FRS expert team: status and development

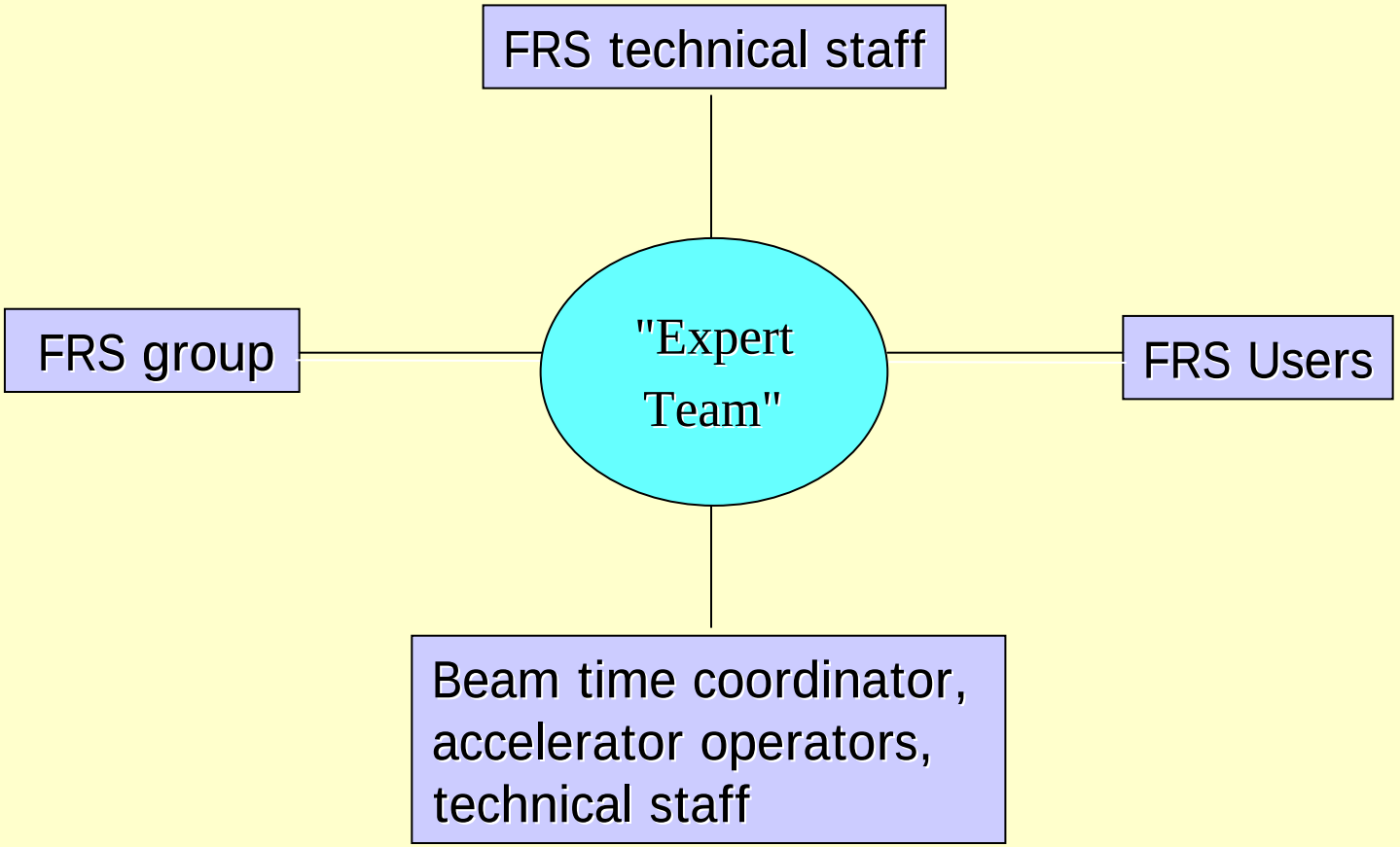
C. Nociforo on behalf of the Expert Team
GSI, Darmastdt

Goal achieved and 2010 activity

- Detector developments
- Electronics & DAQ
- Go4
- Documentations
- FRS000 and other experiments

Perspectives

Interactions



FRS expert team

In 2008: J. Kurcewicz, C. Nociforo (coordinator), J. Winfield
S. Pietri (Rising exp.)
A. Kelic and M.V. Ricciardi (Cave C exp.)

Main duty was the preparation and realization of FRS beam time, including FRS000.

FRS000 was dedicated to FRS developments and in training PhD students and post-doc in running the FRS.

We have a laboratory (room 1.187) for testing detectors and electronics.

Presently: A. Estrada, F. Farinon, J. Kurcewicz, C. Nociforo, S. Pietri, A. Prochazka, S. Terashima, H. Weick and J. Winfield

Goals in 2009

(10 days parasitic FRS000 beam time)

- Time Projection Chambers (TPC)

  part of PhD thesis of *A. Prochazka*

  Manual: *http://www-w2k.gsi.de/frs/technical/FRSsetup/detectors/tpc.asp*

- Isomer TAGger (ITAG)

  part of PhD thesis of *F. Farinon & GSI Report 2009*

  Manual: *http://www-w2k.gsi.de/frs/technical/FRSsetup/detectors/itag.asp*

- **Muti-event DAQ**

  C. Nociforo, N. Kurz, GSI Report 2009

- **Diamond** test

  see *Shoichiro Kawase* report, 2009 GSI summer student

  C. Nociforo, Carat09 workshop

- MUSIC test

  K-H Behr et al., GSI report 2009

Activity in 2010

(supporting the FRS/ESR experimental program)

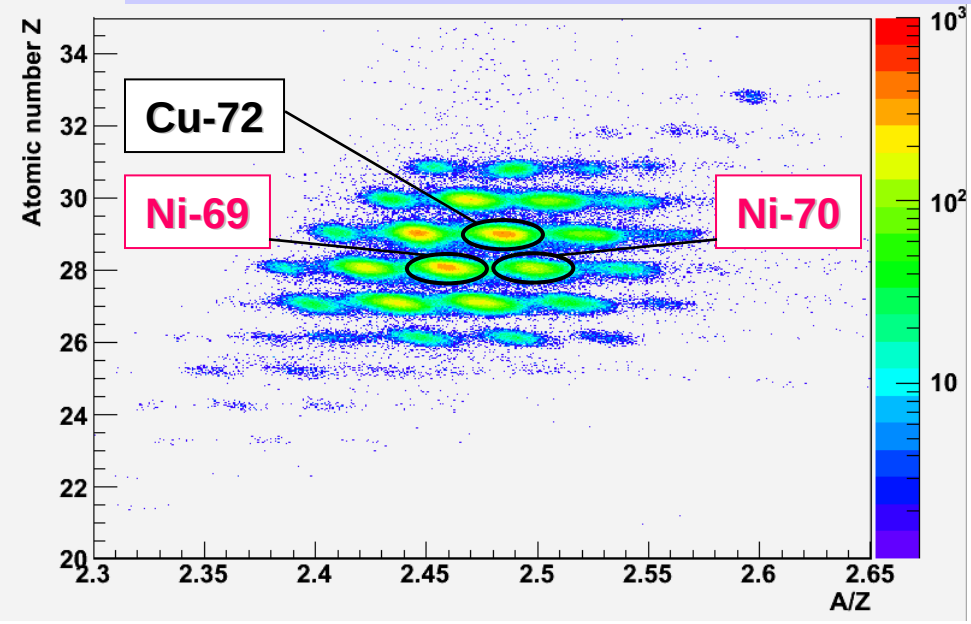
- **S272** experiment (Mar-Apr)
- E082 (Apr-May)
- E084/**Belen test** (Jul)

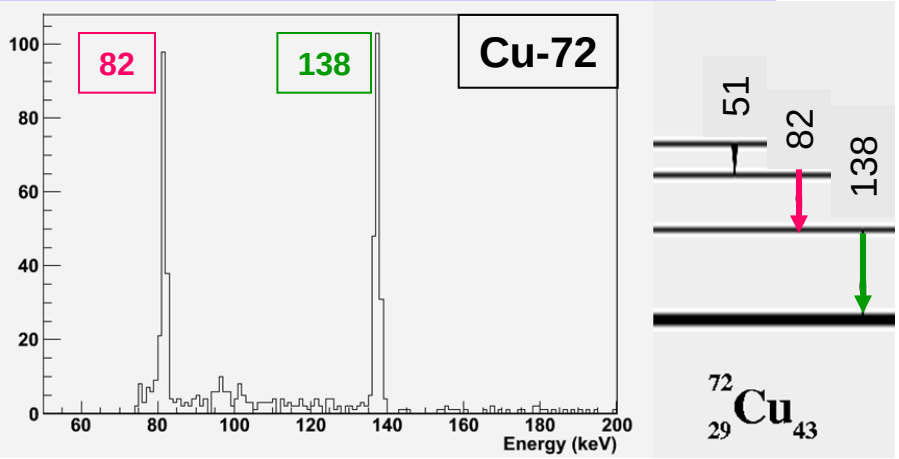
  DAQ changes: **RIO4** in the FRS crate
  F4 crate for ITAG electronics a
  (see *http://www-w2k.gsi.de/f lectronics/VMEcrate0.asp)*
  multihit TDC (unpacking plemented in Go4)
  go4 version used v4.04.01 *(soon update to v4.04.2)*

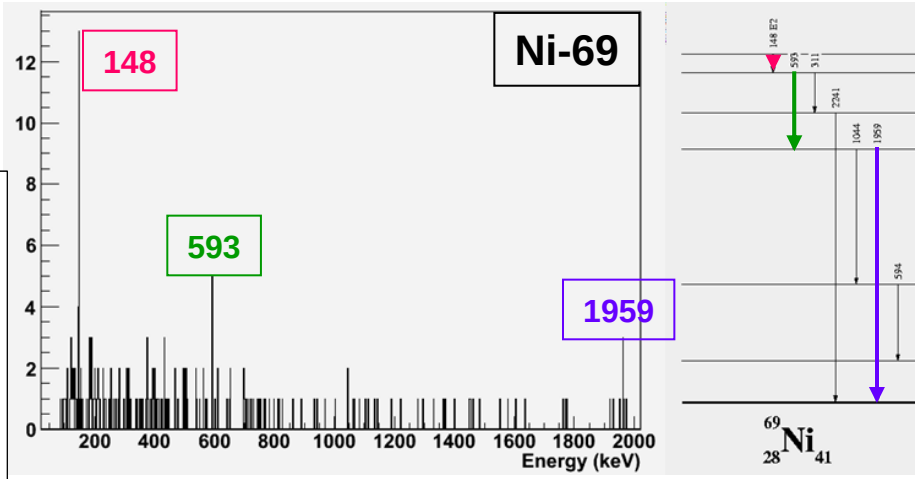
In total: ~150 days

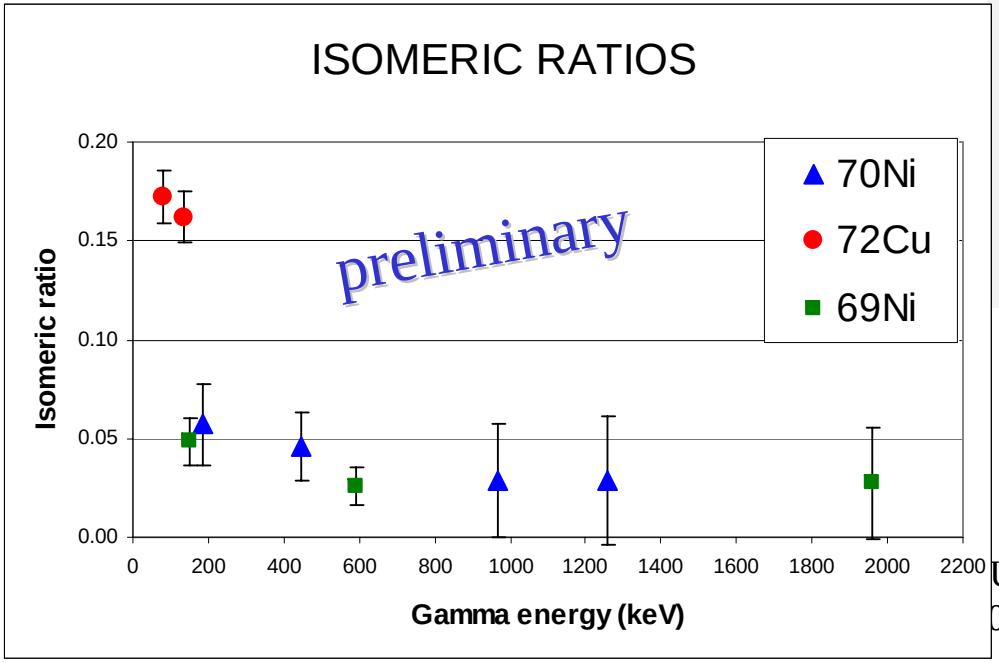
- Cave C exp: S393/S306, S389 (Aug-Oct)
- **Prespec** exp. (Sep-Nov), S387 (Oct), **FRS000** (Oct)

Isomer tagging at S272









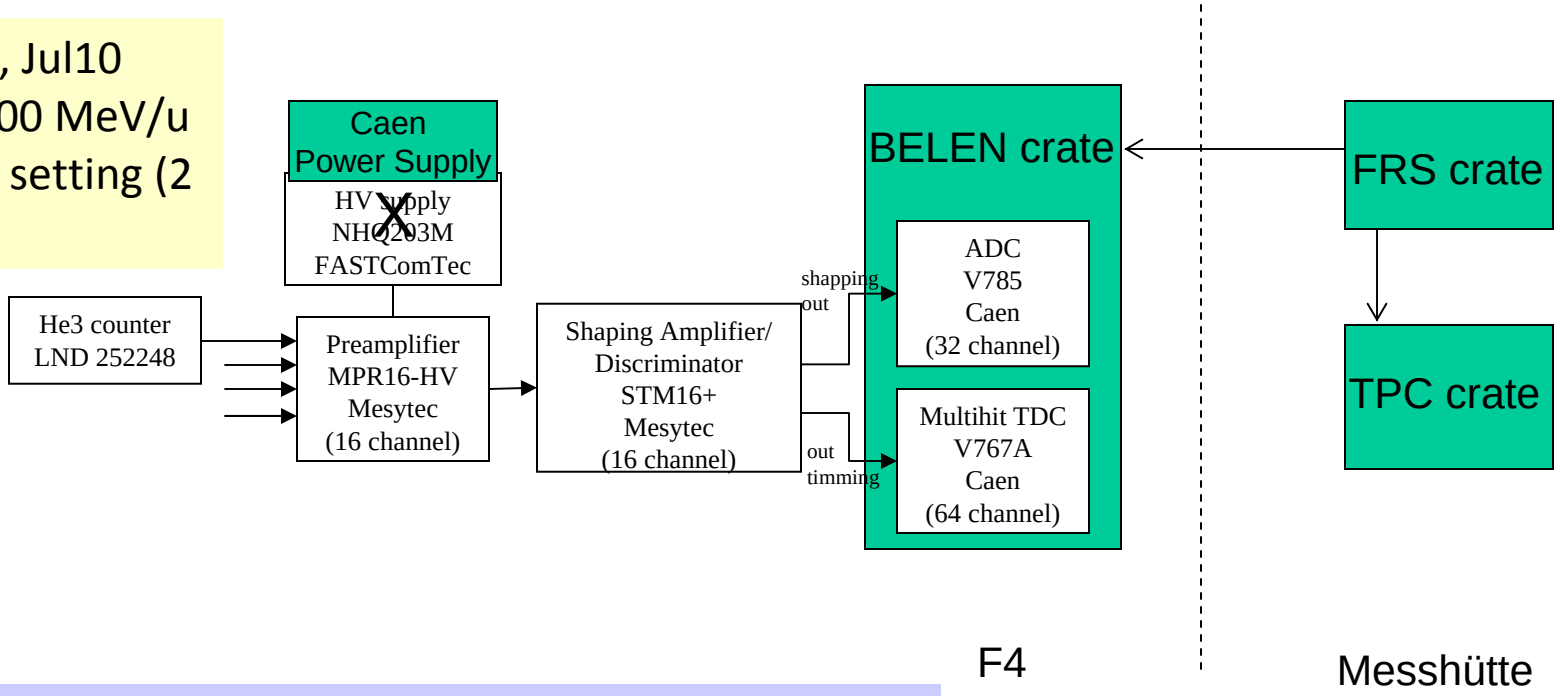
S272 Mar10, ^{86}Kr @500 MeV/u
^{69}Ni setting, PID confirmed by ITAG after 2-3 hours

F. Farinon

BELEN test

Nr.6 ^{3}He counters+electronics available

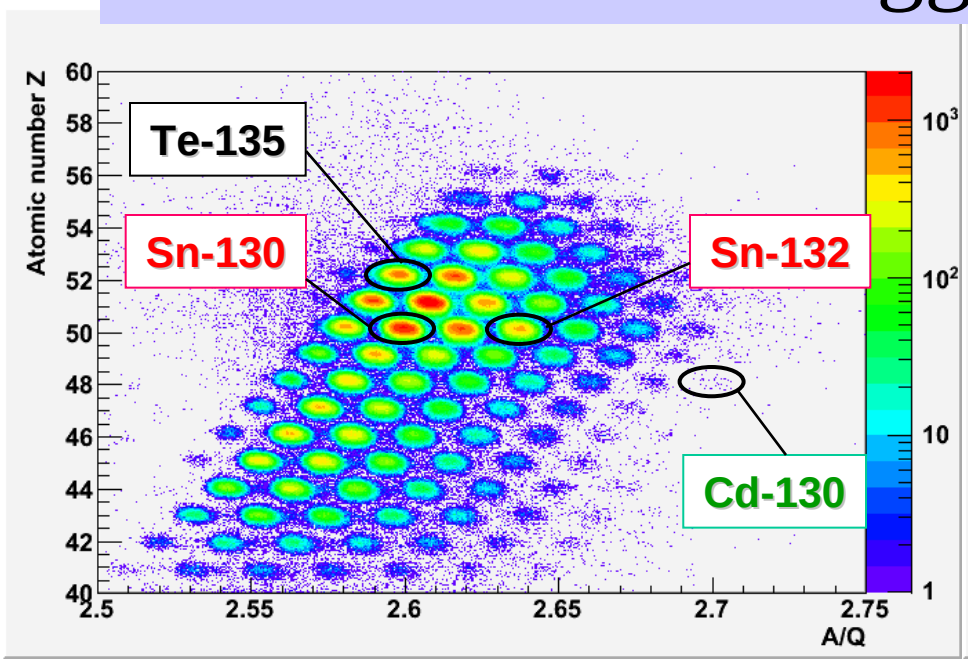
E084-F4, Jul10
^{238}U @400 MeV/u
^{130,132}Cd setting (2 nigths)

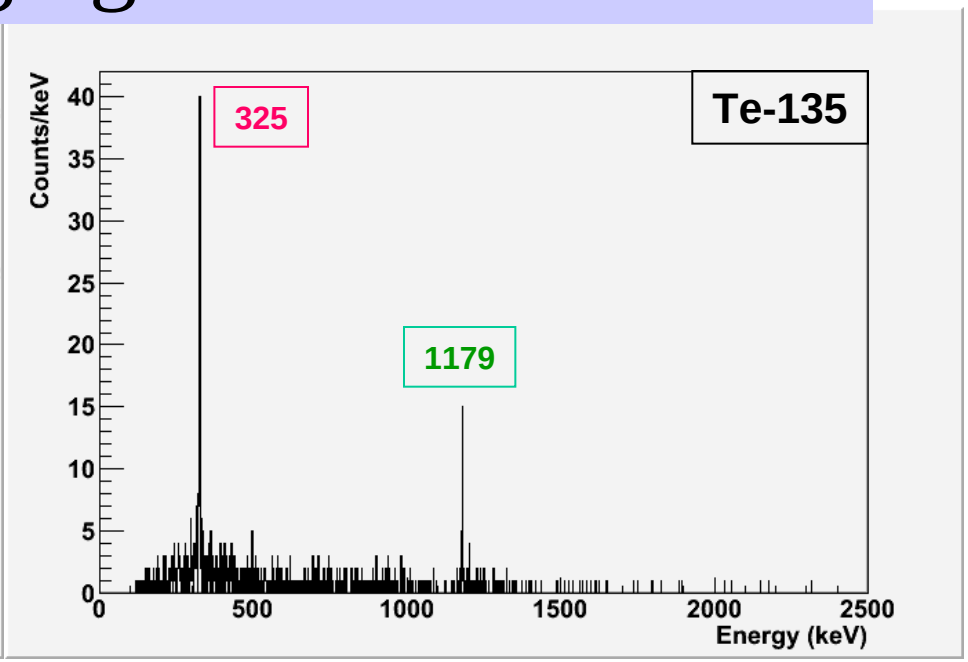


- DAQ tested with all three crates running (Simba to be included)
- Go4 code updated

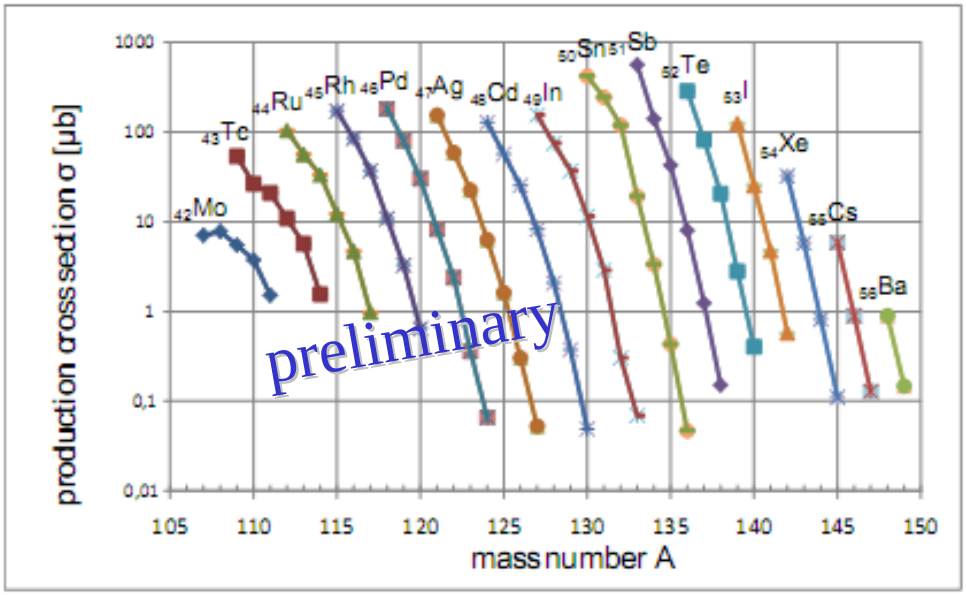
see K. Smith´s talk

Isomer tagging at E084



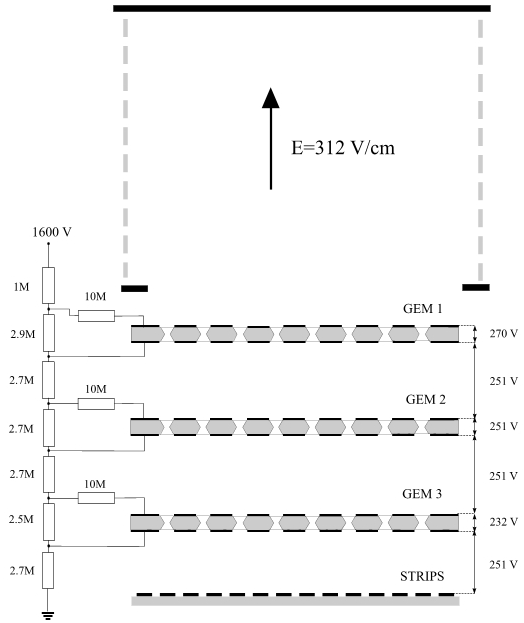


- no calibration with primary beam,
- no F4 degrader calibration

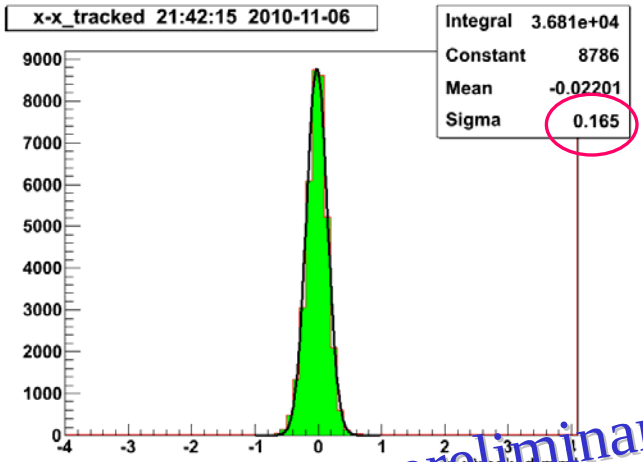


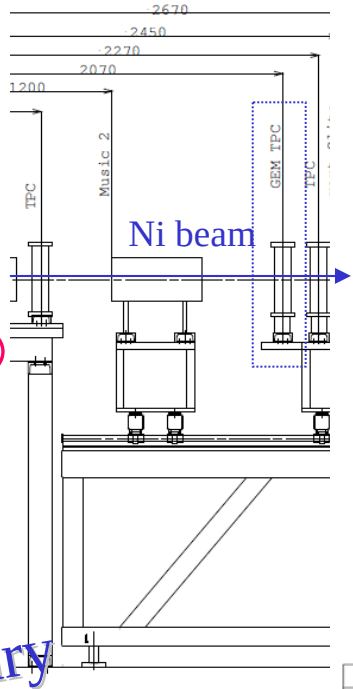
F. Farinon,
S. Möller

GEM-TPC test

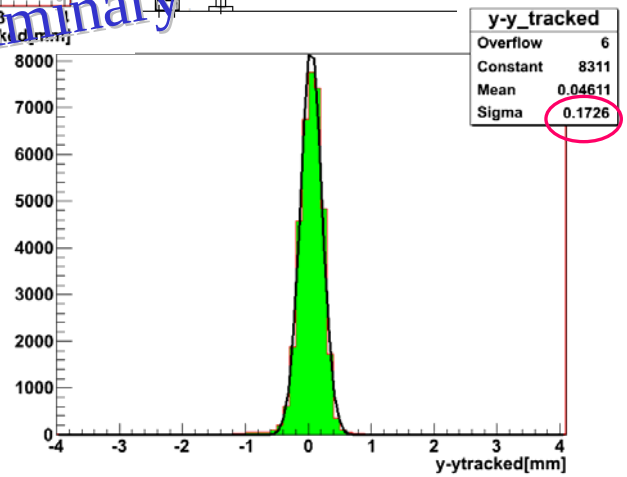


Prespec run, Sep10
^{64}Ni @600MeV/u up to F4





preliminary



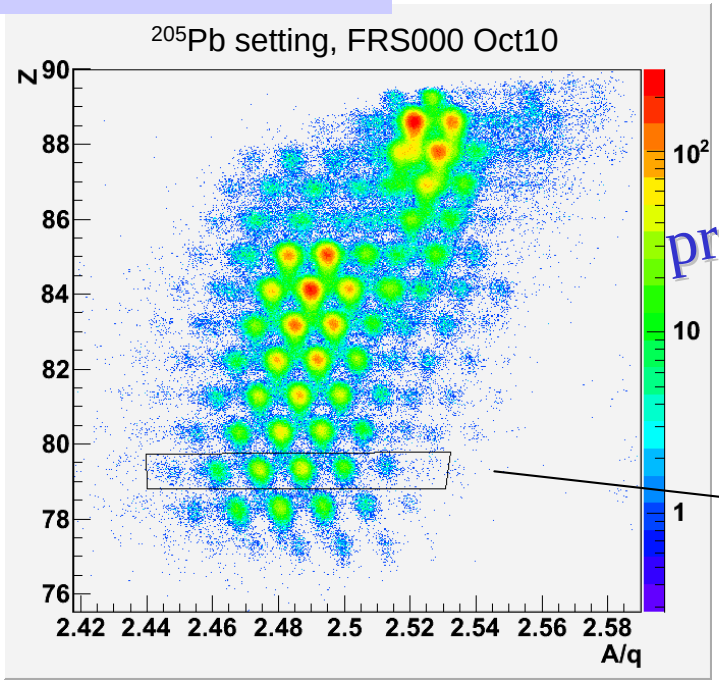
In addition:
Music tested with FADC

A. Prochazka

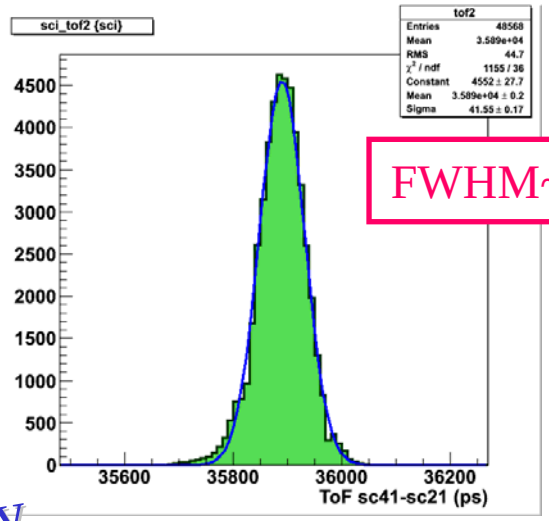
ToF resolution

FRS000, Oct10 (5 days)
^{238}U @1GeV/u, slits F2: (-1,1), F3: (-0.5,0)

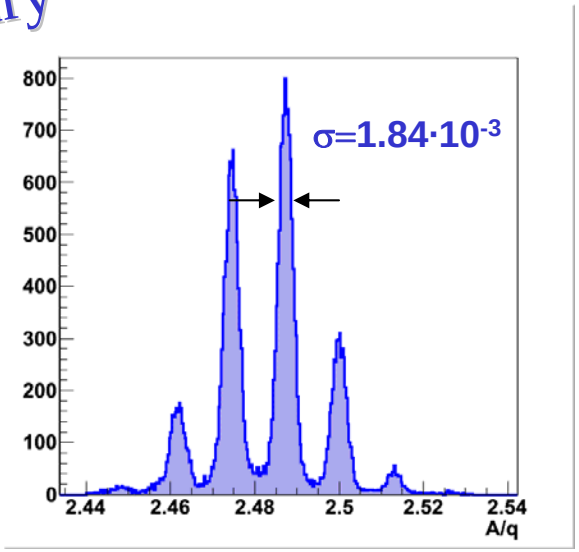
In addition:
- second ToF F2-F4
- RPC tested



preliminary



FWHM~100 ps



see J. Kurcewicz´s talk

MUSIC detector status

- Available
  - Two 200 x 80 mm^2 TUM MUSIC80s (CF_4 or P10 gas)
  - Two 450 mm Ø "old" MUSICs (P10 gas)
  - Two 200 x 200 mm^2 "older" MUSICs (P10 gas)†
  - One Twin (2-stacked) MUSIC (P10 gas)

†presently at CERN (Nov 2010)

- Towards higher counting rate (pile-up discrimination)

  H. Schaffner, S. Pietri, : 4 TUM MUSIC anode signals sent to a SIS3302 Flash ADC.

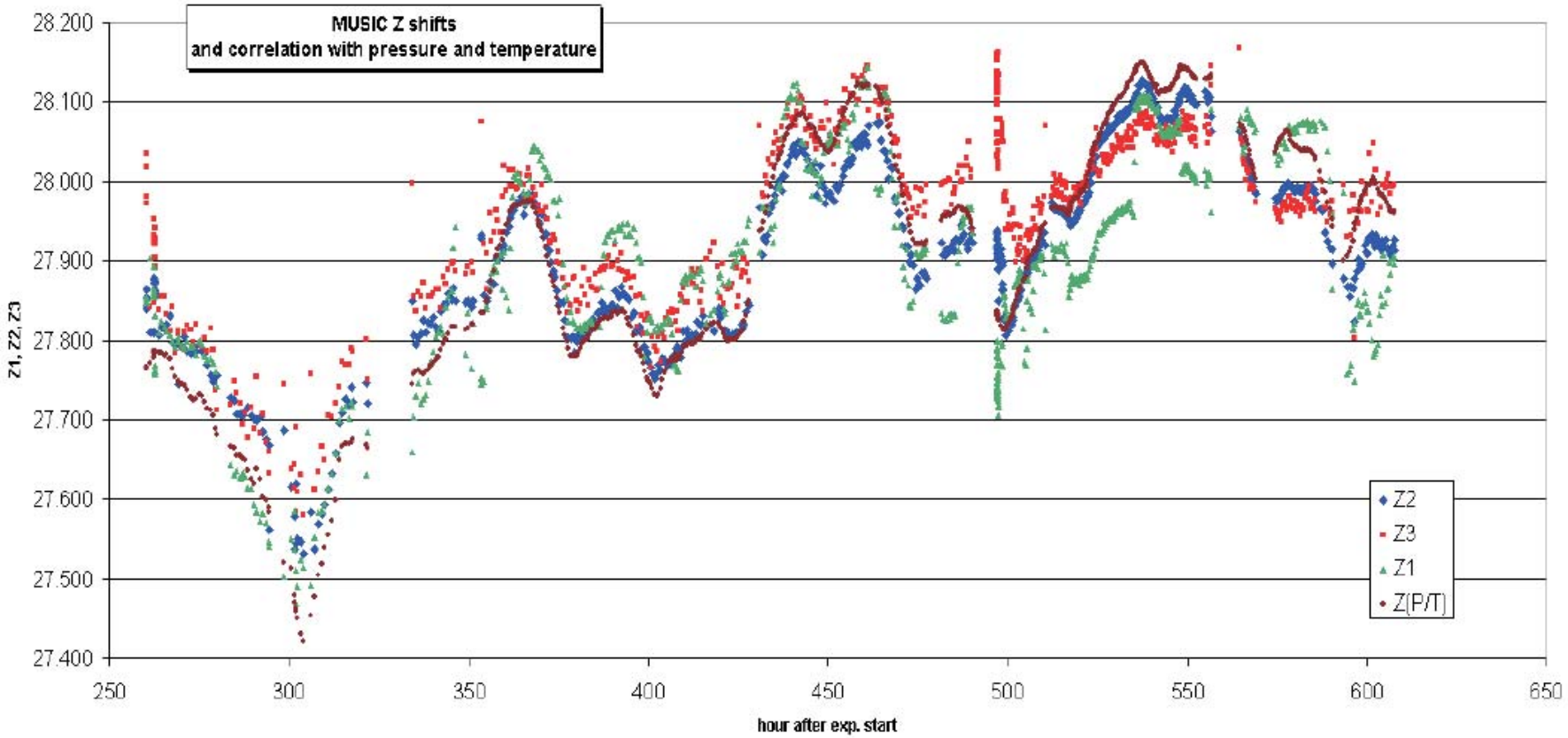
Questions

Is it possible to identify on-line (and of course off-line, too) the atomic number of fission fragments, when the calibration was done with the primary U-beam at different energies? How stable is the Z-identification over long periods of time (~2weeks of beam time)?

J. Winfield

Analysis of S272 experiment with three MUSICs, H. Weick Aug 2010 (Z1,Z2 = TUM Music with CF4, Z3= big round MUSIC with P10)

Shift in observed Z as function of time for three MUSICs (~1000 files with Ni peak fitted), compared with a calculated shift as function of measured pressure and temperature.
A very strong correlation can be seen but also some additional long term drift which is different for each MUSIC.



H. Weick

Conclusion

- **Detector developments**
  - ITAG, GEM-TPC, MUSIC, SCI, TPC in vacuum, ...
- **Electronics & DAQ**
  - fast digitalization, multi event readout, RIO4, ...
- **Go4**
  - PID with ITAG, ...
- **Documentations**
  - TPC manual, ITAG manual, ...
- **FRS000 and other experiments**

On behalf of the expert team I thank all FRS technical staff for the excellent work and cooperation.

Outlook

• ITAG, second Ge ordered but at the moment no space left behind F4 degrader

• new optical device to be tested

- bandwidth: from 950 to 2150 MHz
- optical losses (fiber): 0.4 dB/km
- maximum input: 5V dc
- fiber: single mode 9/125

~4k€ (2chs)
cable~10€/m

ViaLite®

SATCOM L-BAND FIBRE-OPTIC-LINK

ppm® P·P·M

• Si station at S6 (see *ESR meeting*)

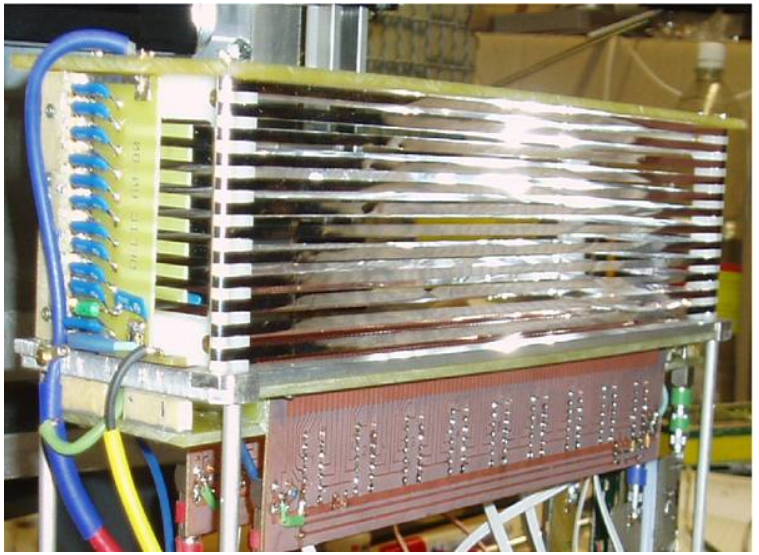
• Standard laser lithography μPG101 (Heidelberg FCA, 250000dpi) by GSI lab (98k€)

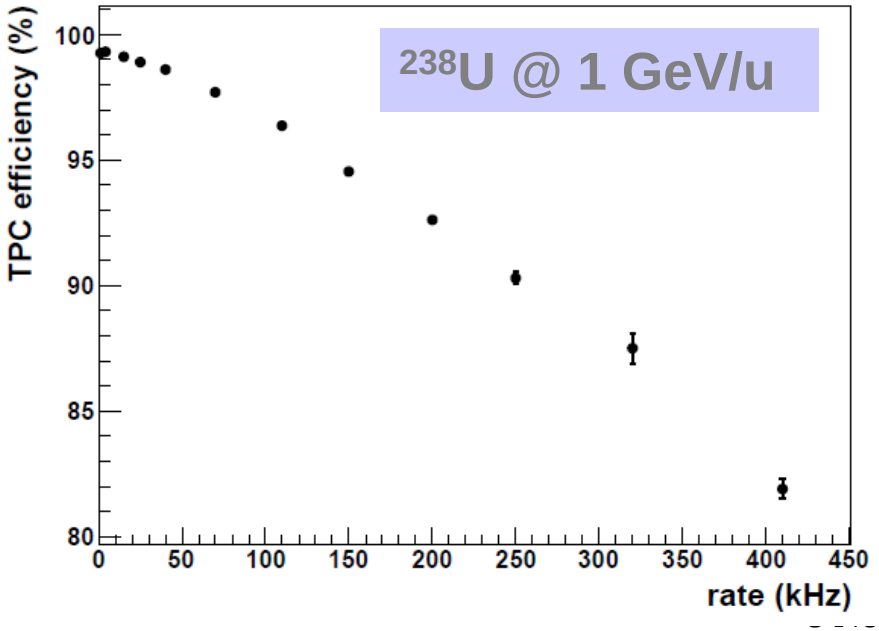
Official FRS000 beam time requested last week at the G-PAC (see *tomorrow talk*)

Tracking detectors at the FRS

Time Projection Chamber

- (240x100) mm^2 active area
- Gas P10 at 1 atm
- Integrated delay lines (2x-pos, 4y-pos)
- $\sigma_x \sim 0.1$ mm, $\sigma_y \sim 0.05$ mm





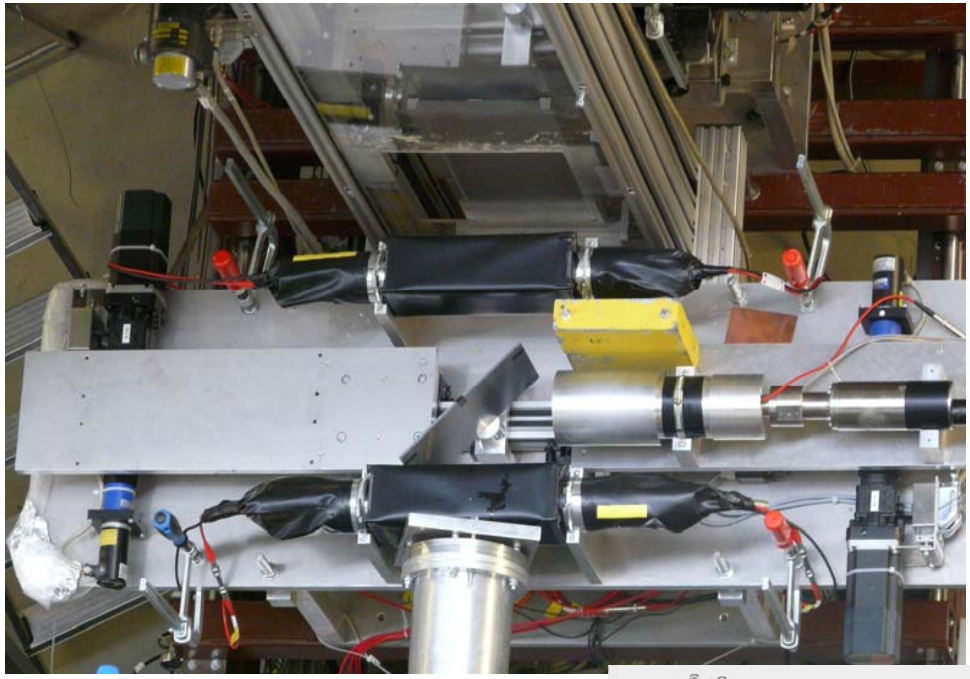
- On-line calibrations
- VME standard electronics
- 95% efficiency at ~100kHz

CUB Bratislava & GSI

R. Janik, *et al.*, NIM A 598 (2009) 681

Isomer TAGger (ITAG) at FRS focal plane

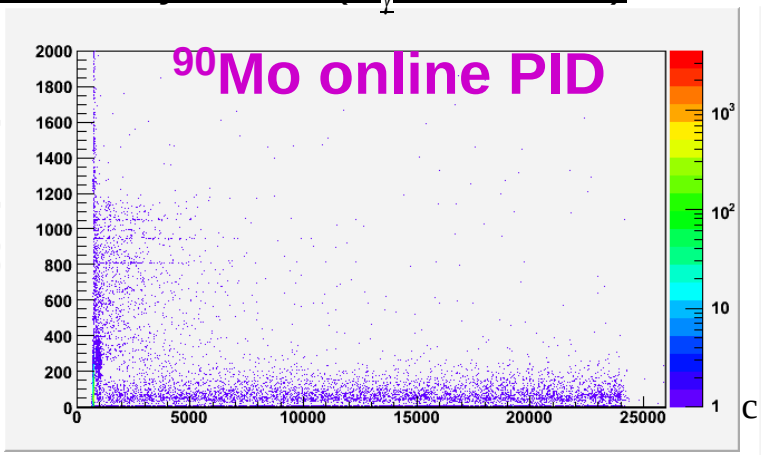
HPGe: mechanical cooling system,
mounted in a movable holder,
shielded with 50 mm Pb,
1 capsule available, the second ordered

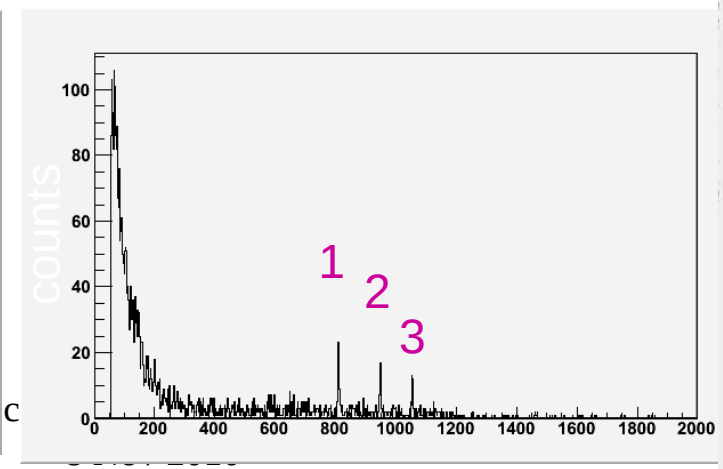


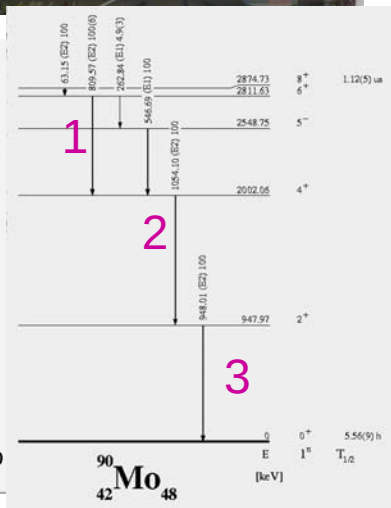
2 Scintillators: 5 mm BC-400

Stopper: (150 x 150) mm^2 Al
thickness 4.2 mm

Efficency: 0.5% (E_γ=1332keV)





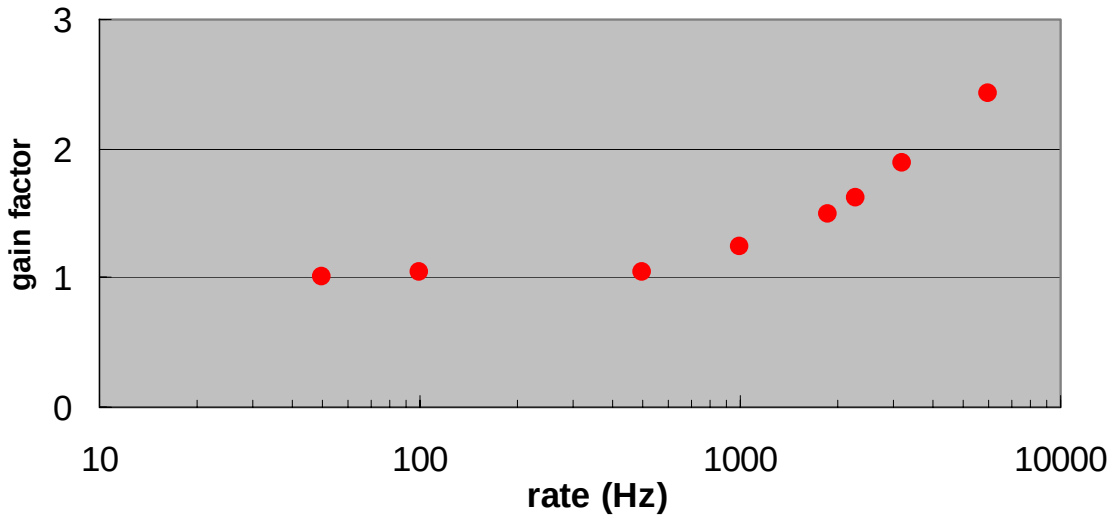


Results

The FRS multi-event DAQ:

- runs in stable condition
- more effective starting from 400 Hz
- gain factor = 2 at 4 kHz
- dead time at 10 kHz : 48%

C. Nociforo, N. Kurz, GSI Report 2009

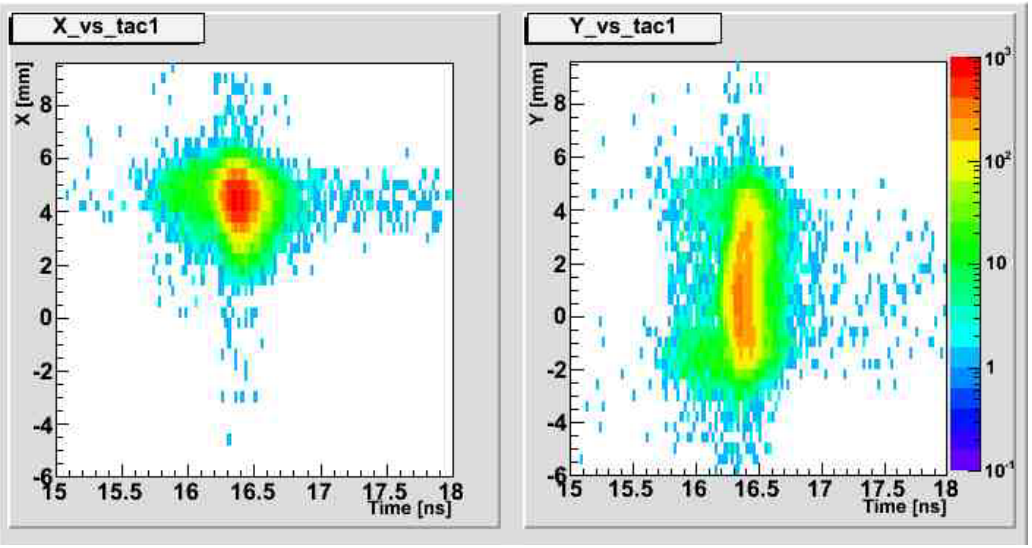


Next steps will be to include the scaler Caen V830 into the new readout and use RIO-4 to gain another factor ~2.

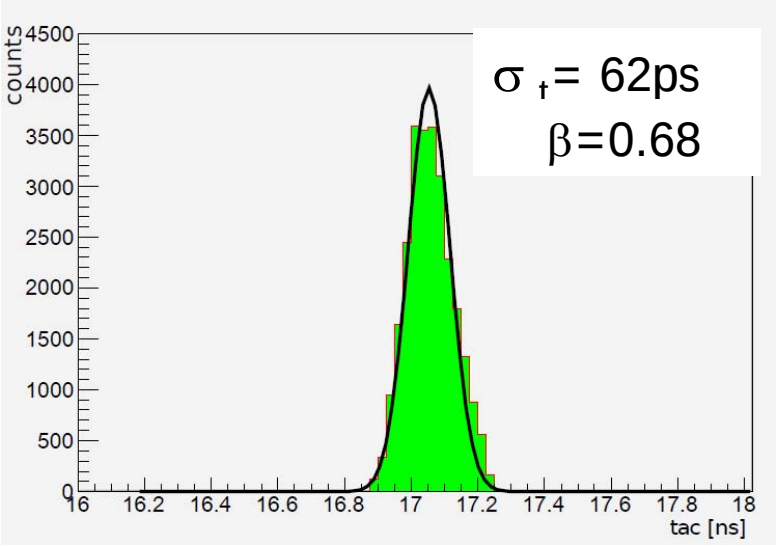
Results of diamond test

I_{beam} ~ 2kHz

position vs ToF



Results comparable with the standard FRS ToF res.



Efficency : 70-60 % , constant up to 10^7/spill

At higher rate only few pulses have been characterized with a scope Tektronix TDS7404

Shoichiro Kawase