Darmstadt, Mar. 5-9 2012

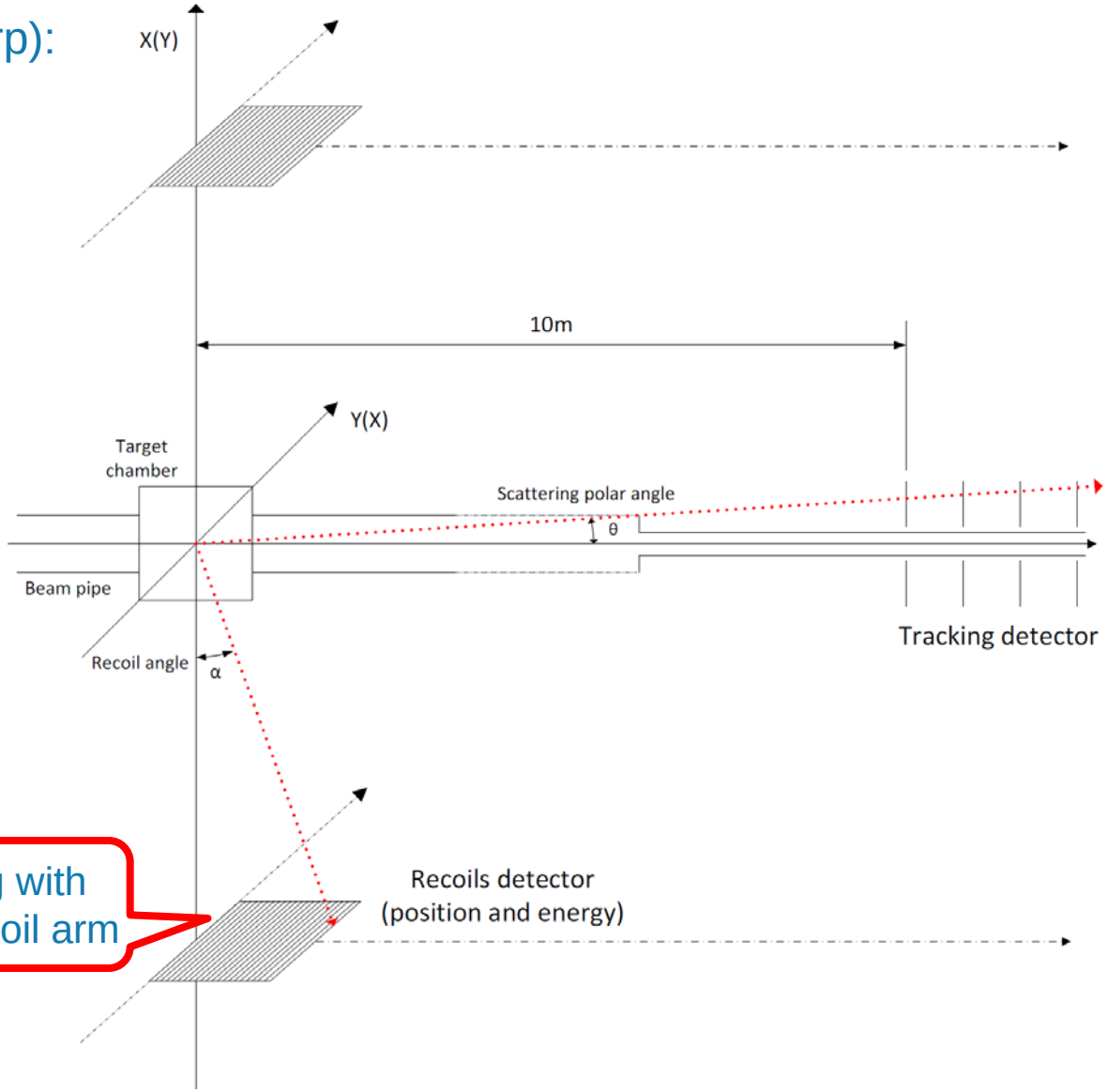
Update to day-one experiment

Huagen Xu

LuMo @ IKP: J. Ritman, T. Stockmanns, Q. Hu and T. Randriamalala

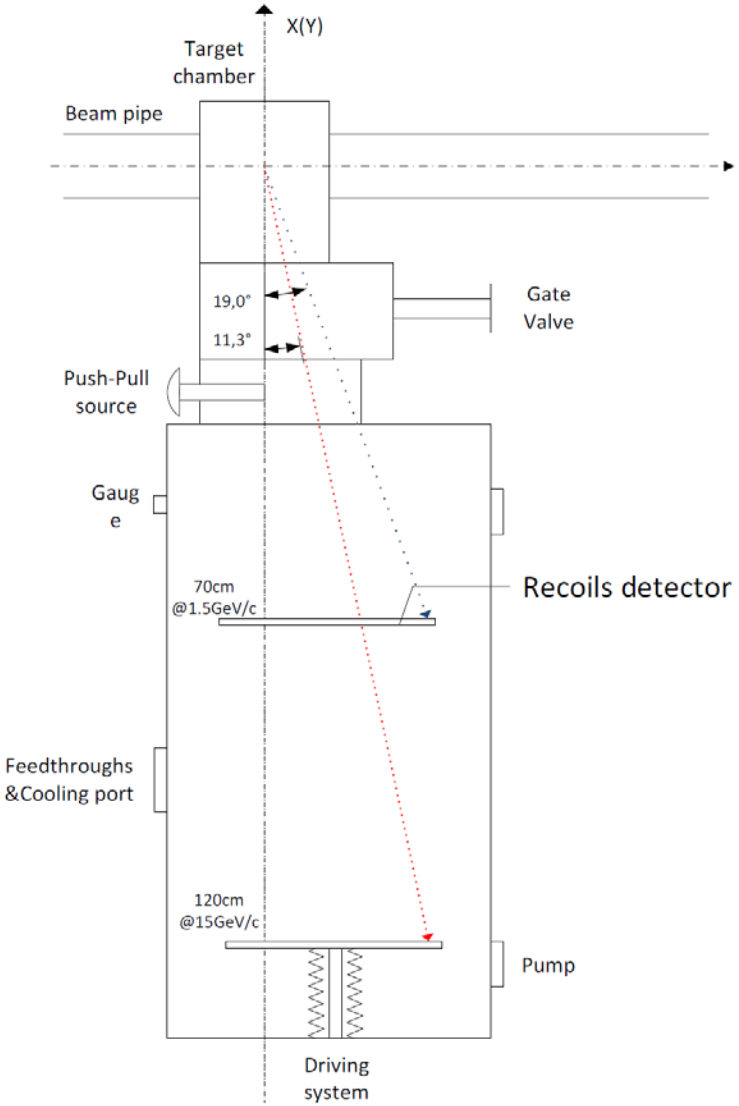
Sketch of day-one experiment

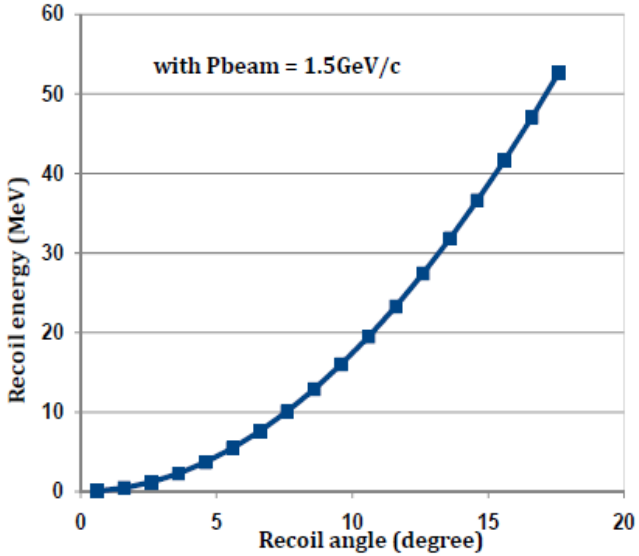
Large t-range (pbarp):
0.0008-0.1 GeV²

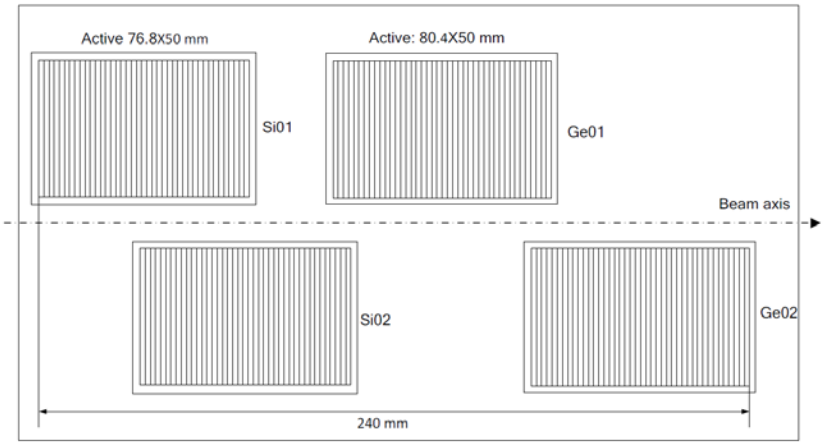


Starting with one recoil arm

Recoil arm

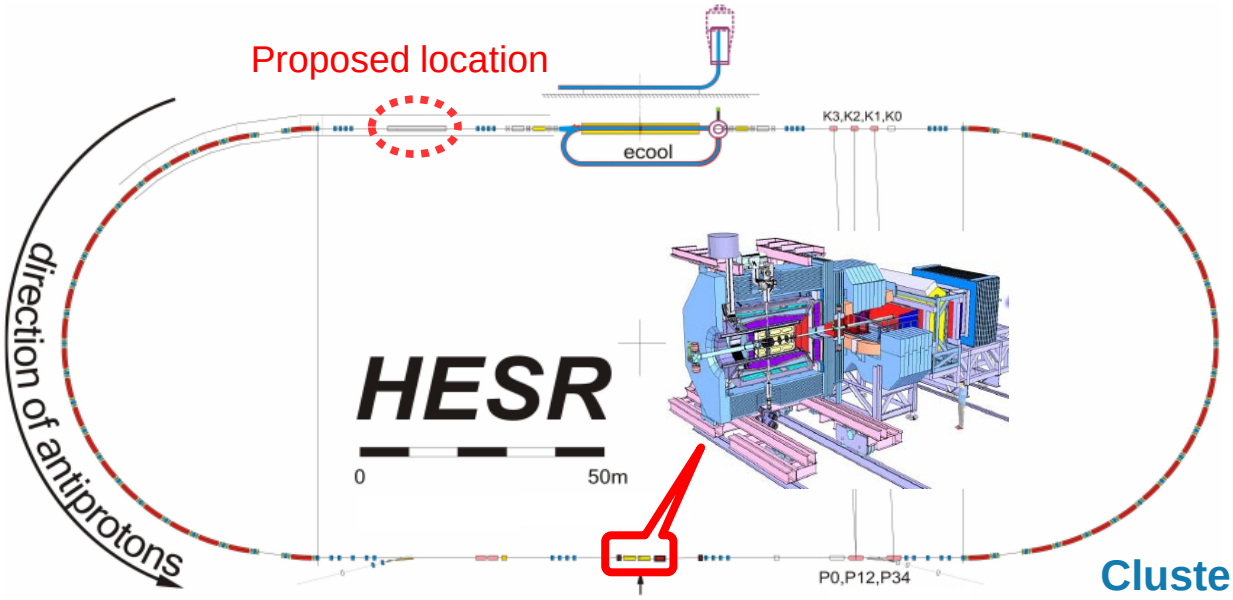






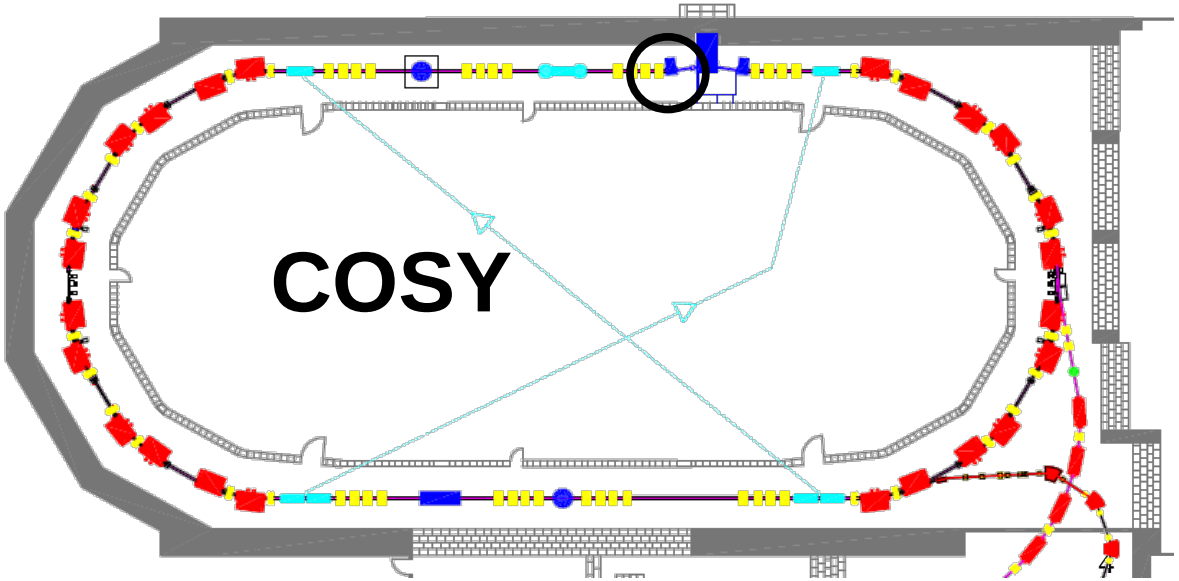
- 2 Si : 7.68cm x 5cm x 1mm (64ch, 1.2 mm pitch)
- 2 Ge: 8.04cm x 5cm x 4 &10mm (67ch,1.2mm pitch)

Goal of day-one experiment at HESR



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

Cluster target at ANKE



Time schedule

- **Submitting the commissioning proposal to COSY PAC in March**
- **Finishing the experiment preparation by the end of 2012**

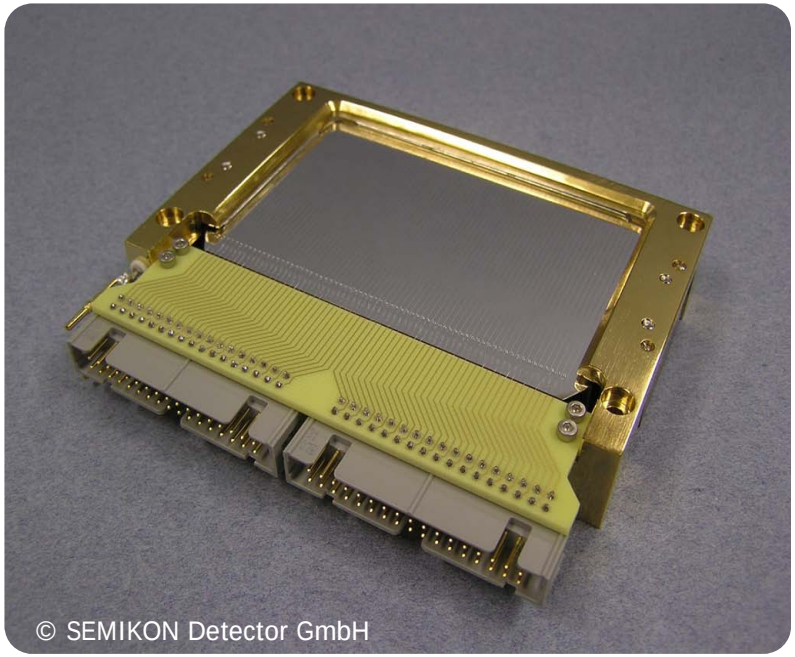
Schedule for Commissioning of day-1 experiment

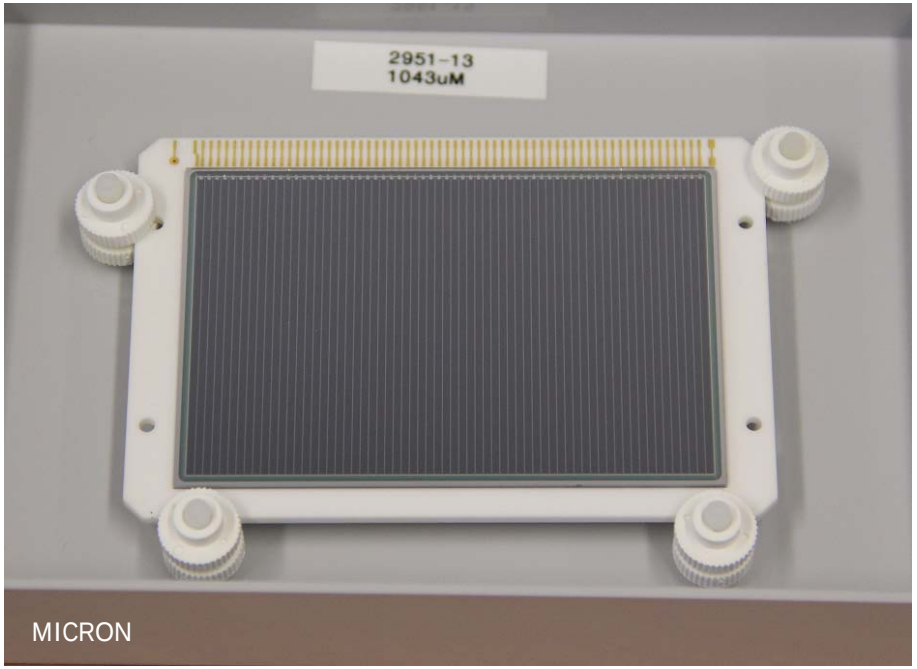
Part	Resource	2012 1	2	3	4	5	6	7	8	9	10	11	12	2013 1	2	3	4	5	6	7	8	9	10	11	12
Target	**Muenster**																								
0. General and Specifications																									
1. Effort estimation to change the target																									
2. Replace the skimmer																									
3. Test the target after change																									
4. Move the target into COSY																									
5. Tuning with detector setup																									
6. Beam time phase																									
Detector																									
Si (Micron)																									
1. Delivery to Juelich	Micron																								
2. Design of readout PCB	HG																								
3. Production of readout PCB	HG																								
4. Wire bonding	Semikon?																								
5. Sensor Test	HG																								
6. Integration in det chamber	HG																								
7. Test/Calibration	HG																								
8. Installation at COSY	COSY/HG																								
9. Beam time	HG/COSY																								
Ge (Semikon/Umicore)																									
1. Sensor Test	HG																								
2. Integration in det chamber	HG																								

Status of recoil arm construction

- **Part 1: Detector**
  - Ge detectors are ready and received
  - Si detectors are received and waiting for assembly
- **Part 2: FEE**
  - Received including preamp, shaping amp, ADCs etc.
- **Part 3: DAQ and Test system**
  - A test chamber with cooling(LN2) is being built
- **Part 4: Cluster target**
  - Using existing cluster target at ANKE location has been evaluated
  - Maximum opening angle (i.e. recoil angle) is limited by 13.6 degrees
- **Part 5: Vacuum chamber**
  - Drawings of detector vacuum chamber is close to finish.
  - Details on cooling plate and feedthrough layout is being discussed
- **Part 6: Cooling/Accessories**
  - HV is ordered (Iseg)
  - Pumping for filling LN2 and Dewar are getting ordered

Part 1: Detectors





Both 5mm & 11mm thick
Ge detectors have been fabricated and tested by Semikon

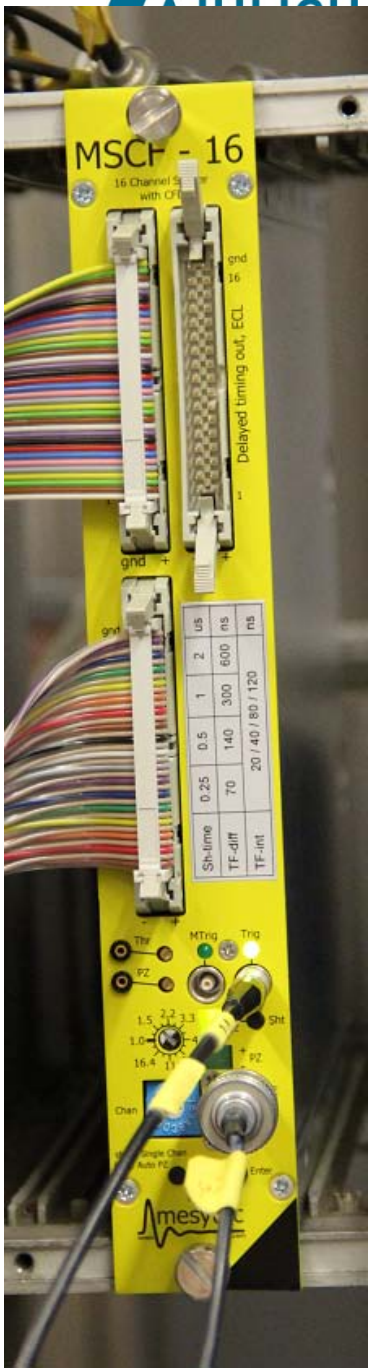
The two 1-mm-thick Silicon detectors are ready for assembly

1) Order for detector holder was made
2) Assembly and wire bonding
3) Detector test

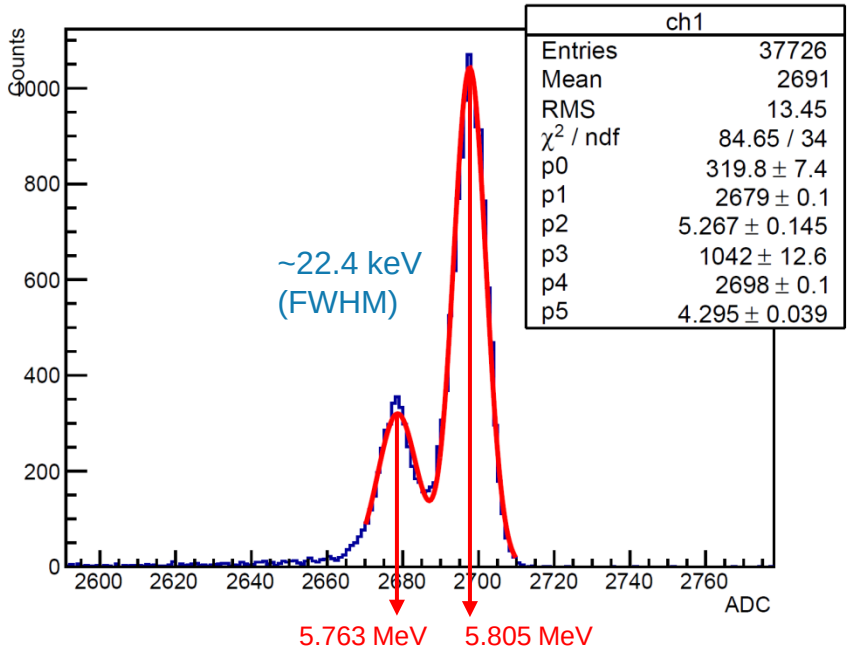
Part 2: FEE solution

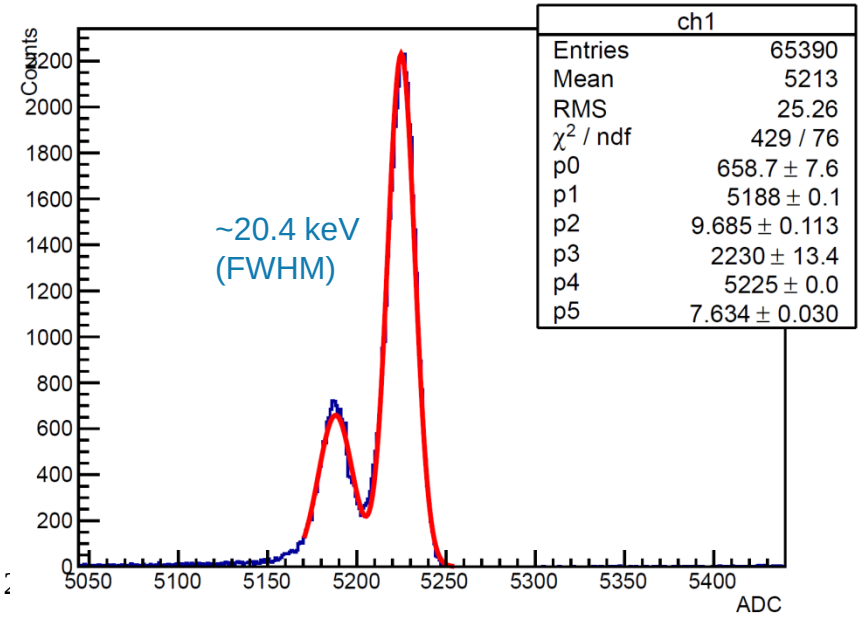
Mesytec:

MPR16: 16ch with variable gain
MPR1: for rear side
MSCF16: 16ch with LED
MADC32: peak sensing ADC, input range and bit resolution selectable



Received:		pcs
1.	MPR-1	5
2.	MSCF-16	11
3.	MADC-32	6
4.	MPR-16	5 of 11
5.	Cabling package	5 of 11





-- Ortec 1000um, 50mm^2 silicon

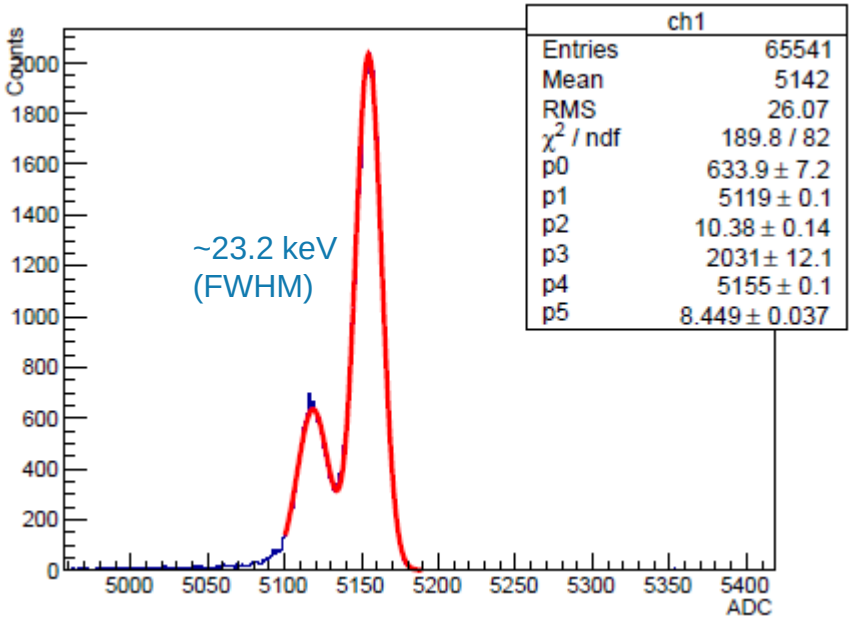
-- MADC32 (13bit, 8V)

Reference: Single channel Ortec electronics

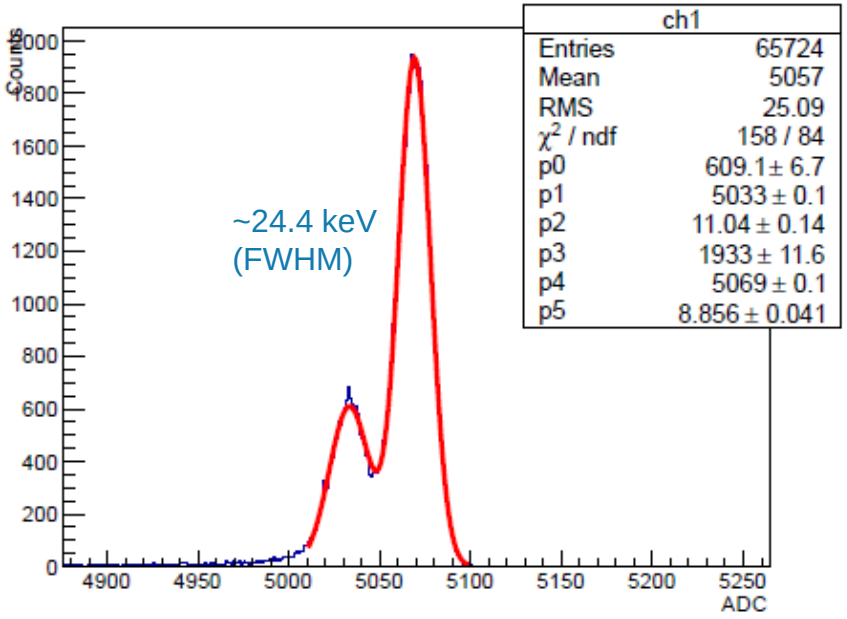
- Ortec 142AH preamplifier
- Ortec 472A shaping amplifier
- **20cm cabling**

- MPR16, preamplifier
- MSCF, shaper
- **20 cm cabling**

Effect of cabling length



- MPR16, preamplifier
- MSCF, shaper
- **60 cm cabling**



- MPR16, preamplifier
- MSCF, shaper
- **120 cm cabling**

Part 3 : DAQ and test system

DAQ hardware:

- VME crate
- 6 MADC32 + 1 CAEN V785

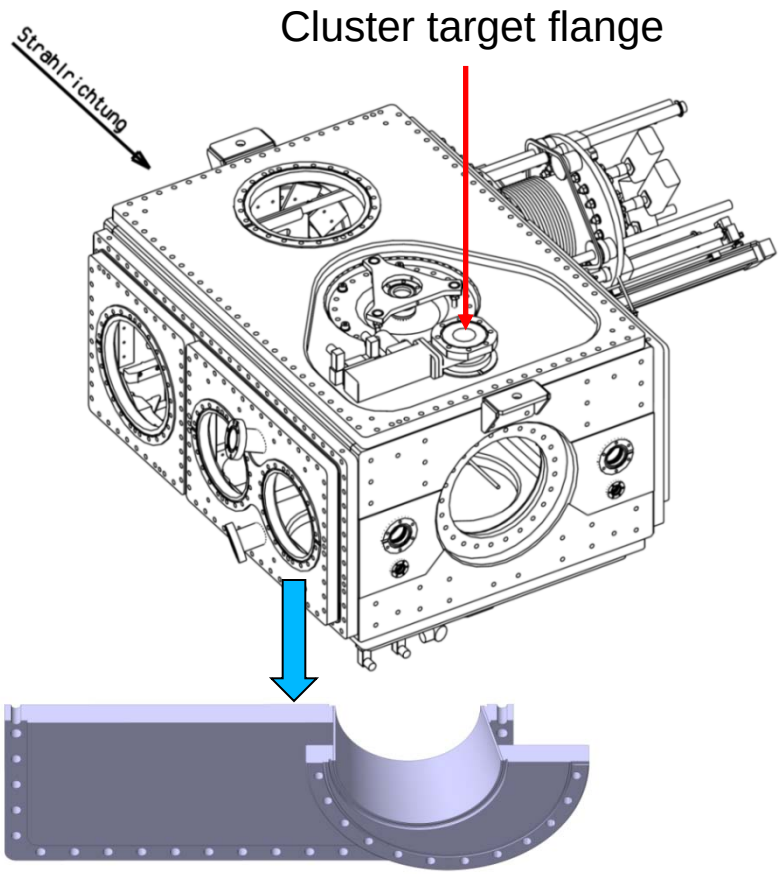
DAQ software:

- Basic data taking function implemented
- IRQ mode is still missing

Test chamber with cooling:

- Chamber is available
- Old Dewar seems to be OK
- Cooling relevant parts are under design

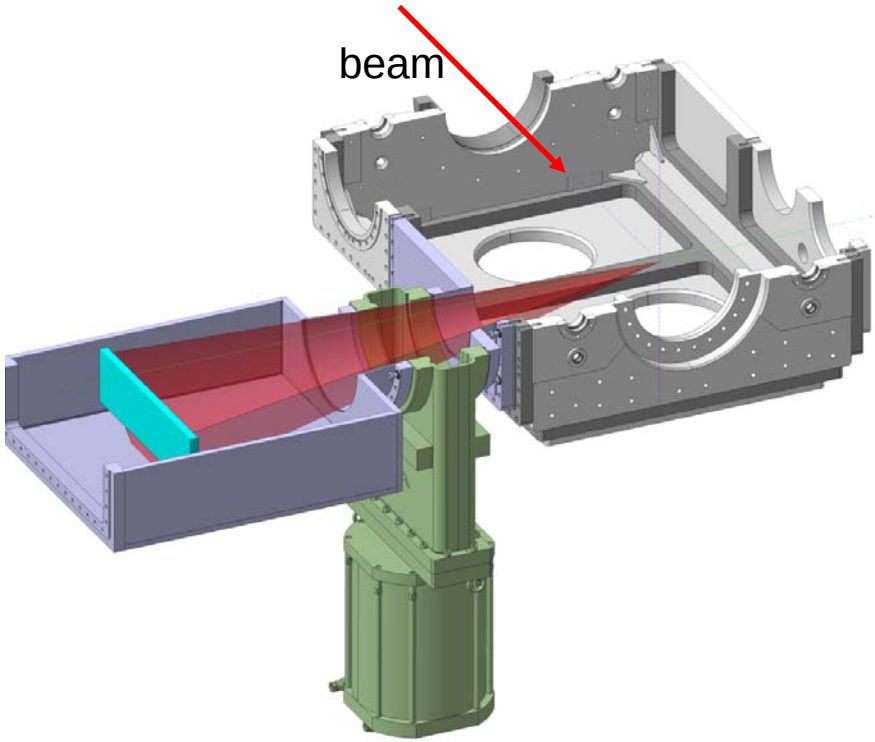
Part 4: Evaluation of existing cluster target



recoil angle up to ~13.6° confirmed

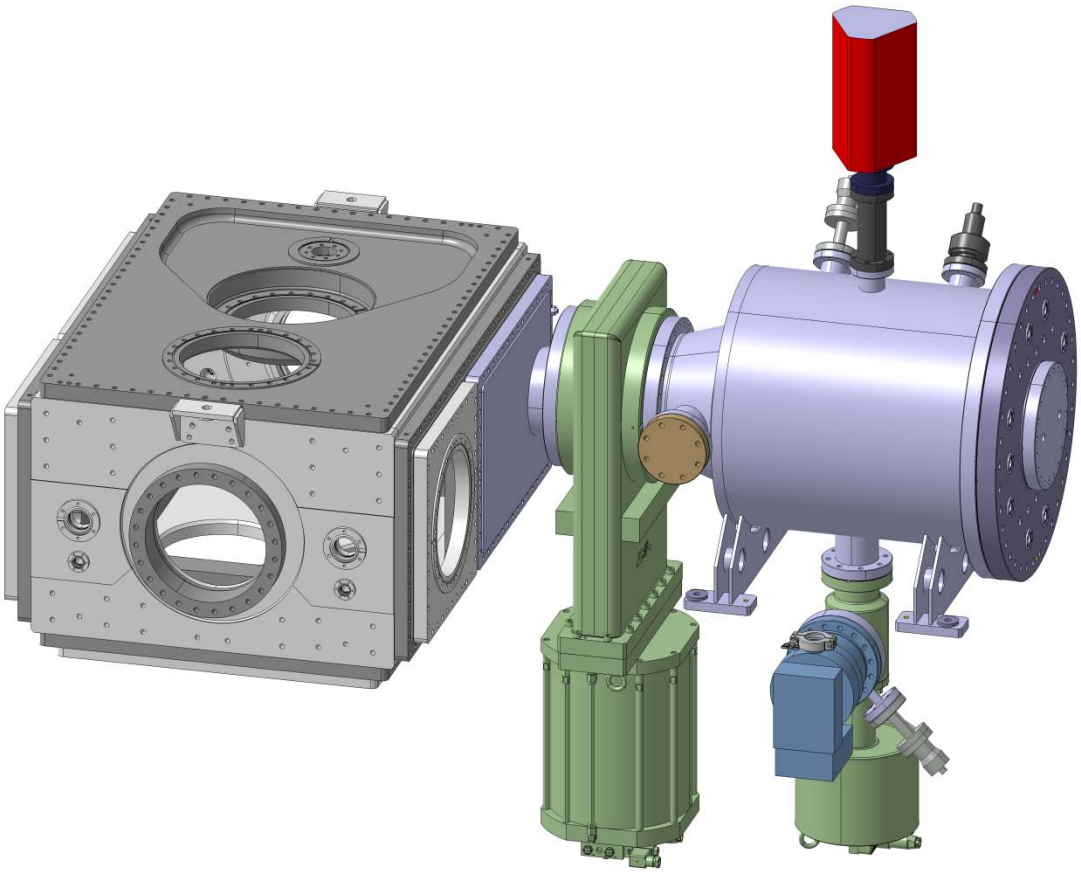
What to be checked

- Target performance
- Maximum recoil angle
- Available space

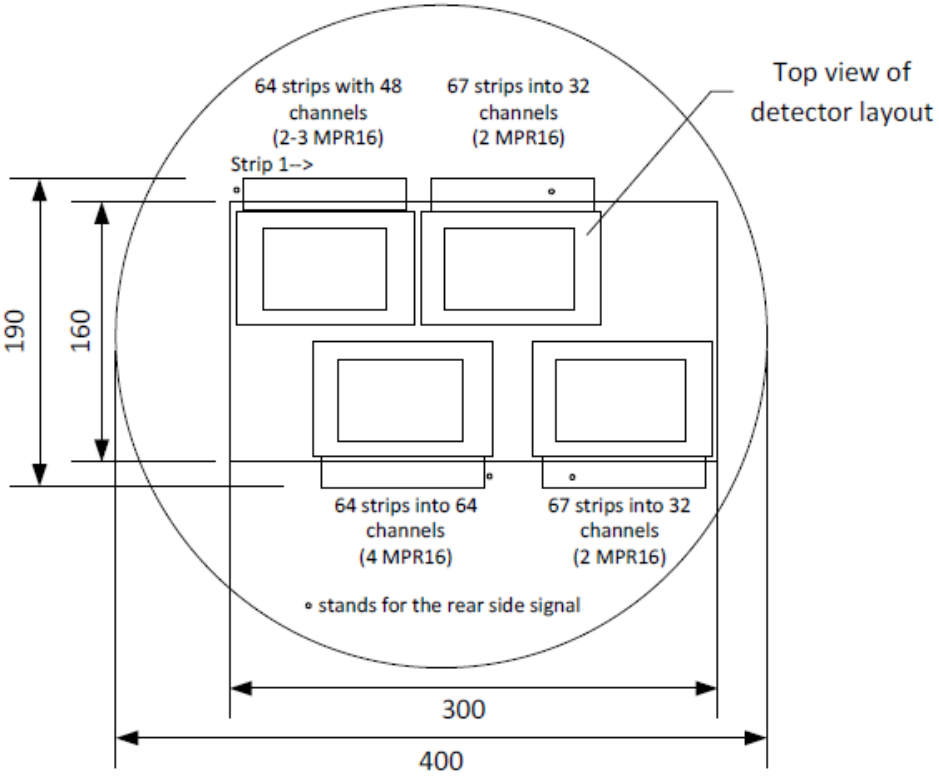


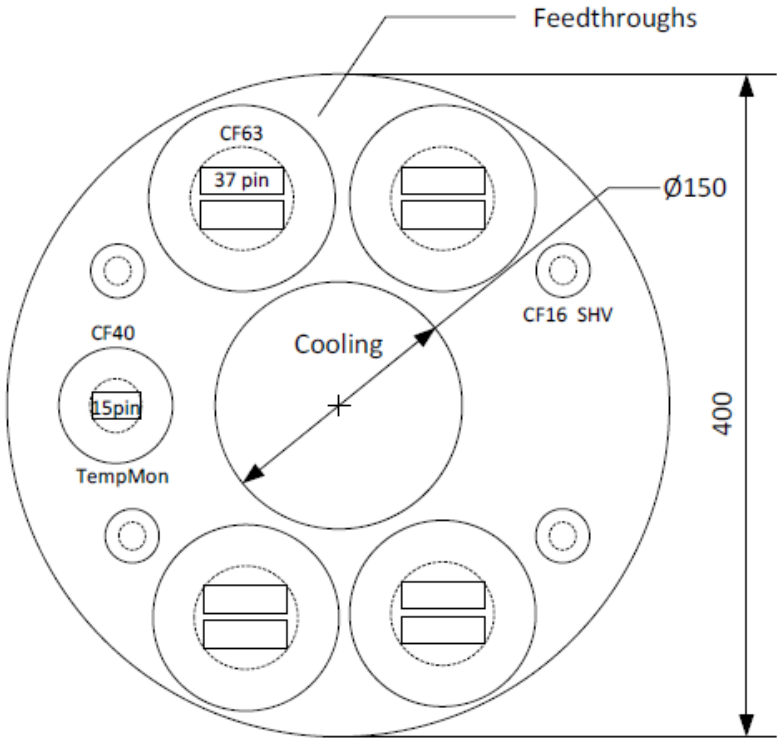
Accepted by ANKE collaboration

Part 5: Vacuum chamber



- Mechanical design is nearly finished
- Cooling details and feedthrough layout to be fixed





CF16
SHV

CF63/40 with Sub D type

Part 6: Cooling and Accessories

Cooling for test chamber

- LN2 option
- To be ordered: Pump for filling

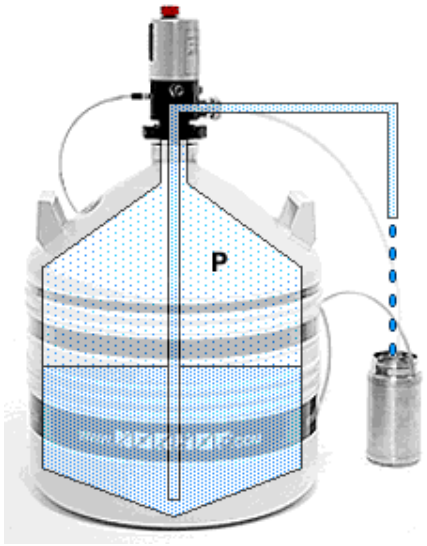
Cooling for Experiment

- if LN2 option, to order large volume Dewar (e.g. 20L)
- if Coldhead option, to order Coldhead

Temperature monitor & HV safety loop

- Temperature monitor module
- Safety loop for over-temperature protection

Working principle



Norhof

Temperature Monitor & safety loop

Relay changes the active status of HV

Offers:

- MA901 from RKC
- IMAGO 500 from JUMO
- 218S from Lake Shore

Relay changes the status of HV.

HV module:

- 8ch with 4ch 500V & 4ch 2000V
- High precision, e.g. 100pA
- Safety loop protection, i.e. 5-20mA

Crate:

- Mini Mpod (4 slots)
- Versatile accessing interfaces

What to be done

- **Part 1: Detector**
  - Assembly of Silicon detector and test
- **Part 2: FEE**
  - Functional check of modules
- **Part 3: DAQ & test system**
  - Codes for online display/offline analysis
  - Building test chamber with cooling
- **Part 4: Cluster jet target**
  - Double check for target performance
  - Schedule confirmation
- **Part 5: Vacuum chamber**
  - Fix the drawings and transfer to workshop asap
- **Part 6: Cooling/Accessories**
  - Cooling option evaluation
  - Orders for missing components
  - Implementation of safety loop for over-temperature case

Thanks for your attention!

Performance evaluation with pure elastic events

Setting for event generator(DPM):

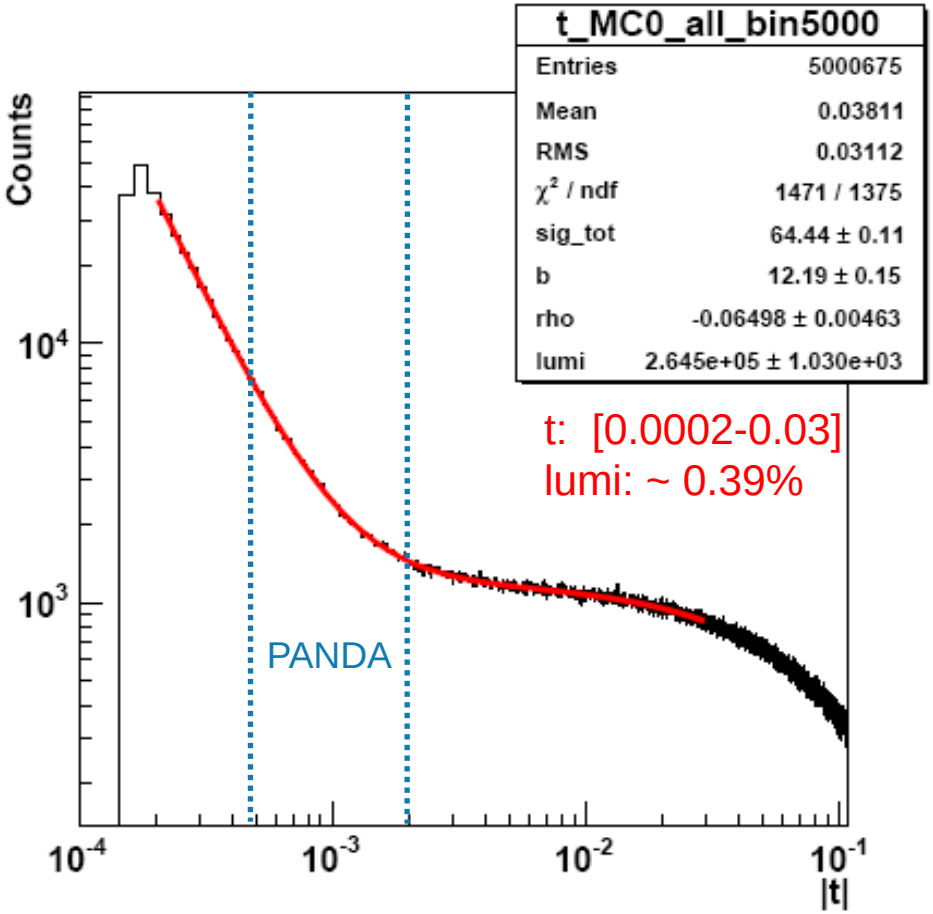
P_{lab} : 6.2 GeV/c, pure elastic events
Theta_min : 0.113° (~1.98mrad)
Events : 5M
Parameters : σ_{el} = 18.97mb, σ_{tot} = 64.50mb,
b = 11.89(GeV/c)$^{-2}$, ρ = - 0.063

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

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

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

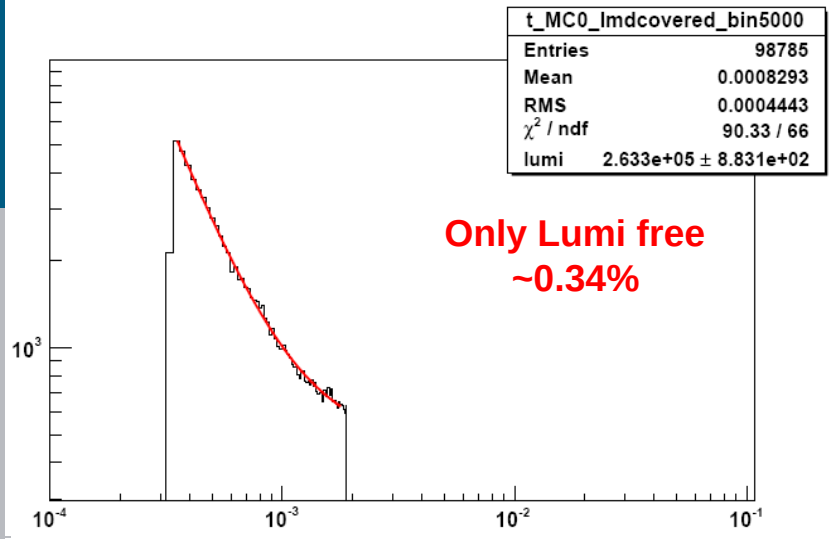
$$\frac{d\sigma_{int}}{dt} = \frac{\rho\sigma_T G^2(t)(\hbar c)^2}{\beta|t|} e^{-\frac{1}{2}b|t|}(\rho\cos\delta + \sin\delta)$$

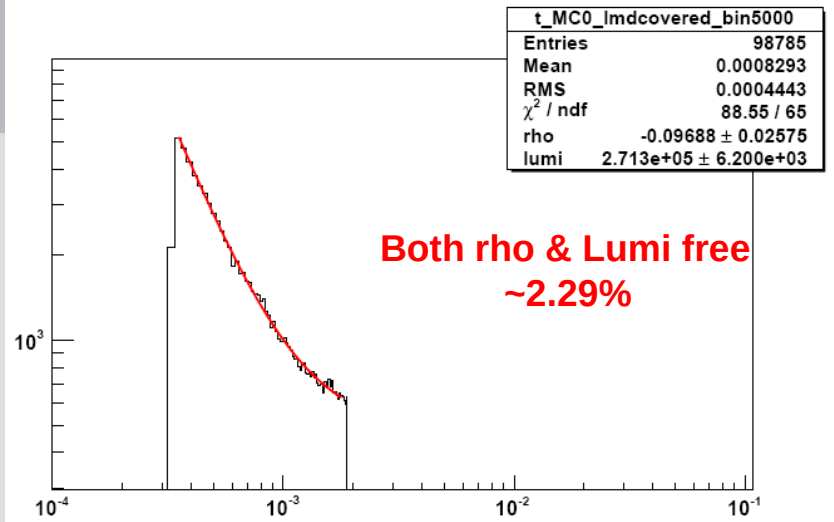


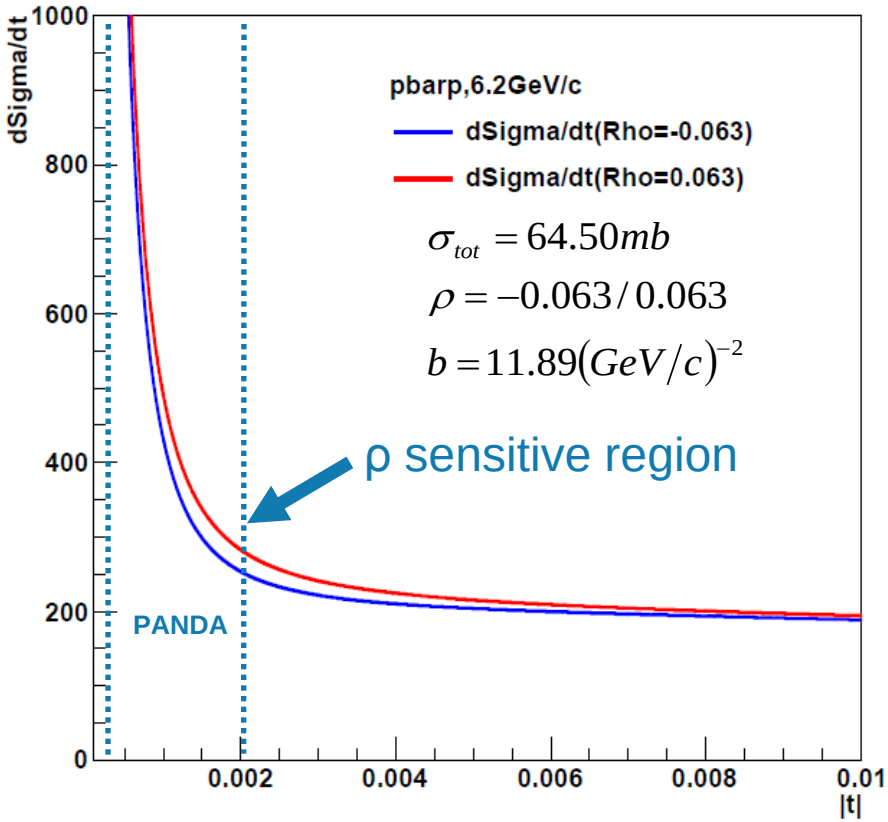
t: [0.0002-0.03]
lumi: ~ 0.39%

The measurable t is limited to a small range!

Parameters correlation







Fixing the parameters is needed to determine the absolute luminosity!

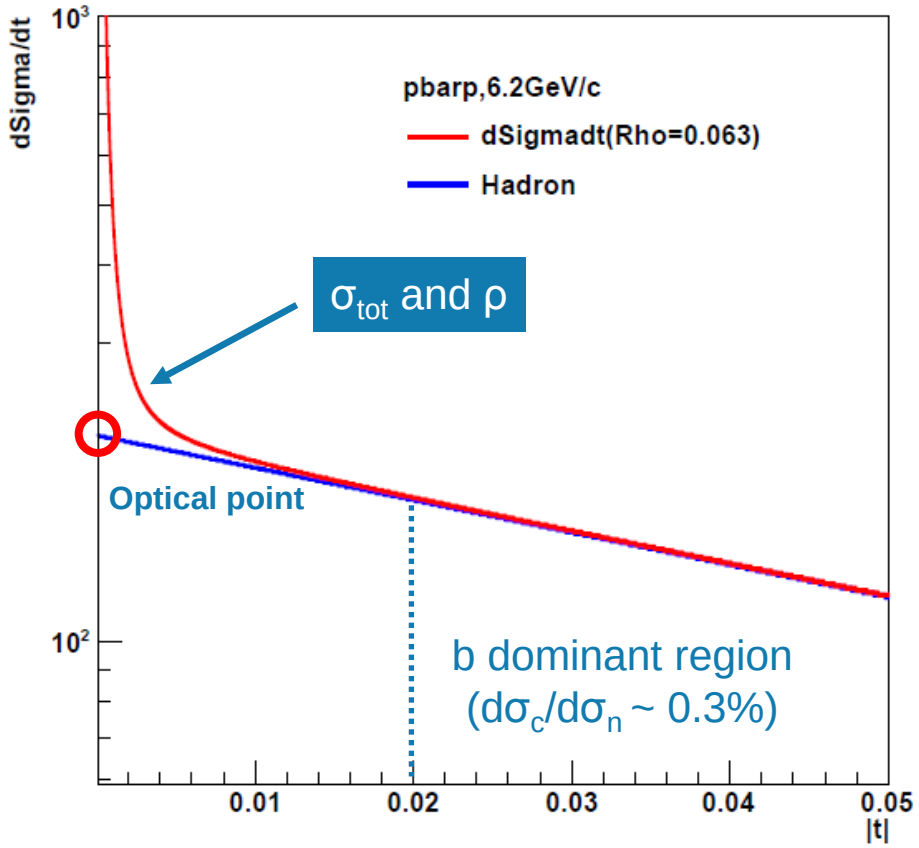
Parameters determination

Typical parameterization

$$\frac{1}{L}\frac{dN_{el}}{dt} = \frac{d\sigma}{dt} = \frac{d\sigma_c}{dt} + \frac{d\sigma_{\text{int}}}{dt} + \frac{d\sigma_n}{dt}$$

Optical theorem

$$\sigma_{tot}^2 = \frac{1}{L}\frac{16\pi}{1+\rho^2}\frac{dN_{el}}{dt}\bigg|_{t=0} \Rightarrow \frac{1}{L} = \frac{\sigma_{tot}^2(1+\rho^2)}{16\pi\frac{dN_{el}}{dt}\Big|_{t=0}}$$



Parameterization for slope b

$$\frac{d\sigma_n}{dt} = Ae^{bt}$$

for $|t| < 0.8\ \text{GeV}^2$, moderate energies (5-30GeV)

Luminosity independent analysis is feasible!

How large t-range?

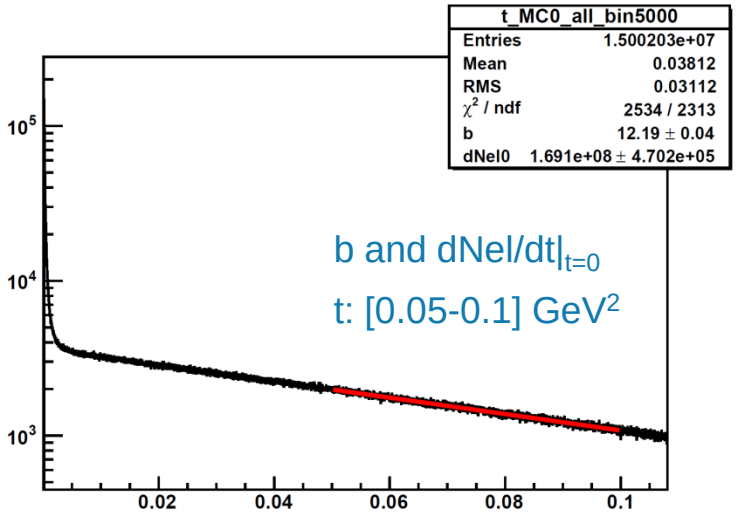
t:Optical point and b
Nuclear dominated region

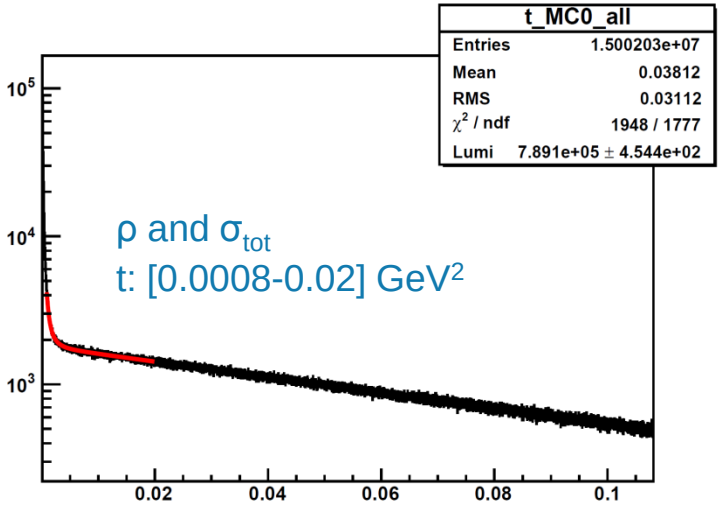
↓

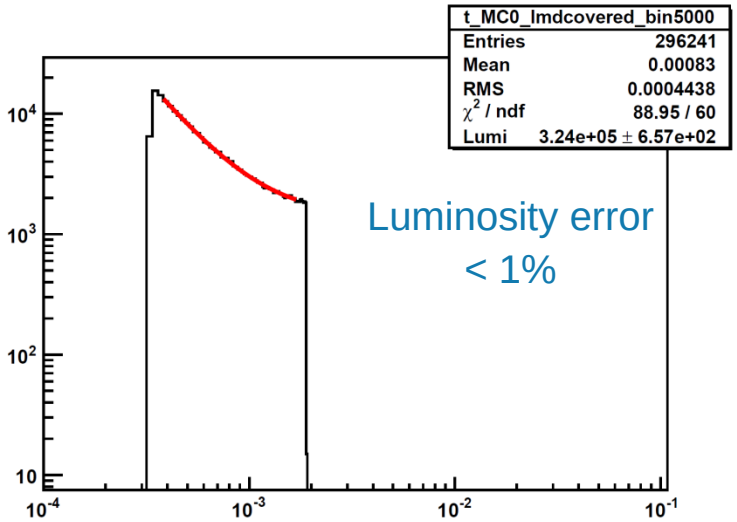
t:ρ and σ_{tot}
Coulomb-strong region

↓

Known b,ρ and σ_{tot}
absolute luminosity **<1%**







Expected t range : 0.0008 – 0.1 GeV²


MSCF - 16
MSCF - 16
MSCF - 16
MSCF - 16
MSCF - 16
MSCF - 16
CAEN
MODEL
401B
BIN
TEMP
POWER
ON
OFF
OSIRIS
mesytec