Following Ernest Rutherford with ICARE
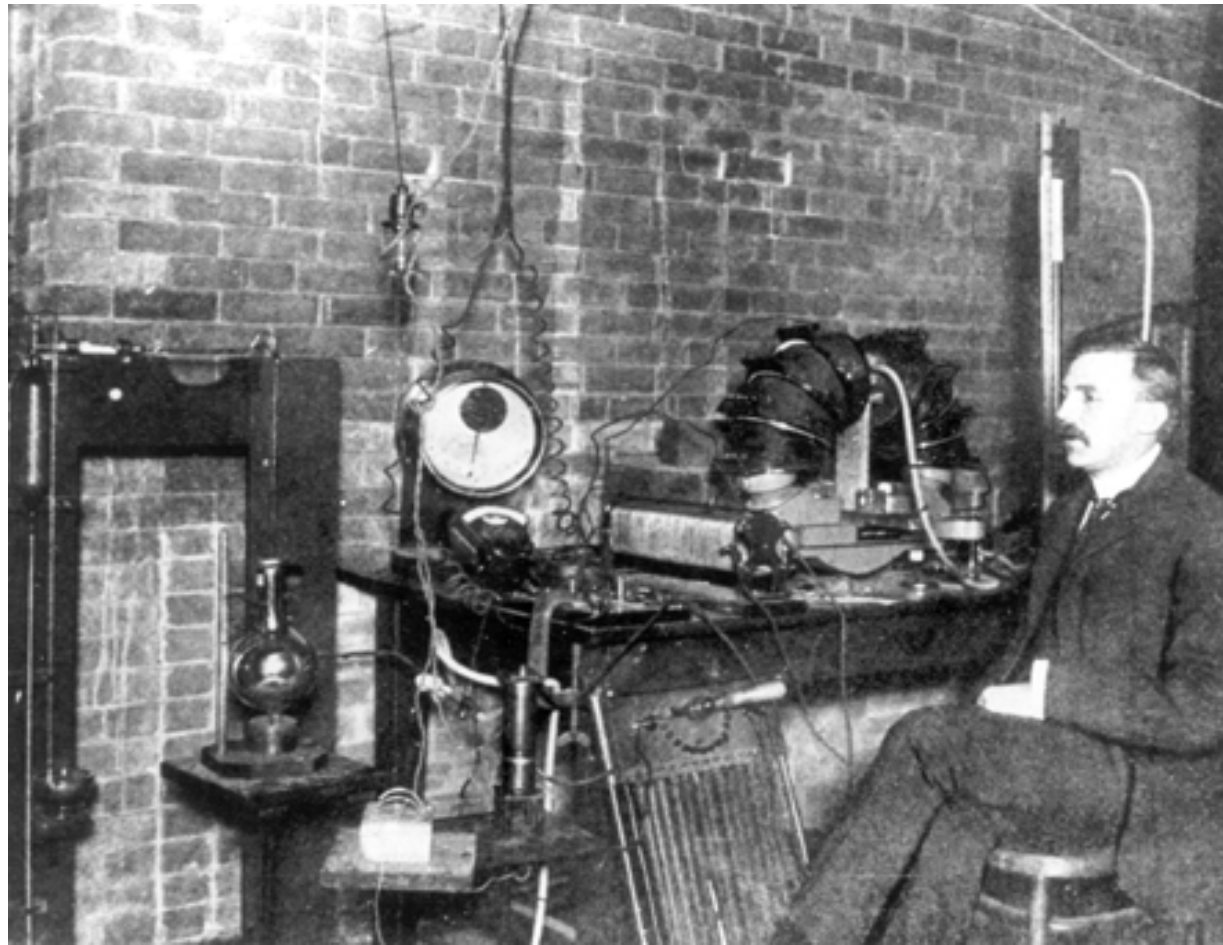
Vassil Karayonchev,University of Sofia
Süleyman Fatih Özmen, Akdeniz University
Maria Żurek, Jagiellonian University

Supervisors:
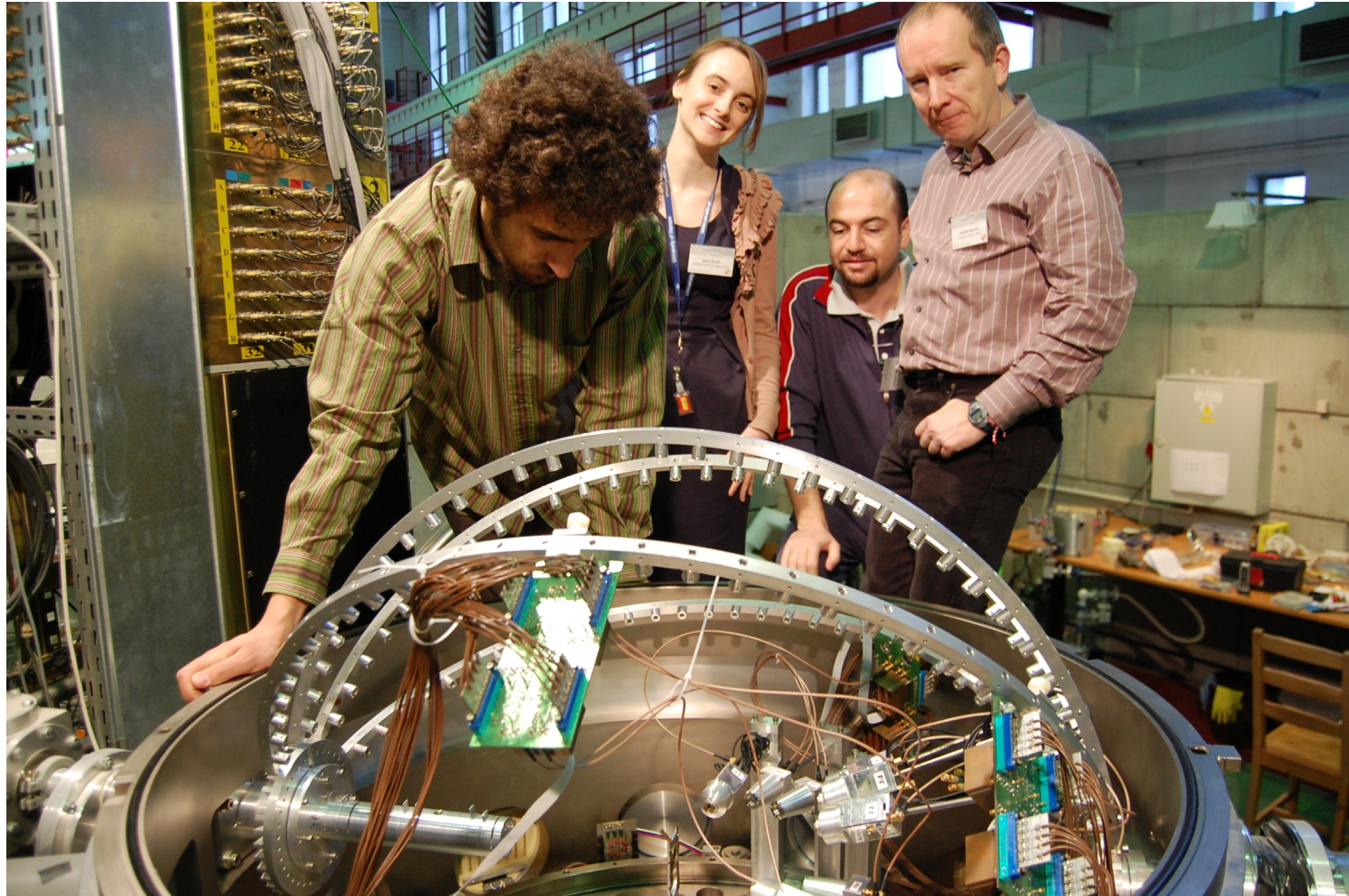Jędrek Iwanicki, HIL
Julian Srebrny, HIL

In 1911 Ernest Rutherford discovered the nucleus

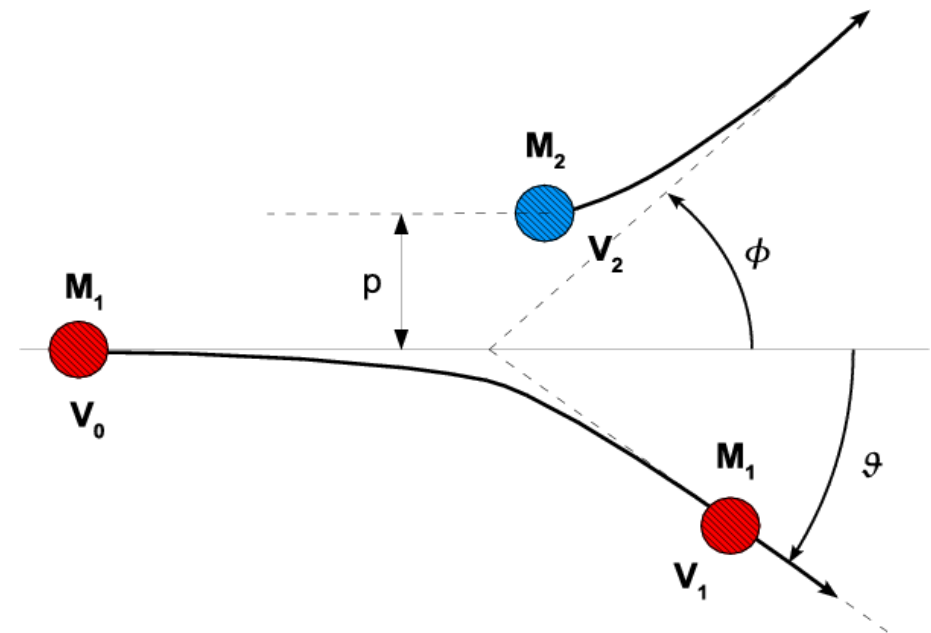# After 101 years the group of "young" physicists decided to check his results...

What the elastic scattering is?

- There is no kinetic energy losses:

$$E_0 = E_1 + E_2$$

- One needs a beam of ions and a thin target foil
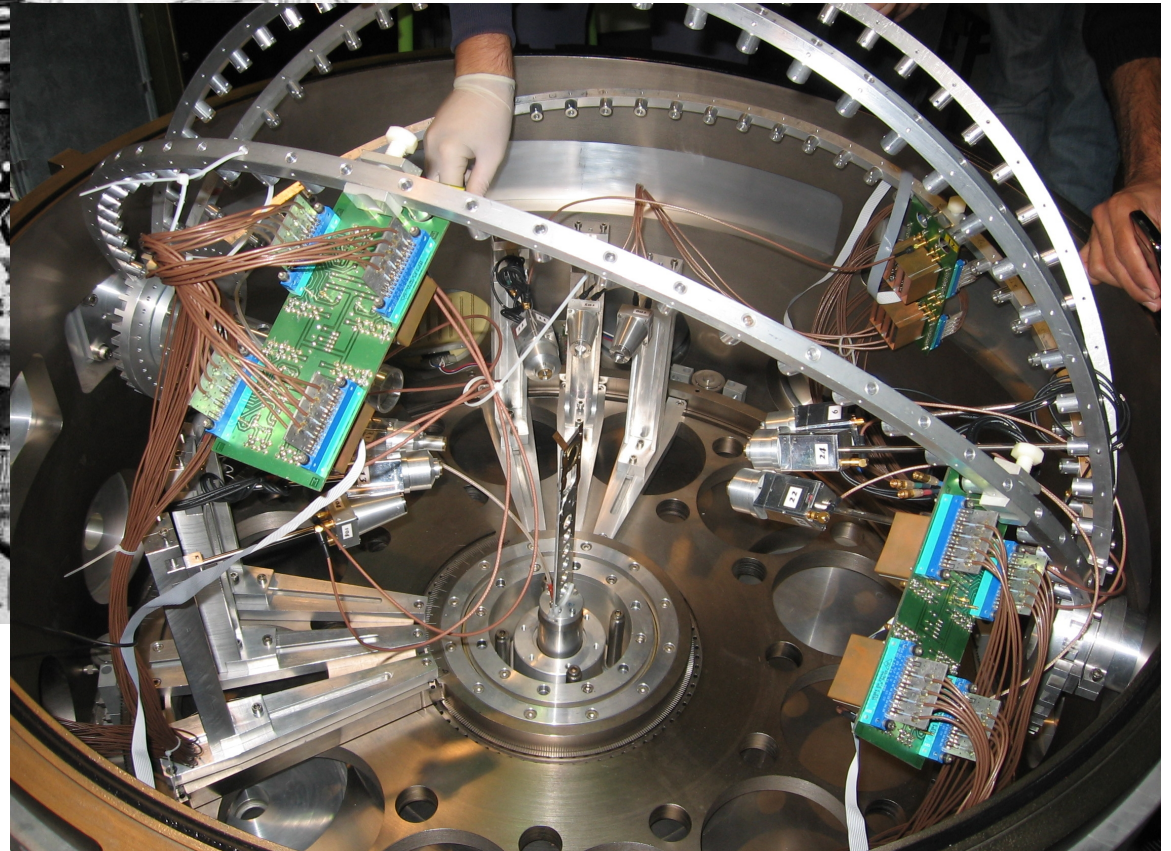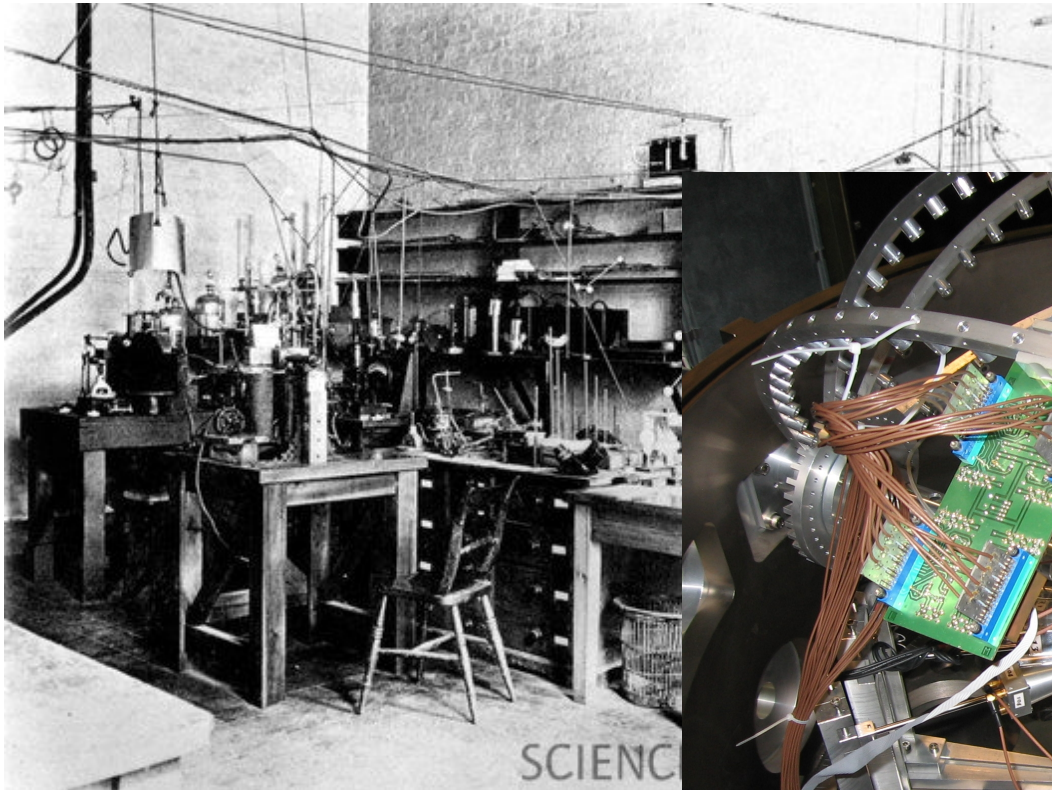

LABORATORY COORDINATES

Differential cross section formula

$$\frac{d\sigma}{d\Omega} = \left(\frac{Z_1 Z_2 e^2}{16\pi\varepsilon_0 E_{kin}} \right)^2 \frac{1}{\sin^4(\theta/2)}$$

Assumes point like objects

- Z_1, Z_2 – atomic number of projectile and recoil

- E_{kin} – kinetic energy of beam

- θ - scattering angle in CM
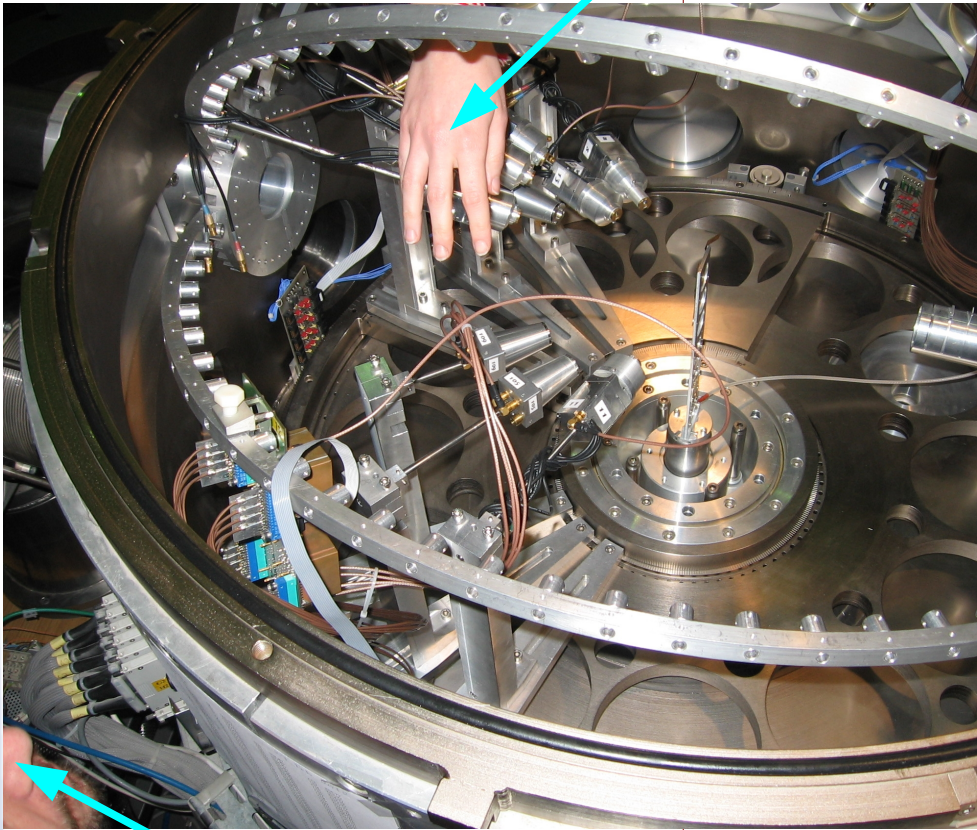
Experimental setup

Experimental setup:

Marysia's hand

Süleyman's nose

Group B - Rutherford scattering

Energy calibration

α peak

E = 5.486 MeV

Pulser

07-Mar-12 18:32:04   0   0

Number of counts

1500

1000   2000   3000

Number of channels

E = f(ch) = **a** ch + **b**

Targets
Silver target prepared by rolling

About 0.86 mg/cm²

Targets
Copper target prepared by evaporation

Just before beam time...

Group B - Rutherford scattering

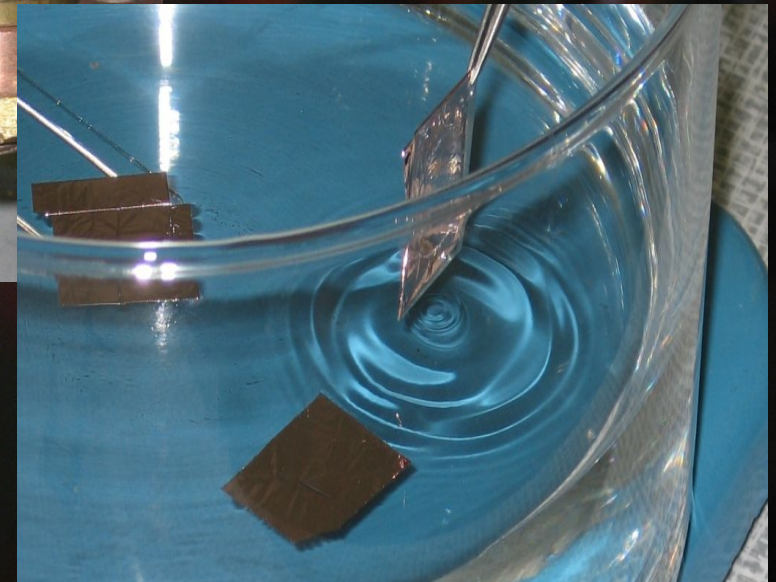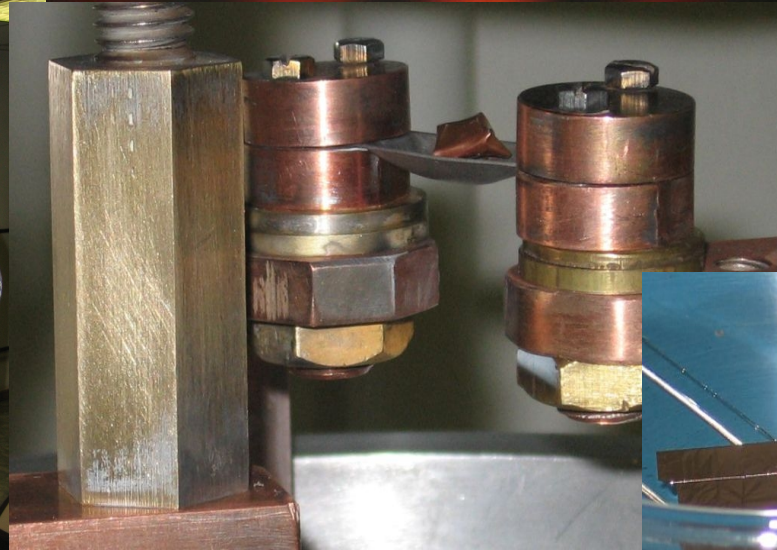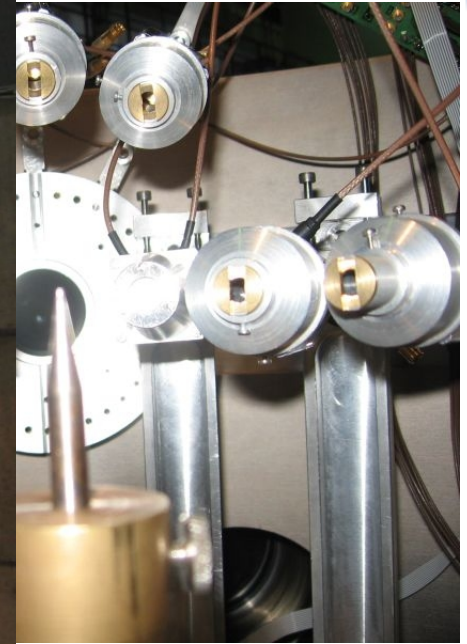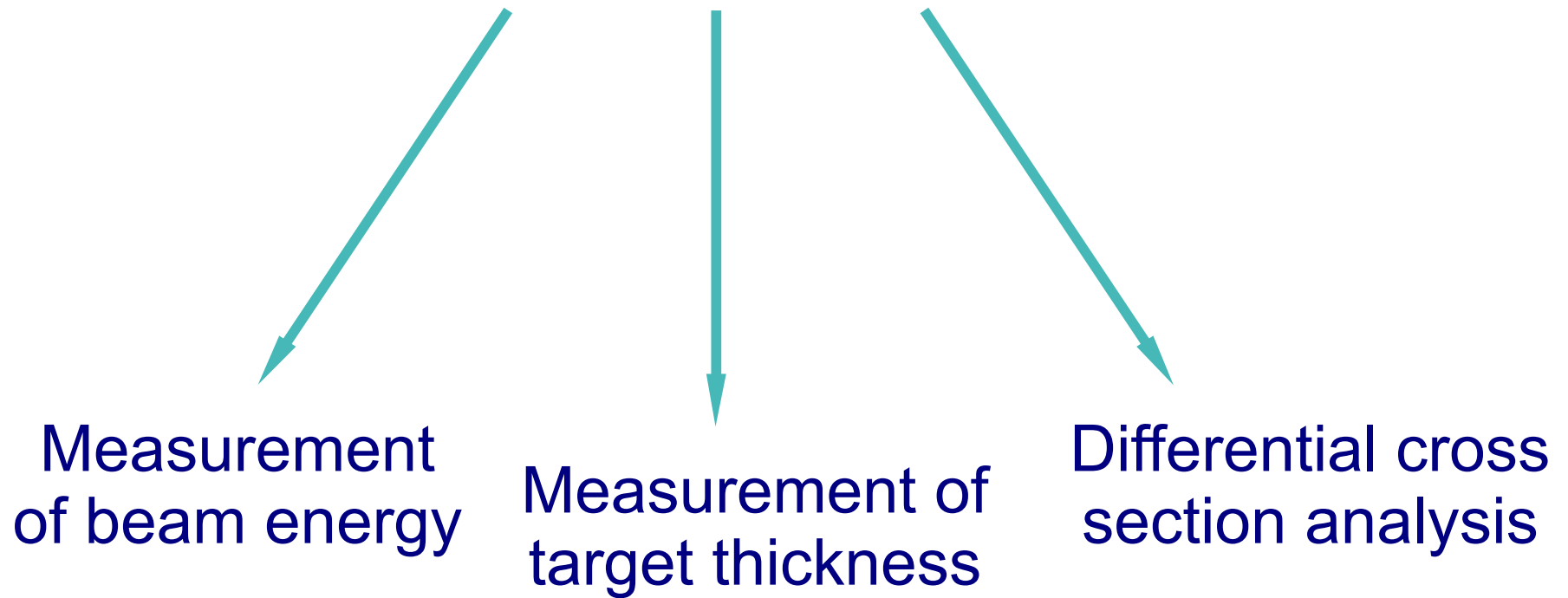# Experimental run

Target		Polar angle θ of detectors					
material	angle	t04	d13	d08	t09	t05	d11
copper	30	10	25	40	45	60	75
copper	90	40	55	70	40	55	70
copper	67.5	30	45	60	120	135	150
copper	72.5	20	35	50	130	145	160
copper	77.5	10	25	40	10	25	40
copper	57.5	50	65	80	50	65	80
copper	52.5	60	75	90	60	75	90
silver	77.5	10	25	40	10	25	40
silver	90	40	55	70	40	55	70
silver	90	40	55	70	40	55	70
gold	77.5	10	25	40	10	25	40
gold	90	40	55	70	40	55	70

We measured and analyzed 72 spectra.

3 different targets
7 different target angles
21 different polar angles

Data analysis

Measurement
of beam energy

Measurement of
target thickness

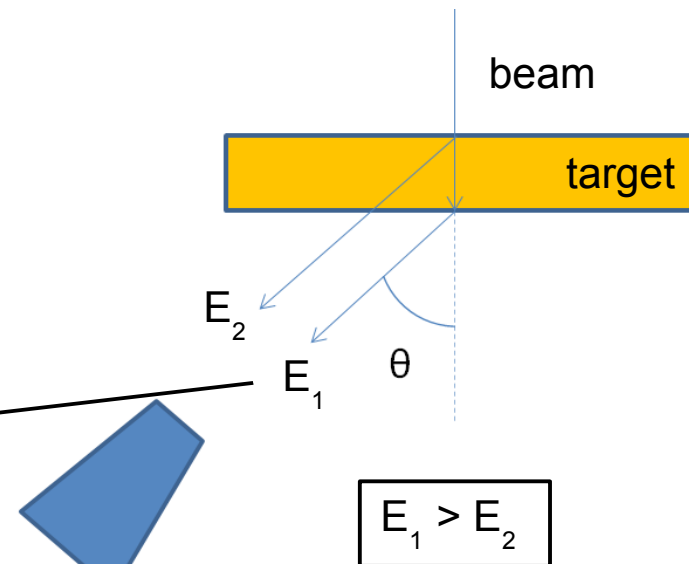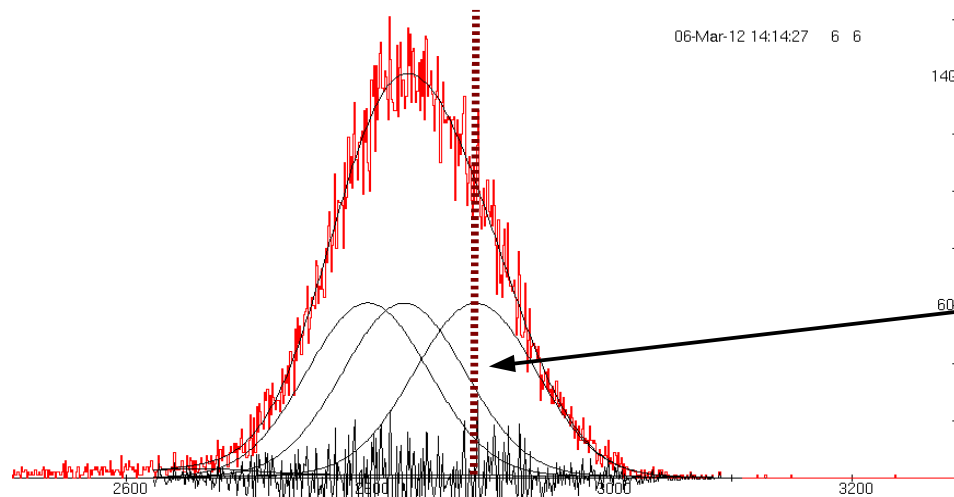Differential cross
section analysis

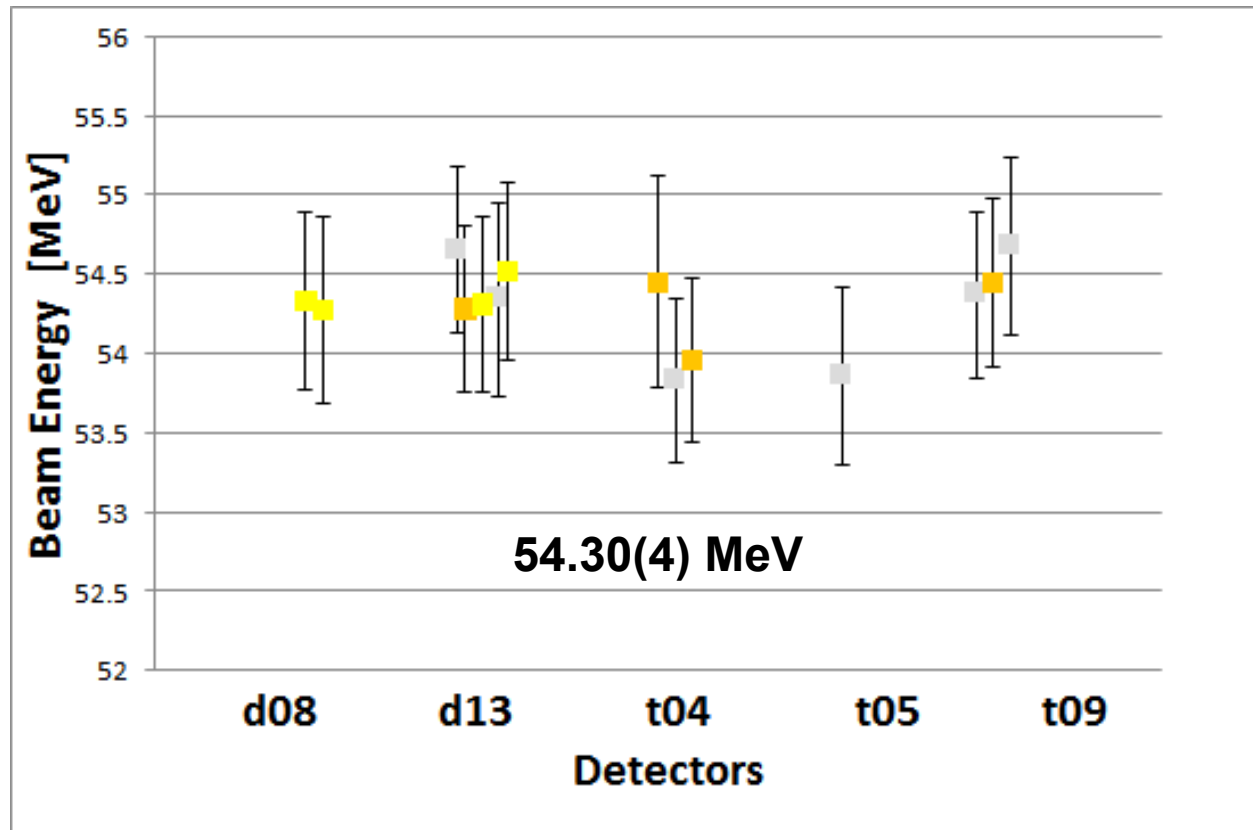# Beam energy and target thickness determination method

Width of energy spectrum peak:

- Energy resolution

- Thickness of the target

We calculated the energy losses in gold target (reference target) – 100 µg/cm^2

06-Mar-12 14:14:27   6   6

beam

target

E_2

E_1

θ

$E_1 > E_2$

Results
Beam energy

Beam energy value given by operators: 54 MeV
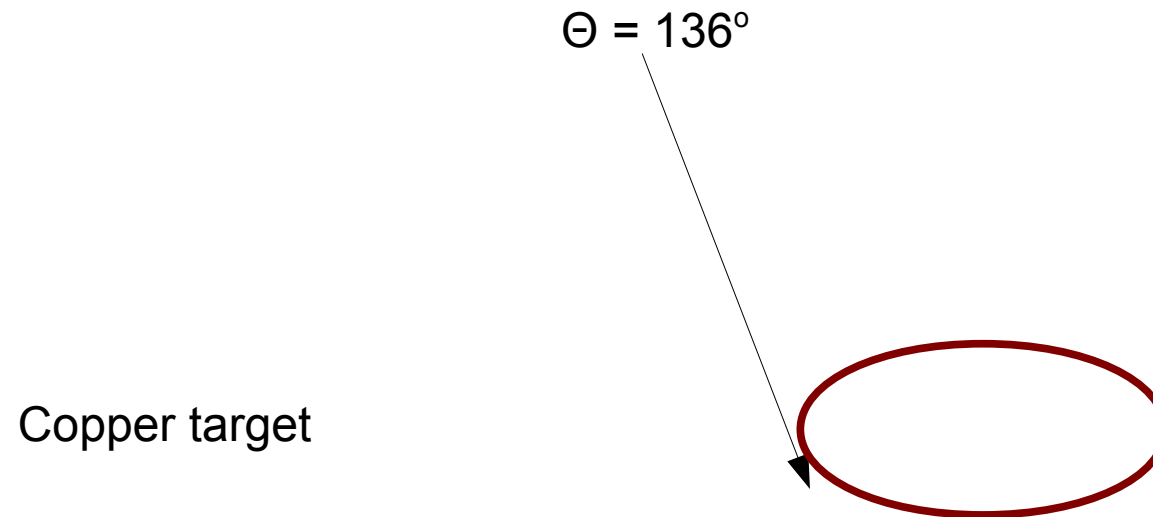
Results
Target thickness

Silver: 0.89(6) mg/cm^2

Copper: 0.37(3) mg/cm^2

Results
Differential Cross Section

Title:/home/mania/Pulpit/slcj/cross.ep
Creator:ROOT Version 5.30/02
CreationDate:Thu Mar 8 20:14:42 2012

$\Theta = 136^{\circ}$

Copper target

- Effective target thickness corrections
- Solid angle corrections

Outcomes

Measurement of beam energy

Measurement of target thickness

Differential cross section analysis

Title:/home/mania/Pulpit/slcj/thicknes
Creator:ROOT Version 5.30/02
CreationDate:Thu Mar 8 19:09:37 2012

Title:/home/mania/Pulpit/slcj/cross.ep
Creator:ROOT Version 5.30/02
CreationDate:Thu Mar 8 20:14:42 2012

Last conclusion

The guy was great...

Greetings from Group B...

...trying hard to be as cool as Sir Ernest!