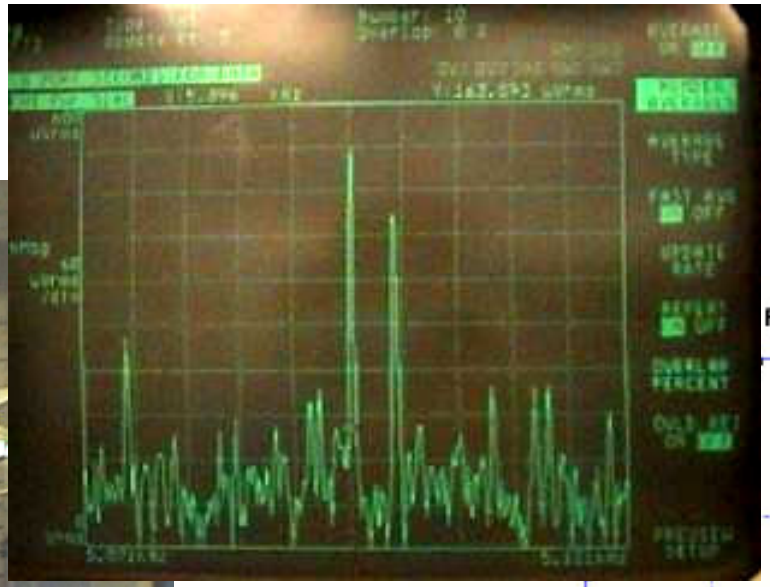
done in 2003

100 KHz DAQ, controls and Aux I/O

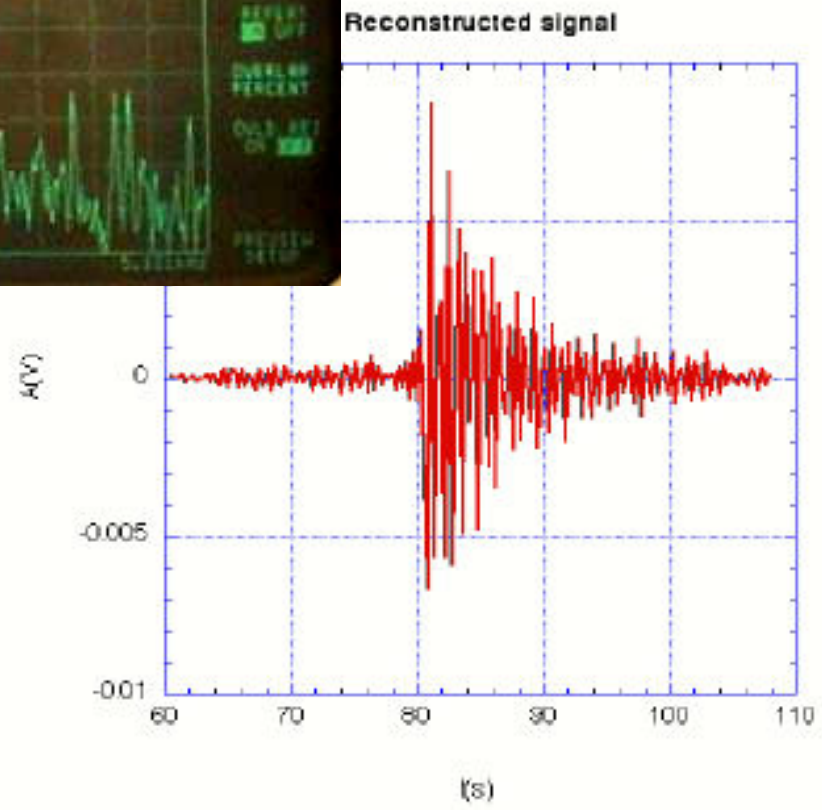


first run result (@ 300K)





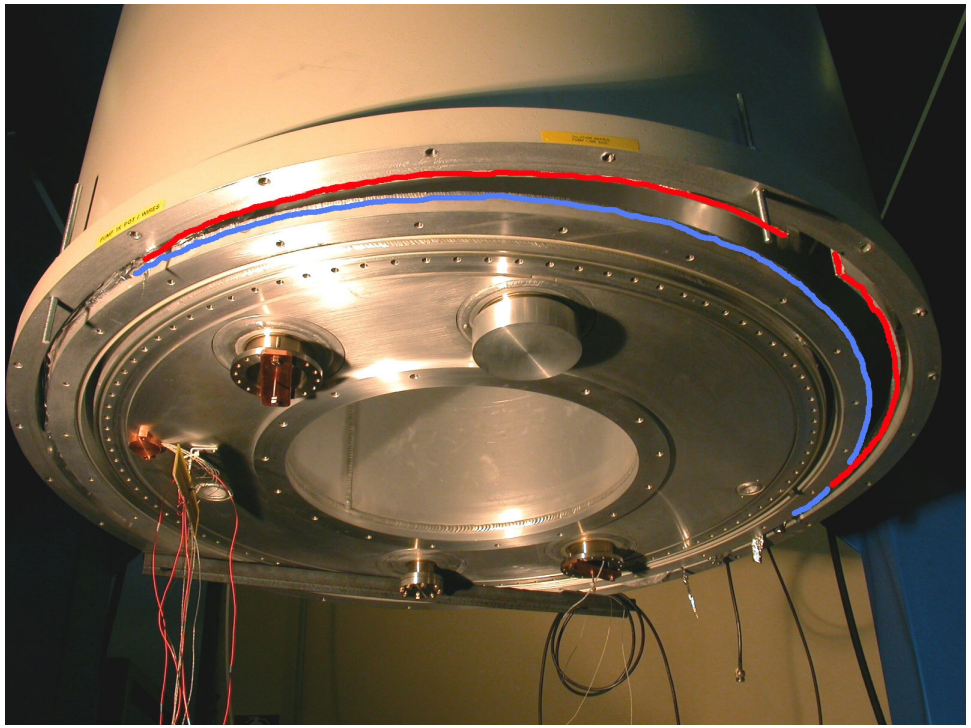
18 June 2003



measurement/theory = 0.70 +/- 0.11

Phase 2: 300-4K test

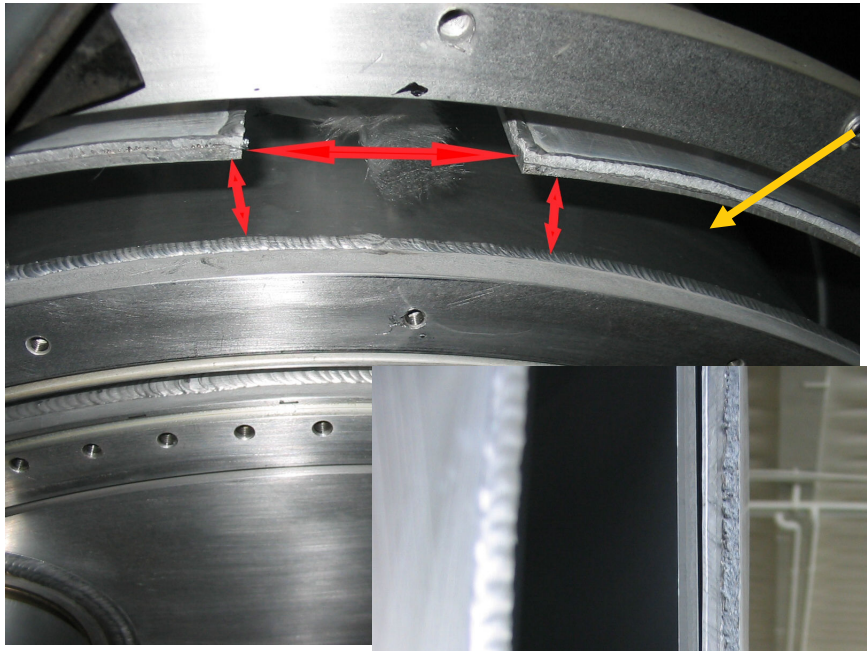
cryogenic test, and low temperature measurement in non super-conducting state



A cryostat failure during the second nitrogen cool down stops the scheduled runs on February. The problem has been recovered in May when RAP started cool down directly in the BTF experimental hall

done in 2004 according to the milestones

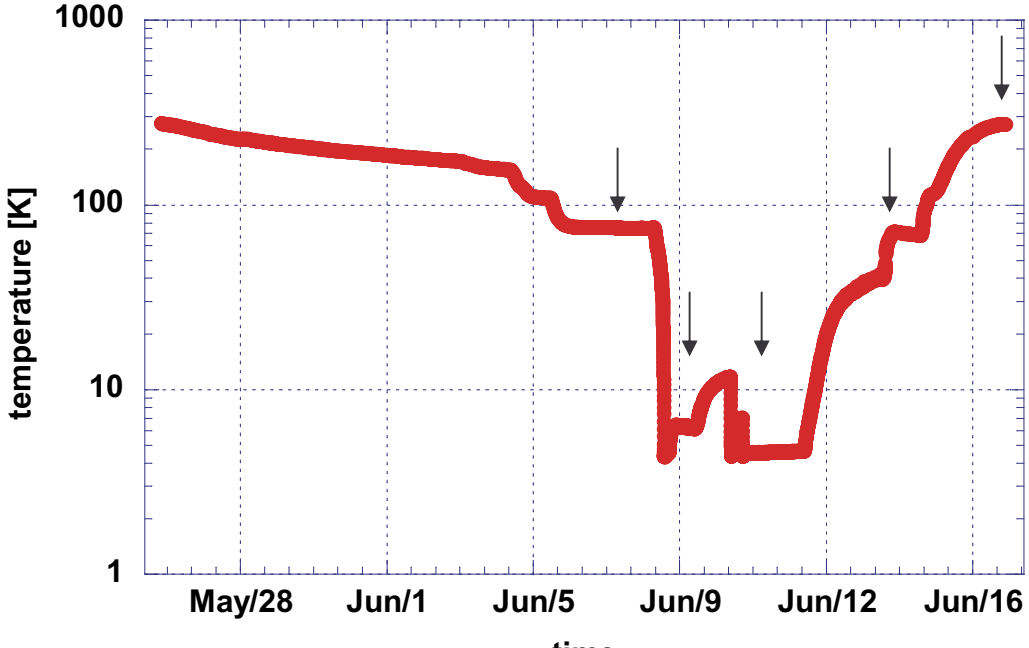
Cryostat failure detail



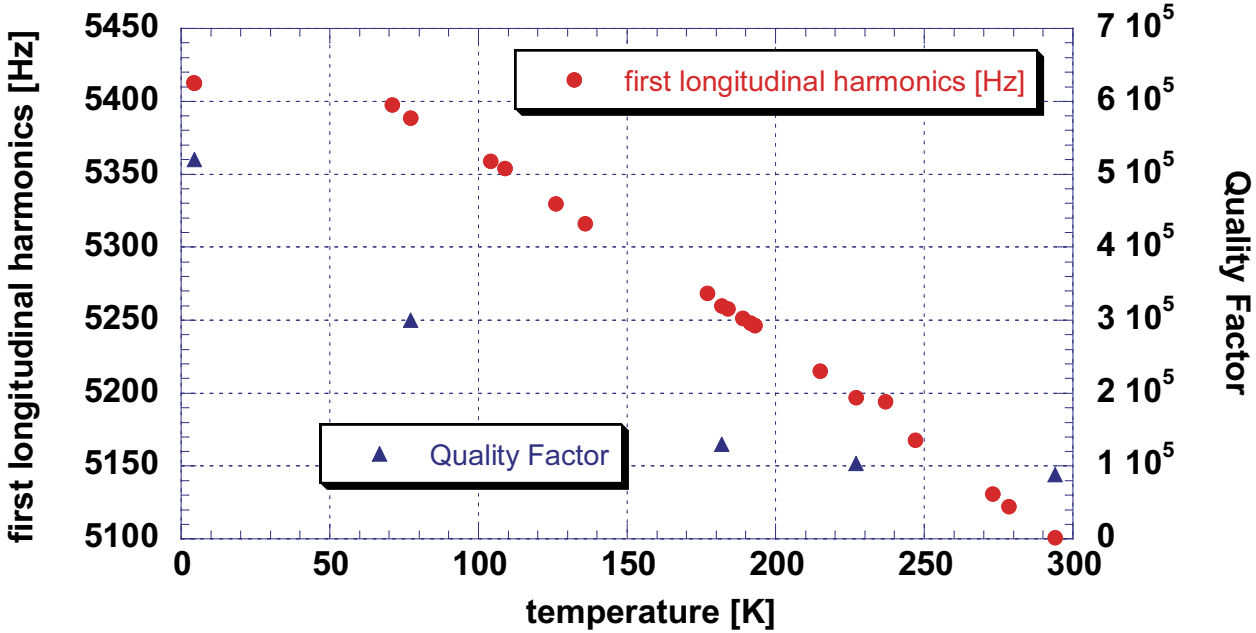
LN2 container

The cryostat failure was probably due to a not enough thick welding

RAP first Cool Down

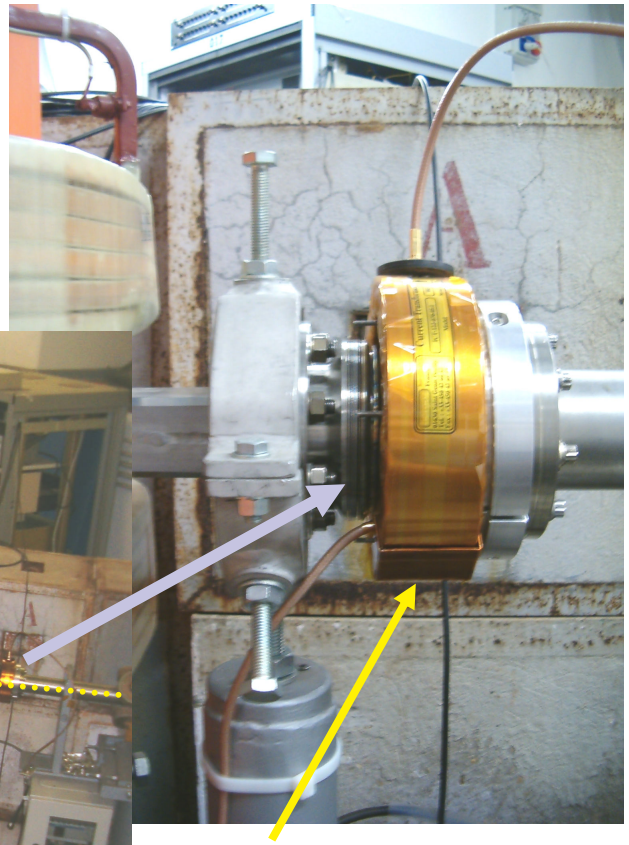


data taking

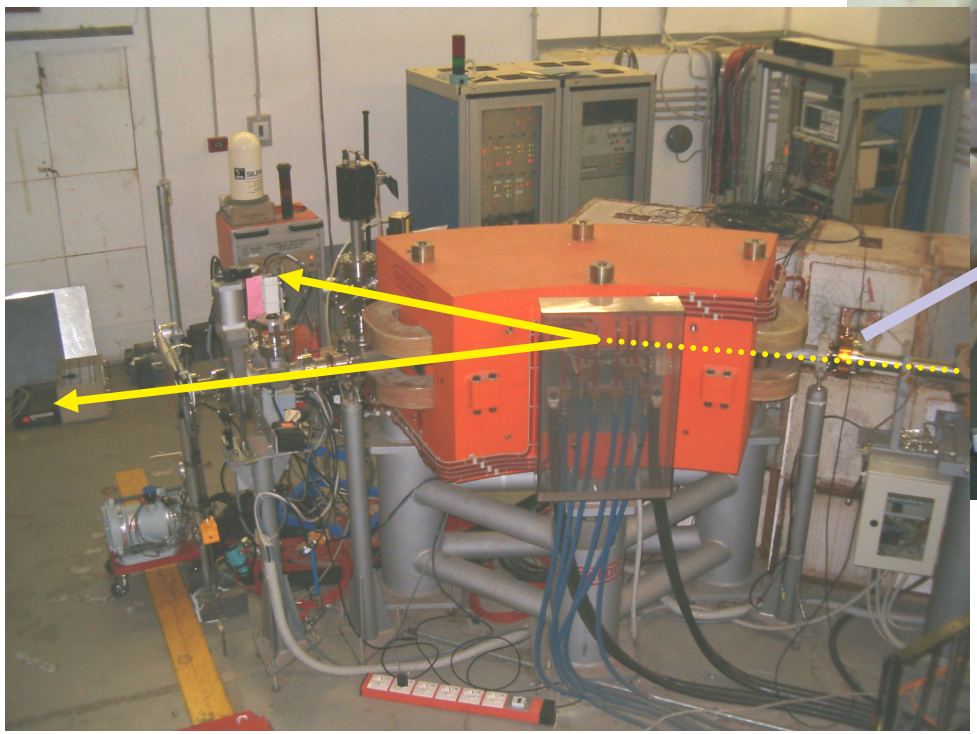


High intensity monitor

Beam Charge Monitor (BERGOZ)
noise < 550 fC ~ 3*10^6 e$^-$

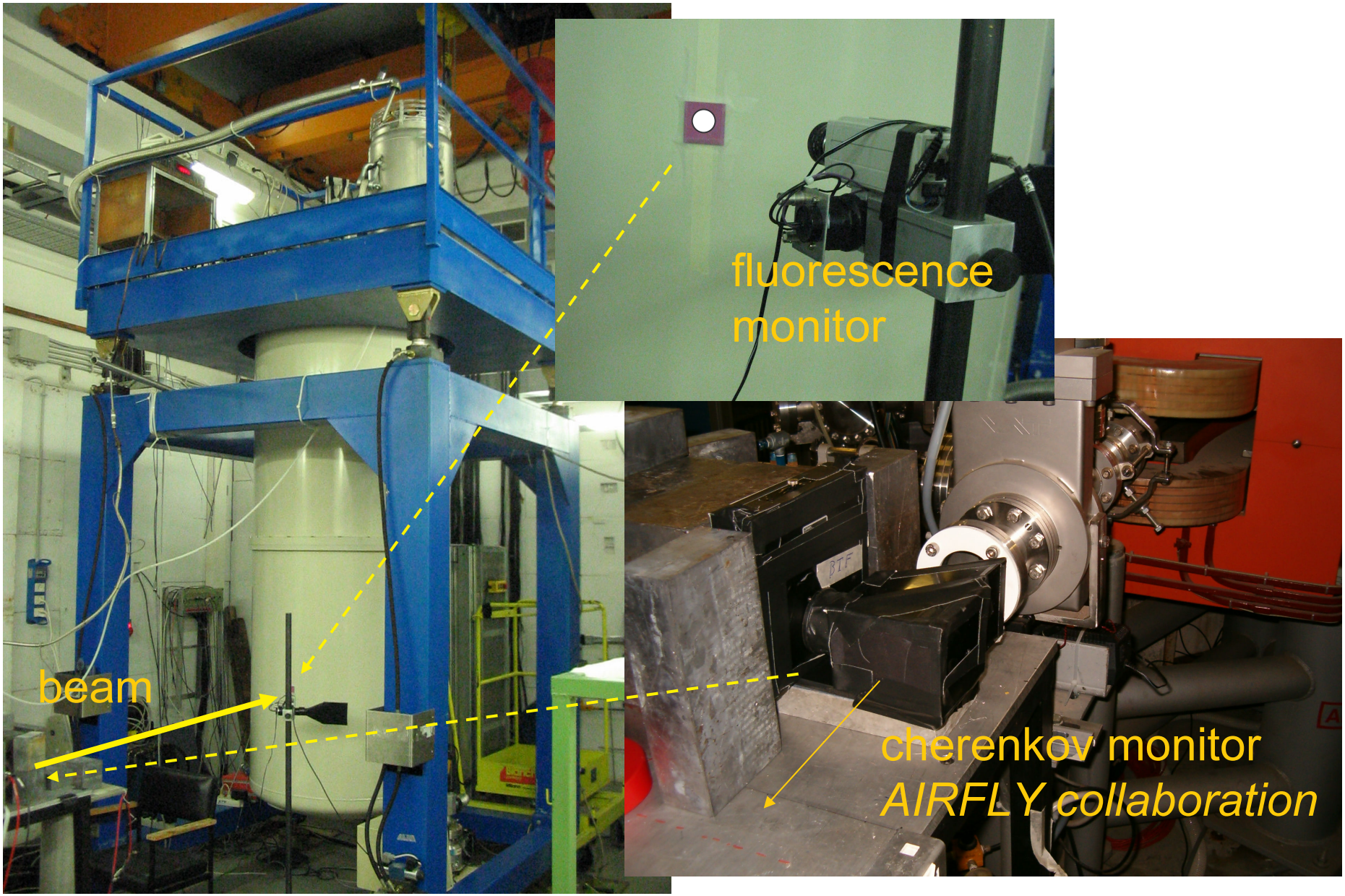


to QDC

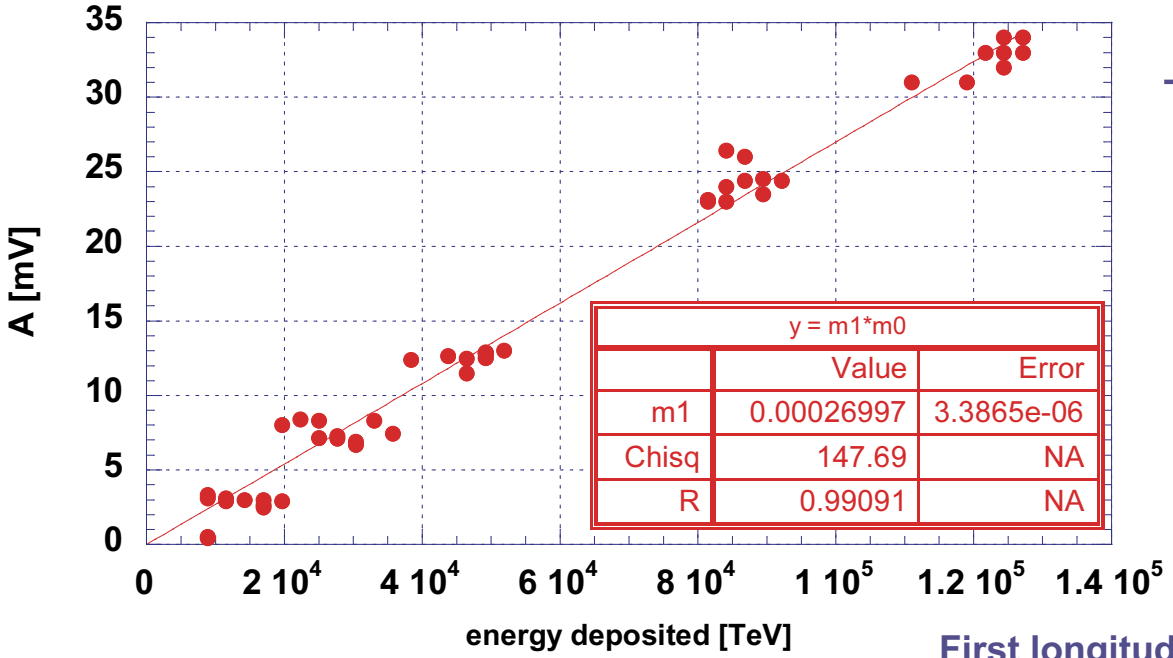


calibration coil

Intensity and position monitor



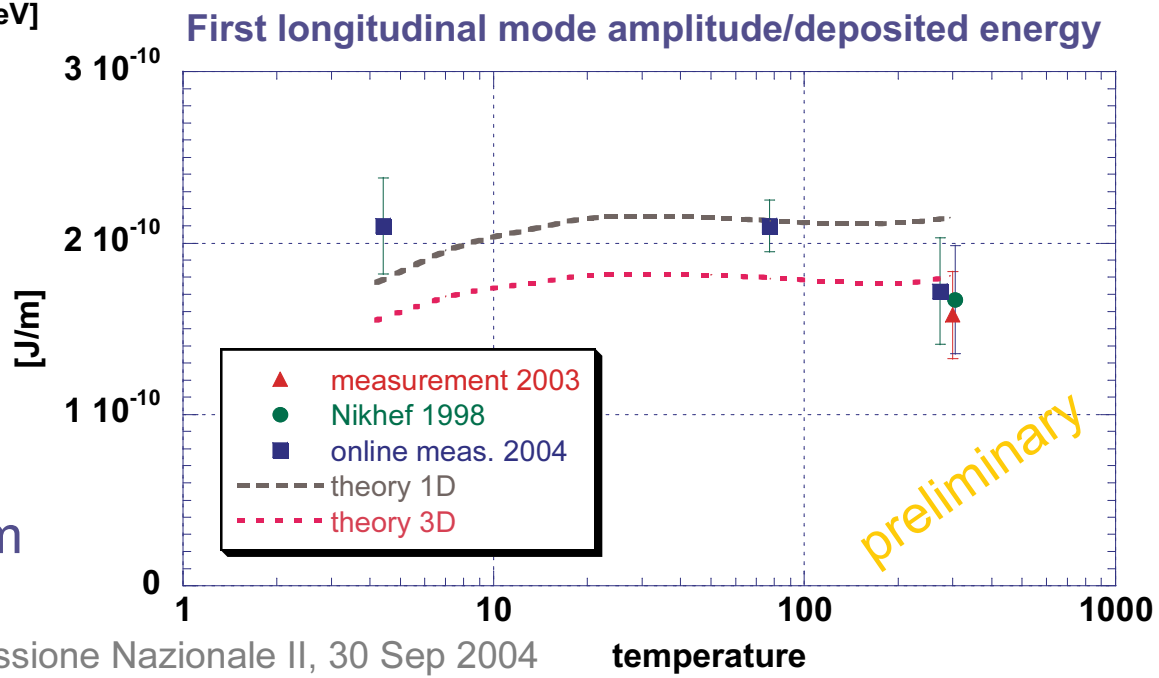
Data analysis in progress…



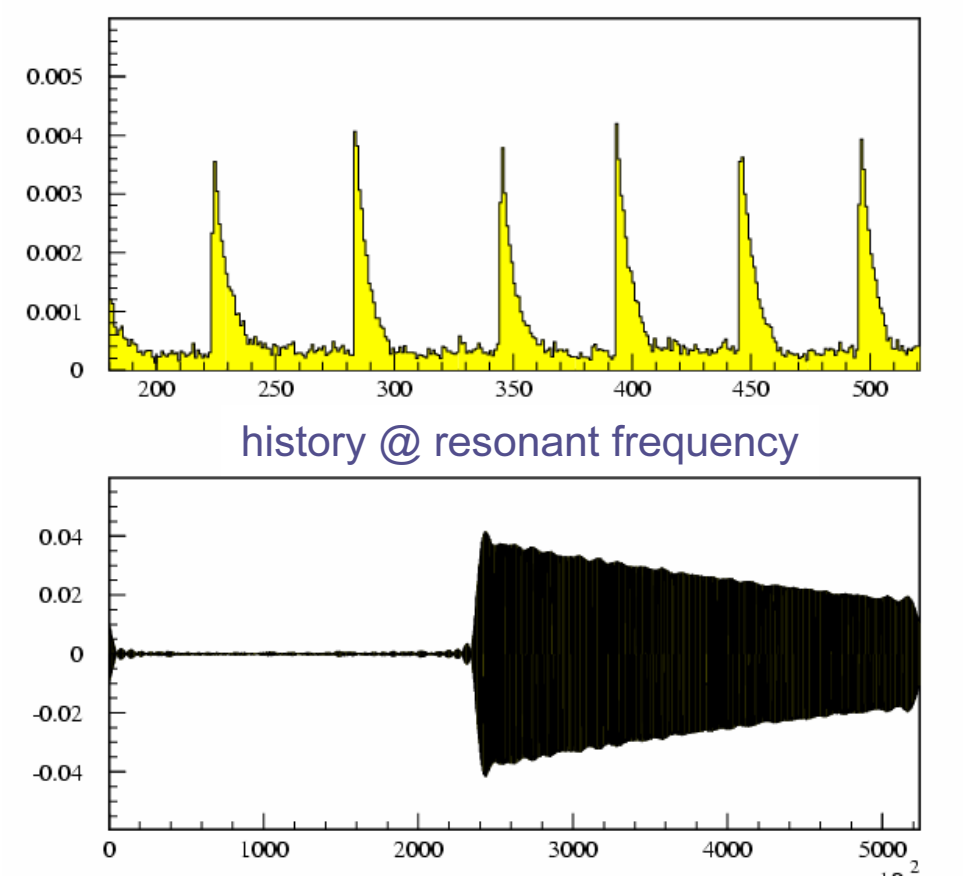
T ~ 4 K

example of data correlation amplitude measured on-line from spectrum analyzer

comparison between experimental data and theory for pure amorphous Aluminum



Data analysis target



- detailed analysis of signal characteristics (timing, noise, calibration, etc)
- evaluation on measurement and systematics errors due to beam intensity at low current

Conclusion and future plans

- *Results:*
  - first measure at low temperature. Good agreement with previous experiments (room temperature) and theory.

- *Work in progress:*
  - back-end software improvements
  - quasi on-line data monitoring and filtering implementation
  - accurate data analysis and errors evaluation

- *Phase 3:*
  - dilution refrigerator delivering by the end of 2004
  - installation and characterization (late spring 2005)
  - measurement in super-conducting state before the end of 2005

6 months delay on the planned general schedule of the experiment is due to the dilution refrigerator delivery