Meetings

Brookhaven Conference

MEV Neutron Cross Sections

The conference on neutron cross sections in the million electron volt energy region, sponsored jointly by the ONR and the Neutron Cross Section Advisory Group of the AEC, was held at the Brookhaven National Laboratory, Upton, N. Y. on January 20 and 21, 1953. Its purpose was to furnish an opportunity for discussion of the progress and problems in this field, particularly with regard to the cross section needs of the AEC. About 100 scientists attended, representing all of the large national laboratories and most of the university and industrial laboratories active in cross section measurements in the United States and Canada.

The program of the conference consisted of three sessions. The first session was devoted mainly to total cross sections, beginning with a review of the theoretical aspects of the problem by V. F. Weisskopf. The general discussion included descriptions of attempts to extend the useful range of Van de Graaff generators to lower energies than those at which they are generally used. Recent total cross section measurements were reported, as were some fission and reaction cross sections. Inelastic scattering was the subject of the second session. H. Goldstein itemized the cross section needs of the AEC, and H. Feshbach reviewed the present status of the theory of inelastic and $(n, 2n)$ reactions. The discussion included the presentation of recent total collision and inelastic scattering cross section measurements and elastic scattering angular distributions, a report on a study of background problems in inelastic scattering work, and a report on some measurements of the gamma radiation arising from inelastic scattering. The problem of neutron detection and instrumentation was discussed in the third session. A review of the possible methods of neutron detection was presented by C. O. Muehlhause and several new ideas were described in detail. The problem of obtaining pulsed neutron sources was discussed during the general discussion, as was the use of various detection schemes including He^3 proportional counters, Li-containing scintillators and diffusion cloud chamber. An application of the alternating-gradient strong-focusing principle and an application of the Ranger method were also presented.

Recent measurements of total cross sections in the million electron volt region have indicated that some of the theoretical concepts developed over the past ten or fifteen years must be modified. V. F. Weisskopf, of MIT, reviewed the current status of the theory and discussed the consequences of relaxing the requirement of strong interaction of the neutrons with nuclear matter immediately upon entrance into the nucleus. The strong interaction theory predicted that the total neutron cross sections would be smooth functions of the nuclear radius. By assuming a mean free path in nuclear matter of about two or three times the nuclear radius (for $A \sim 100$), the theory can be brought into agreement with the recently discovered maxima and minima in the variation of total cross section with energy. The dependence of the mean free path on energy and the problem of explaining resonance structure with the new model were discussed.

The recent work at Argonne and at Duke on extending the useful range of Van de Graaff generators down in energy to the region of one to ten kilovolts was described by A. S. Langsdorf, Jr. and H. W. Newson. The use of additional shielding and highly efficient ($\sim 10\%$) detectors made it possible to use the low energy neutrons scattered at large back angles. D. J. Hughes, of Brookhaven, described the extension of pile neutron velocity selectors upward in useful energy range to overlap the lowered Van de Graaff range.

Cross section work done with Van de Graaff generators was described by several experimenters. Several recent total cross section measurements in the region from one to twenty Mev were reported by R. L. Henkel, of Los Alamos. Many new resonances were found. A study of the 258-kev peak in Li^6 was described by C. L. Johnson, of Oak Ridge. Oak Ridge measurements of the angular distributions of neutrons scattered by nitrogen were also presented. Measurements in the region from 100 to 700 kev made at Bartol were discussed by S. C. Snowden.

Fission cross section measurements of uranium 234 and 236 were described by W. M. Good, of Oak Ridge. An extensive study of (n, p), (n, α) and $(n, 2n)$ cross sections at 14.5 Mev was reported by E. B. Paul, of Chalk River. His results were compared with theory and disagreements noted.

C. W. Zabel, of Los Alamos, described some measurements, made by N. Nereson and S. Darden, of total cross sections from 3 to 13 Mev. Neutrons from a fast reactor were used and an energy resolution of about 10% was obtained.

The unclassified cross section needs of the AEC shielding studies and reactor studies programs were outlined by H. Goldstein, of NDA, at the beginning of the second session. For shielding studies the needs included total inelastic scattering cross sections and the energy distribution of the emitted gamma rays, differential elastic scattering cross sections in light elements, and the gamma ray spectra from neutron reactions. For reactor studies the needs included energy distributions of inelastically scattered neutrons and fast neutron absorption cross sections.

Sphere techniques for measurement of total collision cross sections (total minus elastic scattering) were described by several Los Alamos experimenters. R. C. Allen reported on results with neutrons from 0.2 to 1.7

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Mev obtained with a Van de Graaff generator. Fission detectors were used. Work done with fission neutrons and fission detectors was described by R. E. Carter. Energy distribution studies with 14 Mev neutrons, presented by G. M. Frye, showed a low energy tail which might be ascribed to $(n, 2n)$ reactions.

The finding, at MIT, of an inelastically scattered group of neutrons in iron at about 0.9 Mev was reported by P. Stelson. The number of tracks was very small and the statistics consequently poor. A means of increasing the intensity by using the $H(T, n)$ reaction, as suggested by Barschall, was discussed. It will be tried at Oak Ridge.

The theory of inelastic neutron scattering was reviewed by H. Feshbach, of MIT. The Bohr strong interaction model of the compound nucleus was assumed at the beginning, and the consequences of the new ideas introduced by Weisskopf in the first session were discussed at the end. An expression was derived for the inelastic scattering cross section, assuming the statistical model holds for the compound nucleus. The dependence of the cross section on the neutron angular momentum was discussed. The consequences of the $(n, 2n)$ reaction on the emitted neutron energy distribution were described. It was stated that the relaxation of the strong interaction requirement, introduced by Weisskopf, would not radically change the expected total inelastic cross sections but would affect the angular and energy distributions of the scattered neutrons.

An experimental study was described by C. E. Mandeville, of Bartol, in which the best geometry for shielding photographic plates in inelastic scattering experiments was determined. A paraffin wedge between the neutron source and the plates was found to be best.

R. E. Day, of Los Alamos, reported on a study of the gamma rays emitted in the inelastic scattering process. 2.5 Mev neutrons and a scattering ring geometry, with a NaI-Tl detector in the middle, was used. Known transition gamma rays were found in several elements. C. W. Zabel, of Los Alamos, described angular distribution measurements of elastically scattered neutrons. Very pronounced forward scattering was found.

The properties of fast neutron detectors were reviewed at the beginning of the third session by C. O. Muehlhause, of Brookhaven. Such characteristics as efficiency, energy resolution, background sensitivity, and time response were discussed for the classes of counters using gaseous, liquid, or solid media and using light quanta or charge as the energy form of the pulse. The possible use of sound quanta from a piezo crystal was mentioned. Boron-loaded fast liquid organic scintillators were suggested as the best all-purpose counter because of good efficiency, ability to discriminate against gamma-rays and slow neutrons, fast time response, and modest energy resolution.

The problem of obtaining pulsed sources was discussed by several experimenters. B. Jennings, of Westinghouse, described the use of deflecting electrodes to sweep the deuteron beam from an electrostatic generator across the entrance slit of an analysing magnet. The use of a deflecting magnet to bunch the pulses and thereby increase the beam current was reported by R. C. Mobley, of Duke. The associated scattering and detecting assemblage for the above two schemes was presented. A setup similar to that used at Westinghouse was described by C. W. Snyder, of Oak Ridge. The problem of obtaining pulsed neutrons from the Cornell cyclotron by means of time bunching was discussed by J. E. Draper. K. Boyer, of Los Alamos, proposed the use of phase bunching to produce short pulses from a cyclotron.

The design of a He^3 proportional counter for use as a neutron spectrometer was described by B. J. Toppel, of Brookhaven. A study of lithium containing solid scintillating phosphors has been carried out at Oak Ridge. J. Schenck reported that only a few were promising. The best results were obtained with lithium iodide activated with europium. The use of a diffusion type cloud chamber for survey work in inelastic scattering was discussed by W. B. Fowler, of Brookhaven. A resolution of 30% was obtained.

An application of the new alternating-gradient strong-focusing principle at Minnesota was described by J. H. Williams, who concluded that the principle was easy to apply and worked beautifully. D. A. Cowan, of Vanderbilt, suggested the use of the Ranger method of Hill as a low efficiency, low background neutron spectrometer.

A complete account of the proceedings of the conference can be found in the Brookhaven Conference Report, BNL–224.

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Ionizing Radiations

Seminar at Evans Signal Lab

A Seminar on the Effects of Ionizing Radiations, sponsored by the Nucleonics Branch of the Signal Corps Engineering Laboratories, was held at Evans Signal Laboratory, Belmar, New Jersey, on April 2–3, 1953. Approximately one hundred persons, including representatives from various governmental agencies and investigators sponsored by governmental research and developmental contracts, heard a series of fifteen papers on various phenomena produced by nuclear radiations. The lively discussions which followed each paper indicated that the purposes of the seminar (to correlate research in allied fields and to provide an opportunity for the interchange of ideas) were well met.

After a brief discussion of the theme of the seminar by P. Shapiro, chairman, I. Greenberg of Evans Signal Laboratory presented "A Review of the Effects of Ionizing Radiations." Past developments in this field were summarized with particular emphasis upon the primary process involved in the interaction of radiation and matter, the production of excited atomic states.

Three papers followed on the electrical effects of ionizing radiations. J. R. Parker of Radio Corporation of America, in a paper entitled "Ionization of Nitrogen and the Rare Gases by 0.06 to 1.25 Mev Gamma Radia-