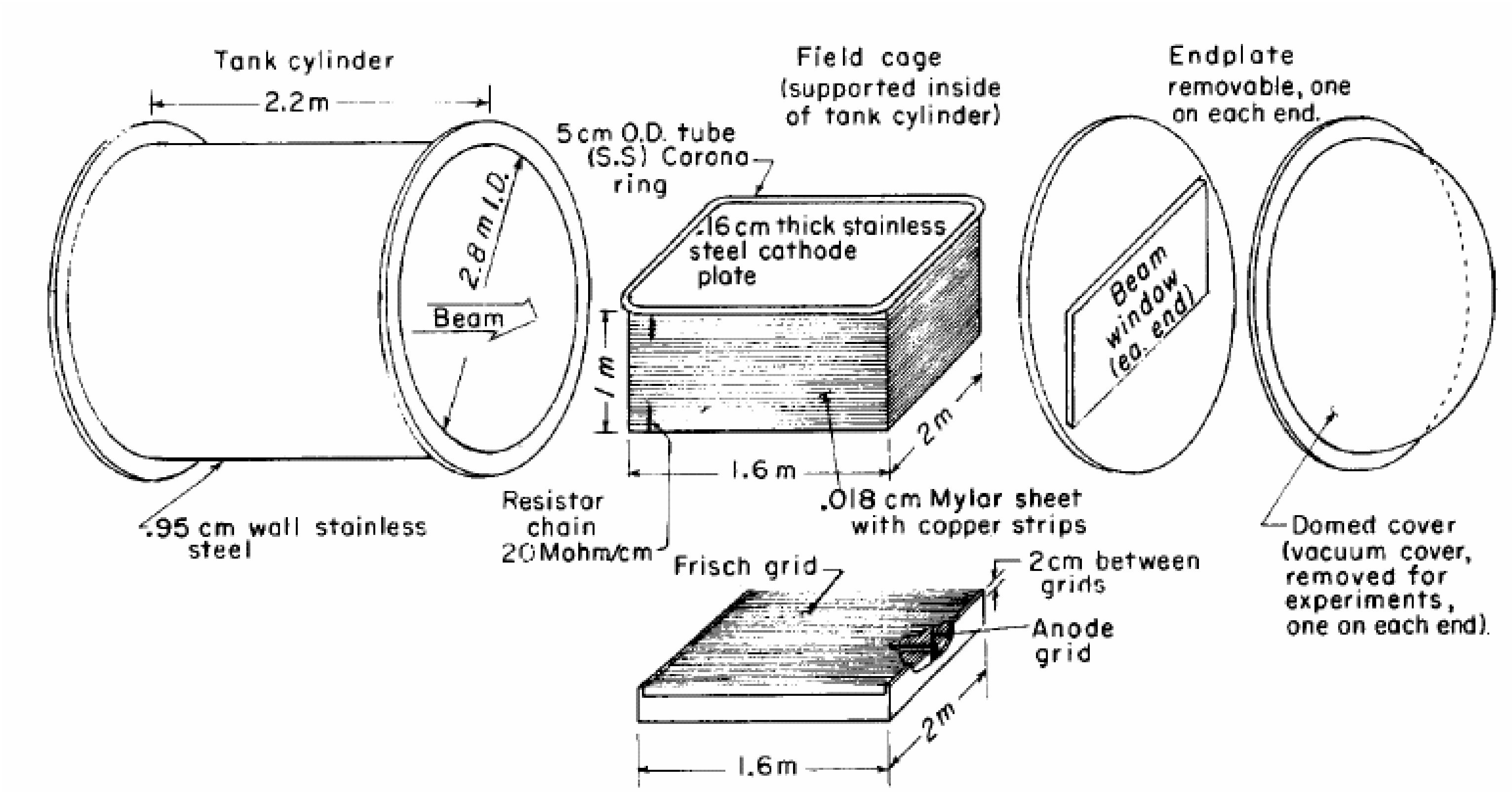
# MUSIC

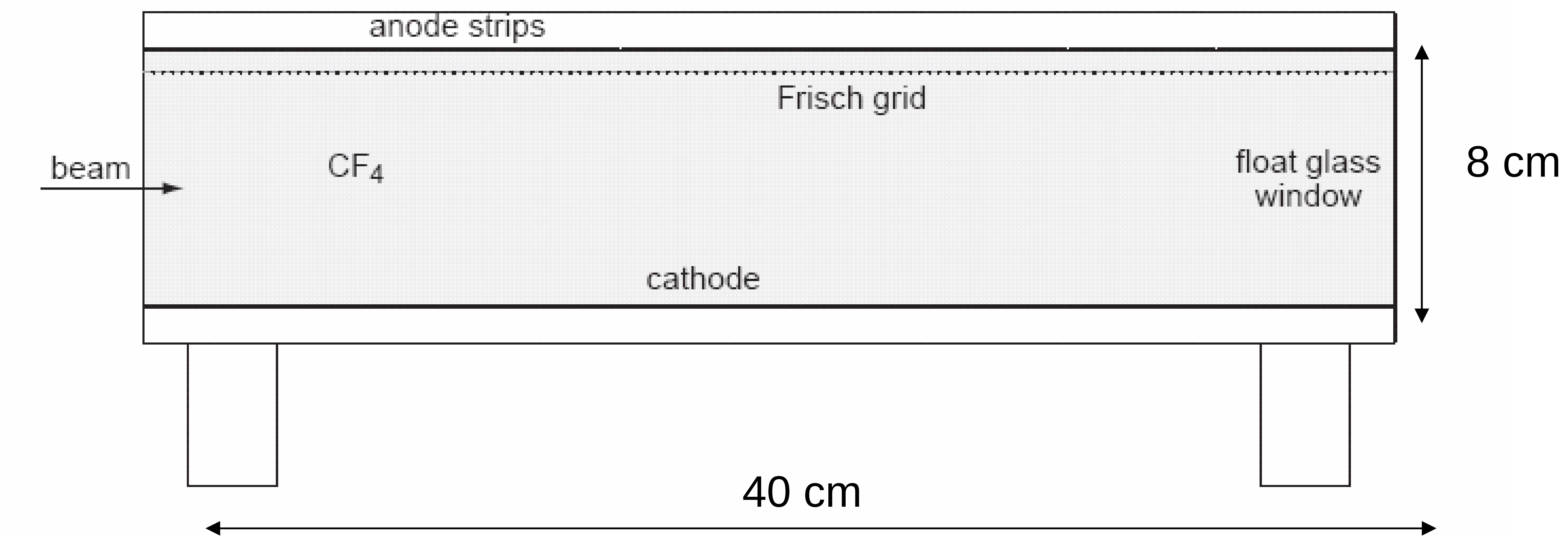
## Current development, near future plan for the PRESPEC (next RISING)




MUSIC I sketch – classical music - 1982
NIM A 255 (1987) 466

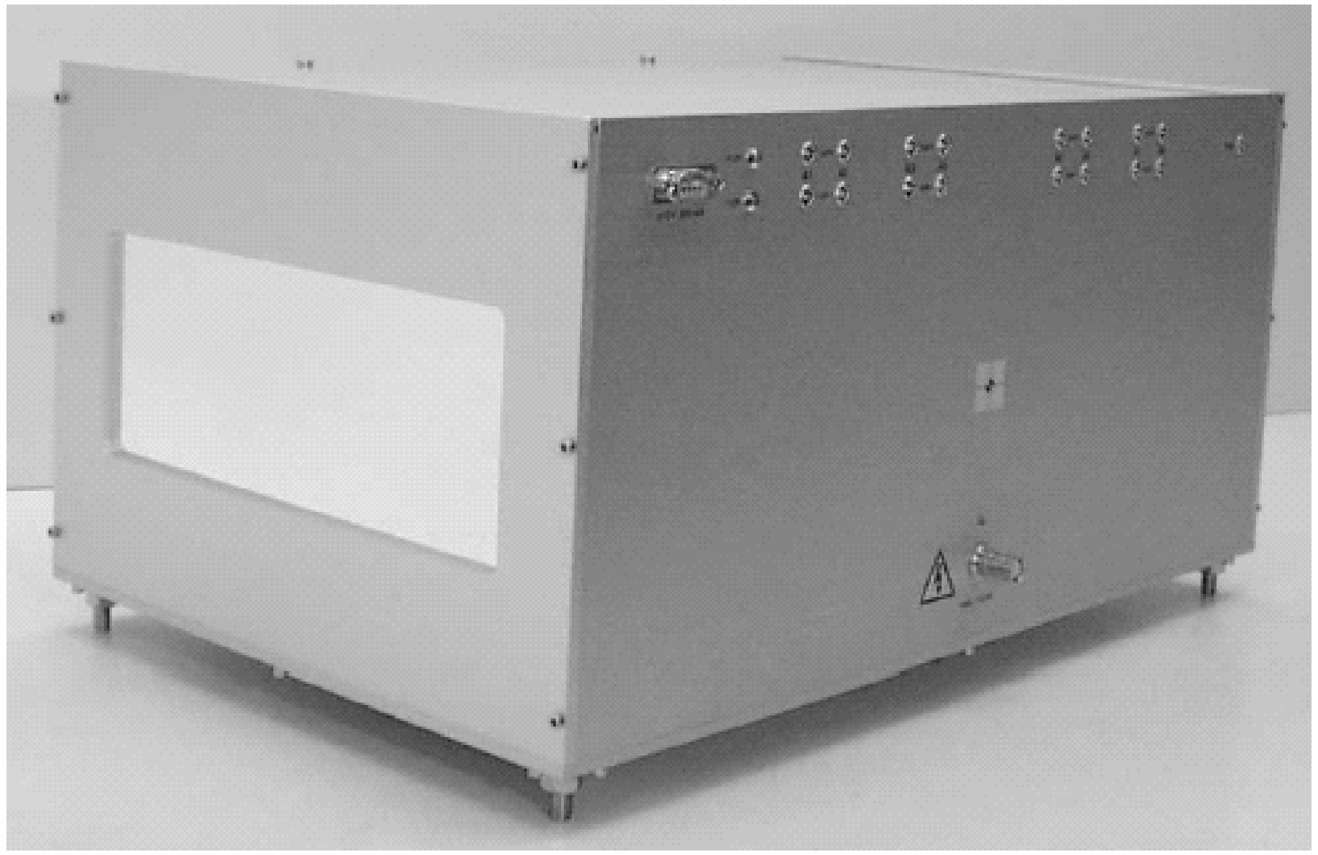
# MUlti Sampling Ionization Chamber

- Sampling the deposited energy on several anodes ($\sigma_{total}=\sigma_{anode}/\text{sqrt}(n)$ )
- Gaseous detector, easy to have large volumes
- At SIS energy : energy deposited narrower than energy loss
    - W.B. Christie et al. Nucl. Inst. and Meth. A255 (1987) 466



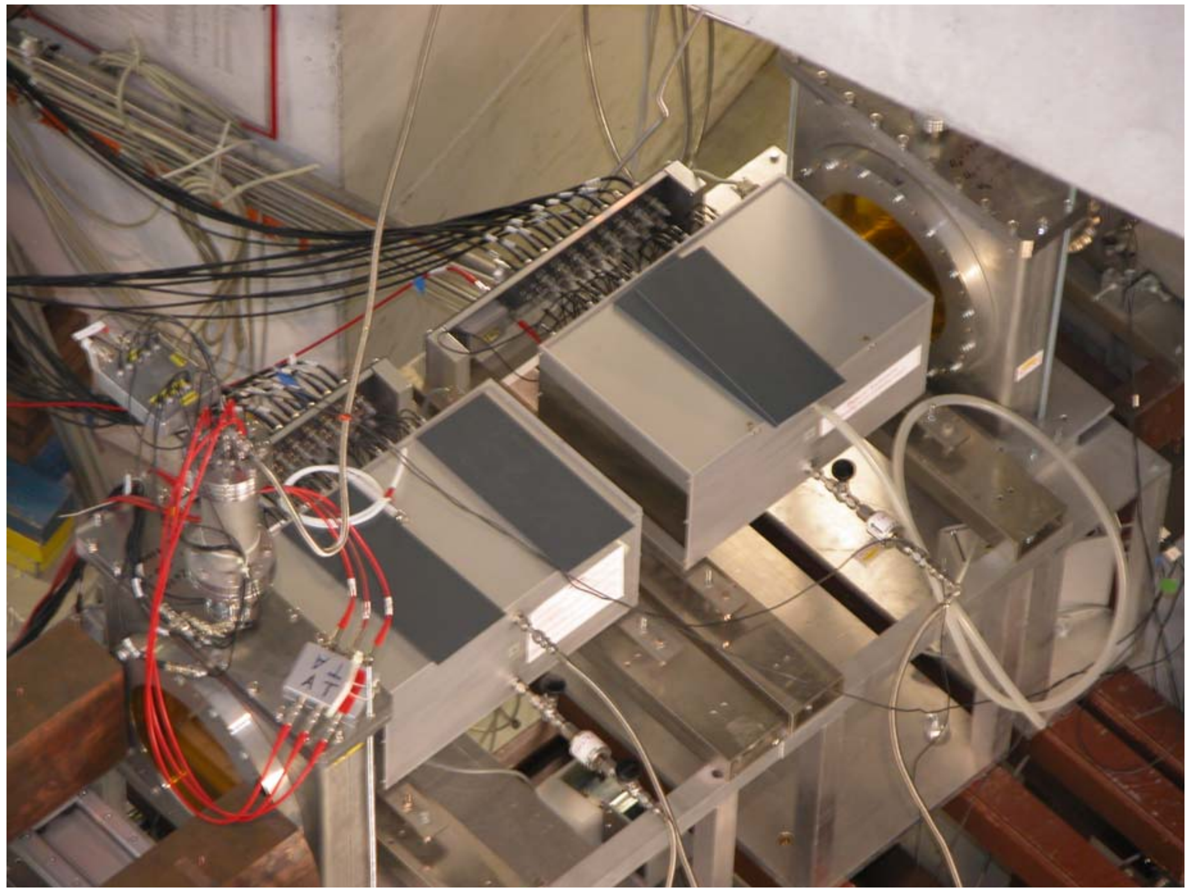

Need to assure multisampling in at least several 10 cm to get good resolution: 8 planes of 5cm

# Present FRS ΔE detector : “Munich” Music80



Routinely used at FRS:

Andreas Stolz
Robert Schneider



Two used as standard FRS setup

A stripper foil in between allows charge state discrimination for heavy ions

# Music 80 - details

**Preamplifiers**

**Common specifications**

| | |
|---|---|
| Output amplitude: | used max range $\pm 1.1$V @ 5 |
| | headroom for high rate stack |
| Risetime: | $< 100$ ns |
| Falltime | $\approx 10\ \mu$s |

**Shaping Amplifiers Specifications**

**Shaper inputs**

- internally terminated with $50\Omega$
- positive and negative input
- adjustable range (10V output) $\pm 0.15$V to $\pm 1.15$V
- Headroom for preamp signal stacking: $\pm 4$V

**Energy outputs** for each channel

- shaping time 550ns FWHM
- signal rise of timing output to shaping peak: 750ns
- Amplitude: max 10V (for standard ADC-inputs, typ. $1\text{k}\Omega$)

glued directly onto the glass plate. The anode strips are read out with an optimised charge sensitive preamplifier and shaper combination for particle rates up to 200 kHz. Since the number of generated electrons in the counting gas is roughly proportional to the square of the charge of the penetrating particle, the output voltage of the shaper is a measure for the atomic number of this particle.

# Music – PRESPEC interest

-RISING stops in September 09 then starts PRESPEC
-A new “fast-beam”/in-beam campaign is planned in 2010
-We need higher rate at S4 and S2 (limit being the cross section)

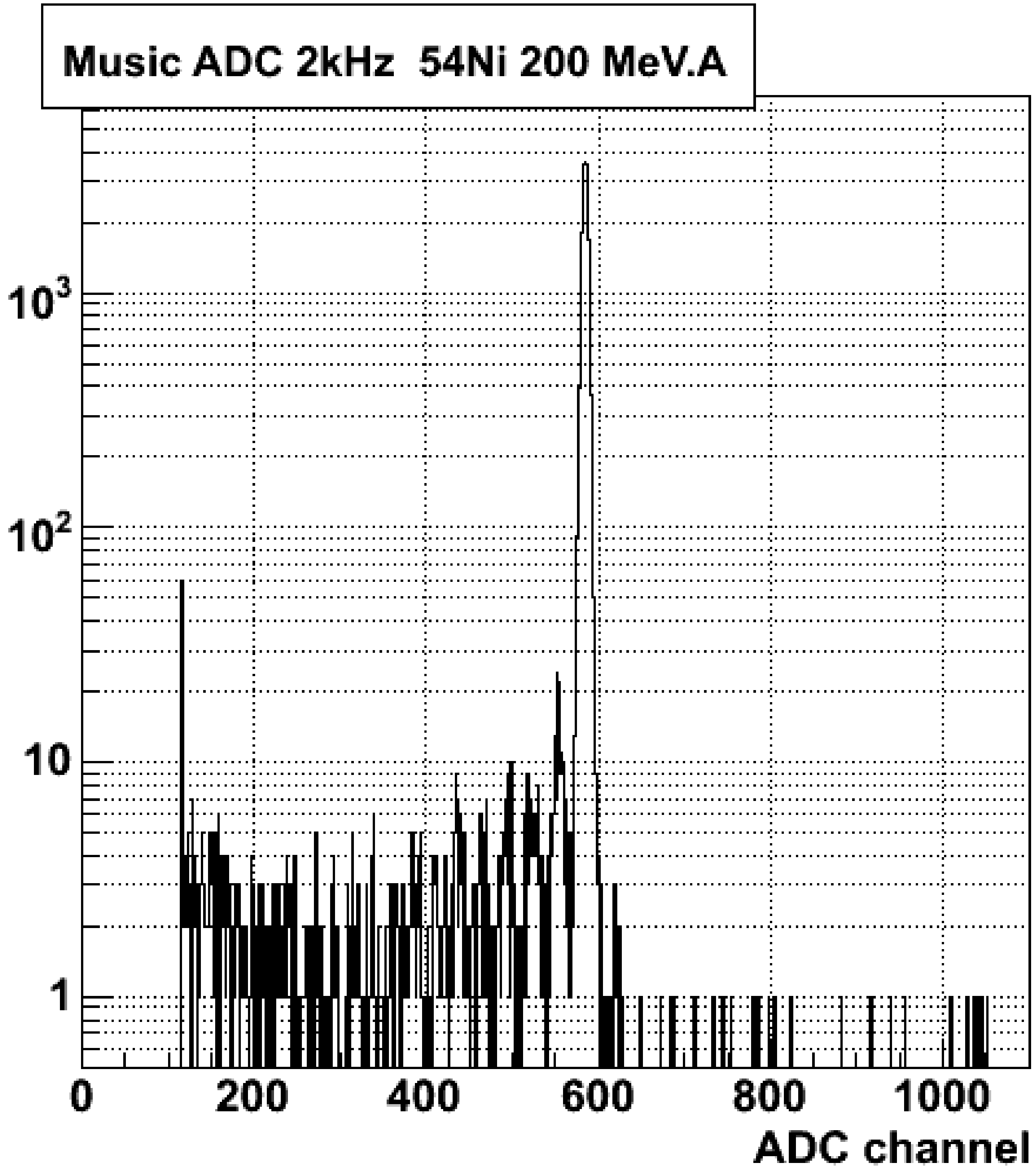
➔ one of the bottle neck could be the MUSIC80

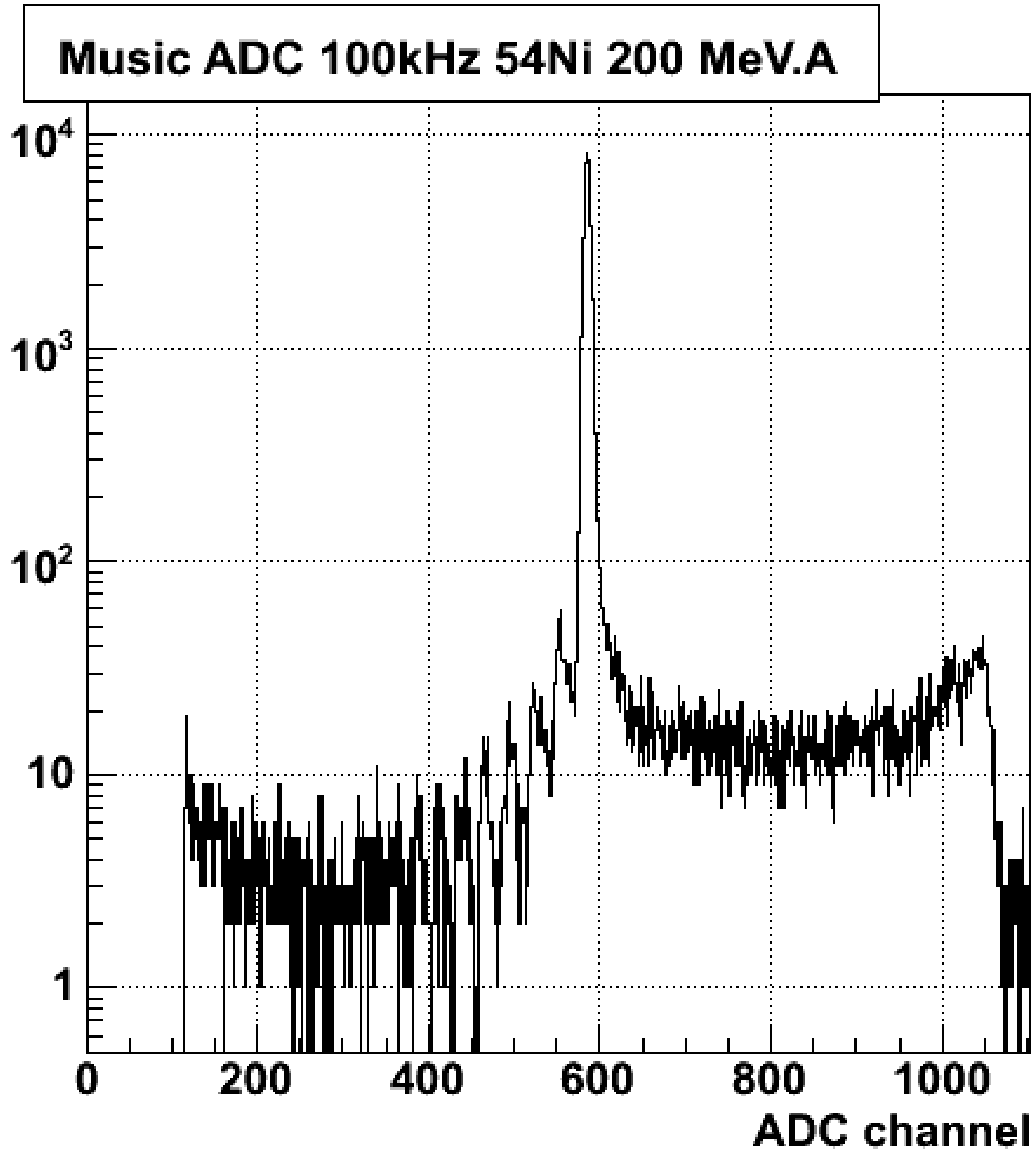
Our interest is two fold :
-See how well the Music fare presently with the current electronics
-Initiate development of new electronic/algorithm to improve the rate capability

Made two beam test :
- July 08 : RISING experiment, 124Xe beam, tested music 1kHz to 100 kHz
- Sep 08 : Slowed down test, 64Ni, tested music 1kHz to 200 kHz

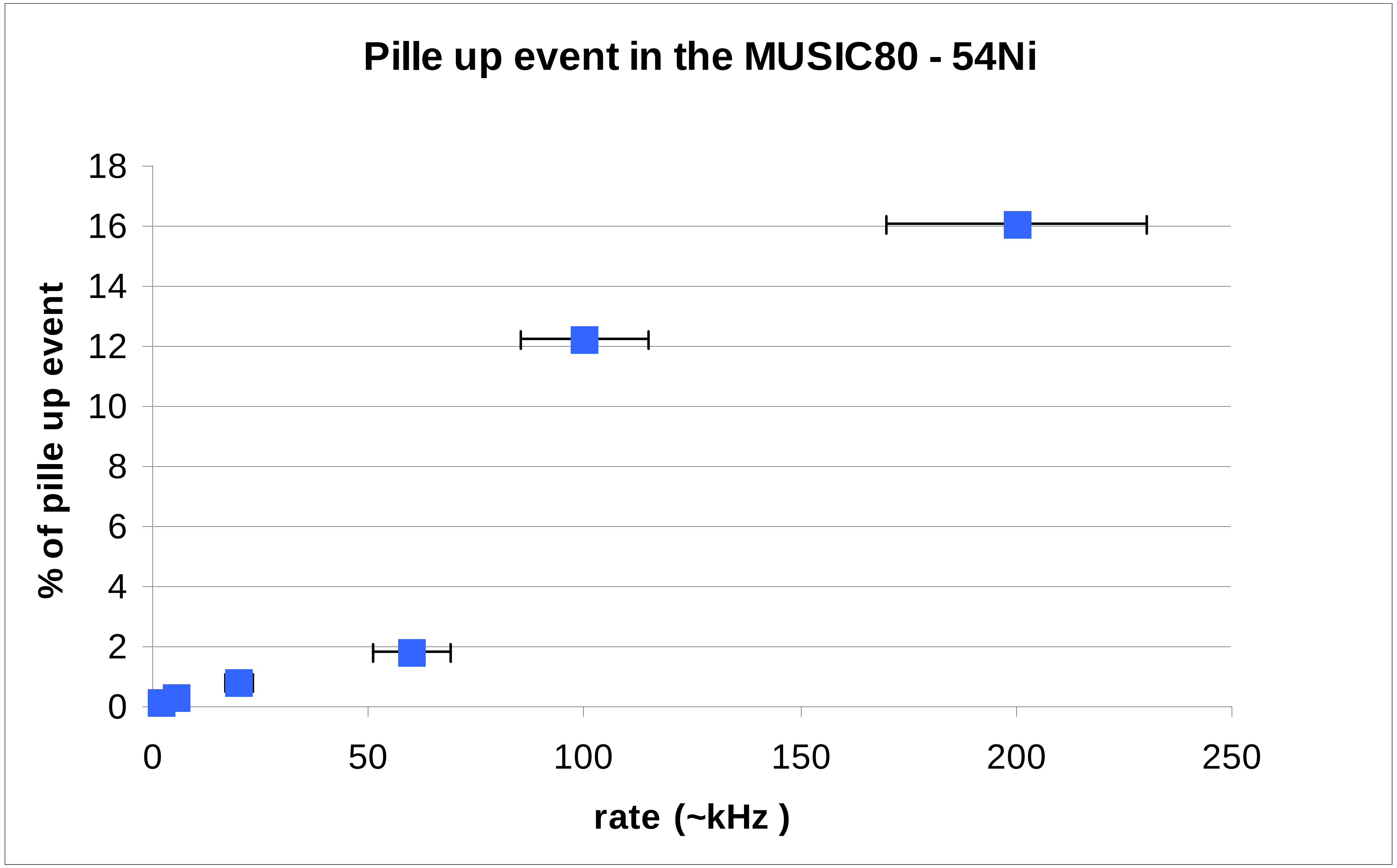
➔ Each time the pre-amplifier output of 4 anodes were connected to pipe line ADCs

# Music80 – Intensity test results



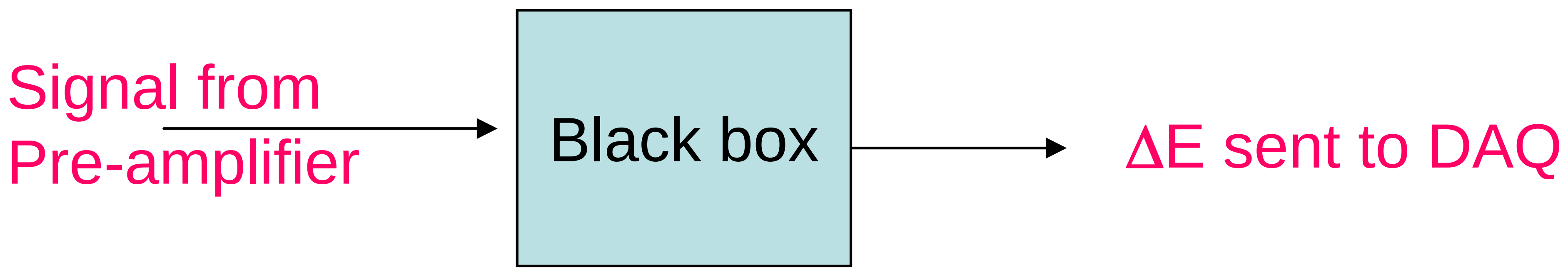
# Music 80 –Intensity test result




No took into account the “sparkyness” of the beam, neither the non perfect Rectangular shape distribution of the spill

# Music80 electronic - developement

Think of a “brighter electronics” to disentangle properly piled-up signals




Black will be :

1. an algorithm - to develop ?
2. a piece of hardware - to build ?

# Music80- developement

Collaboration with KVI : developing algorithm and implement it in FPGA chip
•Base line follower
•Pile-up inspection/disentangling
•Range of the KVI collaboration wider than this precise development

They need :

•typical signal
•typical “pille up” event to test their routine

We need to know if our assumptions made are true: ```

•Shape of signal constant with the rate
•Amplitude of the signal independent of the rate
•Shape of signal constant with the ion species

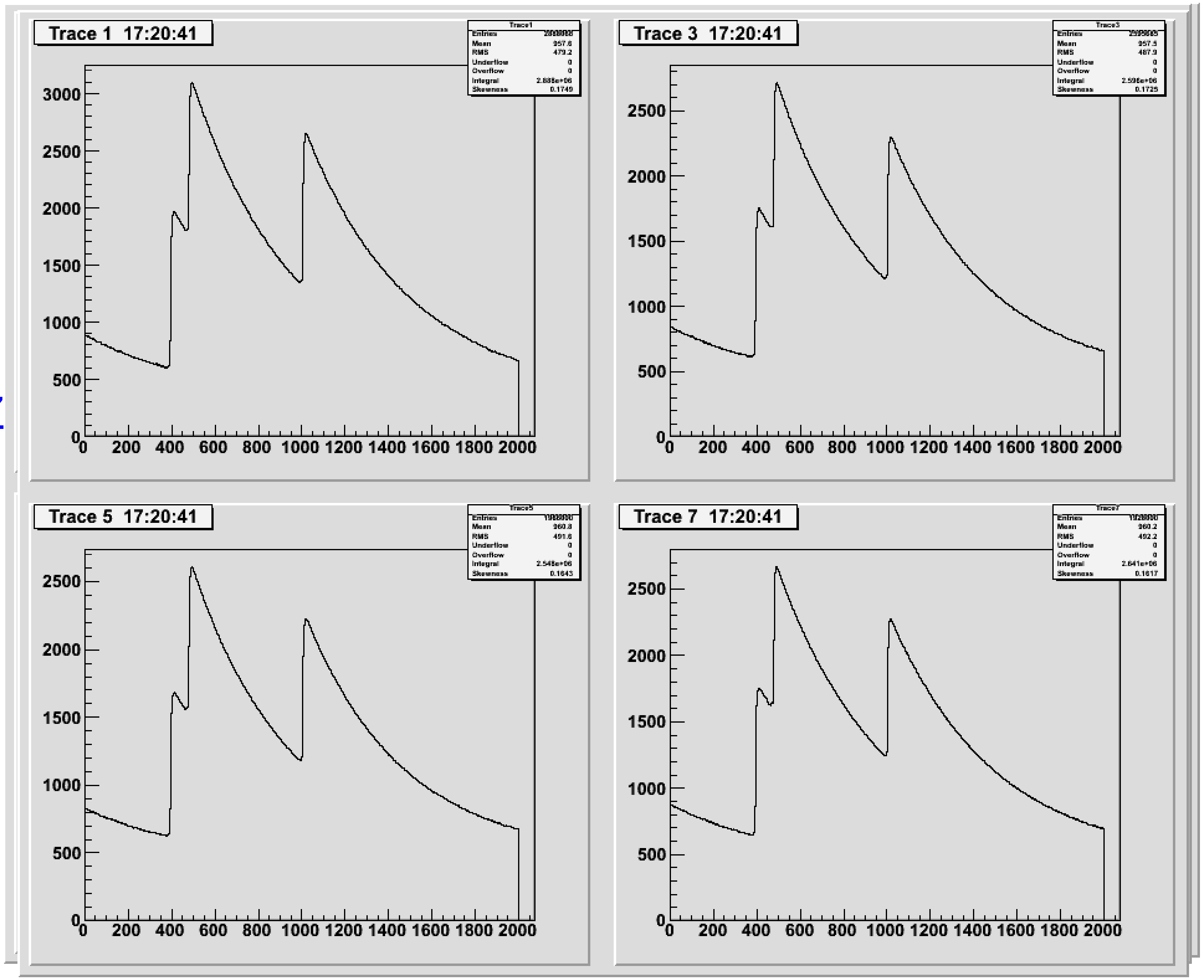
So we use 30 minutes in rising beam times to build this database

# Music80 – pulse shape collection

Some examples of what we got :

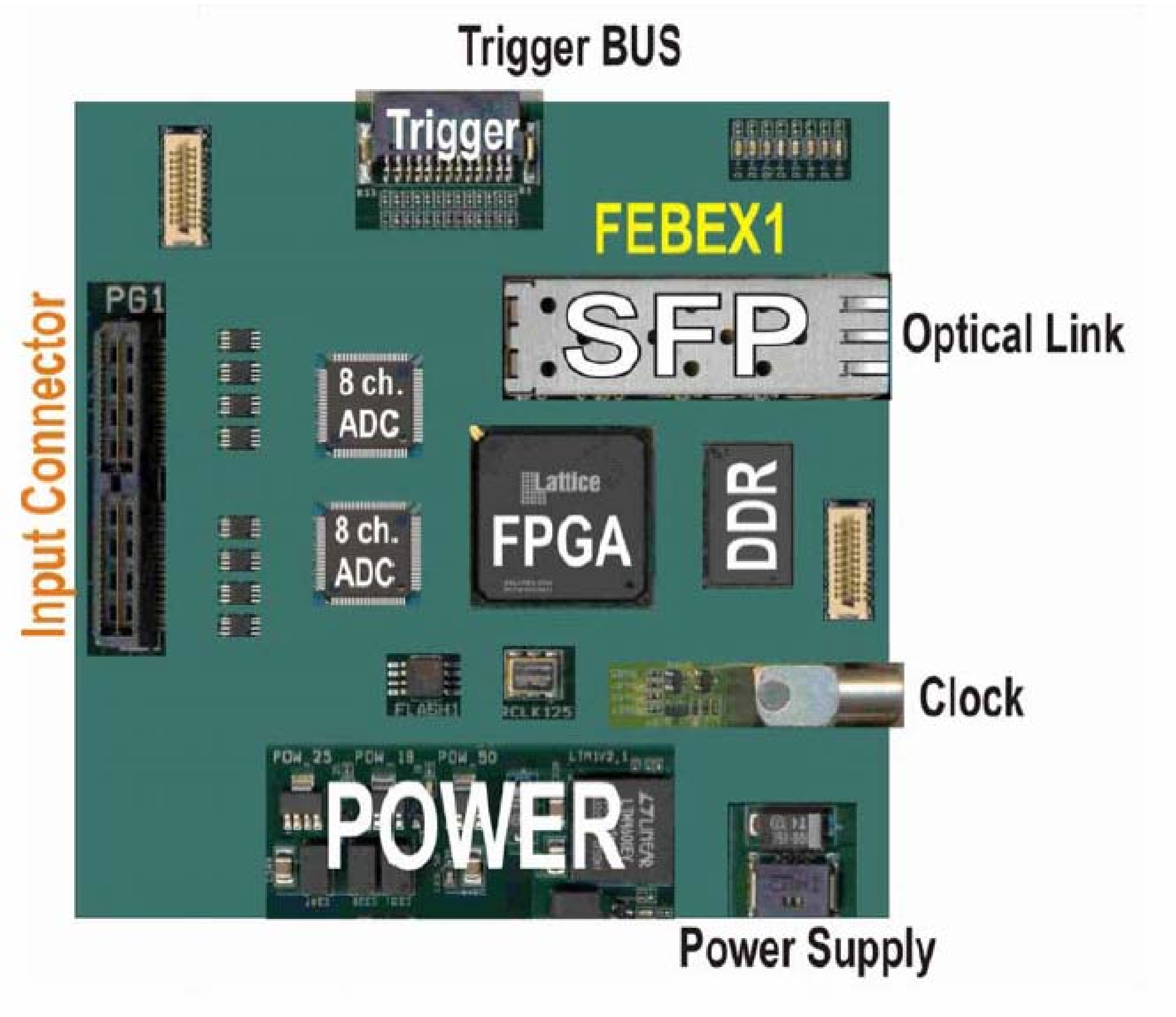
$^{124}$Xe, 1 kHz to 50 kHz
Digitized 100 MHz
With v1724 CAEN

$^{64}$Ni, 1kHZ to ~100kHZ
In DGF 4C (40 MHz)



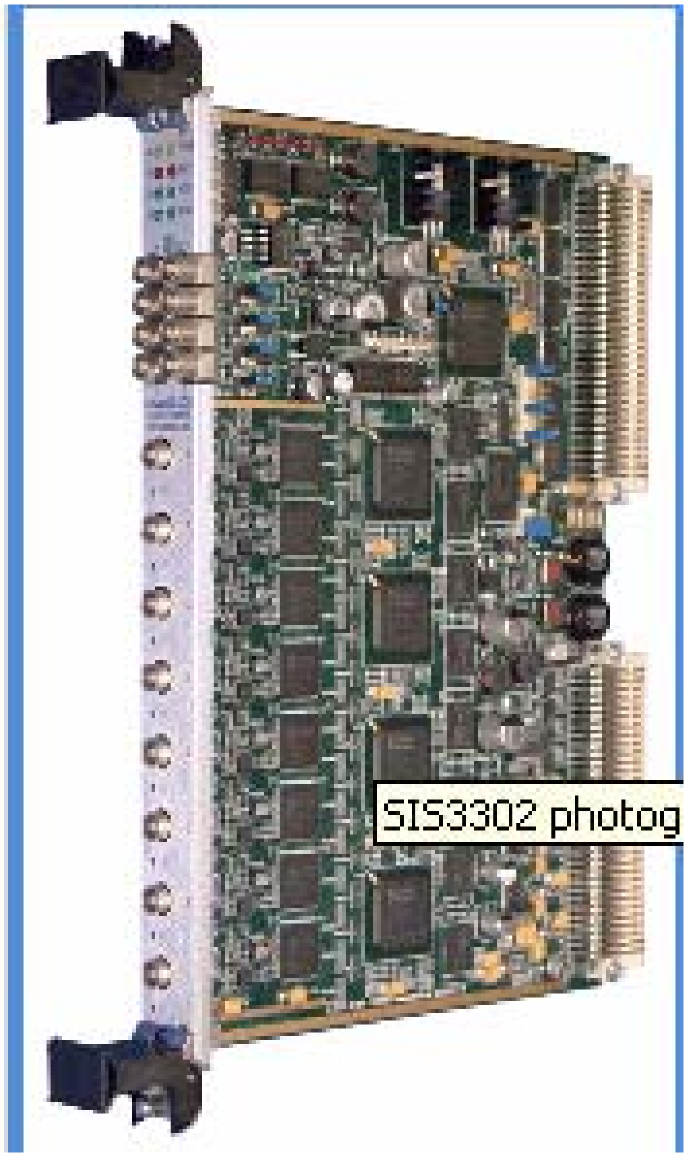
# Music80 – foreseen options

Long range term :



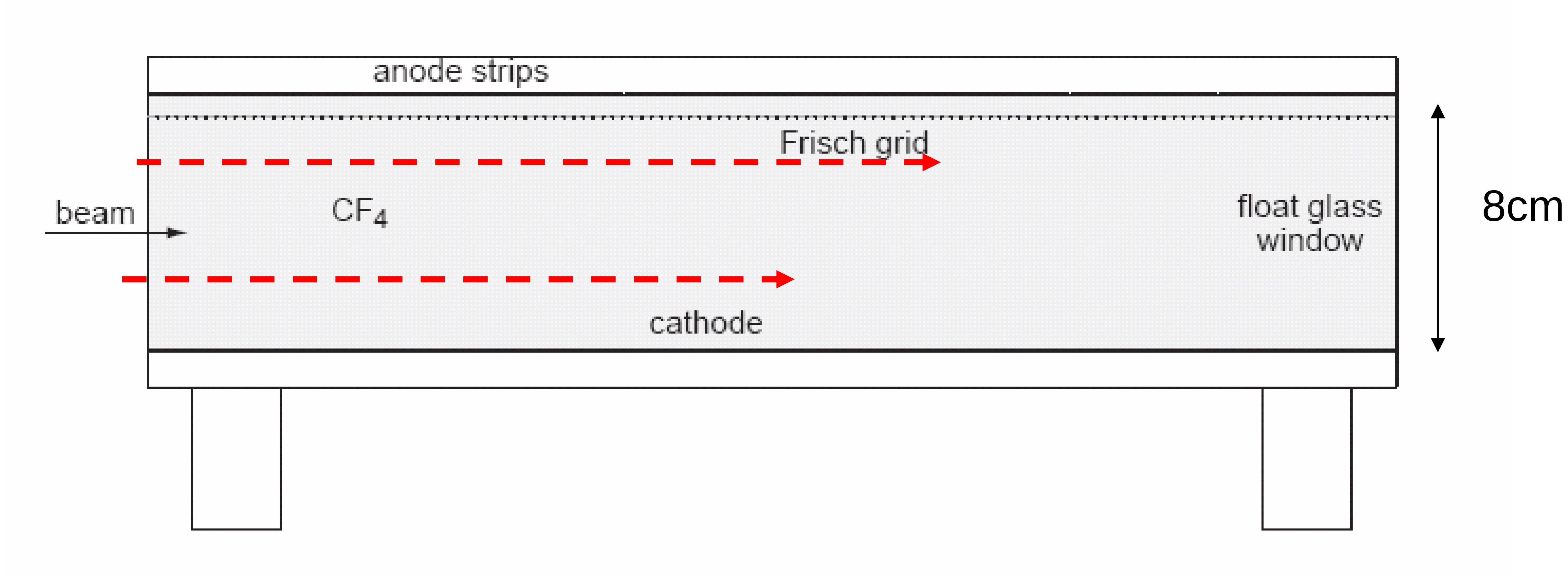

With KVI algorithm
Will be used for other application

Short range term :




With pile-up inspection

# Music80 - limitation




This will always be a limitation : speed of electrons is ~10 cm/us

Work around : anode segmentation, and XY detector before/after

# TEGIC – from RIKEN

## High-rate particle identification of high-energy heavy ions using a tilted electrode gas ionization chamber

K. Kimura[a,*], T. Izumikawa[b], R. Koyama[c], T. Ohnishi[d], T. Ohtsubo[c], A. Ozawa[d,1], W. Shinozaki[c], T. Suzuki[c,2], M. Takahashi[c], I. Tanihata[d], T. Yamaguchi[d,3], Y. Yamaguchi[c]

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**Abstract**

A high-rate particle identification device for high-energy heavy ions has been developed which utilizes a stacked configuration of grid-less parallel plate gas ionization chambers with thin anode–cathode gaps. The high-rate capability of this chamber was realized by adopting bipolar shaping of anode signals and by the suitable choice of a counter gas. $Z$-resolutions of 0.2–0.3 were obtained for nuclear fragments of $^{40}$Ar at 95 A MeV with an intensity as high as $10^6$ cps.


K. Kimura et al. Nucl. Inst. And Meth. 538 (2005) 608

# TEGIC – from RIKEN

K. Kimura et al. / Nuclear Instruments and Methods in Physics Research A 538 (2005) 608–614

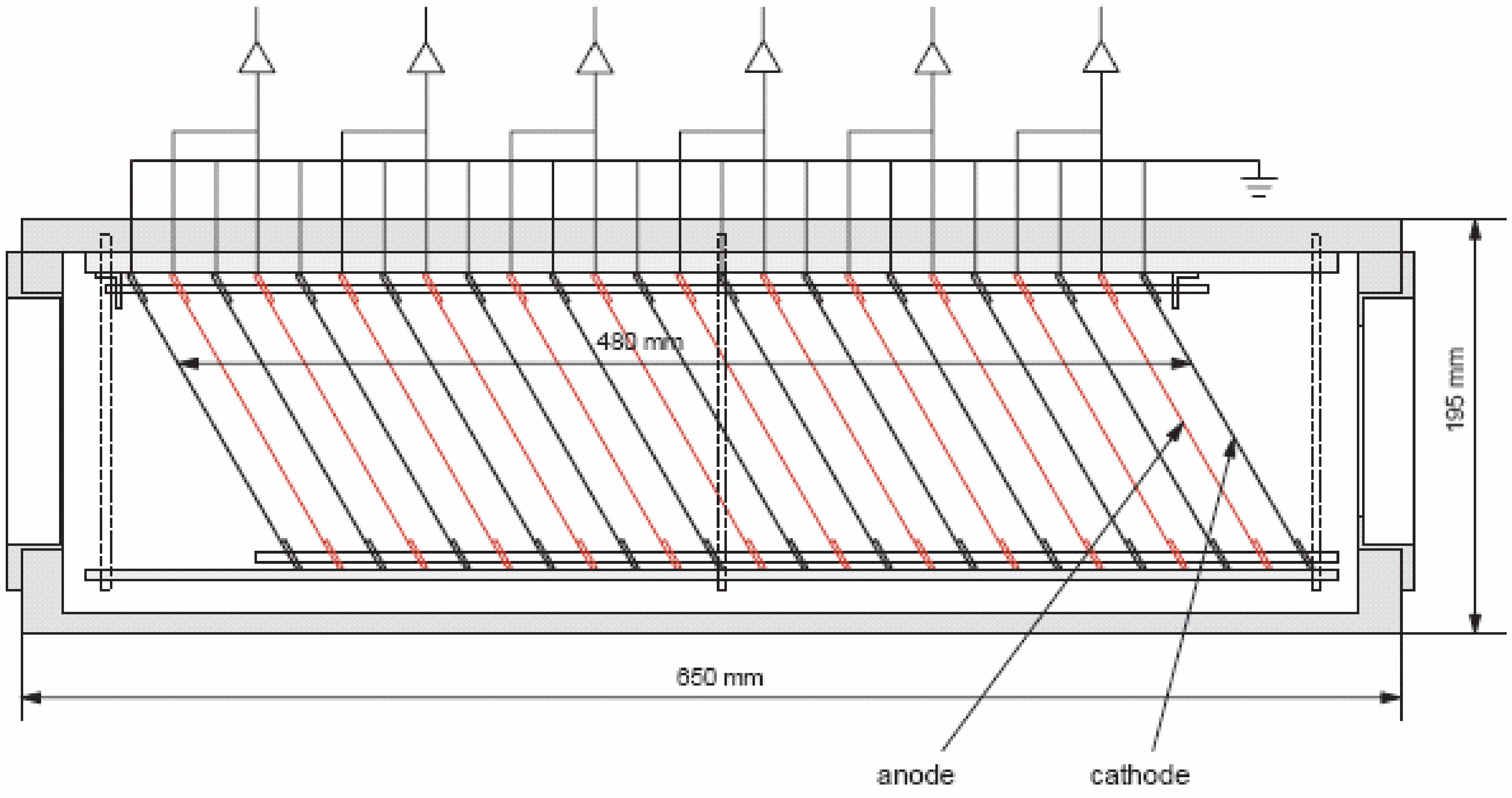



Fig. 1. Cross-sectional view of the tilted electrode gas ionization chamber (TEGIC).

No frish-grid : collect charge and induction but proportional to $\Delta E$
can have anode in the beam line
Induction from positive ions ➔ clean up by using bi-polar shapers (?)

# TEGIC – from RIKEN

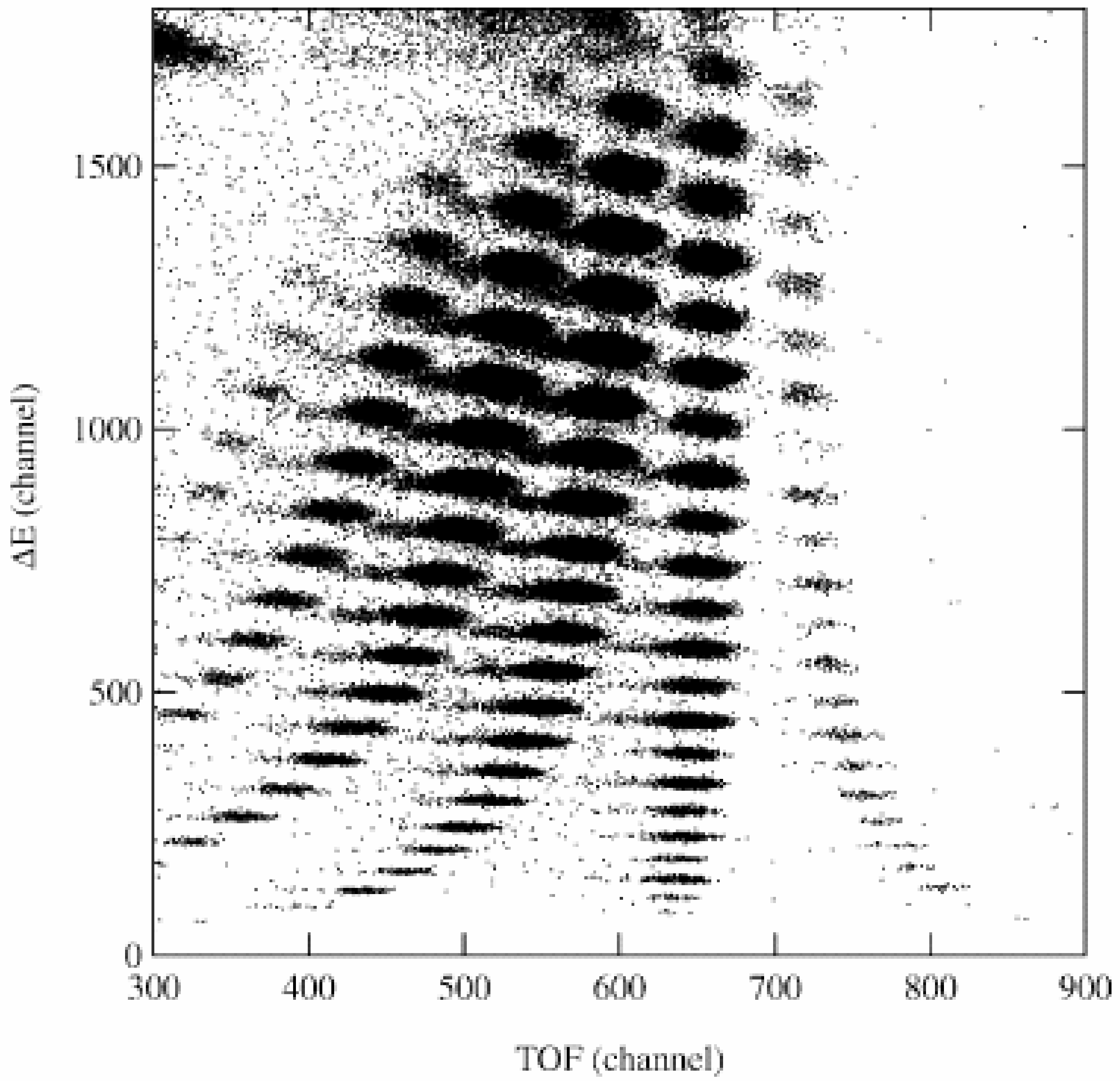



Fig. 2. Two-dimensional scatter plot of $\Delta E$ vs. TOF for the secondary beam produced by nuclear fragmentation of $^{56}Fe$ at 90 A MeV.

$^{56}$Fe fragmentation at 90A.MeV

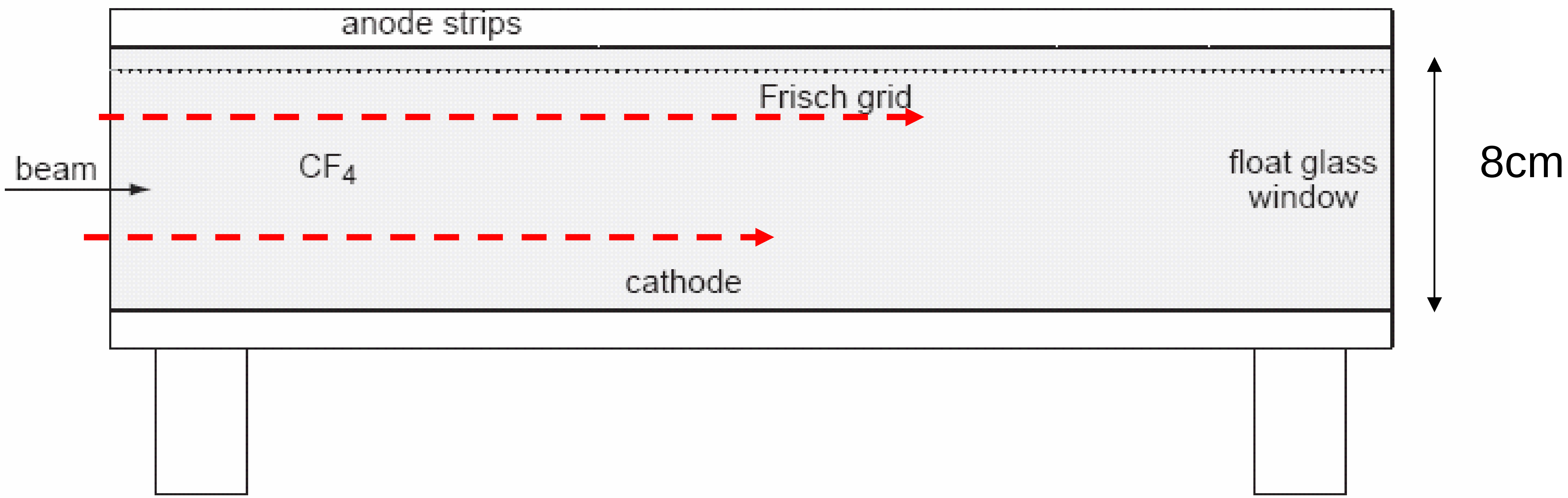
Rate capabilities :
Pille-up 40% at 320 kHz
75% at 1 MHz

Report a loss in resolution (minimal) in the 56Fe Fragmentation at high rate

Solution????

# Gaseous solution for ΔE???

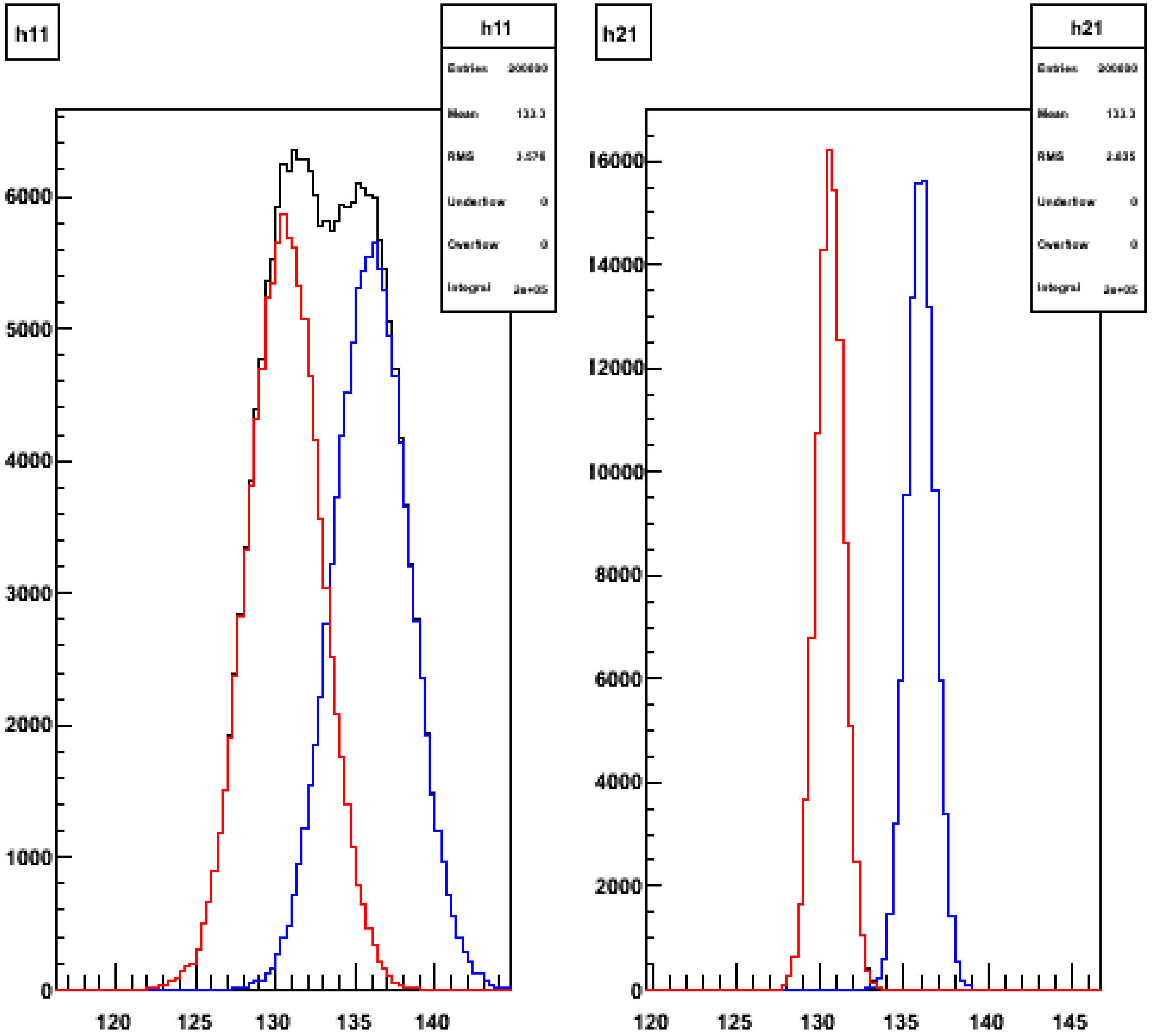
Music type detector can fit large area and if enough depth (30-40cm) give good ΔE




If X-Y tracking and pixel zed anodes this is not a problem anymore, one can disentangle tracks if not in the same plane.

This concept works for high beam intensity (106) and frish grid protect for the diffusion

One could think of a ground of MICROMEGAS/GEM




Energy loss and straggling for 500 MeV/u Sn and In in one strip (left) or 8 strips (right)

In reality the distribution are sharper because we measure the energy deposition