# MEASUREMENT OF $^{16}$O + $^{12}$C ELASTIC SCATTERING BEYOND THE "RAINBOW" ANGLE

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The optical potential for elastic scattering contains much information about the properties of the nuclei involved. Accurate, unambiguous optical potential parameters provide information about heavy-ion scattering at small impact parameters (distorted waves for reaction calculations), constrain the variety of folding model interactions in use today and even help to determine such global nuclear parameters as the compressibility of cold nuclear matter.[4]

Recently, the energy-dependent analysis of $^{16}$O + $^{16}$O and $^{12}$C + $^{12}$C scattering have yielded much new insight into the optical potential and its unique determination.[5] Now these studies are being extended to the non-identical system $^{16}$O + $^{12}$C. This type of analysis requires extensive angular distributions, measured far enough forward to determine the normalization, far enough backward to identify the Airy minima, with sufficient detail to characterize the entire distribution. There are few systematic datasets of this sort.

This experiment measured the elastic scattering of $^{16}$O on $^{12}$C at an energy of 300 MeV to provide an accurate measurement between the bulk of the existing data at lower energies and a measurement at 608 MeV.

In addition to the elastic scattering, we measured the alpha transfer channel to determine the magnitude of exchange contributions to the observed scattering, which calculations show can interfere substantially with the elastic scattering in the vicinity of the rainbow angle.

The experiment was performed at the Texas A&M University Cyclotron Institute, using the K500 cyclotron to accelerate a 300 MeV beam of $^{16}$O. The measurements were performed with the Oxford MDM spectrometer. The spectrometer was fitted with a resistive-wire gas detector designed at TAMU. The angular acceptance of the detector was 4$^\circ$ in the horizontal plane and 1$^\circ$ to 4$^\circ$ in the vertical. The angular distribution within each angular bite was reconstructed from two postition measurements in the gas detector and use of the program RAYTRACE.

The target was a natural carbon target (composed of 98% $^{12}$C), self-supporting and 1000 $\mu$g/cm$^2$ thick. One difficult problem with this measurement was the wide range of projectile energies over the large angular distribution, from 5$^\circ$ to 40$^\circ$ in the laboratory. The differential energy loss at 40$^\circ$ was the primary limitation on our target thickness.

The measurement took about 13 days of beam time. A preliminary analysis, based on an online dataset, has identified the Airy angle and identified a limited set of optical models which fit the data. The data are still being analyzed.

## References

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