Meetings

Resonance Absorption Conference

MORE than fifty reactor physicists met at Brookhaven September 24–25 to discuss resonance absorption of neutrons in nuclear reactors. Four sessions were held with an average of six papers per session. This leisurely program permitted the full discussion and interchange of ideas so often lacking at large meetings of the professional societies.

The importance of the quantity p, called the resonance escape probability, has been recognized since the earliest days of reactor technology. Briefly, p is the probability that a fast neutron born in the fission of say U^{235} escapes radiative capture in the many resonances in the capture cross section of U^{238} as it slows down to thermal energies. At present, there are at least 18 known resonances in U^{238} in the energy range from 1 ev to 500 ev and it is expected that resonances continue to occur, at approximately uniform intervals, with increasing resonance width until they are "washed out" at about 10^4 ev. As neutrons slow down past this energy region, it becomes essential to avoid capture in these resonances, which serves only to remove neutrons which could potentially cause thermal fission in U^{235}. One of the tricks which may be employed to this end is to lump the uranium in the moderator—this has the effect of separating the neutrons from the uranium while they are being slowed down, so increasing the escape probability.

An early and fundamental, though simplified, analysis is due to E. P. Wigner. His work gives what might be called the Western recipe for calculating the resonance escape probability in a lumped lattice: it turns out that p can be written as an exponential whose argument is proportional to the "effective resonance integral" of U^{238}. In Wigner's theory this latter quantity may be expressed as the sum of two terms: one of which expresses that part of the capture in U^{238} which occurs at peaks of the resonances and is therefore confined mainly to the surface of the lump, the other of which expresses that part of the capture which takes place at the higher energy, border resonances or in the wings of the lower resonances and is distributed more uniformly through the volume of the lump. These two components of the resonance integral, apart from their proportionality to mass and surface, depend only upon the cross sections of the fuel atoms and the general character of the slowing-down process. Thus, when they have been tabulated for a particular fuel, calculation of p for a variety of reactor systems is made possible. Two major goals for experimental physicists present themselves, then—the determination of the surface and volume terms, and the direct measurements of p in a reactor lattice—and these are reflected in the following sampling of papers given at the conference.

W. E. Niemuth of Hanford showed measurements of p in Hanford-type lattices (natural uranium, graphite moderated). Similar measurements in slightly-enriched uranium, light water moderated lattices were reported by D. Klein of Westinghouse Atomic Power Division, and C. G. Campbell of Harwell. Although the techniques are at hand, there is still some question (and this stimulated considerable discussion) as to the interpretation of measurements such as these: for example, the effect of absorption in the resonance region which may also take place in U^{235}; here a neutron can cause fission, however, and is thus not necessarily lost to the chain reaction.

H. J. Kouts (Brookhaven) presented an analysis of all available measurements of this type in this country and abroad which indicated (working backwards from p to the effective resonance integral in U^{238}) that the coefficients of the surface and volume absorption terms obtained in this manner may disagree with those obtained by direct measurements in uranium. In particular, some bulk reactor measurements seem to imply smaller volume and greater surface capture than the direct measurements on uranium. The cause of this discrepancy is not clear at this moment. B. I. Spinrad of Argonne National Laboratory gave a paper touching on these and other problems in the interpretation of these measurements.

Papers treating the theoretical and calculational side of the problem of resonance escape emphasized the increasing concern of physicists for the validity of the simple formulas. Attempts to refine the calculations of resonance integrals, using in some cases the rigorous transport theory as a starting point, have been made recently by N. Corngold (Brookhaven), H. Neumann (Hanford), S. Stein (Westinghouse Atomic Power Division), and G. Stuart (Hanford). J. Chernick and K. Spinney of Brookhaven reported on recent work aimed at setting quantitative limits on the accuracy of conventional calculations and at formulating the theory in terms of geometrical "escape probabilities".

A number of papers and much discussion dealt with a new analytical tool for reactor theorists, the "Monte Carlo" technique used in conjunction with high-speed computing machines. Papers were given by R. D. Richtmyer (New York University) and S. Stein (Westinghouse Atomic Power Division) in which the technique was applied to the determination of p in slightly enriched uranium-light water lattices, and by D. St. John (Savannah River) and J. Sampson (Knolls Atomic Power Laboratory) who studied heavy water moderated systems and graphite lattices, respectively. At present, these calculations fall just short of the desired accuracy. With faster computing machines (which permit a larger number of neutron histories to be sampled) they are quite promising.

POSITIONS OPEN

POSITION WANTED

A highlight of the conference was an invited paper by Prof. Wigner. Reference has already been made to the Wigner formulation of resonance capture in terms of surface and volume absorption. In particular the capture can be expressed in terms of the surface to volume ratio of the lump. For cylindrical rods, then, there is a dependence on r^{-1}, where r is the radius of the cylinder. Russian work has recently appeared in which, starting from a point of view apparently quite different from Wigner's, a similar expression is derived, but with a dependence on $r^{-\frac{1}{2}}$. Wigner pointed out that in his formulation, a similar dependence (on $r^{-\frac{1}{2}}$) results in the case of very thin rods. For somewhat thicker rods, whose dimensions are those of practical interest, both the Wigner and the Russian expressions fit experimental data reasonably well, although the Wigner theory seems to be based on sounder grounds, since it does not neglect the moderating effects of uranium. Experiments that have been performed in the US and the USSR to elucidate these effects seem to give contradictory results.

The after dinner speech on September 24 was given by A. M. Weinberg. With charm and lucidity he discussed the state of reactor physics in the West. One of the most hopeful trends to be noted was the increasing cooperation among reactor physicists throughout the free world; the present conference as a matter of fact heard one Swedish and two British papers, and had representatives from Canada and Harwell present.

There was general agreement by those present that the meeting was a success. Such small meetings seem to be quite common in many branches of physics now that the professional society meetings have become so large and unwieldy, and it was generally agreed that the Brookhaven conference should be followed by others.

A final word of appreciation to Jack Chernick of Brookhaven is in order. The concept and success of this conference were due to him and his efforts were duly appreciated by those present. Marietta Kuper, also of Brookhaven, took capable charge of the many details which insured a smooth meeting and the comfort of the visiting participants.

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National Biophysics Conference

A STEERING committee of some fifty scientists, representing various aspects of biophysical research in the United States, has organized a national biophysics conference to take place in Columbus, Ohio, March 4–6, 1957. The conference will encompass studies which employ the approach of physics in biological measurement and theory, at levels of organization from molecules and cells to complex systems and psychophysics. The program is expected to include twelve invited papers related to different biophysical fields and a large number of contributed papers. The program committee is under the chairmanship of Samuel A. Talbot of the Department of Medicine at Johns Hopkins Hospital in Baltimore. Scientists with biophysical inter-