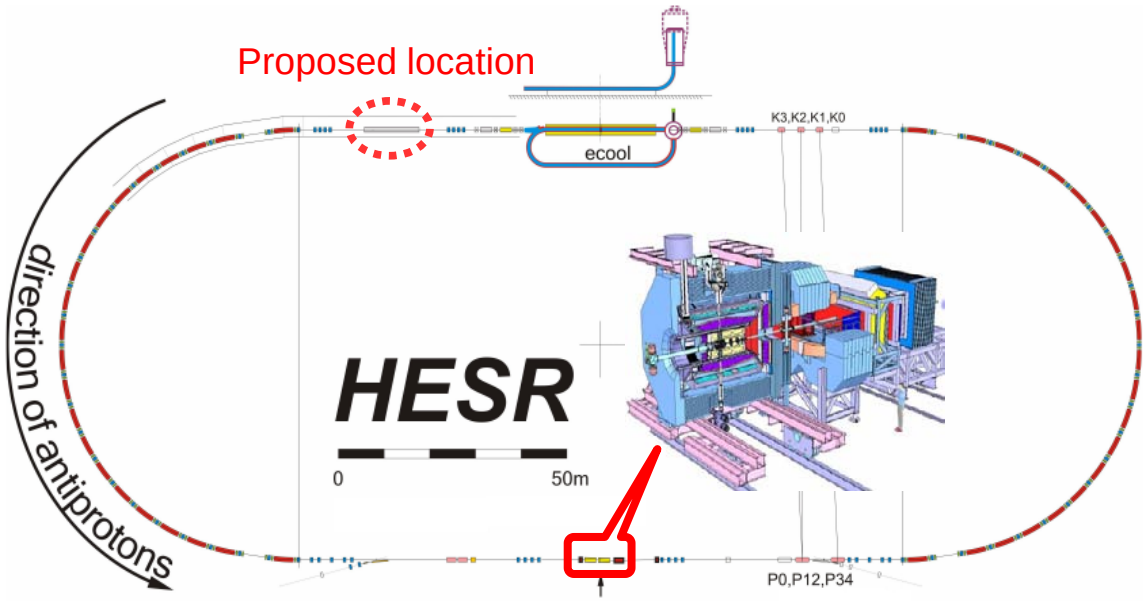
Paris, Sep. 10-14 2012

Status of day-one experiment commissioning at COSY

Huagen Xu

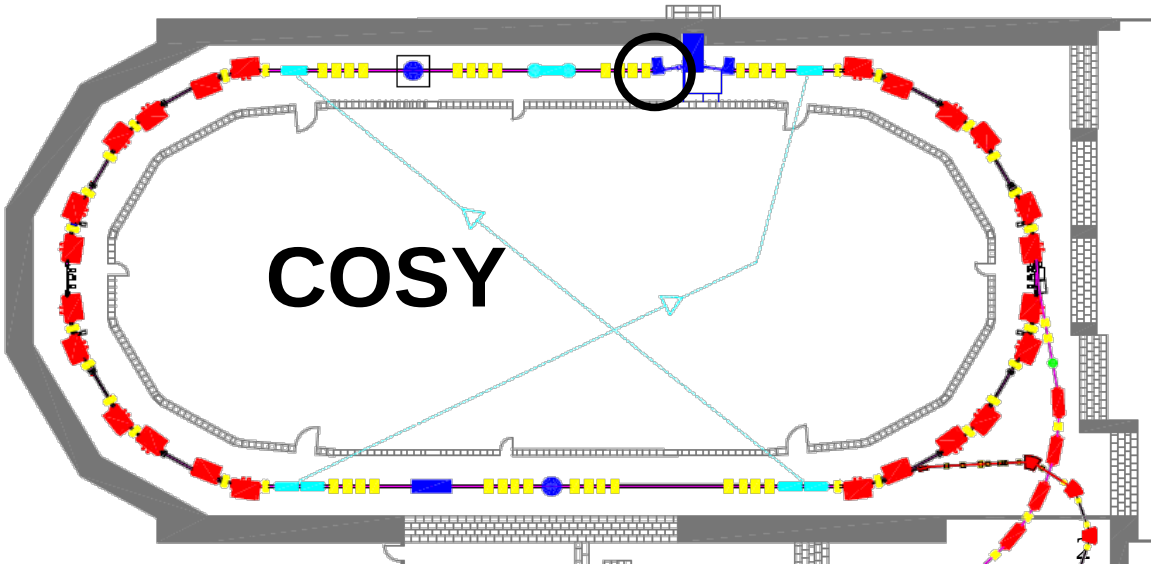
Goals of day-one experiment at HESR



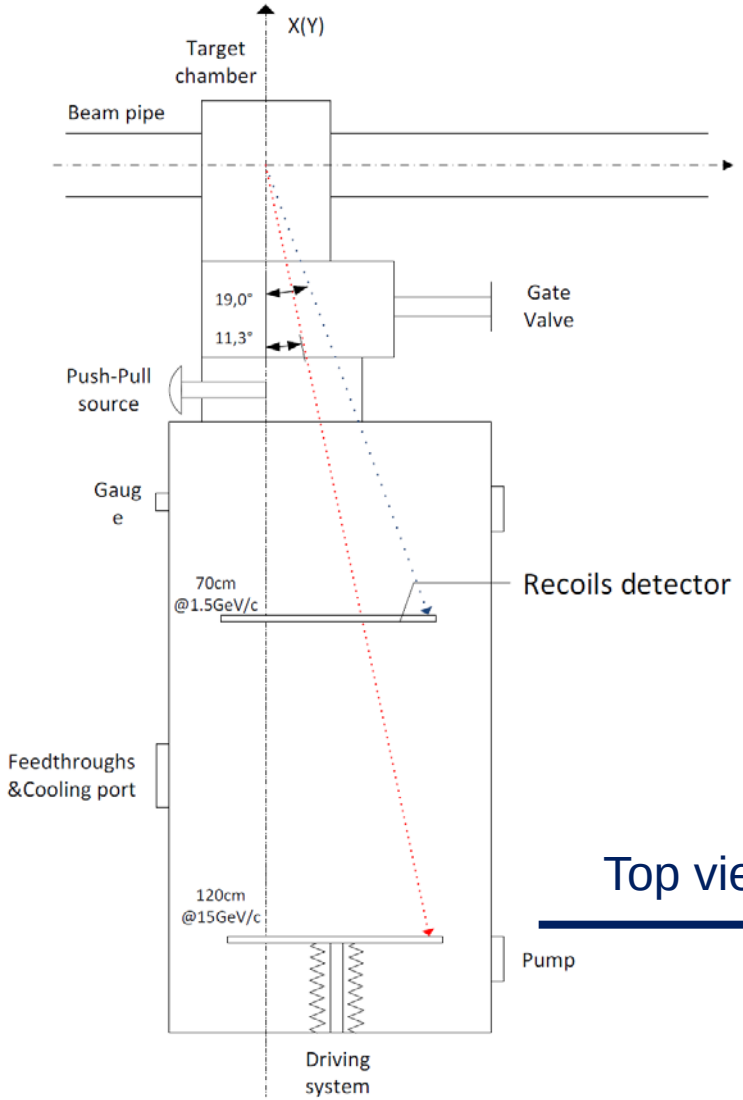
- Pbarp elastic scattering
- Coincidence (forward&recoil)
- Large range of t : 0.0008-0.1 GeV^2

- Test method
- Recoil arm construction
- Commissioning at COSY

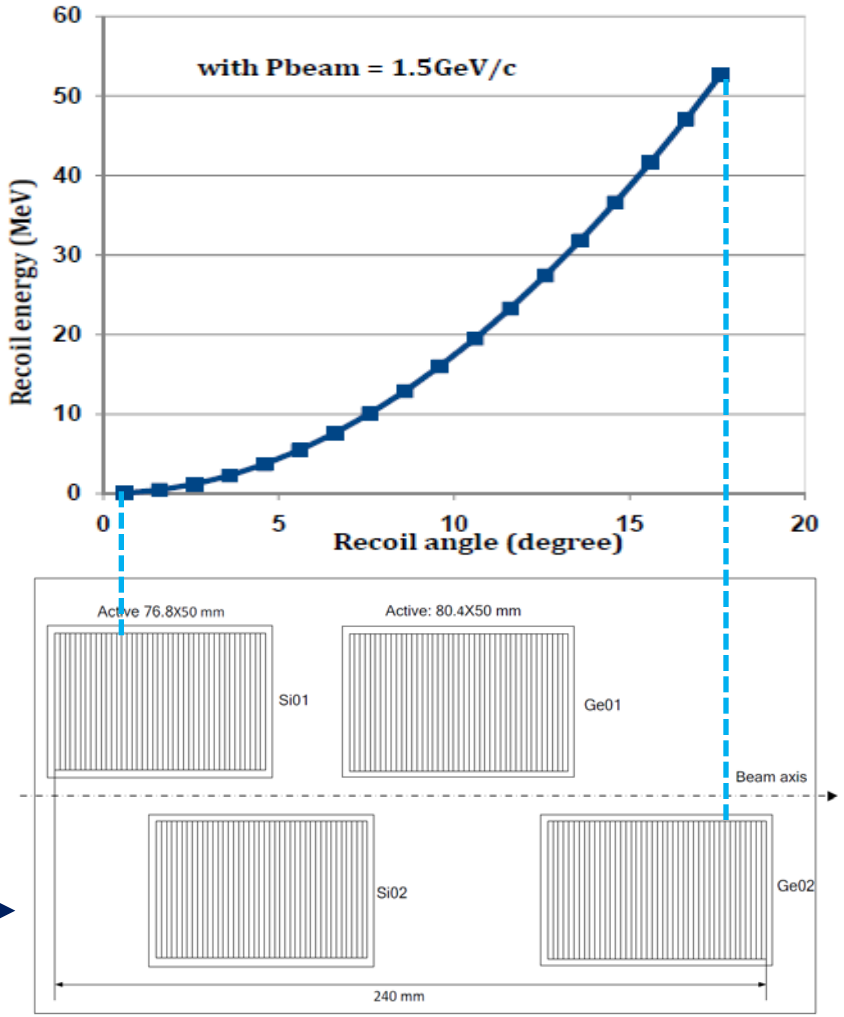
Cluster target at ANKE



Recoil Arm



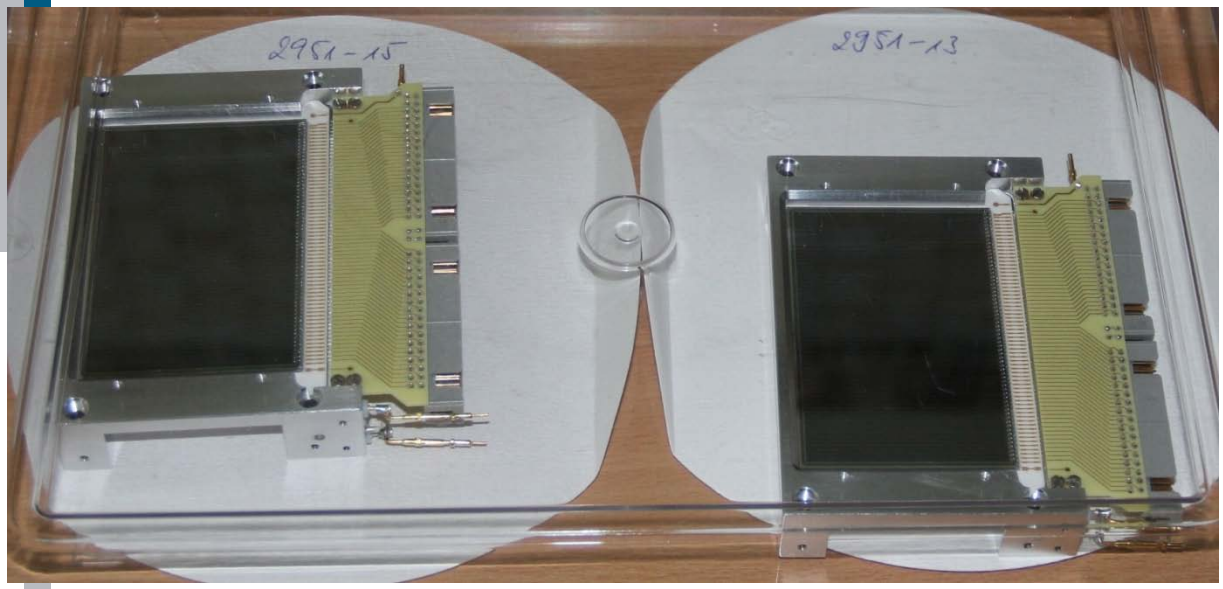
Top view



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

Fixed plane for commissioning

Part 1: Detectors

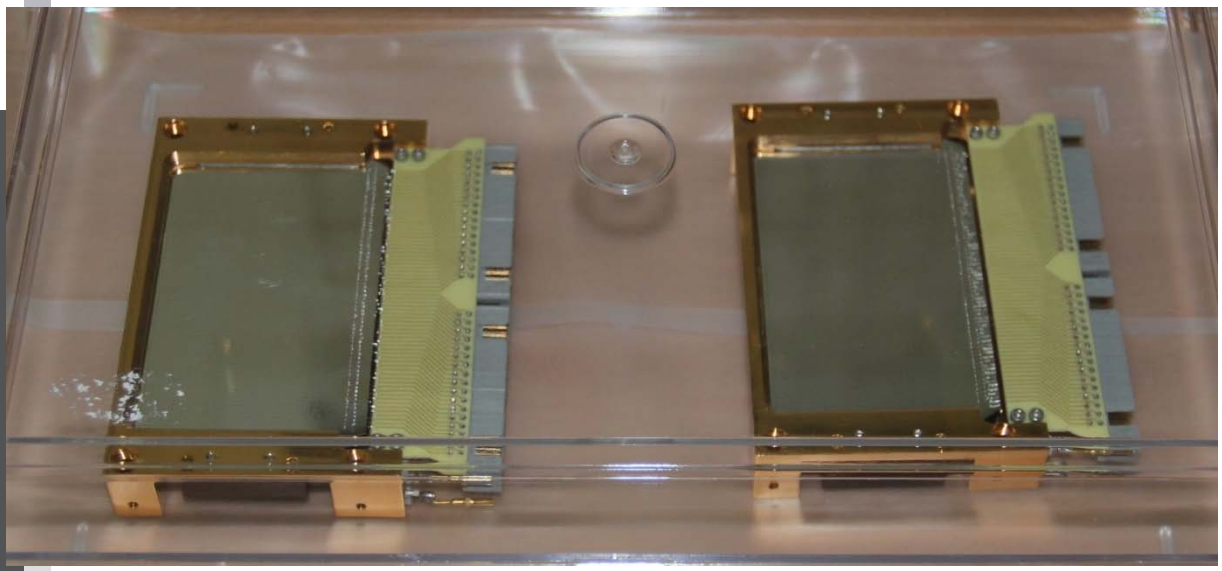


Achievements:

- Both have been tested at room temp and cooling temp;

To do:

- Final assembly



Achievements:

- 5 mm thick one has been tested;

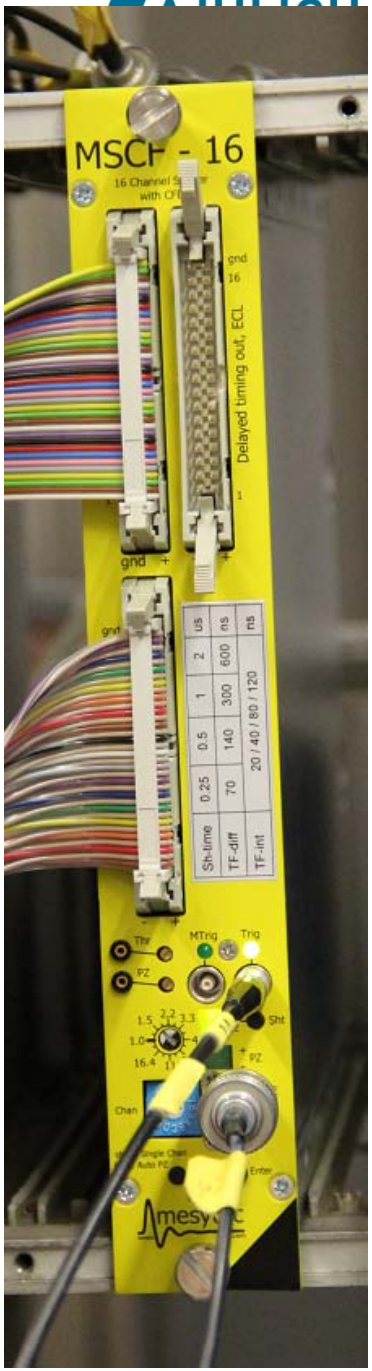
To do:

- High leakage current study
- 11 mm thick one test
- Final assembly

Part 2: FEE solution

Mesytec:

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

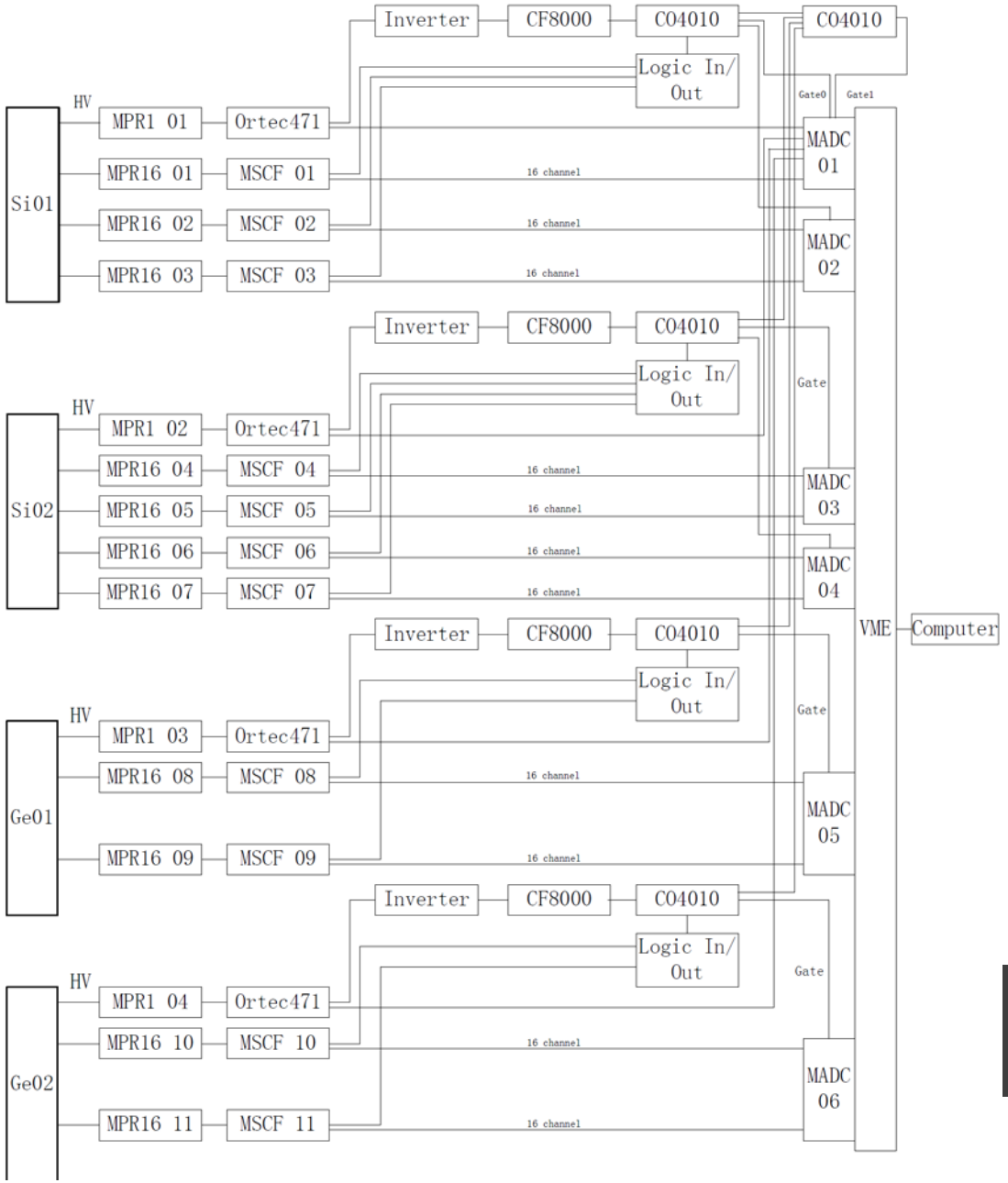


Received:	quantity
1. MPR-16	12 / 12
2. MPR-1	5 / 5
3. MSCF-16	12 /12
4. MADC-32	6 / 6

Achievements:
- Requested new FEE complete

To do:
- Test with final setup
- Logic modules, NIM crate, Rack

Day-1 commissioning FEE diagram



To do:

- To search the missing parts

Cables

Cabling in vacuum (between feedthrough and detector)

Signal (262 strips): 262 strips => 178 FEE channels (Kapton insulated)
HV: 4 stranded core single cable (Kapton insulated)
TempMon: 5 pairs twisted Kapton insulated cable
Heater: 1 pair twisted Kapton insulated cable

Cabling in air (between feedthrough and preamp)

Signal (178 channels): 178 channels
HV: 4 channels (SVH-MHV)
TempMon: 5 pairs twisted
Heater: 1 pair twisted

Achievements:
- Order of cable for vacuum side has been made

To do:
- Making cables

Part 3 : DAQ and test system

DAQ hardware:

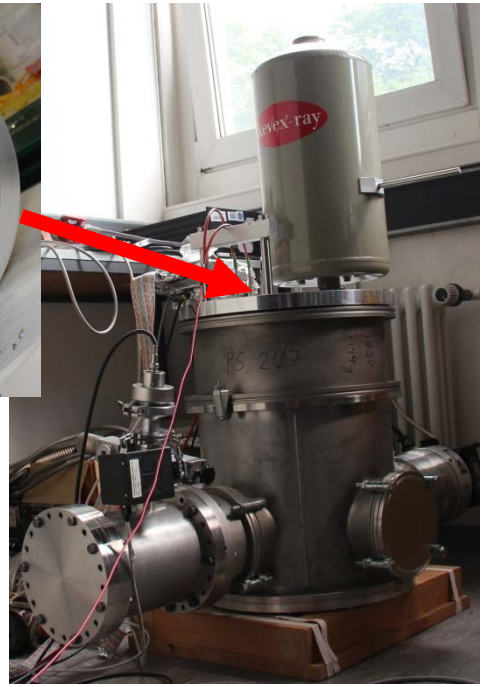
- VME crate and 6 MADC32 + 1 CAEN V785

DAQ software:

- IRQ mode
- Time stamping
- Online display

Test chamber with cooling:

- Vacuum pressure: 10^{-6}~10^{-7} mbar order
- Temp at cooling plate: ~ 94K (best case)



Achievements:

- Hardware are complete

To do:

- Code work for DAQ
- Better chamber for Ge test

Part 4: Confirmation of existing cluster target

- The expected specification of existing cluster target at ANKE location has been verified by target operating group.
- The relevant change of the cluster target will be done together with the installation of recoil arm.

Proposal to use the ANKE cluster target has been accepted by ANKE collaboration!

Achievements:

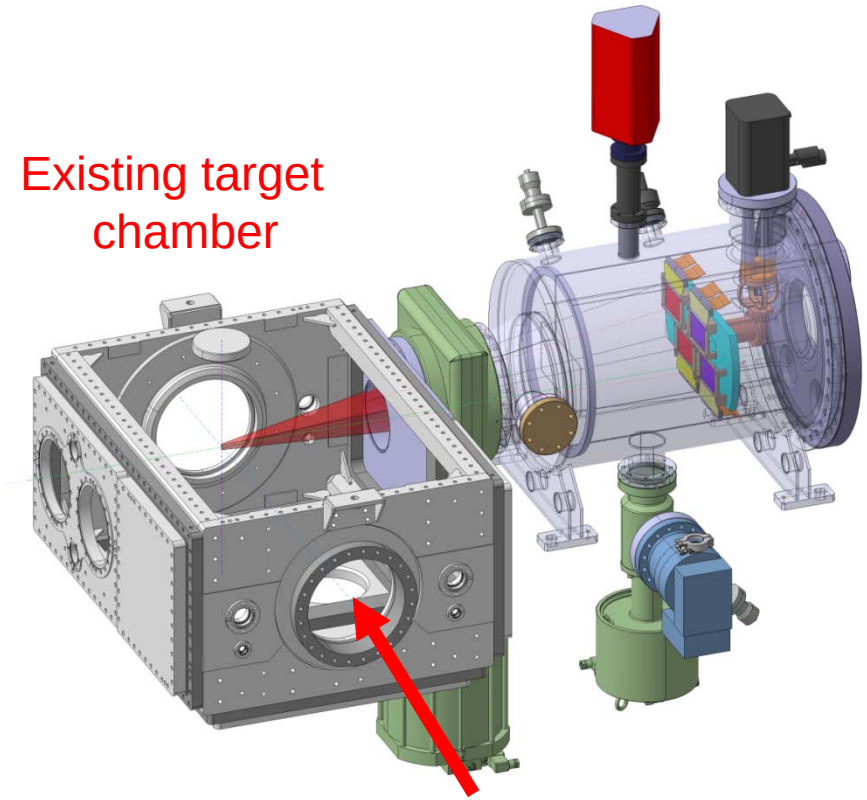
- Specification of target verified by target group

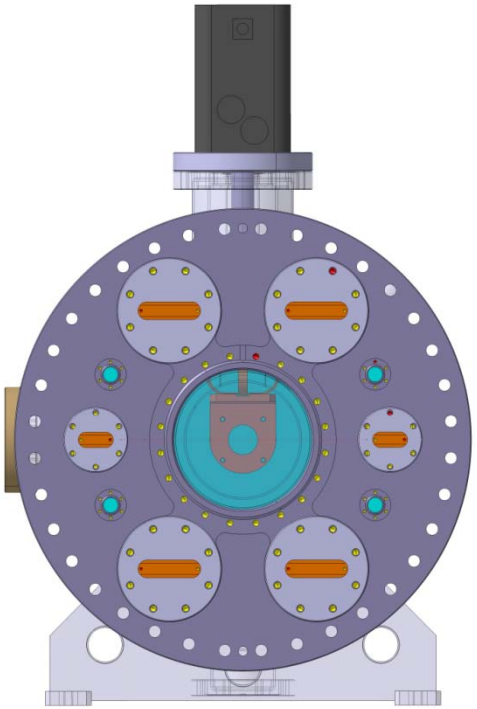
To do:

- Modifying the collimator and test the spec

Part 5: Detector chamber

Existing target chamber





- **Construction will be finished by the end of January of 2013**

Achievements:

- Drawings is being transferred to workshop

To do:

- Fix the details for temperature sensor and heater on the cooling plate

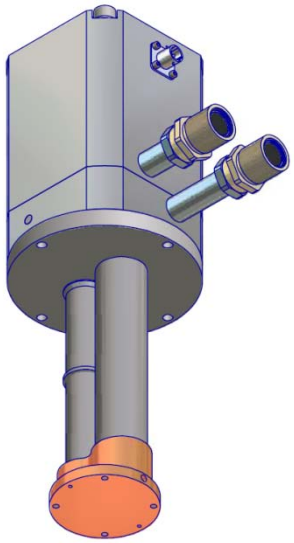
Part 6: Cooling and Temperature controller

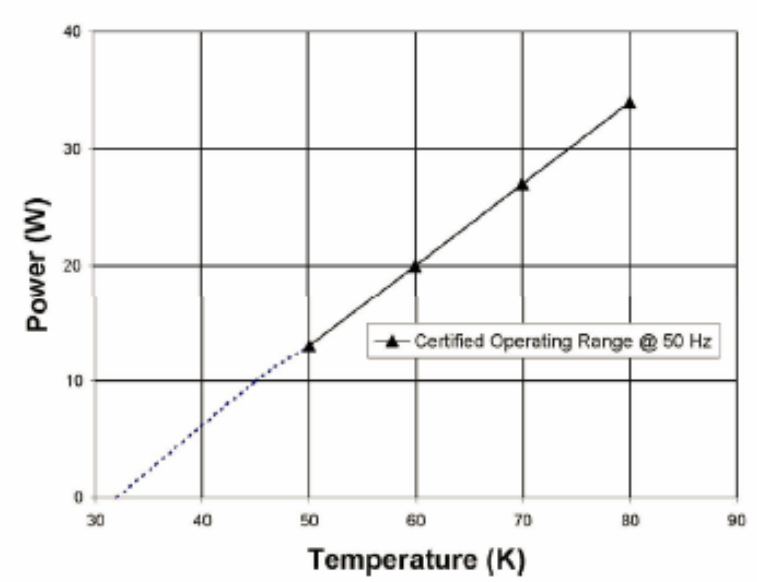
Cooling for test chamber

- LN2 solution

Cooling for experiment

- Coldhead has been ordered (CRYOMECH)





Temperature controller

- Lakeshore 336 module for temperature controller
- Heater for desired temperature setting

Achievements:

- Delivery of coldhead on Oct.

To do:

- Investigate the temperature controlling with heater
- To order heater resistor

Part 7: HV and Accessories

Relay changes the active status of HV

Temperature controller

- Temperature monitor, 5 channel
- Safety loop if over-temp

Achievements:

- Hardware are complete

To do:

- Implement over-temp safety loop
- Test the remote control

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

General Topics

- **Infrastructure at site (to be fixed in Oct.)**
  - Power supply
  - Space to put FEE rack
  - Space to put coldhead compressor
  - Cooling water for coldhead compressor
  - Ventilation status at site
- **Installation schedule**
  - Target modification
  - Day-1 chamber installation
  - Pumping time requested
- **Slow control system for day-1 setup**
  - Pumps (integrated into COSY slow control system)
- **Beam time window**
  - May. 13 – Jul. 13, 2013

Thanks for your attention!

Status of recoil arm construction

- **Part 1: Detector**
  - Silicon detector has been tested and ready for use
  - Ge detectors tested by supplier and being tested (high leakage current problem)
- **Part 2: FEE (incl. cabling)**
  - Received including preamp, shaping amp, ADCs etc.
  - Outgas of cabling is being tested
- **Part 3: DAQ and Test system**
  - Optimized data taking strategy is required
  - Current chamber is not qualified for Ge test?
- **Part 4: Cluster target**
  - Availability of cluster target at ANKE has been confirmed
- **Part 5: Detector chamber**
  - Drawings is nearly finished.
- **Part 6: Cooling**
  - Coldhead has been ordered, to be delivered on Oct.
- **Part 7: Accessories**
  - HV is ready for use
  - Temperature controller 336 is available

What to be done

- **Part 1: Detector**
  - Performance test for Ge; Investigation on high leakage current
- **Part 2: FEE (incl. cables)**
  - Functional check of modules
- **Part 3: DAQ & test system**
  - Code work for online display
  - IRQ working mode with time stamp
- **Part 4: Cluster target**
  - Double check for target performance
  - Schedule confirmation
- **Part 5: Detector chamber**
  - Fix the details on drawings
- **Part 6: Cooling**
  - Temperature controller with coldhead and heater;
- **Part 7: Accessories**
  - Orders for missing components
  - Implementation of safety loop for over-temperature case

Performance evaluation with pure elastic events

Setting for event generator(DPM):

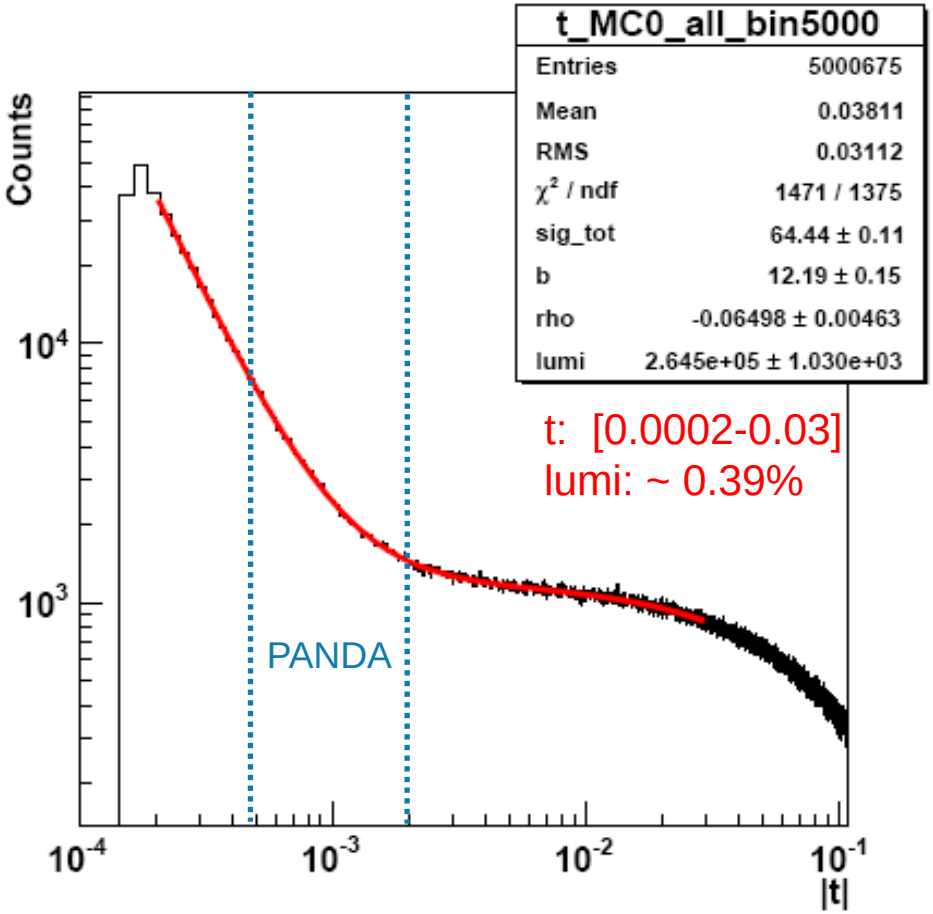
P_{lab} : 6.2 GeV/c, pure elastic events
Theta_min : 0.113° (~1.98mrad)
Events : 5M
Parameters : σ_{el} = 18.97mb, σ_{tot} = 64.50mb,
b = 11.89(GeV/c)$^{-2}$, ρ = - 0.063

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

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

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

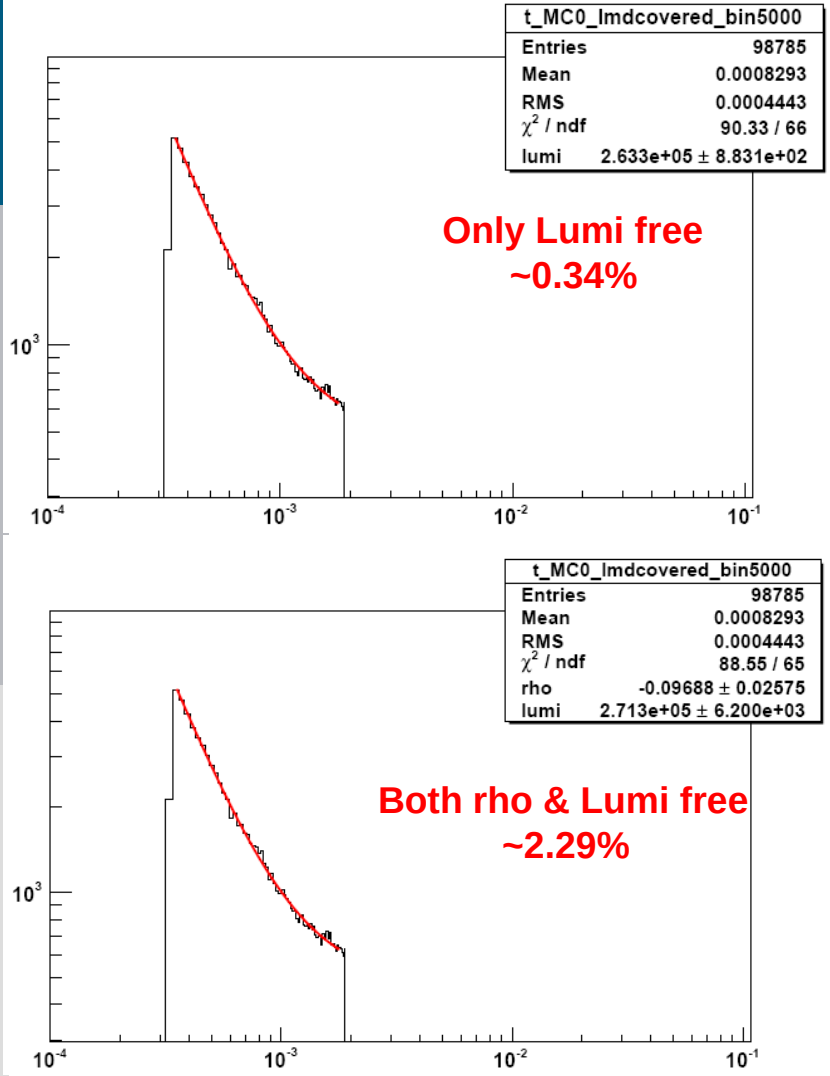
$$\frac{d\sigma_{int}}{dt} = \frac{\sigma\sigma_T G^2(t)(\hbar c)^2}{\beta|t|} e^{-\frac{1}{2}b|t|}(\rho\cos\delta + \sin\delta)$$

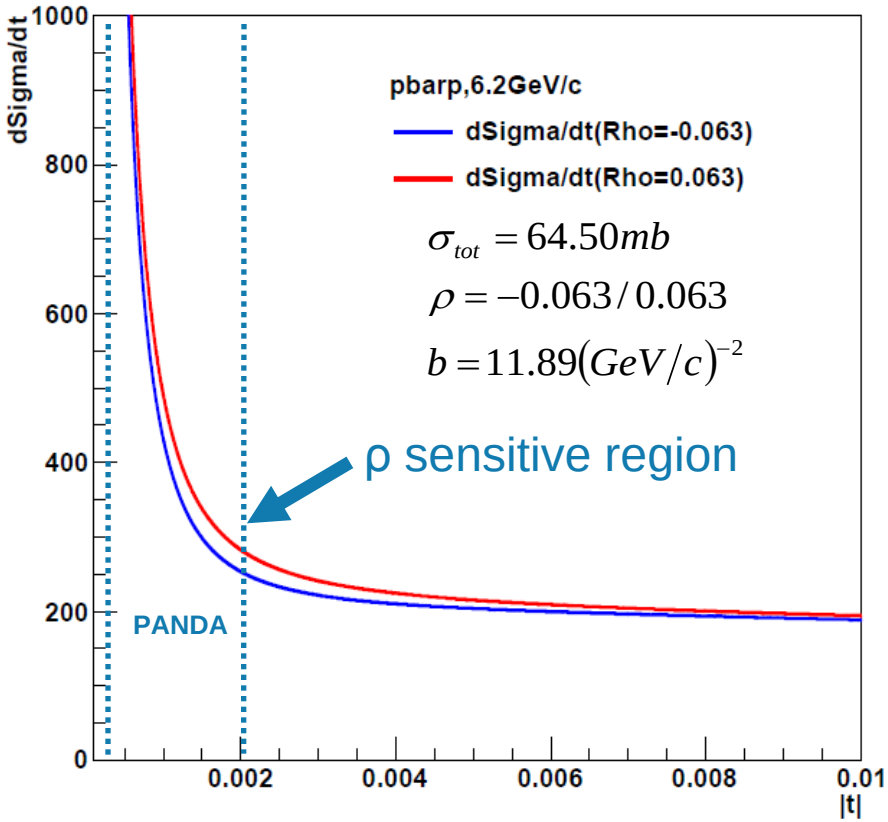


t: [0.0002-0.03]
lumi: ~ 0.39%

The measurable t is limited to a small range!

Parameters correlation





Fixing the parameters is needed to determine the absolute luminosity!

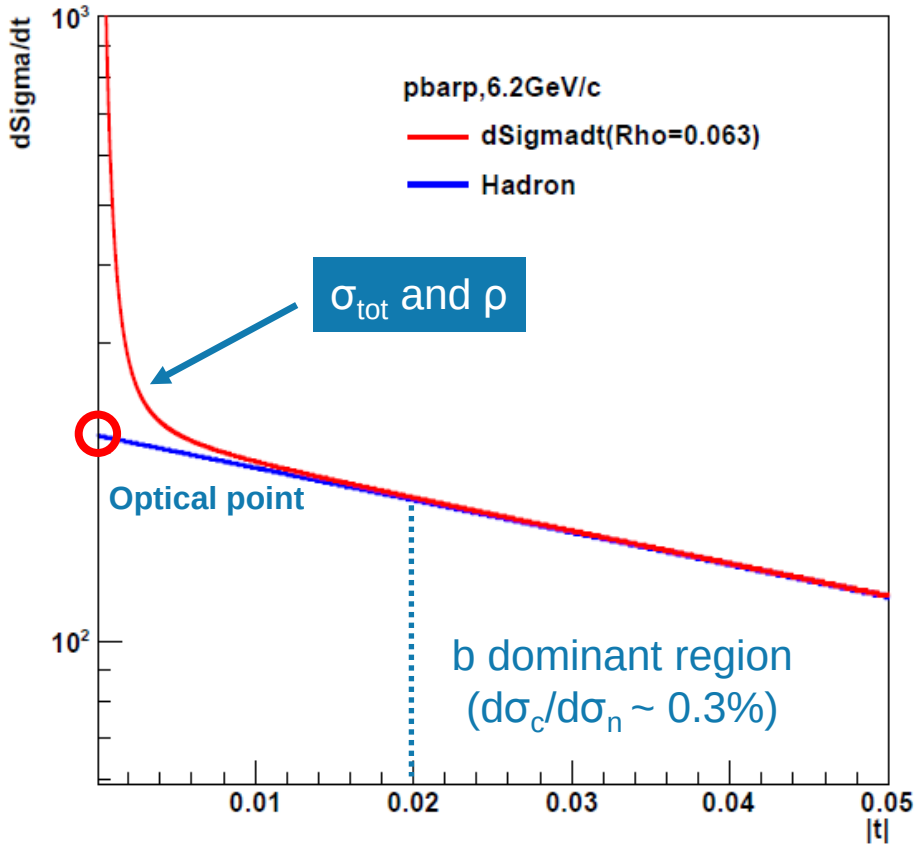
Parameters determination

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?

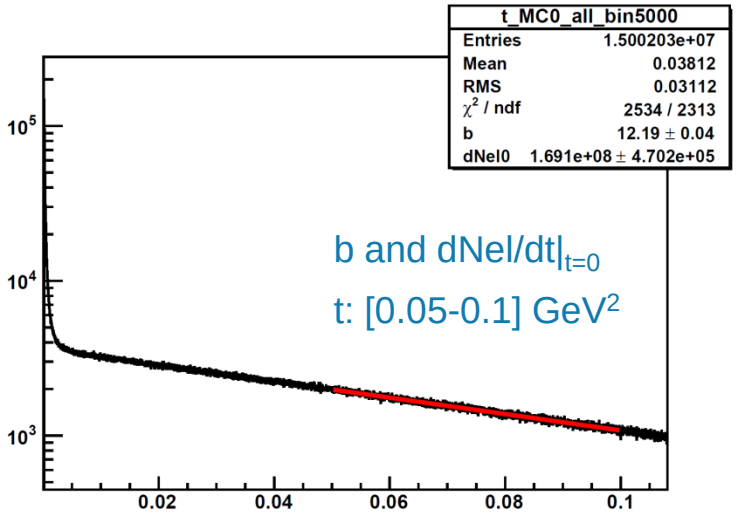
t:Optical point and b
Nuclear dominated region

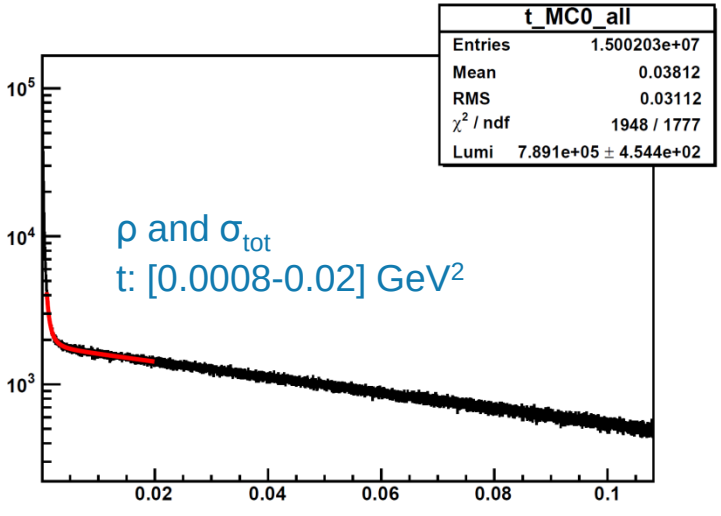
↓

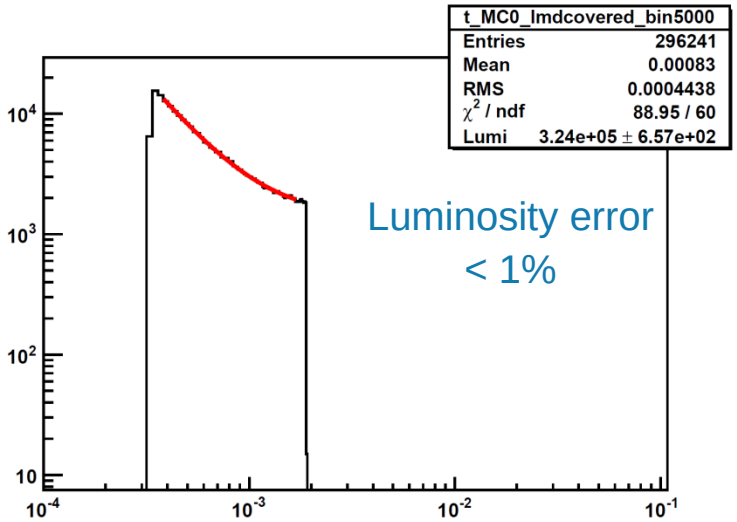
t:ρ and σ_{tot}
Coulomb-strong region

↓

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



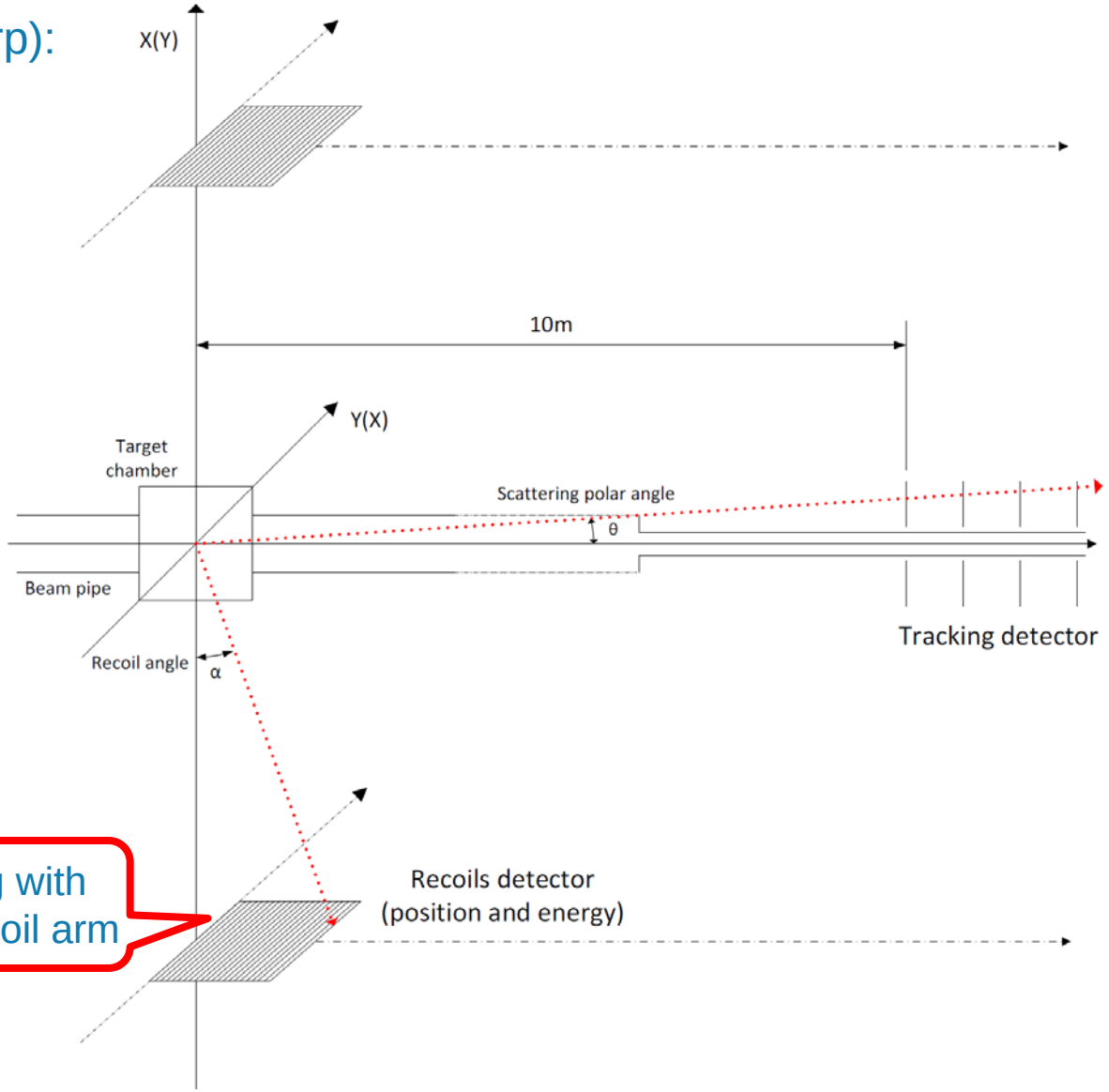




Expected t range : 0.0008 – 0.1 GeV²

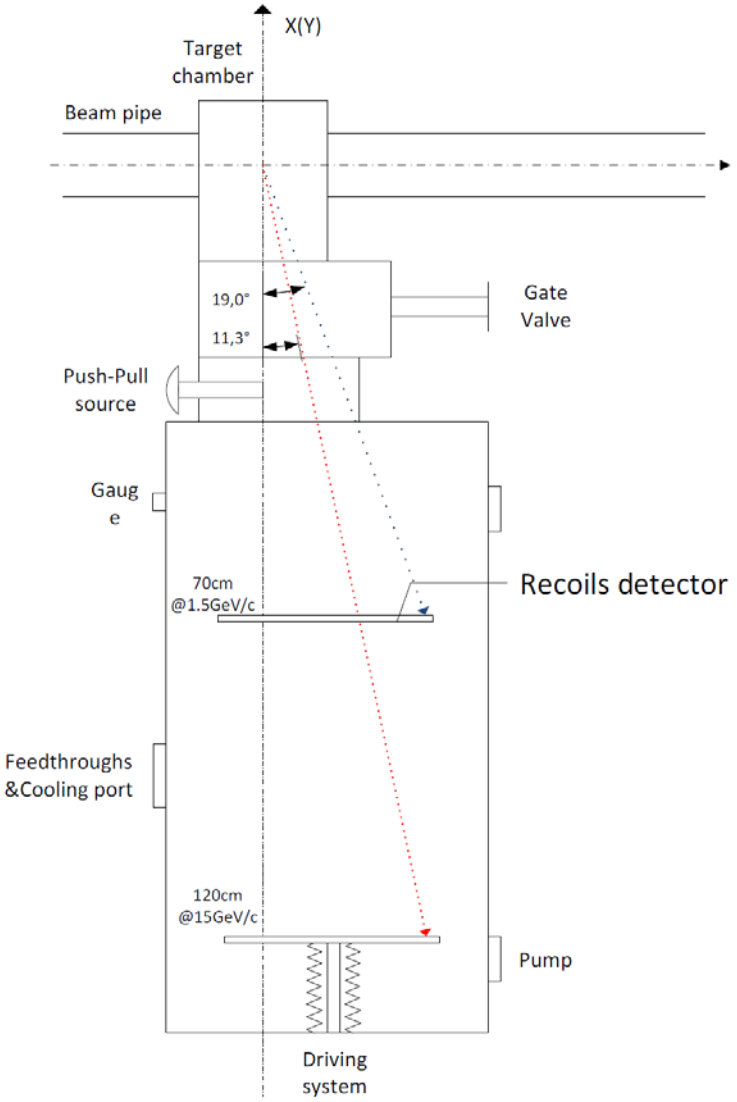
Sketch of day-one experiment

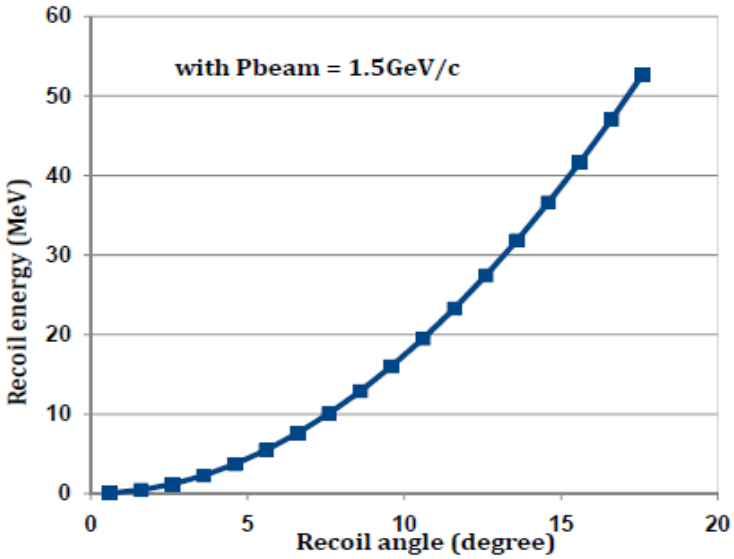
Large t-range (pbarp):
0.0008-0.1 GeV²

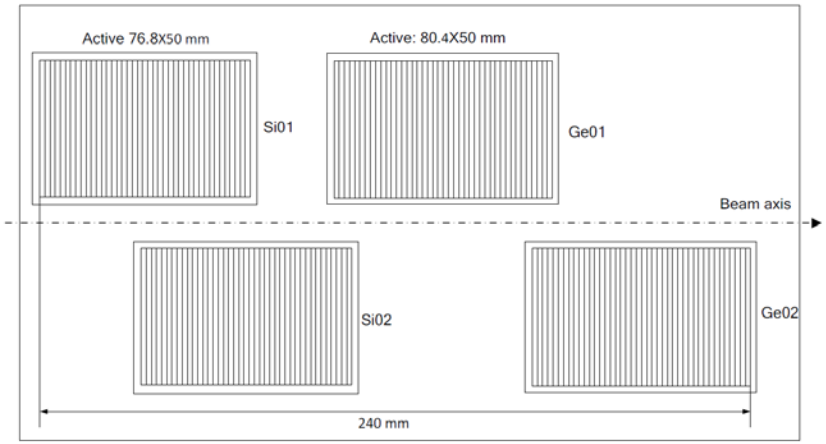


Starting with one recoil arm

Sketch of recoil arm







Fixed plane for commissioning

- 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)