

Hellenic Institute of Nuclear Physics
2nd Hellenic Institute of Nuclear Physics Workshop

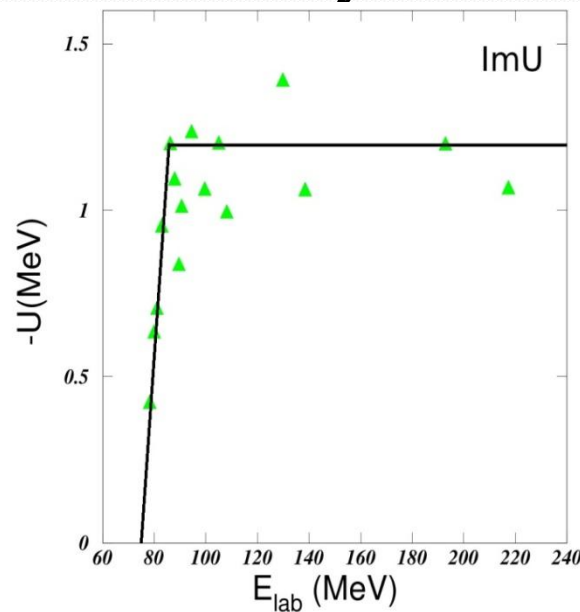
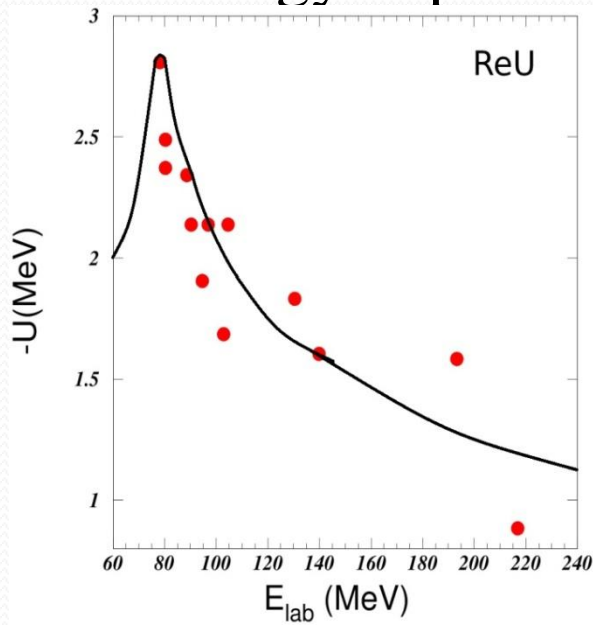
Elastic scattering measurements for the system ${}^7\text{Be}+{}^{28}\text{Si}$ at 17.2 MeV

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12th of April, 2014, Thessaloniki, Greece

Introduction

- Elastic scattering is the main tool for probing the optical potential.
- The energy dependence of the optical potential at near barrier energies is a very appealing subject.
- Well bound nuclei: **Threshold Anomaly (TA)**.
- The energy dependence of weakly bound nuclei deviates from

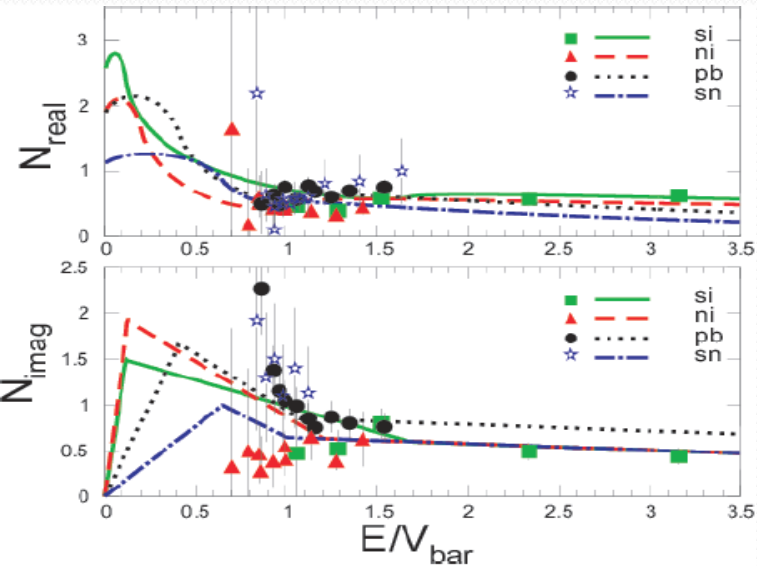


$^{16}\text{O}+^{208}\text{Pb}$

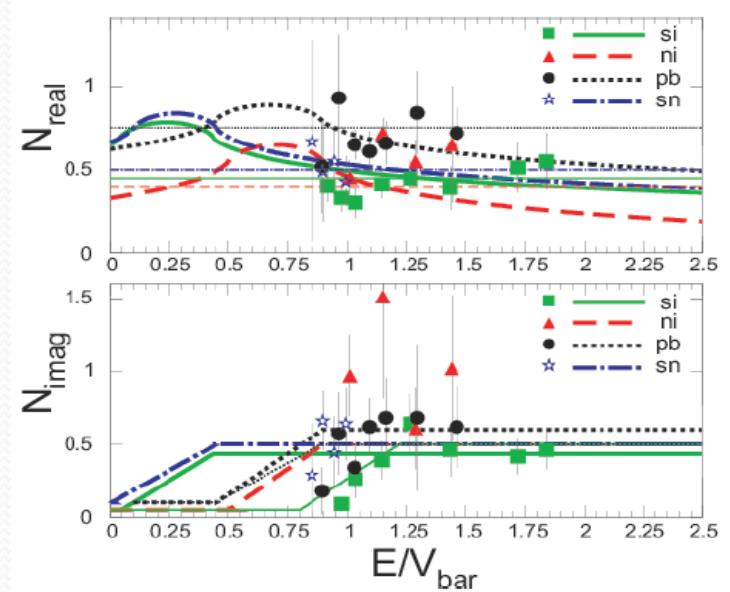
M. A. Nagaragan et al.
Phys. Rev. Lett., 54, 1136
(1985)

${}^6,7\text{Li}+{}^{28}\text{Si}$ potential

- ${}^6\text{Li}$: The **imaginary part** of the optical potential presents an **increasing trend** as we approach the Coulomb barrier, while the real part develops smoothly until a peak appears.



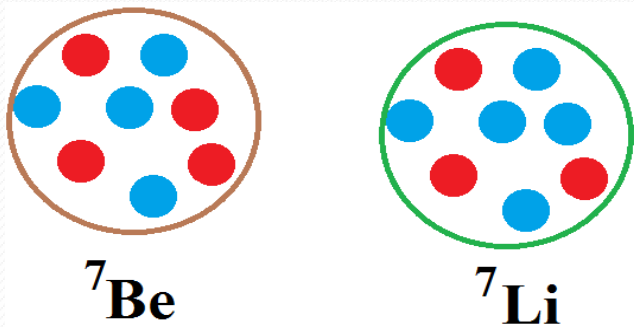
- ${}^7\text{Li}$: Both real and imaginary part **develop smoothly** till low energies, while later it drops producing a peak on the real part.



K. Zerva et al., Eur. Phys. J. A. 48, 102 (2012)

Motivation

${}^7\text{Be}$: The mirror weakly bound radioactive nucleus of ${}^7\text{Li}$.



Nucleus	Breakup Threshold (MeV)
${}^7\text{Be}$	1.6
${}^6\text{Li}$	1.48
${}^7\text{Li}$	2.45

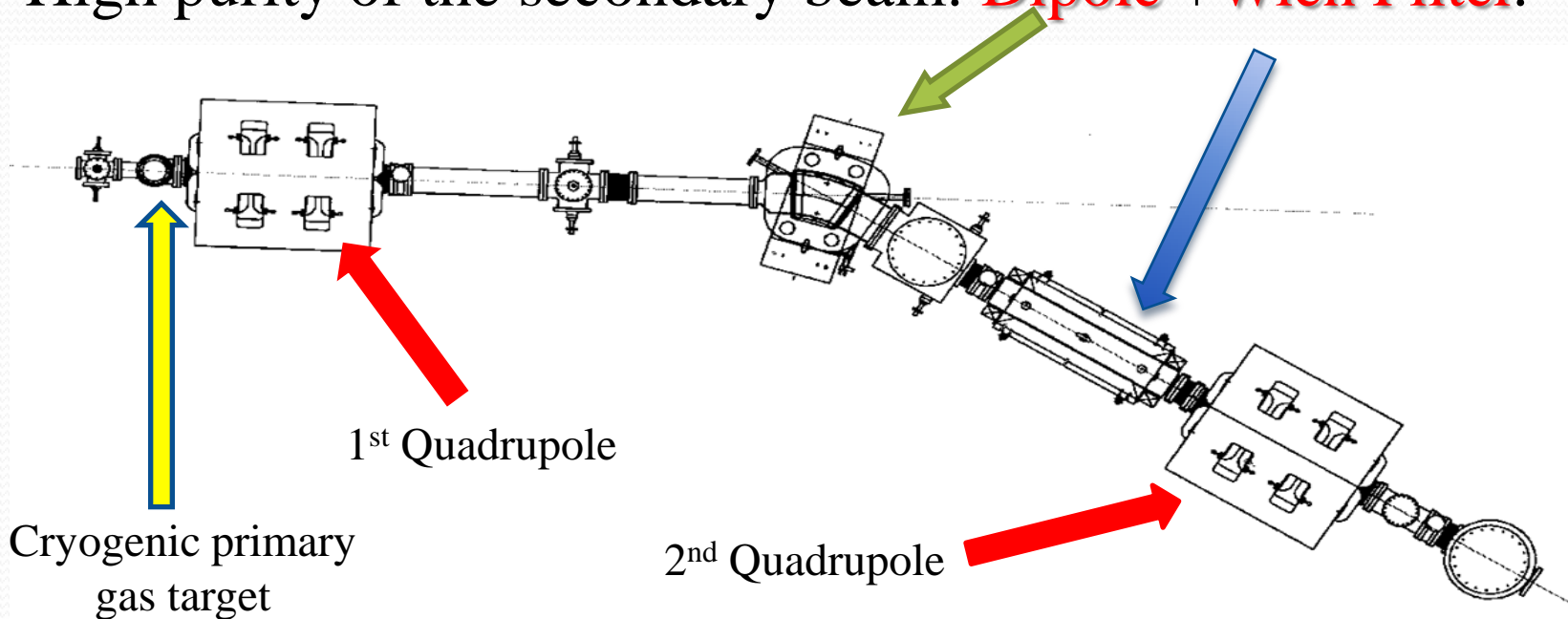
Question: The energy dependence of ${}^7\text{Be}$ optical potential behaves like the ${}^7\text{Li}$ or ${}^6\text{Li}$ one?

The Experiment

- In this respect, we proposed the study of **elastic scattering** and **relevant reaction mechanisms** for the system ${}^7\text{Be}+{}^{28}\text{Si}$ at near barrier energies, namely 9.1 MeV, 17.2 MeV, 21.8 MeV and 26.6 MeV corresponding to $(0.78-2.3)E_{\text{cb}}$ in order to study the energy dependence of the optical potential.

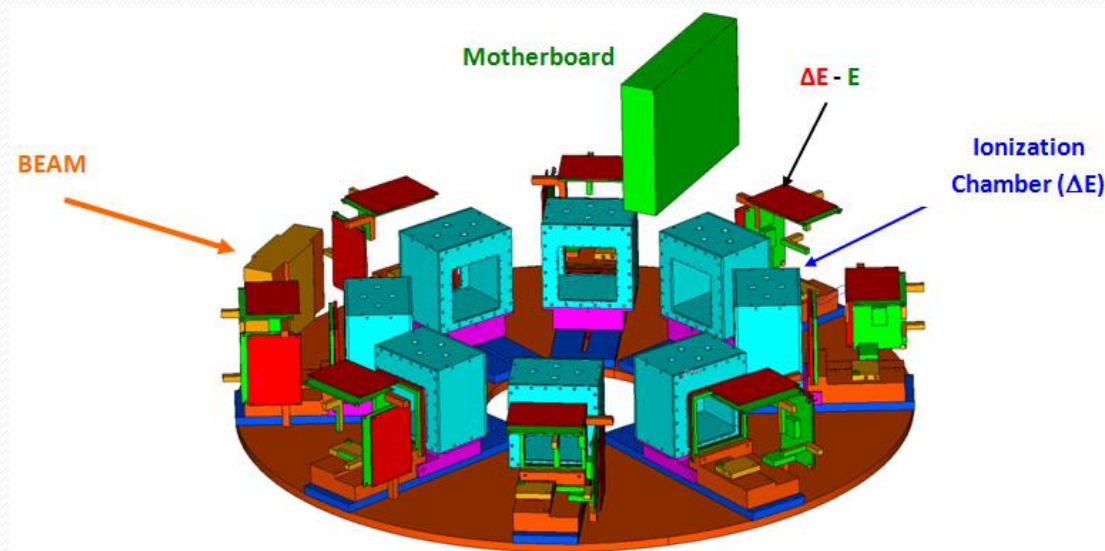
The EXOTIC Facility

- The experiment was visualized at the EXOTIC facility at the Laboratori Nazionali di Legnaro (LNL).
- ${}^7\text{Be}$ production: In flight technique via the $p({}^7\text{Li}, {}^7\text{Be})n$ reaction ($Q_{\text{val.}} = -1.64 \text{ MeV}$).
- High purity of the secondary beam: **Dipole + Wien Filter.**



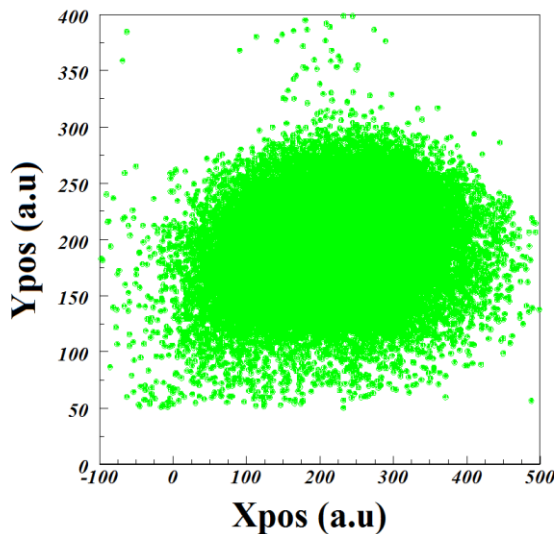
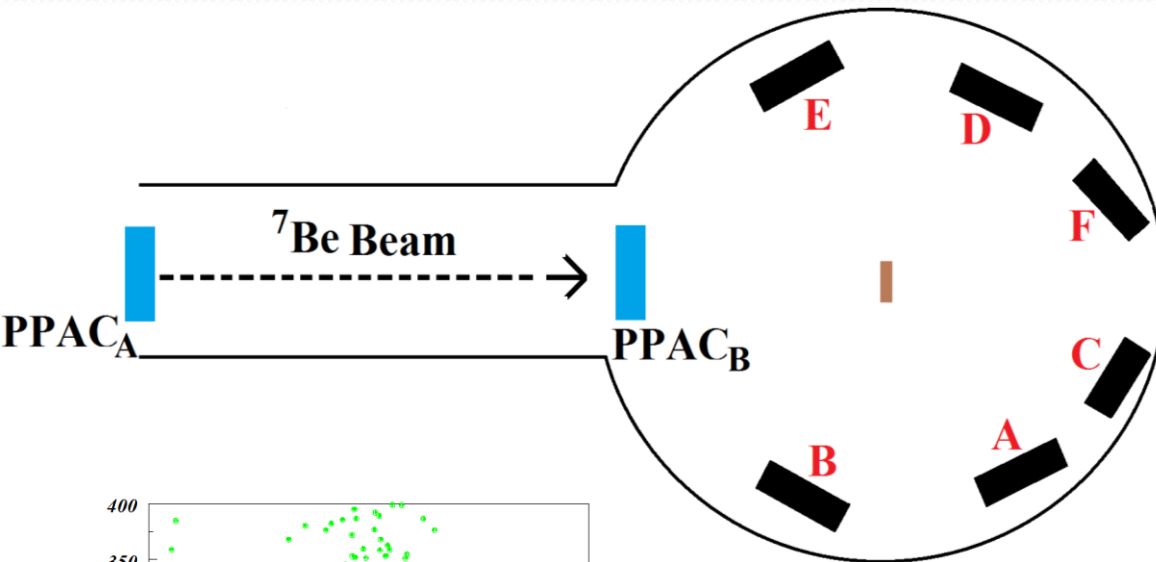
Detection array **EXPADES**

- **EXPADES**: 8 ΔE - E_{res} telescopes in cylindrical configuration
- ΔE_1 : Ionization chamber.
- ΔE_2 detector: $\sim 50\mu\text{m}$ thick DSSSD with an active area of $(64 \times 64)\text{mm}^2$ and 32 strips per side.
- $E_{res.}$: $300\mu\text{m}$ thick DSSSD with an active area of $(64 \times 64)\text{mm}^2$ and 32 strips per side.



A photo of EXPADES array. Each ΔE - E telescope is consisting of a ΔE_1 ionization chamber, a ΔE_2 DSSSD($50\mu\text{m}$) + E_{res} DSSSD($300\mu\text{m}$).

Experimental Setup

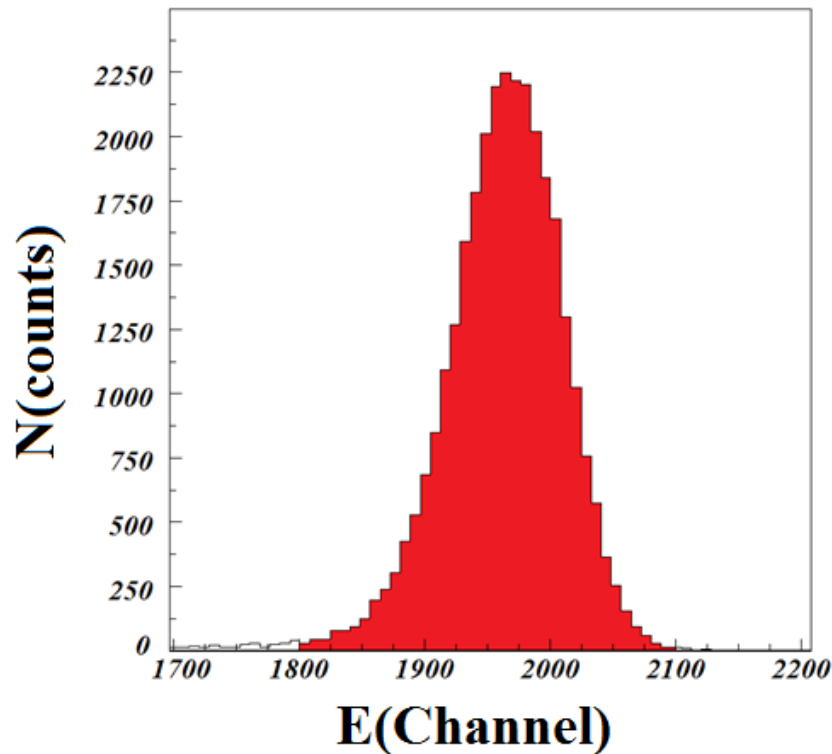


EXPADES
Telescopes

Telescope ID	Angular Range (Degrees)
A	53.51 - 84.49
B	95.51 - 126.49
C	14.27 - 39.73
D	52.94 - 85.06
E	94.63 - 127.37
F	12.79 - 41.21



Identification of the Elastic channel




- The elastic scattering peak is well pronounced.

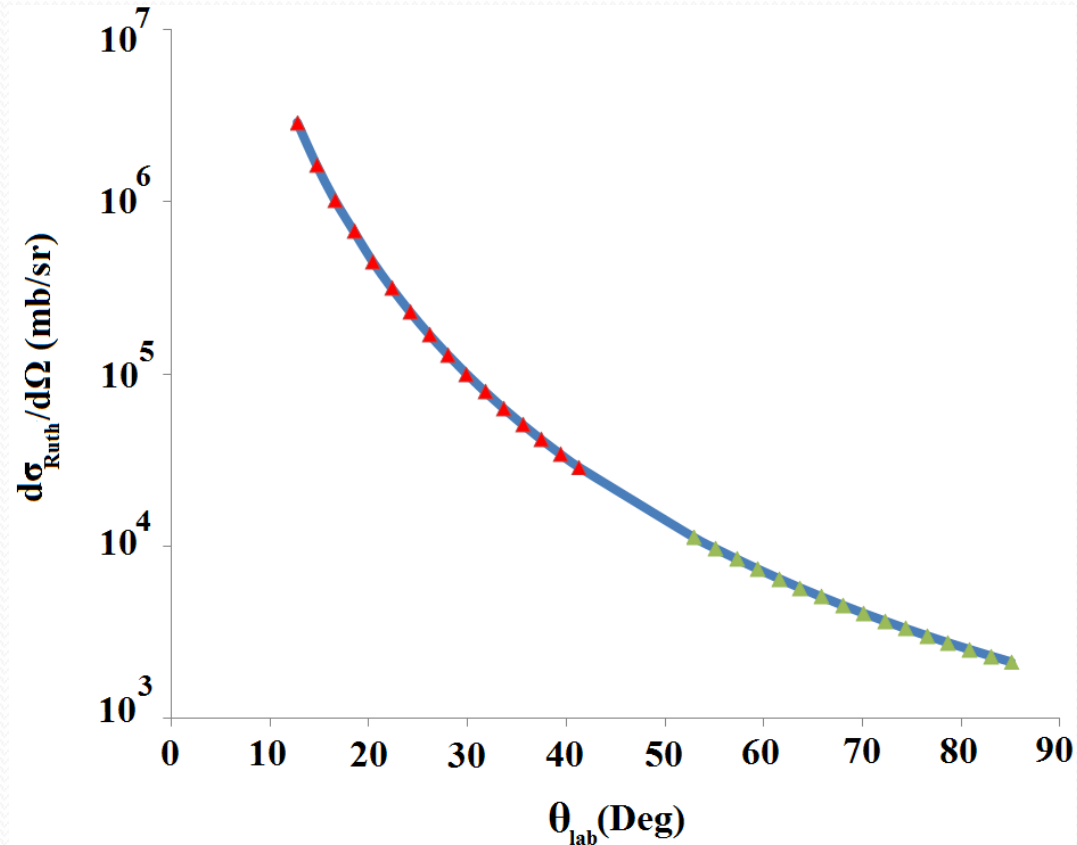
Typical 1 dimension spectrum from ΔE stage of telescope C, $\theta_{lab} = 14.27$ deg at $E_{beam} = 17.2$ MeV.

Angle and solid angle determination

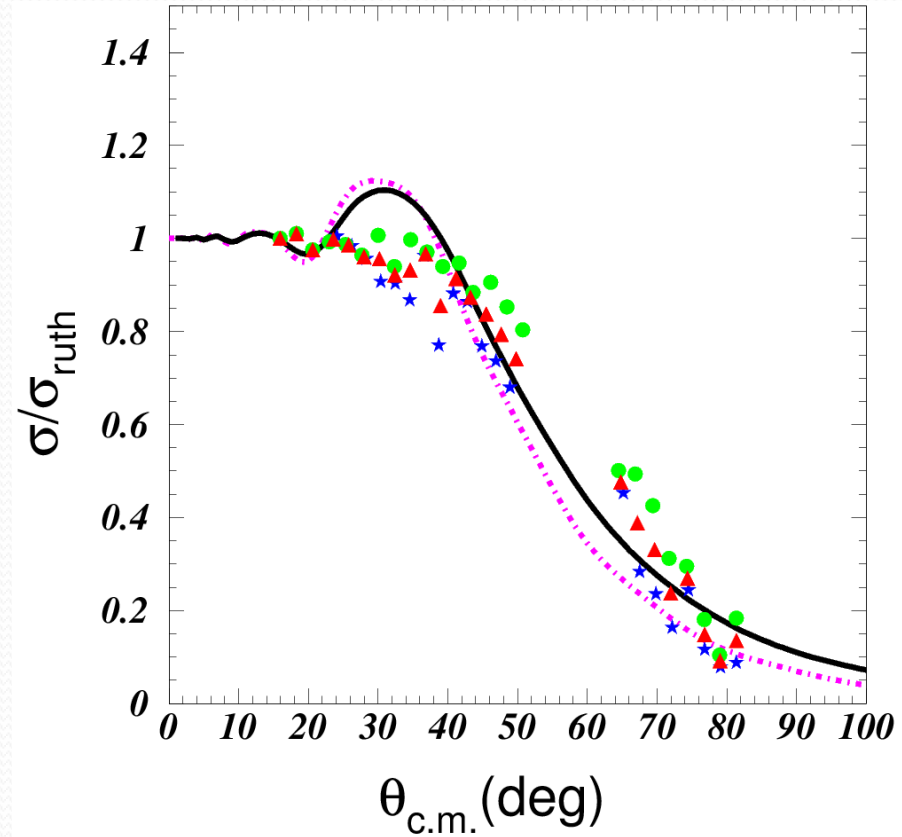
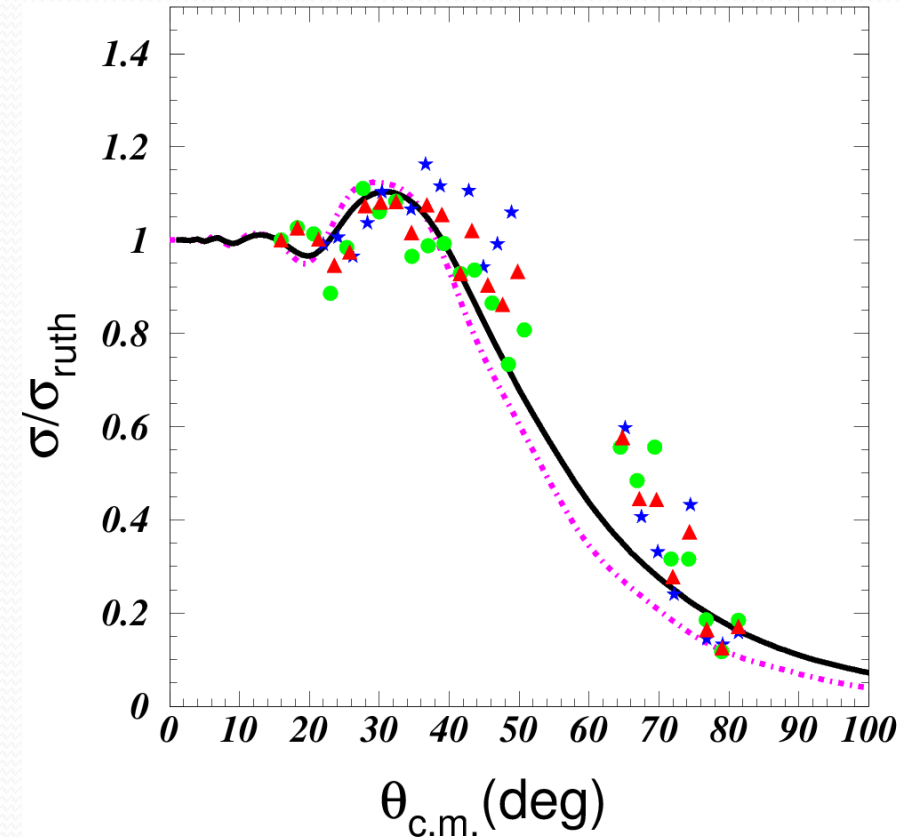
- The solid angle of the detectors was determined via a run with a gold target.


$$\frac{d\sigma}{d\Omega} = \frac{N}{D\Phi\Omega}$$

where N is the number of counts, D are the scattering centers, Φ is the flux of the beam and Ω is the solid angle of the detector.



Angular distribution data at 17.2 MeV

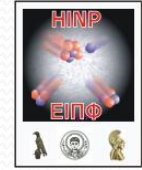


Preliminary angular distribution data for the quasi-elastic scattering of ${}^7\text{Be}+{}^{28}\text{Si}$ measured at 17.2 MeV are compared with a CDCC calculation. Data from telescopes C and A are denoted with the blue stars, data from telescopes F and D are denoted with the green circles while a mean value from data of symmetrical detectors is denoted with the red triangles.

Summary

- Elastic scattering measurements for the system ${}^7\text{Be}+{}^{28}\text{Si}$ were performed at near barrier energies namely 9.1 MeV, 17.2 MeV, 21.8 MeV and 26.6 MeV corresponding to $(0.78-2.3)E_{\text{cb}}$.
- Preliminary angular distribution data were presented 17.2 MeV.
- The analysis is in progress...

Collaborators



- *Department of Physics and HINP, The University of Ioannina, Ioannina, Greece*

- *Departimento di Fisica and INFN – Sezione di Padova, Padova, Italy*



- *INFN – Sezione di Napoli, Napoli, Italy*



- *INFN – Sezione di Milano, Milano, Italy*

- *Dipartimento di Scienze Fisiche, Universita di Napoli, Napoli, Italy*



- *Institute of Accelerating Systems and Applications and Department of Physics, University of Athens, Greece*



- *Departamento di Fisica Aplicada, Universidad de Huelva, Huelva, Spain*



- *Centro de Fisica Nuclear da Universidade de Lisboa, Portugal*

- *National Center for Nuclear Research, Warsaw, Poland*



- *Heavy Ion Laboratory, University of Warsaw, Warsaw, Poland*

