

**ELASTIC SCATTERING OF $^{32}\text{S} + ^{58,64}\text{Ni}$
AROUND THE COULOMB BARRIER**

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The study of elastic scattering, i.e. the basic process in heavy-ion collisions, is a very interesting tool which supplies us with much information about the properties of the interaction, such as radii, surface diffusenesses and critical angular momenta. Furthermore, especially in the energy region near and above the Coulomb barrier, elastic scattering is essential for the understanding of the mechanisms which underlie the various available reaction channels.

We performed a detailed investigation for the systems $^{32}\text{S} + ^{58,64}\text{Ni}$. The ^{32}S beams, with energies ranging from 82 MeV up to 150 MeV, were sent into a sliding seal scattering chamber where we placed the targets ^{58}Ni and ^{64}Ni , both of which were $30 \mu\text{g}/\text{cm}^2$ evaporated onto $20 \mu\text{g}/\text{cm}^2$ carbon backing (the isotopic enrichments being 99.8% and 96.7% respectively).

The detection of the projectile-like nuclei was carried out with the help of three time of flight-energy counter telescopes, consisting of micro-channel plates and Silicon surface barrier detectors. As it is shown in the figure, it was possible to cover an angular range as back as $\approx 160^\circ$ in the centre of mass frame. The mass resolution $\Delta A/A \sim 1/50$ in addition to an overall 700-800 KeV energy resolution (FWHM), were enough to distinguish clearly the elastic scattering events from other quasi-elastic reaction channels. The cross sections were normalized by the use of two monitor counters placed at $\pm 16^\circ$ with respect to the beam axis.

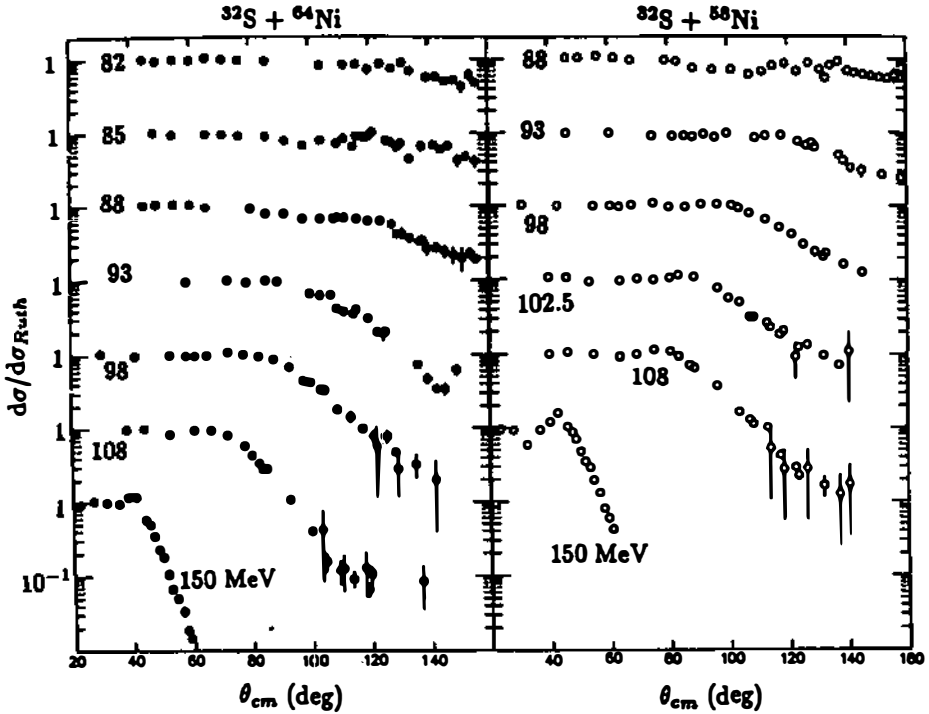
At the lowest energies (some percents below the Coulomb barrier) the differential cross sections at backward angles show an oscillatory structure which doesn't agree with the simple prediction of any strong absorption model. With the help of the code Ptolemy¹⁾ we performed optical model calculations in order to obtain the interaction potential parameters. For the energies over the barrier there is evidence that a simple Wood-Saxon "volume" absorbing potential is sufficient to well reproduce the experimental data.

On the other side, for the lowest energies an acceptable fit of the data was achieved only taking into account also a "surface absorbing" potential. At these energies no quarter point is observed and the obtained optical parameters are affected by a large ambiguity. Up to now, it is not evident if this increased surface absorption is due to the long range Coulomb interaction or if it may be attributed to some other specific reaction channels.

It is interesting to note that, for the systems we have studied, the real and imaginary parts of the potential - at the strong absorption radius - don't show a marked energy dependence, at variance with what observed^{2),3)} in $^{16}\text{O} + ^{208}\text{Pb}$ and for some other α and ^{16}O induced reactions³⁾. Furthermore, we obtain over the barrier a certain surface transparency for $^{32}\text{S} + ^{58}\text{Ni}$ whereas this is not the case for $^{32}\text{S} + ^{64}\text{Ni}$ where quasi-elastic transfer and fusion cross sections are in fact much stronger⁴⁾. The consequences of all this on the sub-barrier fusion cross sections are also under investigation.

References

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Elastic scattering angular distributions for $^{32}\text{S} + ^{64}\text{Ni}$ (left side) and $^{32}\text{S} + ^{58}\text{Ni}$ (right side). The indicated energies are in the laboratory frame.