5/17/84

OG 784

BNL-34819

BNL--34819

DE84 013141

CONF-8405193--13

LOW ENERGY ANTIPROTON NUCLEUS INTERACTIONS

M.E. Sainio, V. Ashford, M. Sakitt, and J. Skelly
Brookhaven National Laboratory, Upton, New York 11973

R. Debbe, W. Fickinger, R. Marino, and D.K. Robinson
Case Western Reserve University Cleveland, Ohio 44106

Submitted to CONFERENCE on the INTERSECTIONS between
PARTICLE and NUCLEAR PHYSICS

Steamboat Springs, Colorado
May 23-30, 1984

LOW ENERGY ANTIPROTON NUCLEUS INTERACTIONS

M.E. Sainio, V. Ashford, M. Sakitt, and J. Skelly
Brookhaven National Laboratory, Upton, New York 11973

R. Debbe, W. Fickinger, R. Marino, and D.K. Robinson
Case Western Reserve University, Cleveland, Ohio 44106

ABSTRACT

We have studied antiproton quasielastic scattering on Al, Cu, and Pb for two incident momenta, 514 and 633 MeV/c. Combining these data with other existing $\bar{p}$ nucleus data, we have performed a global analysis using a nonrelativistic optical potential of the Woods-Saxon form.

EXPERIMENTAL RESULTS

Data for this experiment were acquired in conjunction with an experiment on antiproton-proton interaction using the Low Energy Separated Beam line (C4) at the Brookhaven AGS. Using time-of-flight counters, several dE/dx counters and a lucite Cerenkov counter as a pion veto, resulted in a tagged antiproton beam with better than 99% purity. The only trigger requirement was an incoming antiproton.

For each event the incoming and outgoing angles were determined by use of a drift chamber system. Identification of the outgoing track as an antiproton was provided by the pulse height and time-of-flight information from downstream counter hodoscopes. The pion background, in the worst case at large scattering angles was less than 5%.

Data were taken at two momenta, 514 and 633 MeV/c, for three natural isotopic targets Al, Cu, and Pb and each element was run for two thickness (0.229, 0.686 cm) for aluminum, (0.099, 0.284 cm) for copper and (0.081, 0.244 cm) for lead. At angles greater than three times the multiple scattering angles, the data from the thick and thin targets were in agreement and were therefore merged. At the smaller angles only the data from the thin target were used. While the details of the experimental results are described in Ref. 1, we show in Fig. 1 one of the six differential cross sections, the results for Cu at 633 MeV/c.

ANALYSIS

We analyze the elastic cross sections in terms of a nonrelativistic optical potential model. In addition to the above data we include in this analysis recent data for ^{12}C, ^{27}Al and ^{63}Cu at energies about 110, 150 and 180 MeV from Ref. 2 and for ^{12}C at 46.8 MeV from Ref. 3.

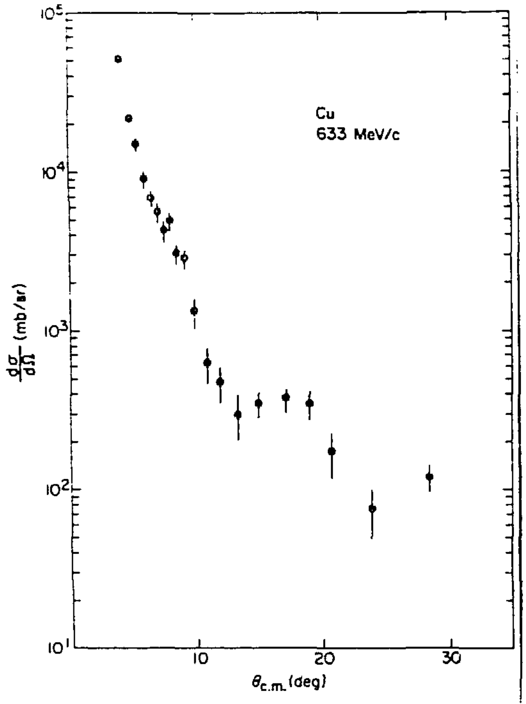

Fig. 1. The quasielastic angular distribution for copper at 633 MeV/c.

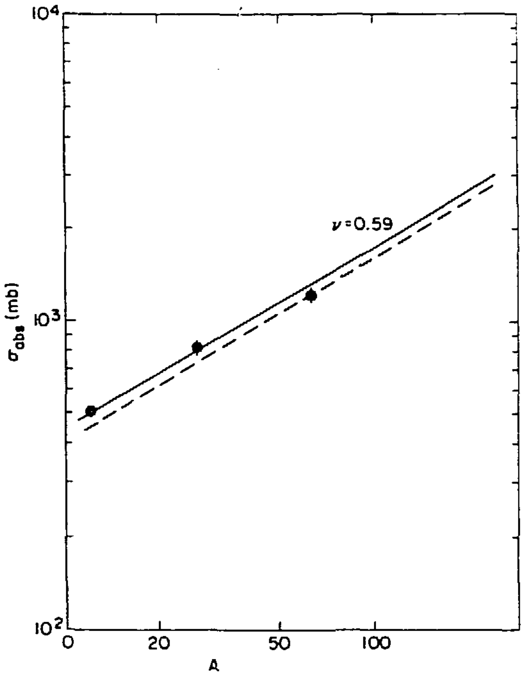

Fig. 2. The absorption cross section as a function of the mass number A for 110 MeV (solid line) and 194 MeV (dashed line). Experimental points for 110 MeV are from Ref. 2.

The potential is taken to be of the form

$$V_{opt}(r) = - V_o f_R(r) - iW_o f_I(r) \tag{1}$$

where f_R and f_I have the Woods-Saxon shape

$$f_{R,I}(r) = \left[1 + \exp\left(\frac{r - R_{R,I}}{a_{R,I}} \right) \right]^{-1} \tag{2}$$

Guidance from the folding model can be used to build in the finite range effect from the two-body interaction resulting in extended range or diffuseness for the real well[4,5]. Because of the quasielastic nature of our data as well as the data of Ref. 2, the diffraction m .ima do not show up clearly. Therefore we choose to fix the shape of the well[4]

$R_R = 1.3\ A^{1/3}$ fm; $R_I = 1.1\ A^{1/3}$ fm; $a_R = a_I = 0.52$ fm

to study the well strengths V_o and W_o. An angular cut-off was introduced to the data to exclude regions where the nuclear excitations are expected to be important. The results of this search are displayed in Table I.

Table I: Optical Model Well Depth Parameters for C, Al, Cu and Pb.

	V_o (MeV)	W_o (MeV)
^{12}C	25	91
^{27}Al	24	96
^{63}Cu	27	121
^{208}Pb	25	173

These fits are then used to compute the absorption cross section predictions which approximately can be fitted with the formula

$$\sigma_{abs} = \sigma_o(E)A^{\nu} \tag{3}$$

with $\nu = 0.59$. In Fig. 2 the predictions are drawn for 110 MeV (solid line) and 194 MeV (dashed line) together with results from Ref. 2 at 110 MeV. Currently we are working on an extraction of σ_{TOT} from our experimental run.

This work has been supported by the U.S. Department of Energy under contract DE-AC02-76CH00016 and by the National Science Foundation under contract PHY80-20418.

REFERENCES

1. V. Ashford *et al.*, Phys. Rev. C (submitted).
2. K. Nakamura *et al.*, Phys. Rev. Lett. 52, 731 (1984).
3. D. Garreta *et al.*, Phys. Lett. 135B, 266 (1984).
4. E.H. Auerbach, C.B. Dover and S.H. Kahana, Phys. Rev. Lett. 46, 702 (1981).
5. S.H. Kahana and M.E. Sainio, Phys. Lett. (to appear).