α-elastic scattering on p-nuclei for the improvement of the α-optical model potential

Annalia Palumbo University of Notre Dame Frontiers 2007





P-Process Synthesis



M. Arnould and S. Goriely, Physics Reports 384 (2003) 1-84

α-nucleus optical potential

Cross sections used to calculate the reaction rates in p-process network studies (~20,000 reactions considered) are based on the Hauser-Feshbach statistical model.

In general, (α, γ) reaction cross sections are very sensitive to the choice of the α -nucleus potential.



Fröhlich/Rauscher potential reproduces α-capture data the best.

α-nucleus optical potential

Elastic α -scattering at low energies (close to the Coulomb barrier) should provide an additional test for the α -nucleus potentials \longrightarrow high precision data needed!



McFadden/Satchler or Demetriou potential reproduces the mass dependence the best?

No global potential that can reproduce alpha capture and elastic scattering data

Get local potential – both energy and mass dependent





 $E_{\alpha} = 17, 19, 22, 24.5, 27 \text{ MeV}$

High accuracy data

Te¹²⁰: 0.096%

1) Target material (>99% enrichment) for elastic scattering

Te¹²⁴: 4.816% Te¹²⁶: 18.95% Te¹²⁸: 31.69% Te¹³⁰: 33.80%

2) Beam Correction

Correction made for both angular shift and beam displacement

UNCERTAINTY IN ANGLE (geometry) - 0.01

3) Statistics (compromise between target thickness, beam current, and beam time

4) Solid angle determination



Pre-experiment (measuring diameter in small chamber with α -source)



Post experiment (measuring diameter in chamber with α -source)

Forward rotations



Online (overlapping angles: forward positions)



α -energy spectra



Preliminary Results



Preliminary Results



Preliminary Results

27 MeV



What now?

We see that currently no global α -potential exists that can accurately reproduce both the alpha capture and elastic scattering data.

Alpha capture: Rauscher potential. Elastic scattering: Mass dependence: McFadden/Satchler Energy dependence: Avrigeanu

Once a local potential is obtained for all isotopes (that will be energy and mass dependent), charge dependence can also be tested (¹¹⁸Sn).

A local potential may also be obtained using inelastic data.

Due to scarcity of material (high enrichment needed), further elastic scattering experiments on p-nuclei are limited.

Acknowledgements

Notre Dame: Michael Wiescher Joachim Görres, Wanpeng Tan, Ed Stech, Elizabeth Strandberg, Hye-Young Lee, P.J. LeBlanc, Shawn O'Brien, James De Boer, Heide Costantini, Manoel Couder, Larry Lamm

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Targets

Argonne: John Greene











