In Fig. 1 (b) reduced profiles for He-Ne, He-A, and Ne-A are compared. When the average atomic weight of the collision partners is high, the absorption is higher at 350 cm^{-1} and falls off more rapidly towards higher frequencies. It is evident that not much can be said about the integrated intensity of the absorption until the experiments are extended to the further infrared.

Participation of the relative kinetic energy of the colliding molecules in induced absorption processes has been observed in the pressure-induced vibrational absorption of hydrogen.[2] According to the theory of Van Kranendonk[1] the Q branch of this absorption owes most of its intensity to interaction in the region of the short-range overlap forces, whereas the rotational lines of the vibrational band are due mainly to the longer range quadrupole interaction. Experimentally, the Q branch shows two components, Q_P and Q_R, which have been interpreted as difference and summation tones, respectively, of the vibrational frequency of the hydrogen molecule with a continuum of frequencies associated with the relative kinetic energy. The magnitude of the changes in the translational energy is of the same order as that observed in the collision-induced translational spectra of the rare gases.

Pressure-induced translational continua have also been observed recently in another connection. The pressure-induced rotational spectrum of hydrogen was studied with CsBr optics and compared with intensity calculations based on pure quadrupole interaction.[3] It was found that, particularly in the case of the collisions of light atoms such as H_2-H_2, H_2-He, the observed intensity of the rotational absorption of hydrogen was considerably higher than that calculated, and the profile of the absorption different from that expected. The observations could be explained by assuming that the rotational spectrum was superimposed on a continuum decreasing in intensity towards higher frequencies, and a tentative interpretation of the continuum in terms of translational absorption was given. The present experiments with mixtures of the rare gases confirm that interpretation.

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NEUTRON CROSS-SECTION MEASUREMENTS AT 4.5 Bev*

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In this Letter we report the results of a series of measurements on the total and reaction cross sections for 4.5-Bev neutrons on carbon, copper, and lead.

The experimental arrangement is shown in Fig. 1. The neutron flux is taken at 0° relative to the proton beam incident on an internal target in the Bevatron. The beam-defining collimator is 5 ft long and is located 50 ft from the target; the aperture in the collimator is 2 × 2 in., and hence the emerging neutron beam has an angular spread of less than 0.1 degree. Two lead filters placed in the collimator serve to eliminate photons present in the neutral beam.

The energy distribution of the neutrons is known[1] to be peaked at about 4 Bev and to extend up to the beam energy of 6.2 Bev. The neutron detector described below has a threshold detection efficiency for neutrons starting at 3.5 Bev, hence the mean energy of the detected neutrons is ~4.5 Bev with an energy spread of $^{+1.5}_{-1.0}$ Bev.

Figure 1 shows the neutron detector schematically. It is a counter telescope with three scintillators and a gas Čerenkov counter.[2] First in the beam line is a scintillator connected in anti-

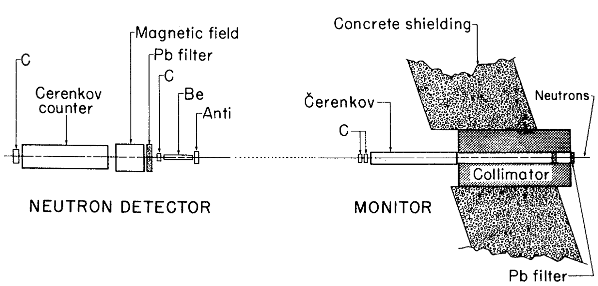

FIG. 1. Schematic of the experimental arrangement, showing the collimator, monitor telescope, and neutron-detector telescope. The absorber is placed in various positions between the monitor and neutron telescopes.

coincidence to the remaining three counters. This is followed by a 12-in. long Be converter, a scintillator, a Pb electron filter, a sweeping magnet, the gas Čerenkov counter, and a final scintillator. Neutrons are detected by the charged pions produced in the beryllium converter and recorded by the triple coincidence of the two scintillators and Čerenkov counter. The threshold energy of 3 Bev for detecting pions is set by the gas pressure in the Cerenkov counter. The Pb electron filter and the sweeping magnet serve to deflect out of the telescope the conversion electrons, originating from decaying π^0 mesons of all energies produced in the beryllium converter. Protons made in the converter have too low a β to count in the Čerenkov counter.

The neutron-counter telescope is placed at a fixed distance of 30 feet from the collimator. A similar telescope at the rear of the collimator monitors the neutron flux by detecting charged pions produced in the lead filter. Absorption measurements in "good" and "poor" geometry were done by placing the sample at various distances from the neutron detector. Figure 2 shows the results of such a series of measurements on Pb. Similar measurements have been performed on carbon and copper. The limiting values of the cross section for "good" and for "poor" geometry yield the total and reaction cross sections listed in Table I. The most interesting feature of the data is that the elastic cross sections, especially for the heavy elements, are considerably smaller than at lower energies, whereas the absorption cross sections

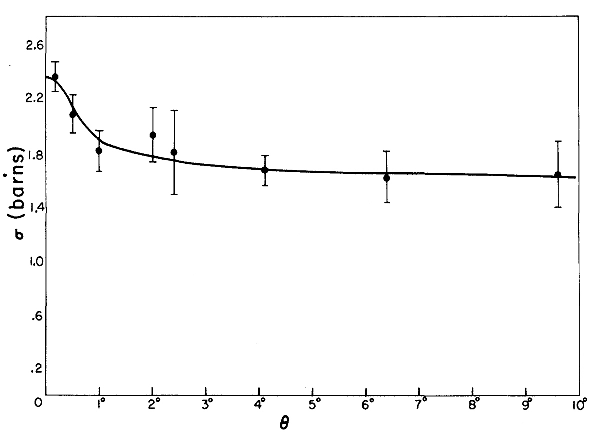

FIG. 2. Cross section of neutrons in lead as a function of the half angle subtended by the neutron detector. The solid curve is a least-squares fit to the data according to an opaque-nucleus calculation for a mean neutron energy of 4.5 Bev.

Table I. Neutron total and reaction cross sections.

	σ_t (in mb)	σ_r (in mb)
Pb	2320±130	1660±90
Cu	1088±22	638±24
C	354±11	218±8

remain essentially constant from 300 Mev up to our energy.

The following Letter discusses the interpretation that can be placed on these values, in relation to the Brookhaven measurements performed at a mean energy of 1.4 Bev, and lower-energy data.[3]

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GENERALIZED DIFFRACTION THEORY FOR VERY-HIGH-ENERGY COLLISIONS*

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It has become customary to interpret nuclear scattering experiments in terms of the optical model in which one introduces a general single-particle operator (optical potential) for the incident projectile and attempts to determine its properties from experiment. Although this procedure has yielded many useful results it has a number of drawbacks, particularly for very high energies. On the other hand, there are a number of simplifications which obtain at very high energies which permit a more satisfactory treatment to be given.