Darmstadt, Dec. 9-13 2013

Status of day-one experiment commissioning at COSY

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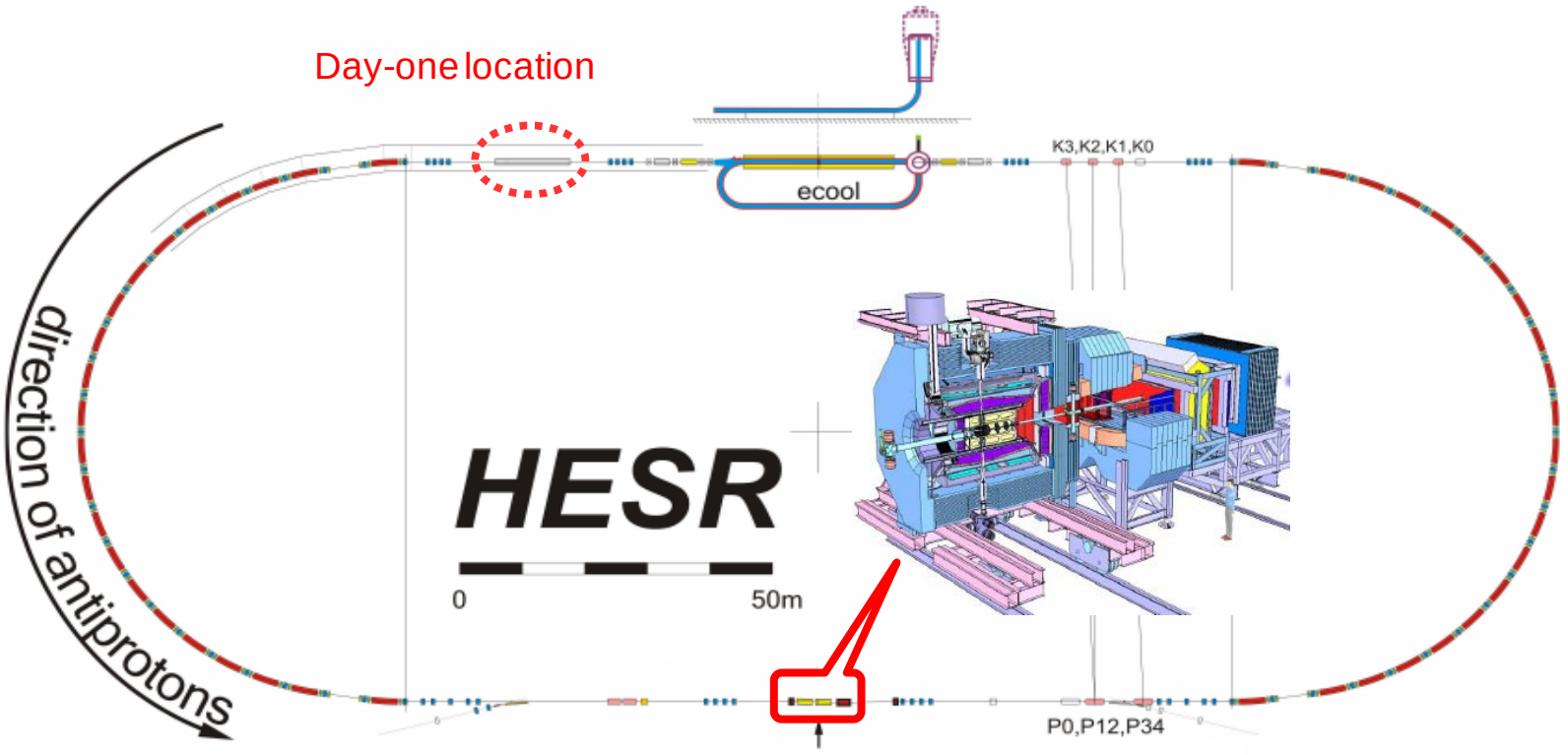
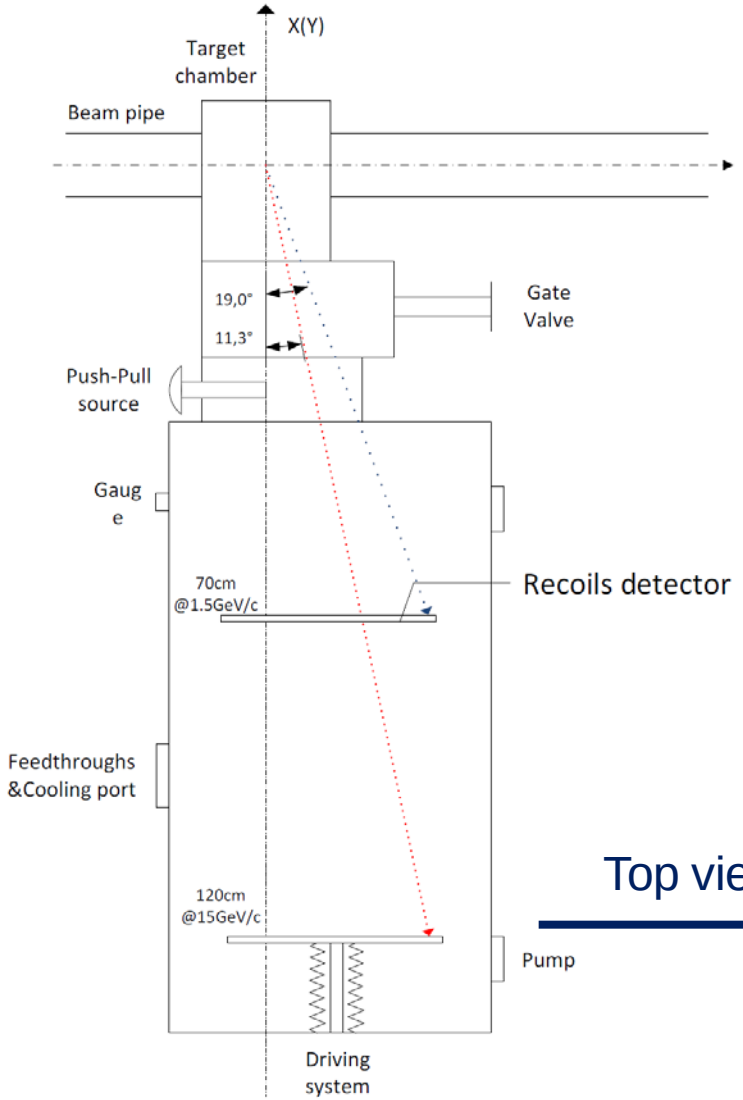
Goals of day-one experiment at HESR

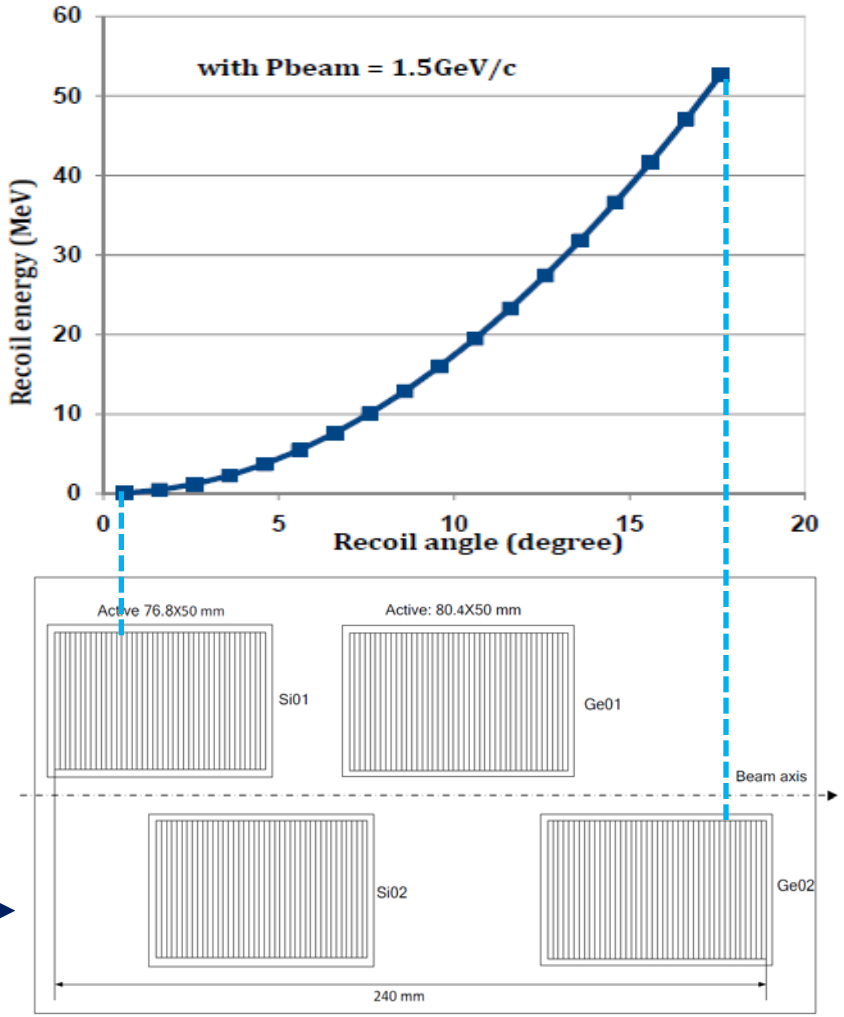
- Pbarp elastic scattering
- Coincidence (forward&recoil)
- Large range of t : 0.0008-0.1 GeV^2



Recoil Arm



Top view



Fixed plane for commissioning

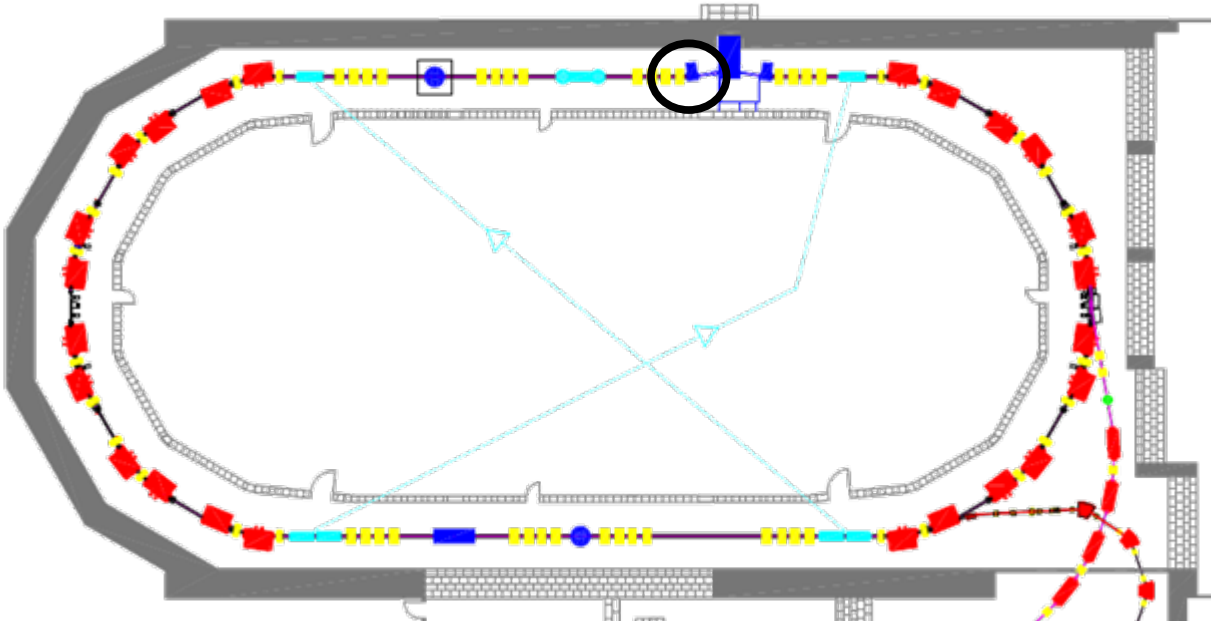
- **Si : 76.8 x 50 x 1 (mm) (1.2 mm pitch)**
- **Ge: 80.4 x 50 x 5/11 (mm) (1.2mm pitch)**

1. Preparation for commissioning at COSY

Questions to be answered:

- **What is the minimum energy of recoil proton to be measured?**
  e.g. 400keV protons possible to be measured?
- **What precision of luminosity of PANDA could be expected?**
  e.g. 3% of absolute precision feasible?

Cluster target location



What to be expected for day-1 experiment commissioning at COSY

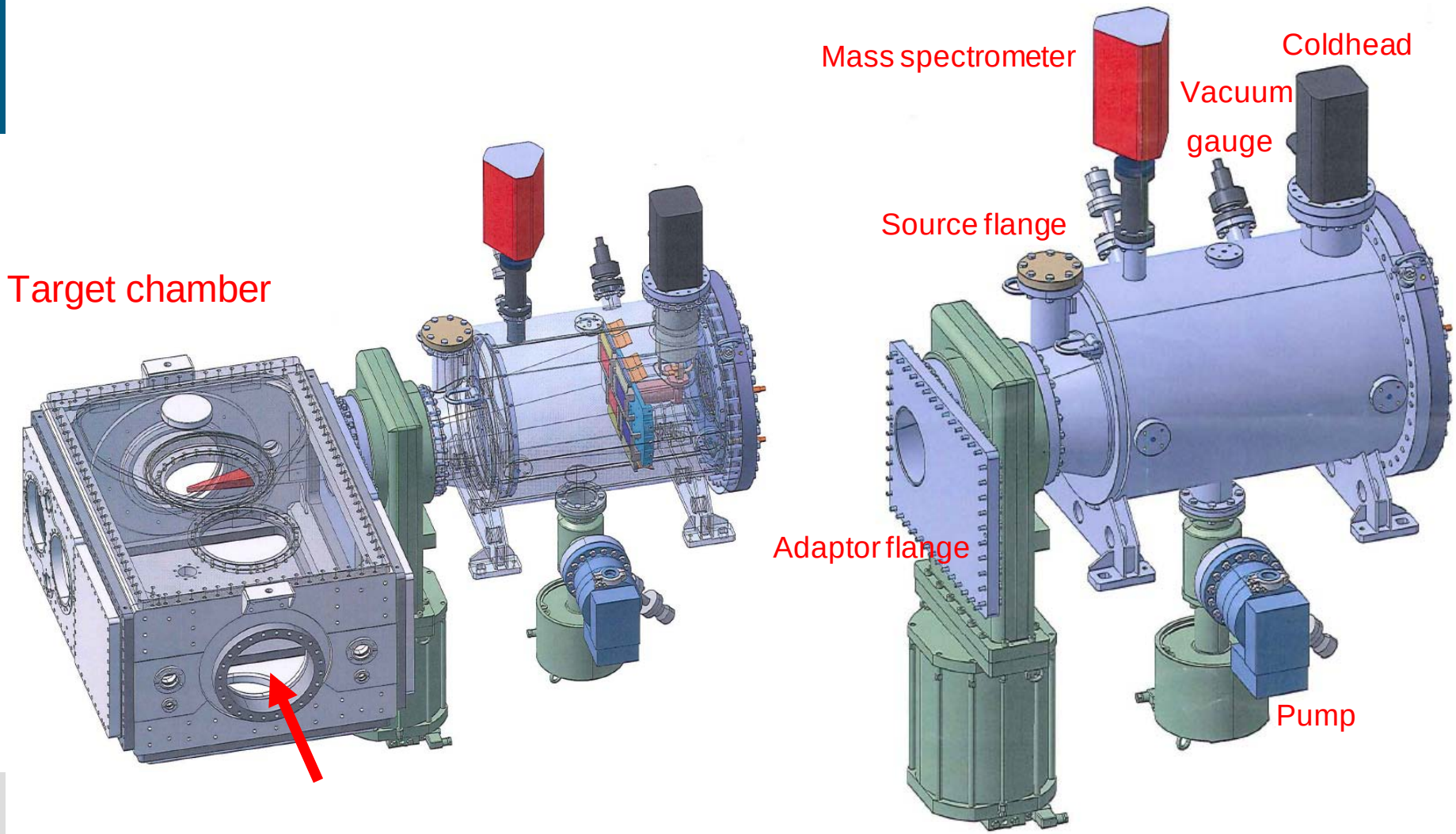
Experiment conditions:

- Cluster jet target at ANKE target station
- Beam momentum max: 3.7 GeV/c (proton beam)
- Recoil angle max: 13.6° (target chamber limitation)
- Expected t range at max recoil angle:

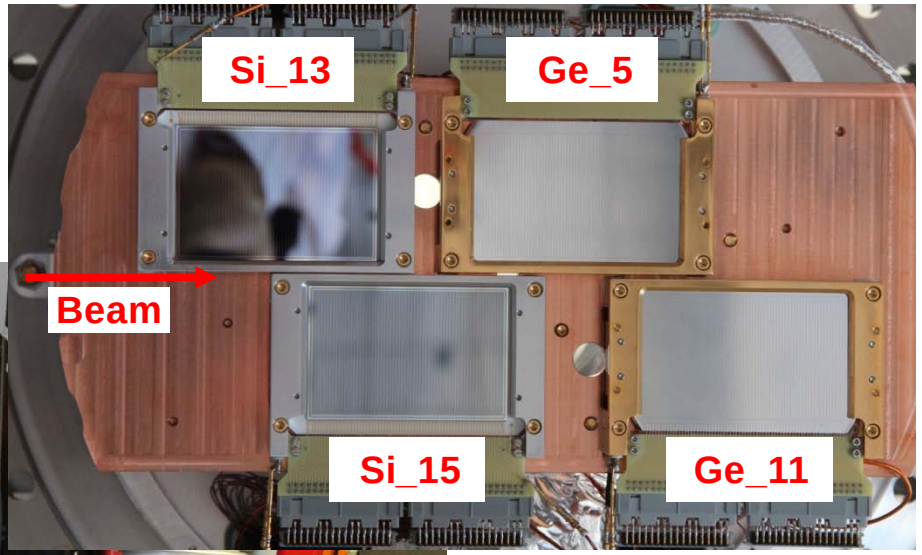
P_{lab}	t_measurable	θ_{cm}	θ_{lab}
2.5GeV/c	[0.0008,0.0921] GeV^2	=> [1.79° , 19.42°]	[0.64° , 7.03°]
3.0GeV/c	[0.0008,0.1036] GeV^2	=> [1.59° , 18.18°]	[0.54° , 6.18°]
3.7GeV/c	[0.0008,0.1161] GeV^2	=> [1.40° , 16.89°]	[0.44° , 5.30°]

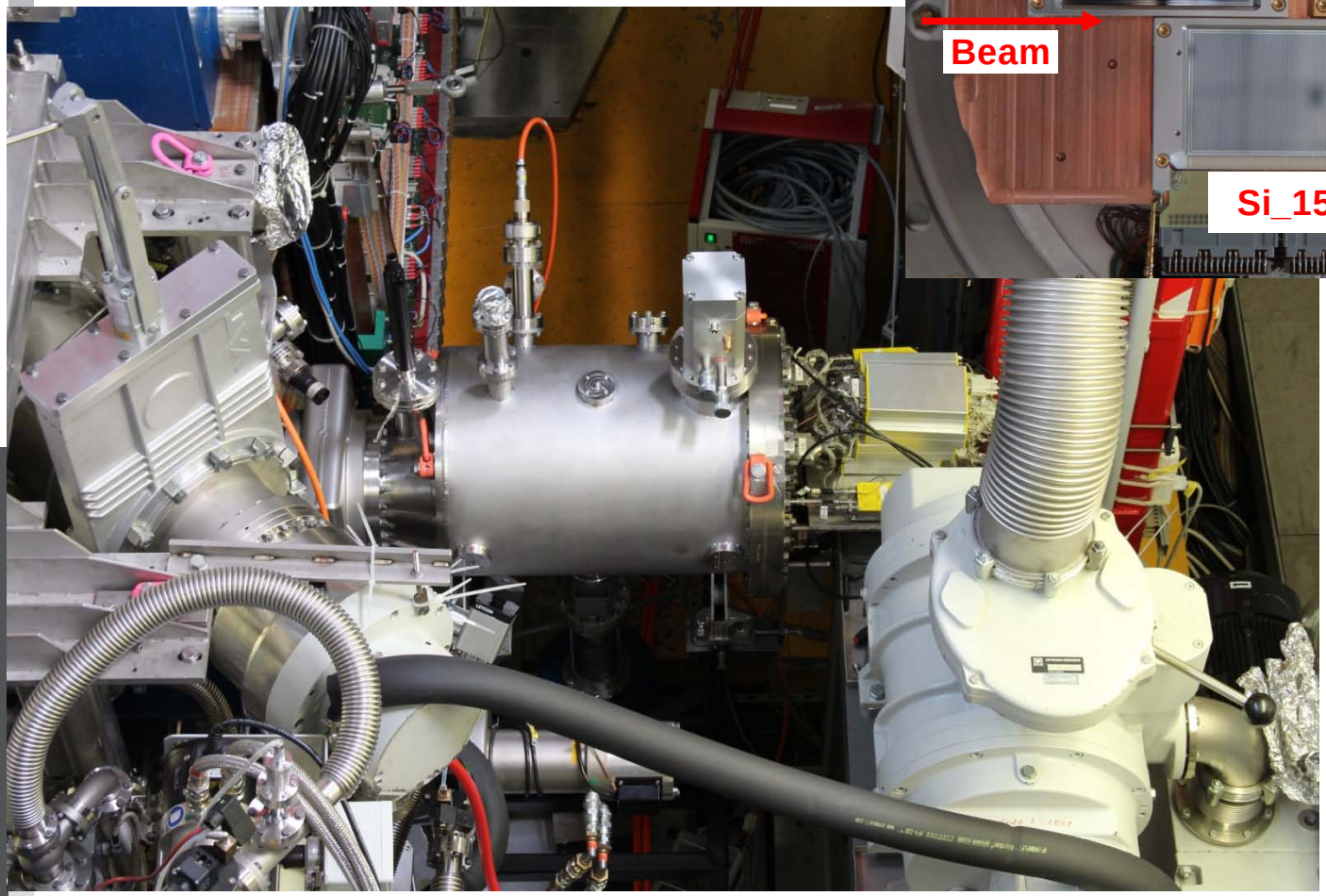
- pp elastic differential cross section

Design of day-one chamber for commissioning

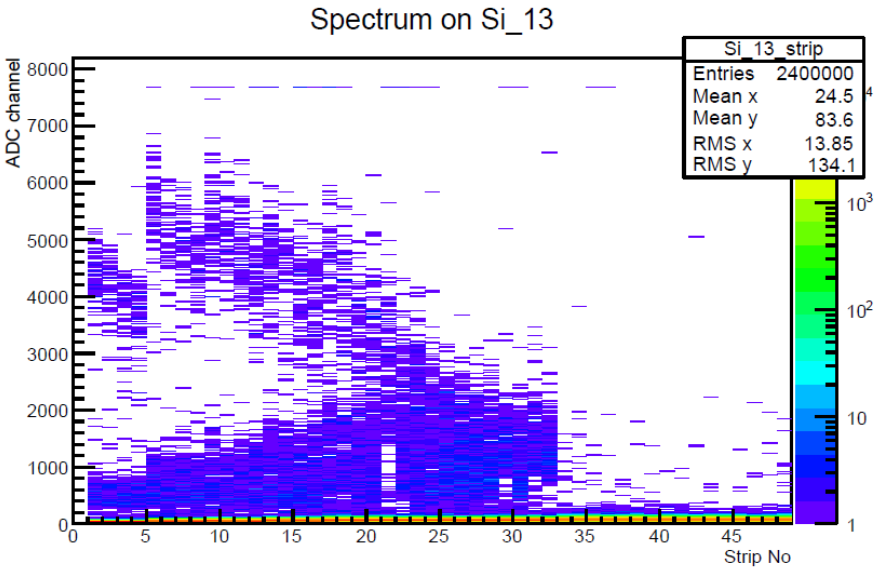


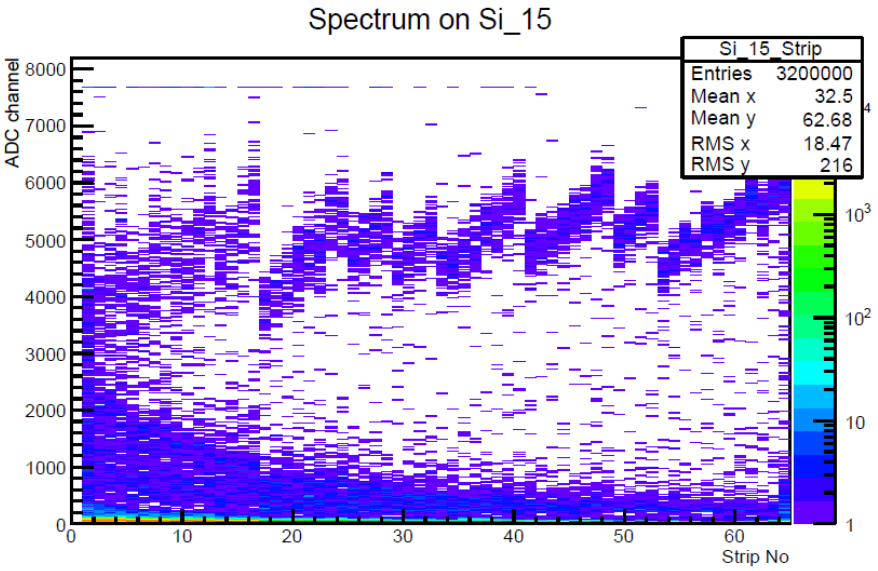
Day-one chamber installed

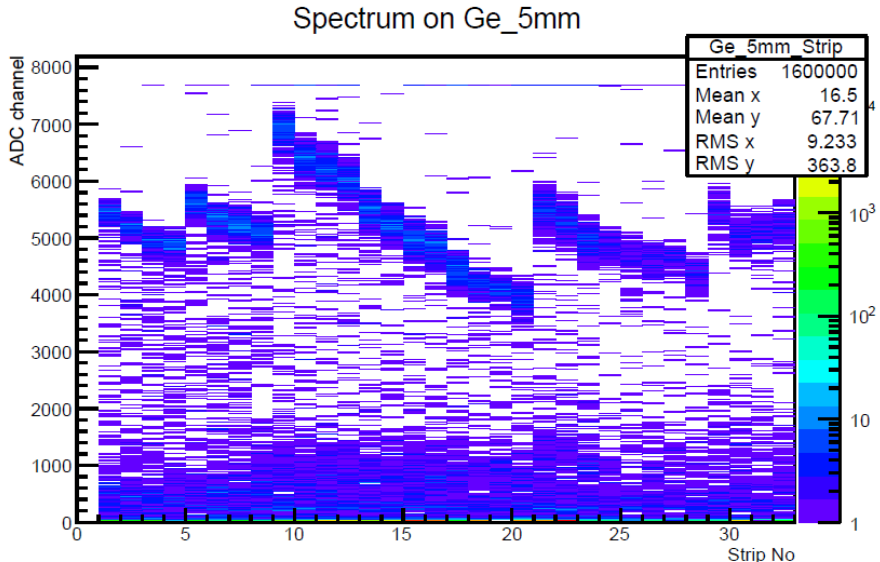


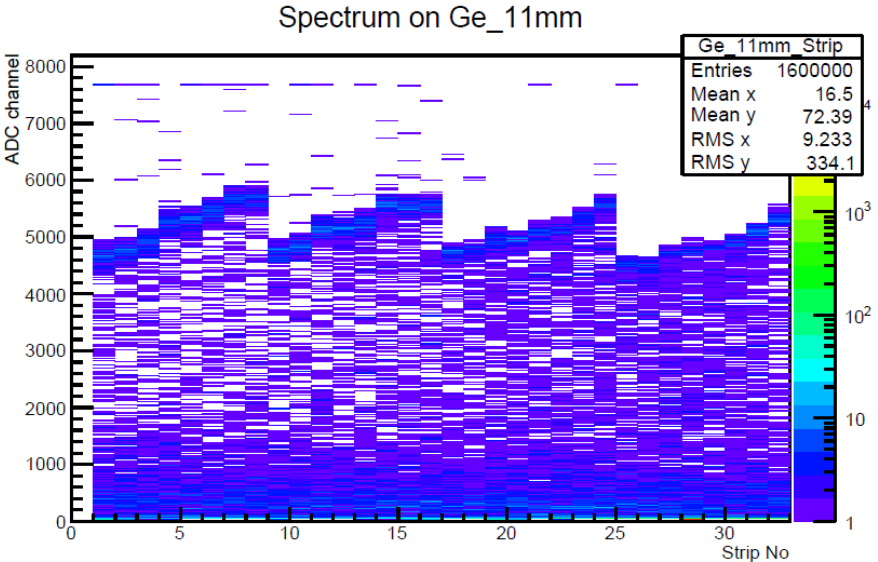


2. Data taking during commissioning

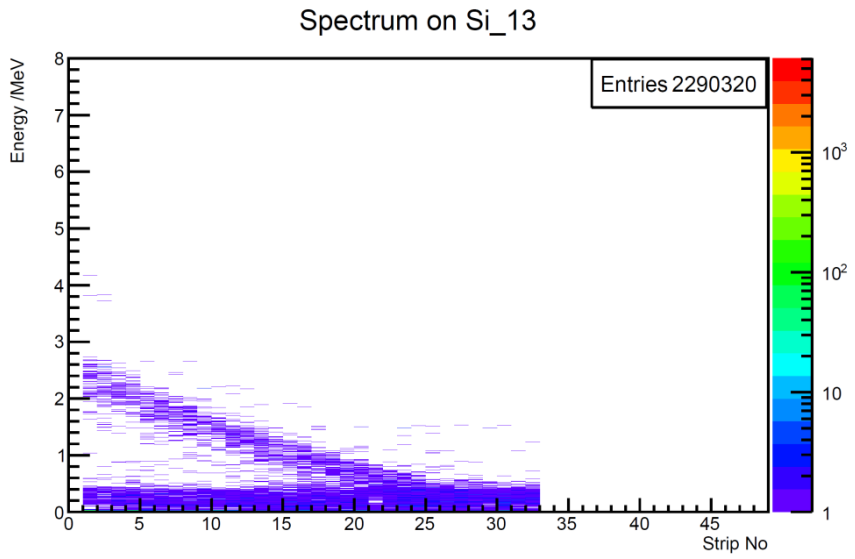


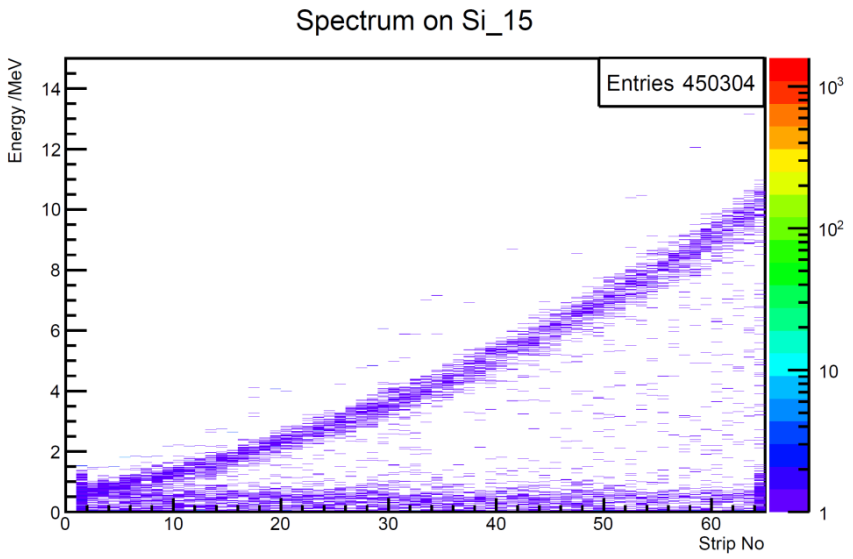


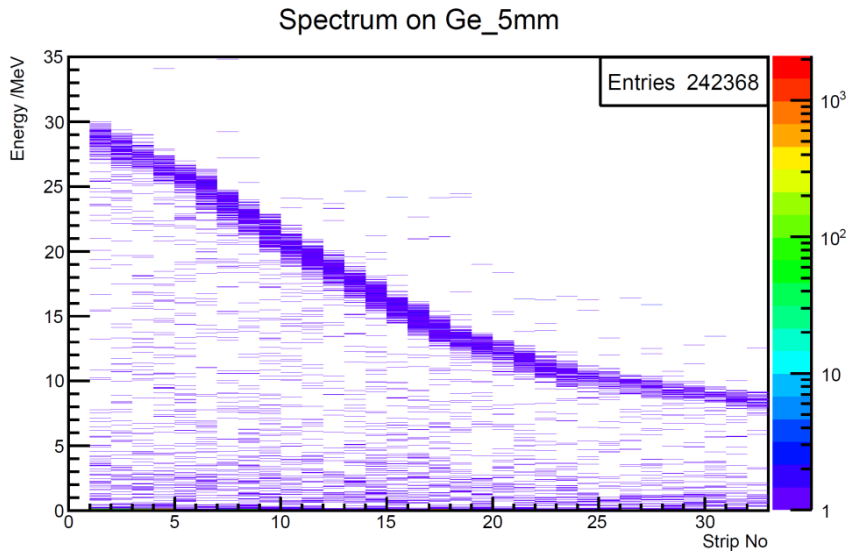


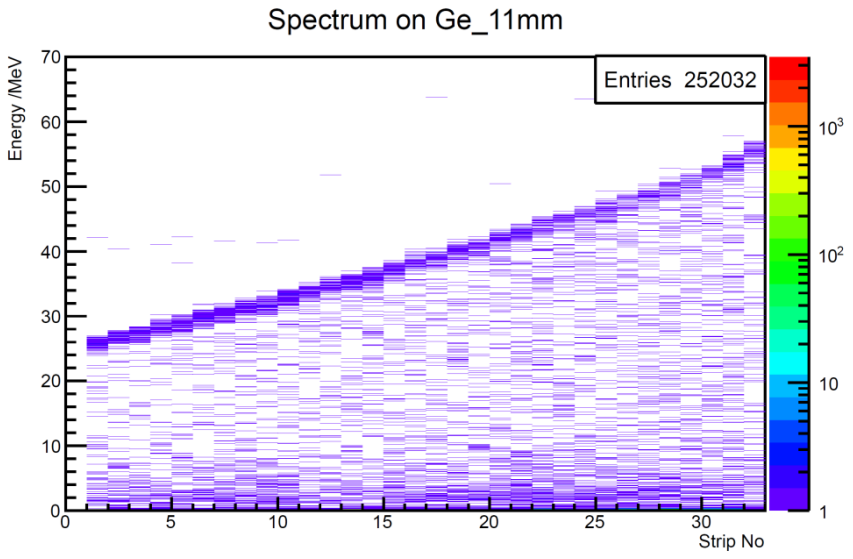


Energy spectrum of each detector (P3.2)

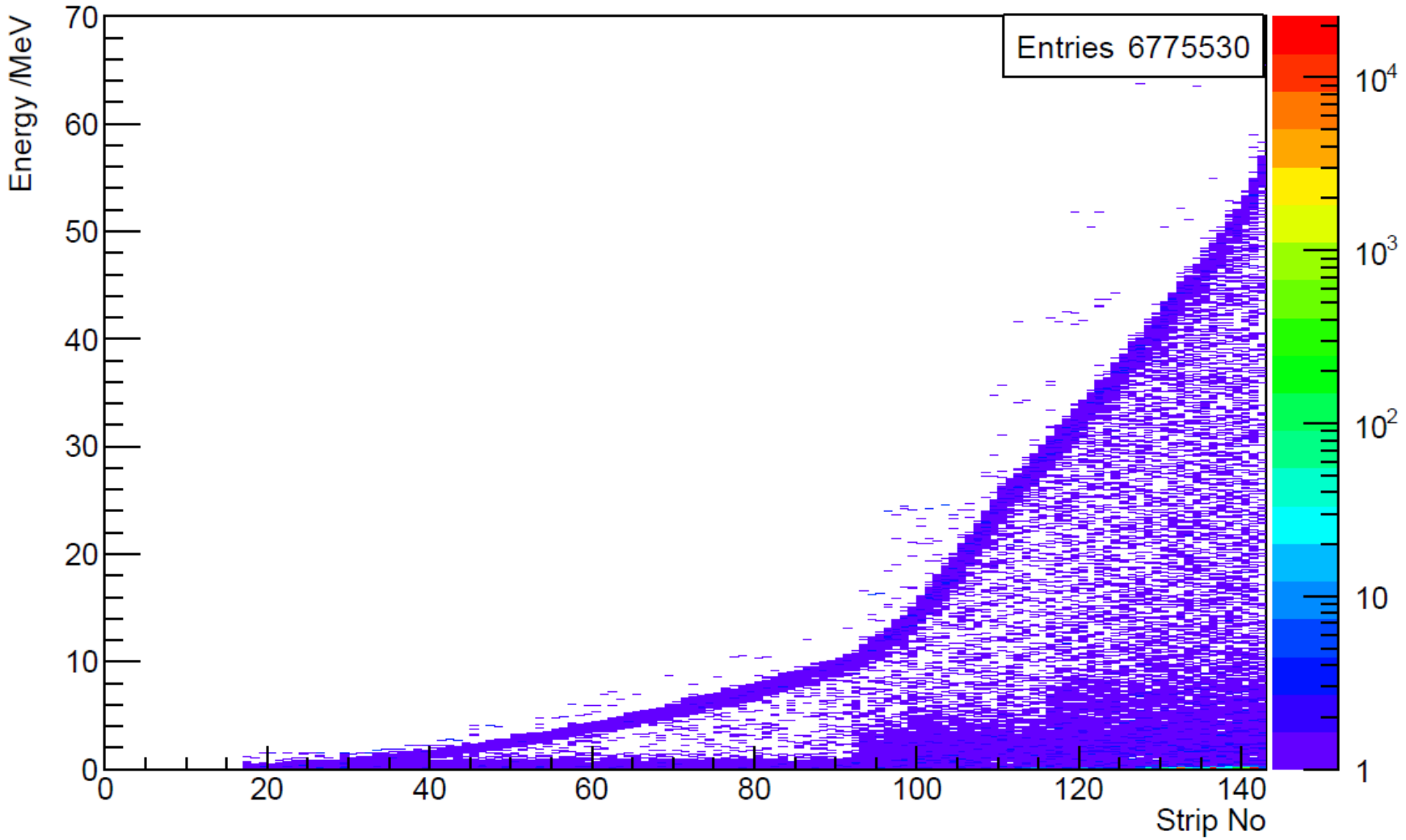




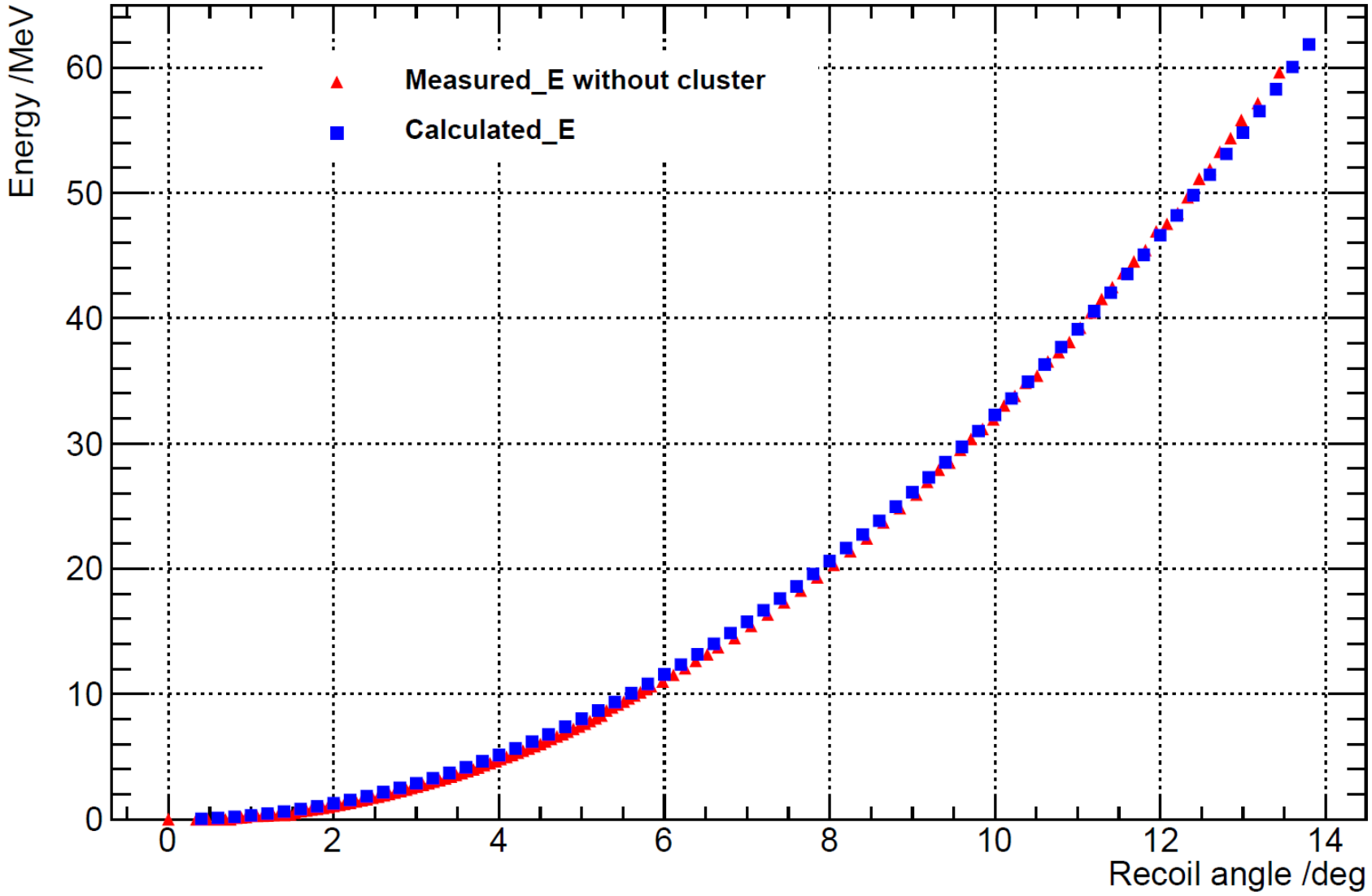


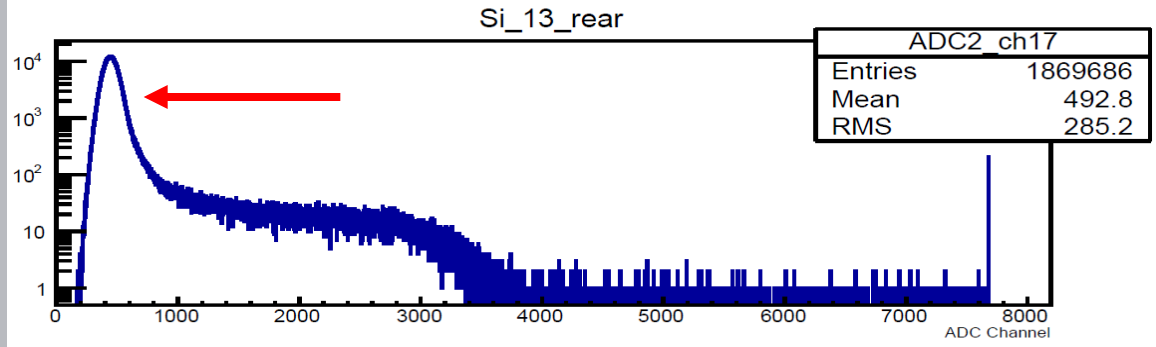


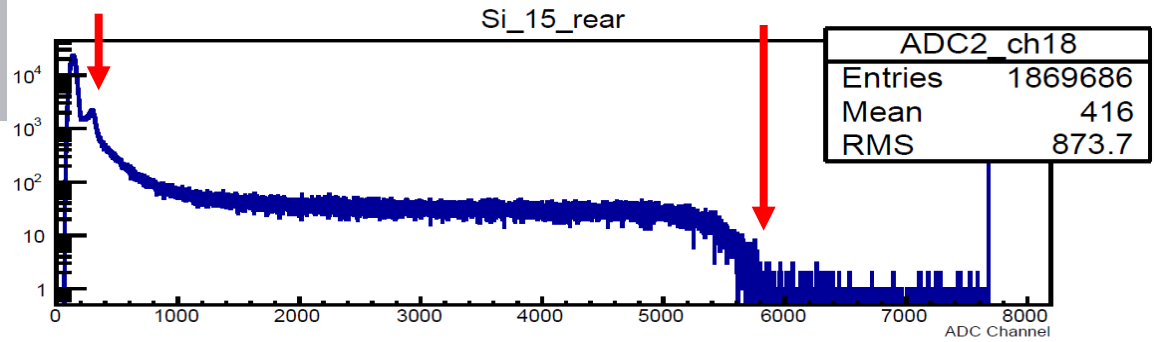
Energy spectrum (energy vs strip no, P3.2)

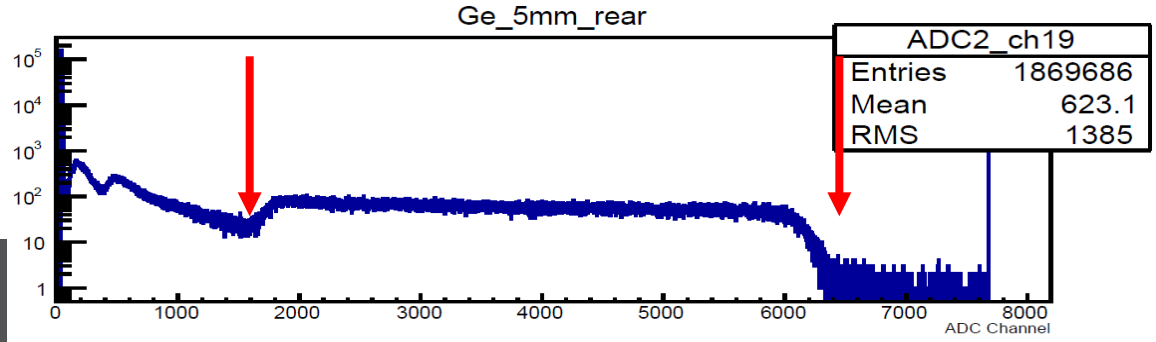


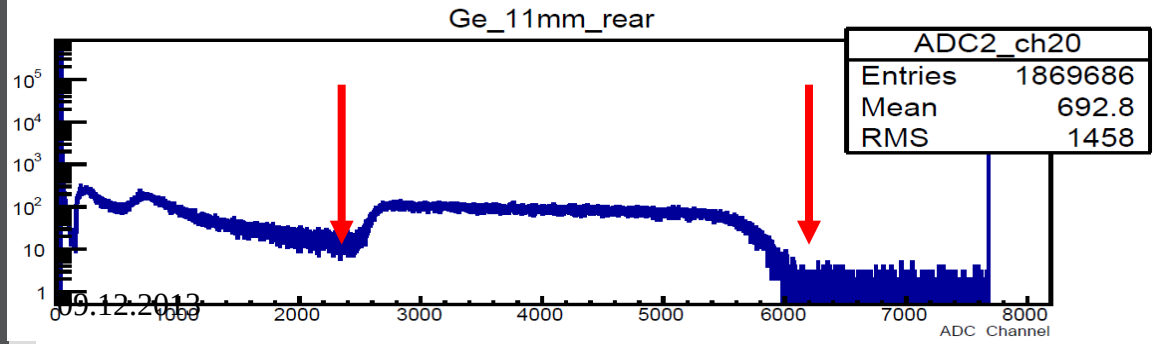
Energy spectrum (energy vs angle, P3.2)









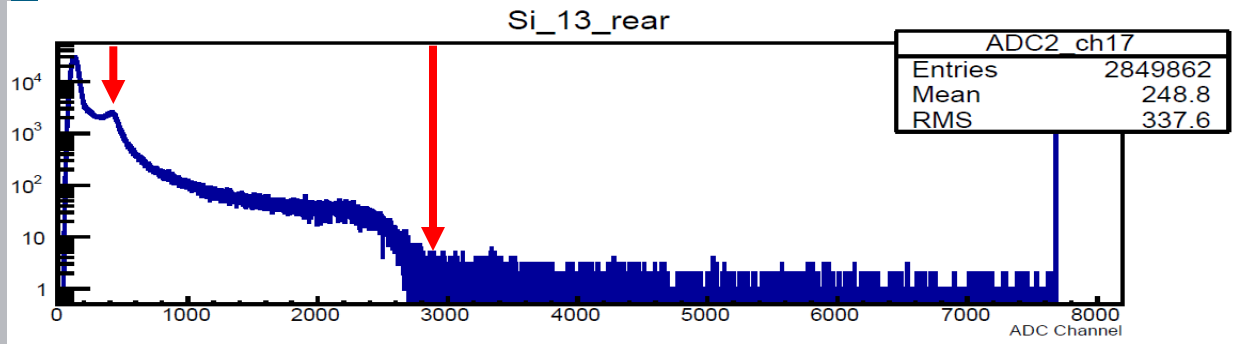


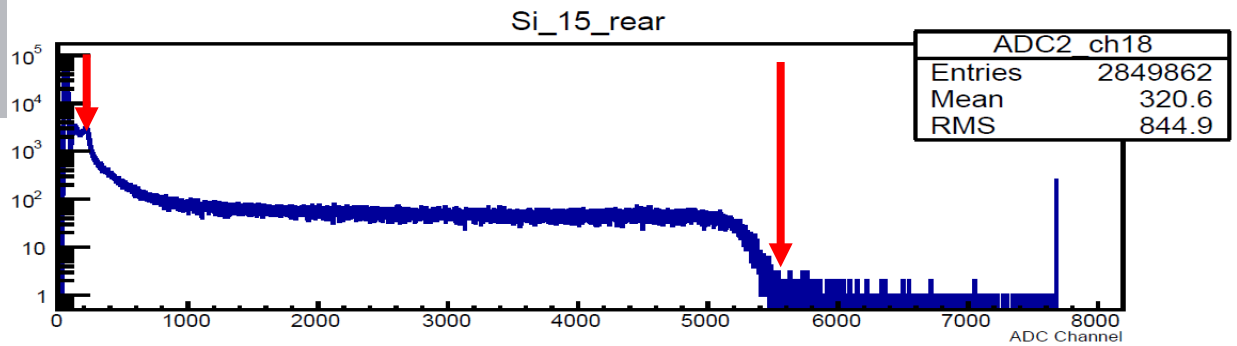
Rear side behavior (CW29,P3.2)

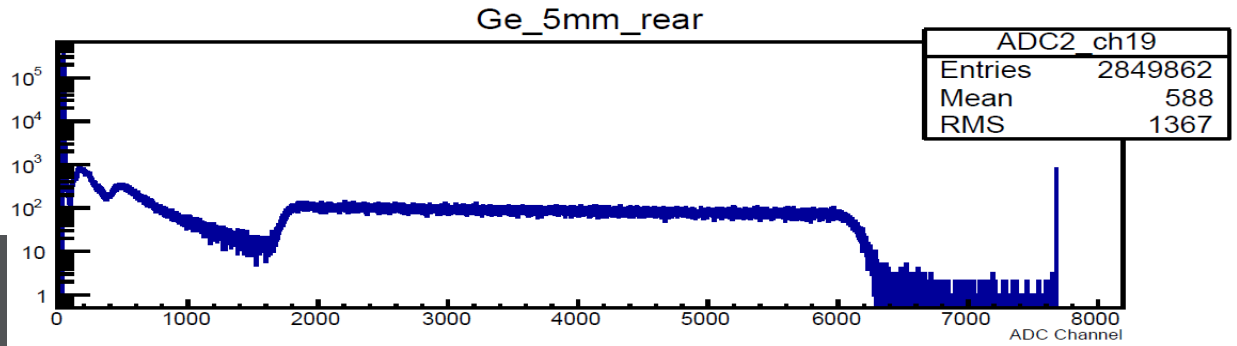
Si13 has bad resolution due to high current but one can still see the plateau which is overlapping with Si15

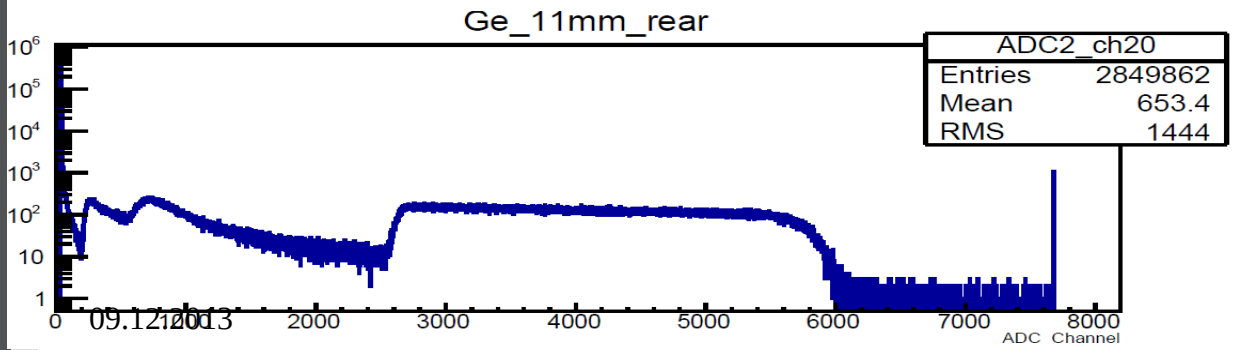
Si15 has shown nice distribution from 600-700keV to 11 MeV as expected

Ge5 and Ge11 show clear data samples (plateau region)



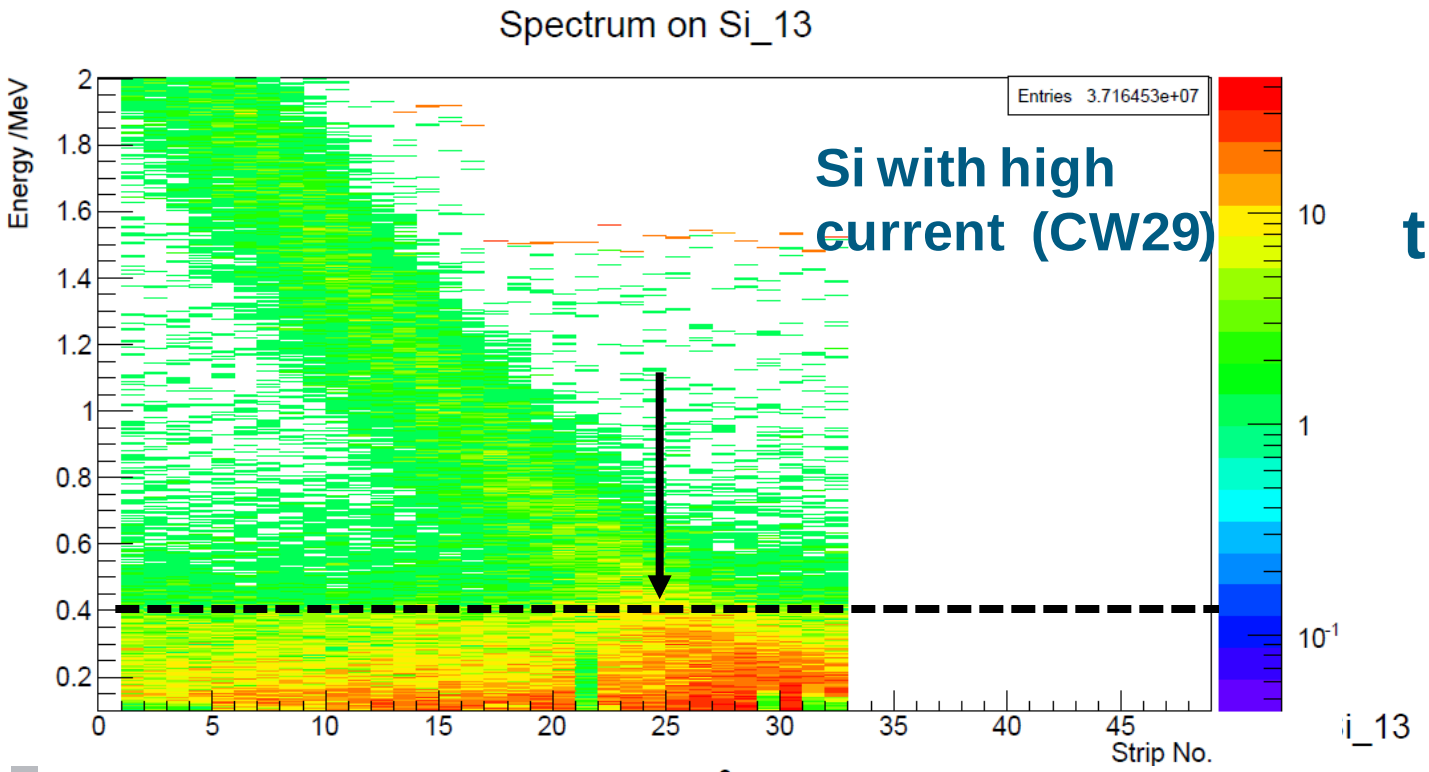




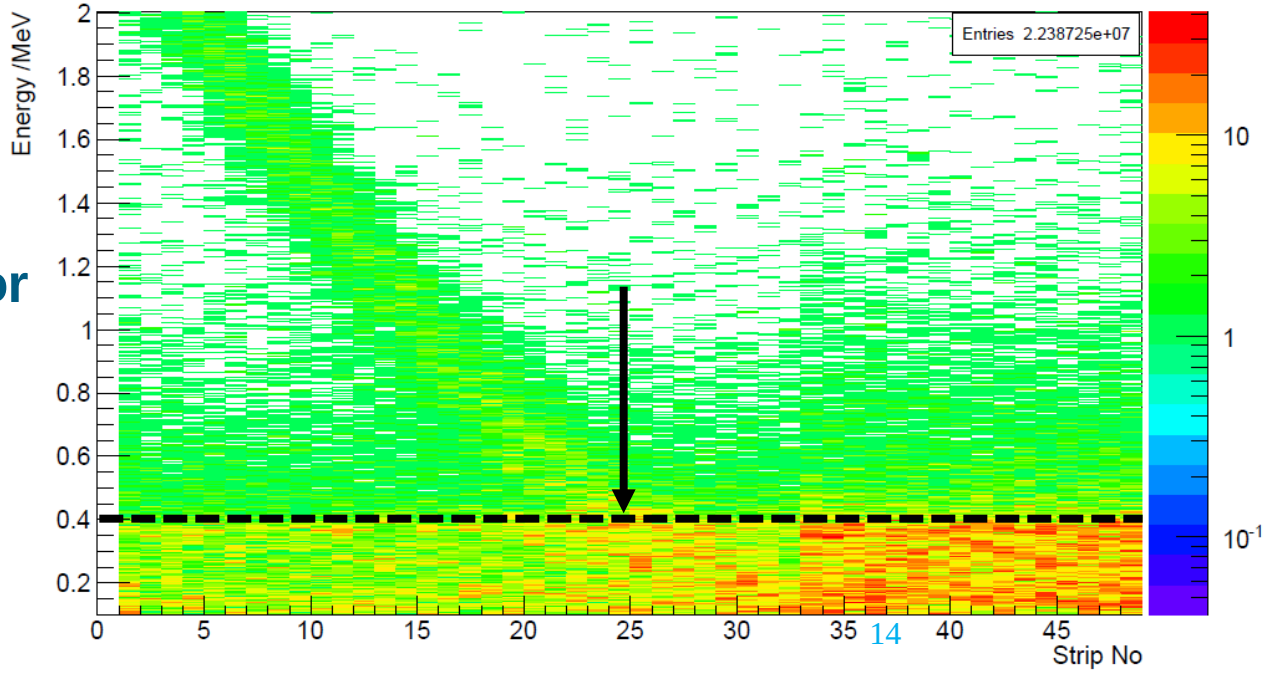


Rear side behavior (CW39, P3.2)

One can see the improvement after replacing the first Si detector



$t=0.0008\ GeV^2$
~ 400keV
(P3.2 GeV/c)



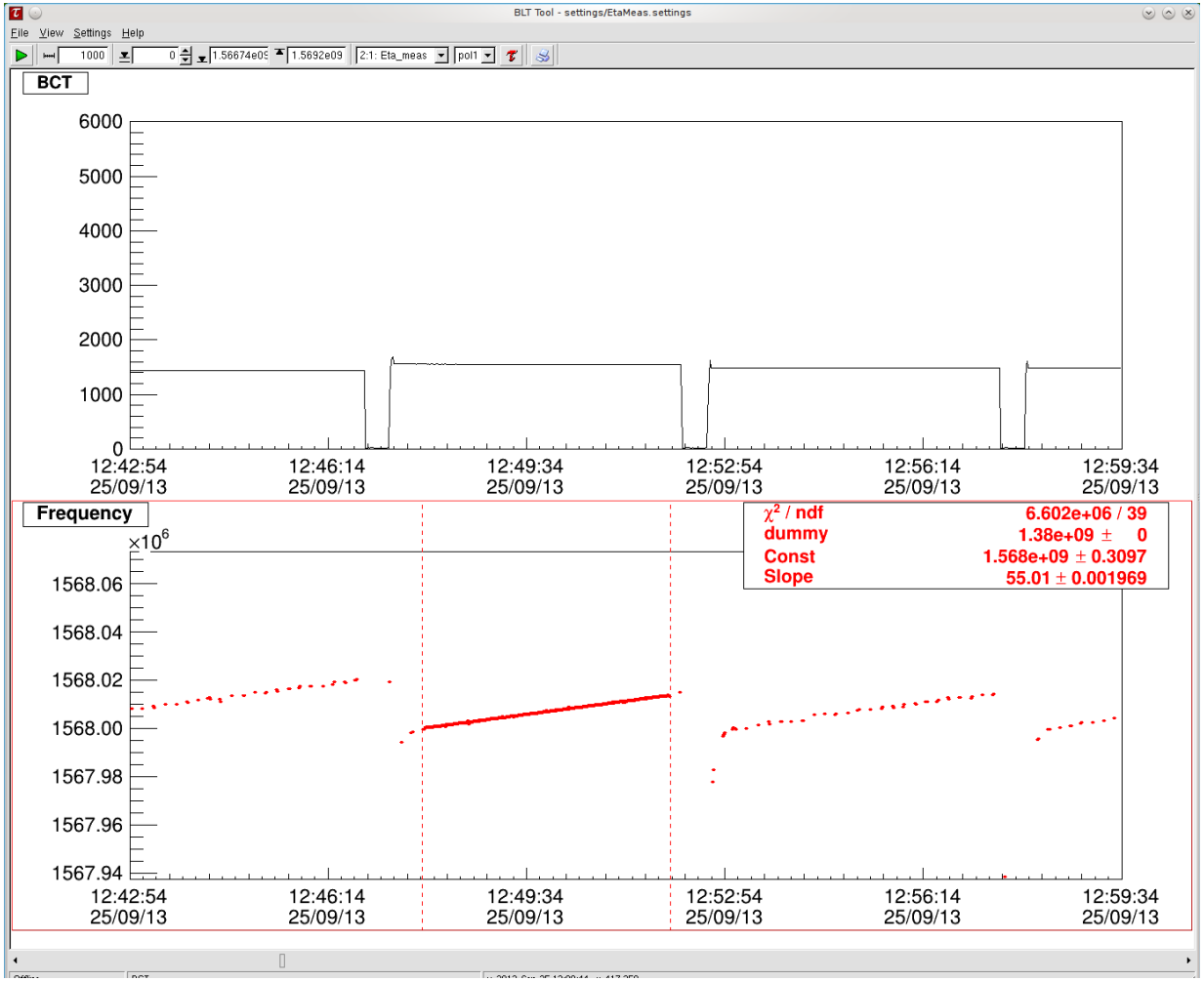
New Si detector (CW39)

Achievements of data taking

	CW29	CW39
Beam intensity	1e10 protons	2-3e10 protons
Data size	P3.2: 27GB (1GB~1M) P1.7: 19.9GB	P3.2: 41GB P2.5: 24GB P2.8: 53GB
Elastic events	~60% of entries	~50%of entries

3. Schottky method for luminosity determination

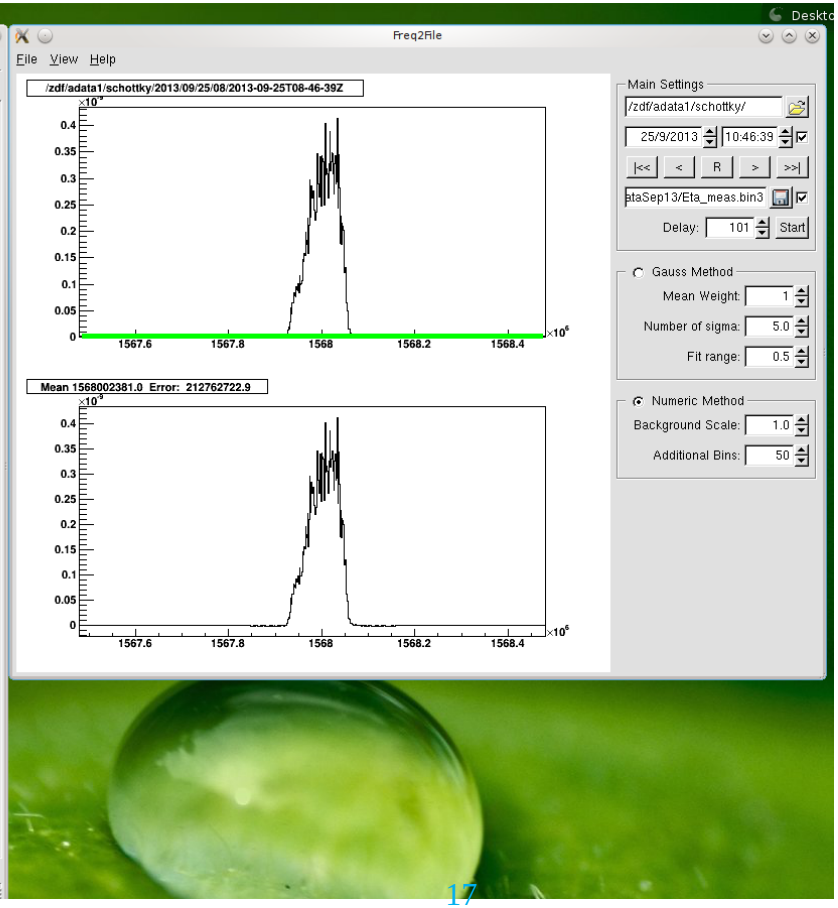
- Schottky frequency shift due to energy loss of beam



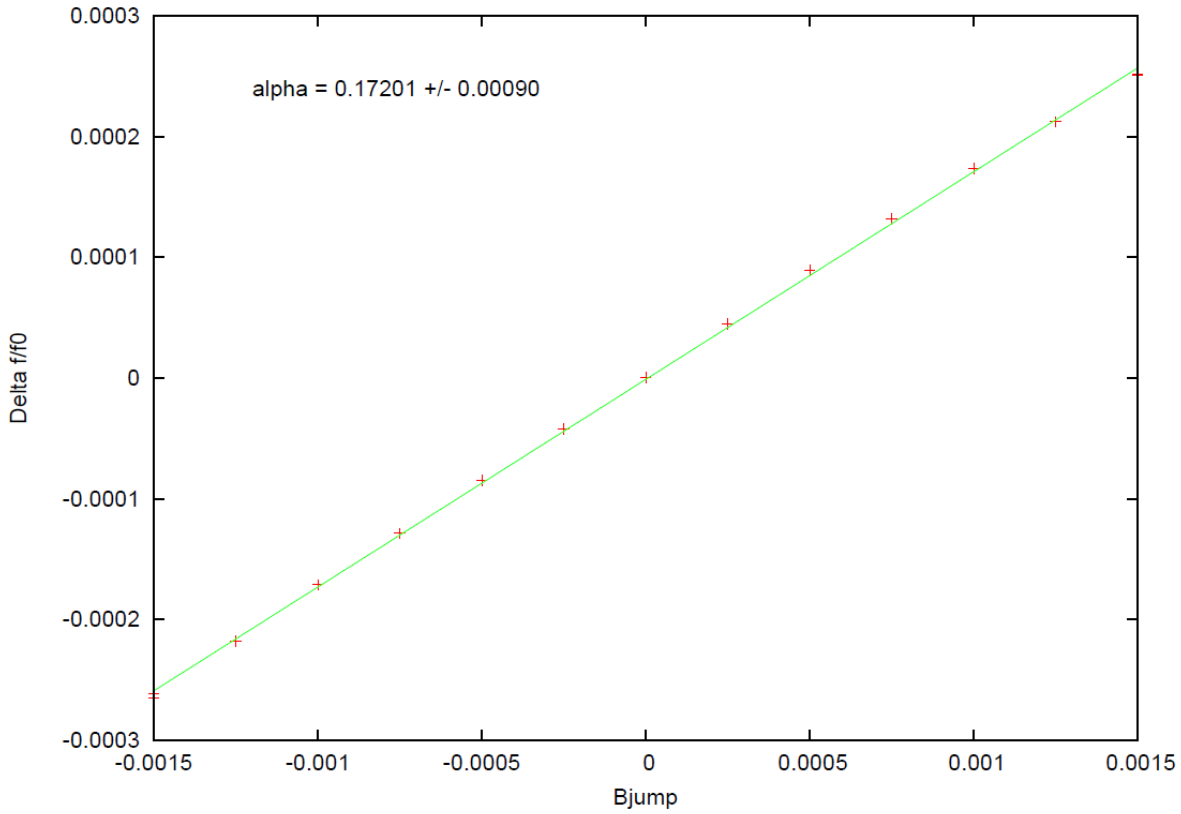
Reference:
Phys. Rev. ST Accel. Beams, 11, 052801(2008)

Eta measurement

1. df/f_0 data of each cycle have been stored
2. Background measurement by steering beam over the target
3. Long cycle for η measurement (5 mins cycle,1000 harmonics)



Eta parameter $\eta = 1/\gamma^2 - \alpha$



P3.2 GeV/c and P2.5 GeV/c

η @P3.2 = -0.0928 +/- 0.0009 error ~0.97%

η @P2.5 = -0.04854 +/- 0.0008953 error ~1.8%

4. Outlook

To be improved

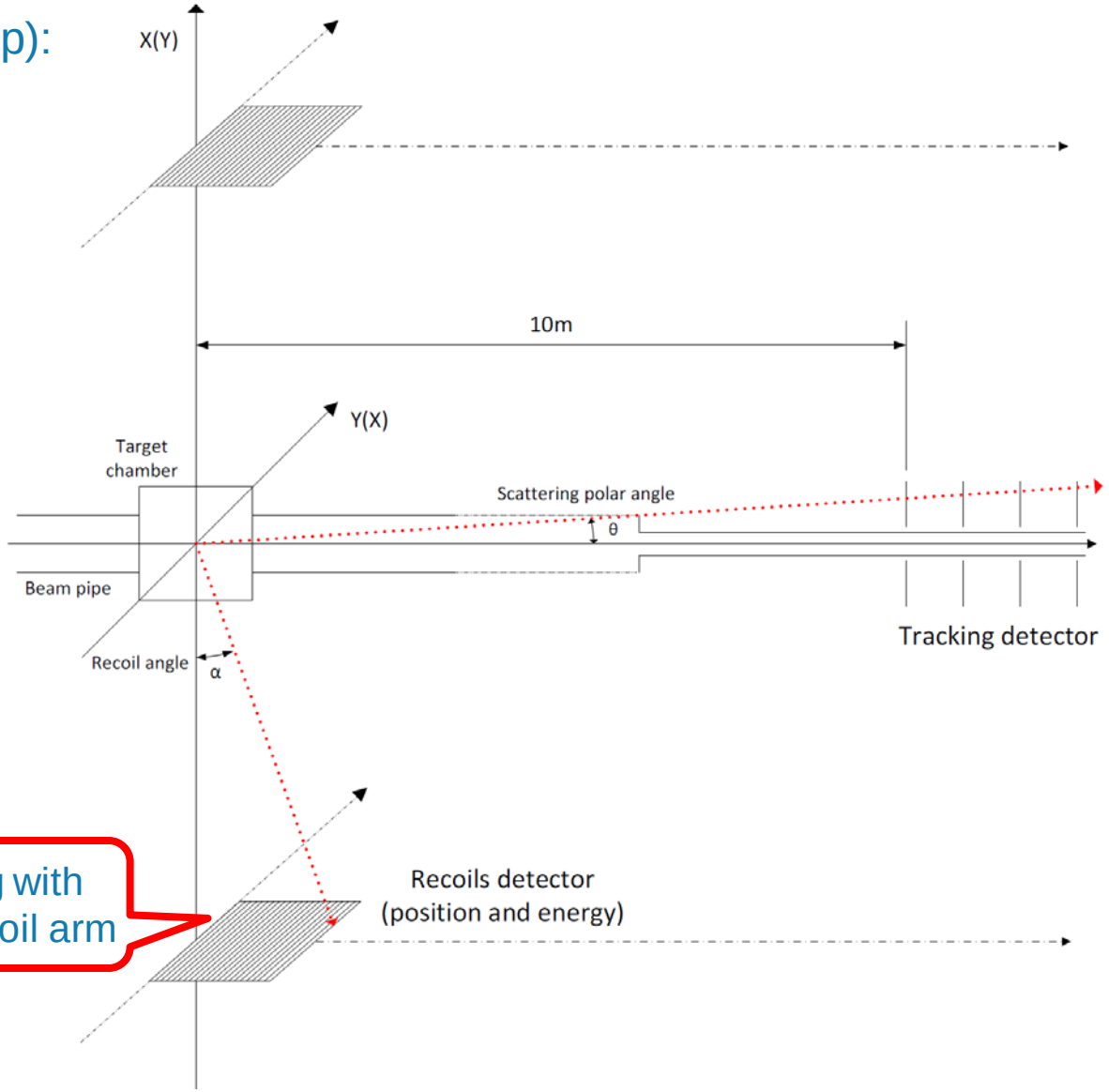
- Background suppression (i.e. 400keV protons mixing with background signals)
- DAQ efficiency must be improved for higher trigger rate (currently, maximum 800Hz)
- Higher beam momentum for larger t and more beam time for better statistics

Further data analysis will answer the question of luminosity determination precision

Thanks for your attention!

Sketch of day-one experiment

Large t-range (pbarp):
0.0008-0.1 GeV²



Starting with one recoil arm

Performance evaluation with pure elastic events

Setting for event generator(DPM):

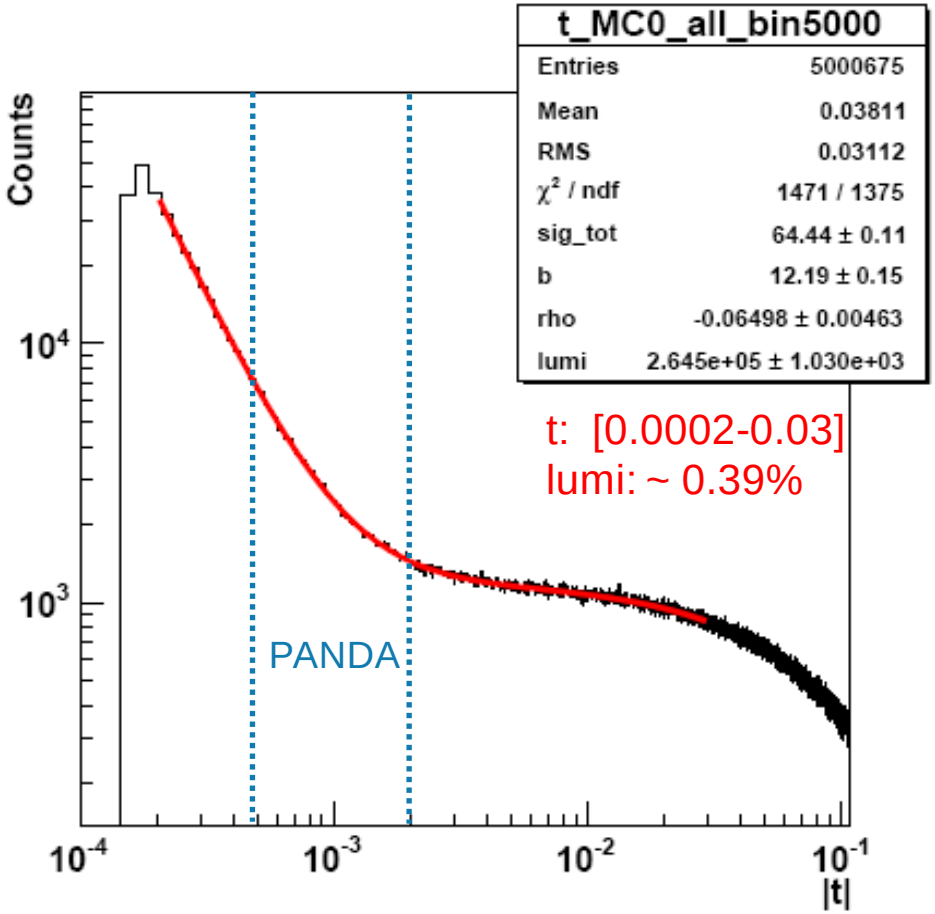
P_{lab} : 6.2 GeV/c, pure elastic events
Theta_min : 0.113° (~1.98mrad)
Events : 5M
Parameters : σ_{el} = 18.97mb, σ_{tot} = 64.50mb,
b = 11.89(GeV/c)$^{-2}$, ρ = - 0.063

$$\frac{dN}{dt} = L\left(\frac{d\sigma_c}{dt} + \frac{d\sigma_{int}}{dt} + \frac{d\sigma_n}{dt}\right)$$

$$\frac{d\sigma_c}{dt} = \frac{4\pi\alpha^2 G^4(t)(\hbar c)^2}{\beta^2 t^2}$$

$$\frac{d\sigma_n}{dt} = \frac{\sigma_T^2\left(1+\rho^2\right)e^{-b|t|}}{16\pi(\hbar c)^2}$$

$$\frac{d\sigma_{int}}{dt} = \frac{\rho\sigma_T G^2(t)(\hbar c)^2}{\beta|t|} e^{-\frac{1}{2}b|t|}(\rho\cos\delta + \sin\delta)$$



t: [0.0002-0.03]
lumi: ~ 0.39%

The measurable t is limited to a small range!

Si13 has been changed due to high current