

PHYSICS

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ABSTRACTS

A Project in Gamma Ray Spectroscopy. CHARLES S. MORRIS and ROGER DILLING, Manchester College.—The gamma ray spectrometer, consisting of two single channel spectrometers with a coincidence circuit, in use in the Manchester College physics department, is described. Spectra of Cs134 taken with this apparatus are shown and discussed. The necessity of collimation is indicated by contrasting a collimated with an uncollimated spectrum. The contribution of coincidence data to the determination of decay schemes is discussed and illustrations given. Further proposed work on Cs134 is described.

Direct Interactions in (α , p) Processes.¹ W. D. PLOUGHE, Purdue University.—The direct interaction which is most probable in the case of (α , p) reactions is the knock-out process. In this process the incident alpha particle interacts directly with a single proton of the target nucleus, and the proton is ejected while the alpha particle is captured into the residual nucleus. A "crude" theoretical treatment of such a process predicts that the angular distribution of the outgoing protons should be given by the square of a spherical Bessel function in which the argument is angle dependent. A comparison of this "crude" theory with the (α , p) reactions on fluorine, sodium, aluminum, and silicon will be presented.

The Status of Physics Teaching and Research in Indonesia. LEWIS W. SALTER, Wabash College.—The writer, recently returned from two years residence in Indonesia as a visiting faculty member at the Institute of Technology in Bandung, summarizes briefly some of the problems and progress in physics teaching and research in present day Indonesia. Special reference is made to the problems in laboratory teaching resulting from deep rooted cultural differences between east and west, and to the beginning of a modest nuclear training and research program based on a Triga type reactor presently under construction.

An Extension of Maxwell's Demon Theory. JOHN G. GOSSELINK, Hartford City.—The adiabatic lapse rate law is rigidly derived, not as commonly supposed as holding only for a state of convective equilibrium, but for static equilibrium as well. This raises the question of whether introducing the factor of "bias" into the mathematical principle of statistical probability by the spontaneous action of the gravitational field, the result Maxwell postulated that his demons could bring about in the sub-microscopic realm may be brought into the macroscopic realm.

1. Supported in part by the U. S. Atomic Energy Commission.

Teaching Physics with an Analog Computer. D. L. SHIRER, Valparaiso University.—Differential equations are the heart of physics, but students often do not grasp the essential physical structure of a problem because of difficulties with the mathematical solution of the equations. Numerical, digital and analog methods of solution of complicated equations, if treated properly, do not obscure the basic physics of the situation. The use of a small analog computer to solve differential equations as a lecture aid and an advanced laboratory tool is discussed. Typical problems in mechanics, heat, nuclear and reactor physics are illustrated, and suggestions are made as to its optimum use in the classroom.

Proton Magnetic Resonance Spectra of Amino Acids in D₂O Solution. L. DWIGHT FARRINGER, Manchester College.—Application of nuclear magnetic resonance to the study of molecular structure is discussed, with particular reference to the proton resonances of D₂O solutions of some amino acids. Chemical shifts due to diamagnetic shielding are described and correlated with known molecular structures. Splitting of resonances due to spin-spin coupling between proton groups at non-equivalent sites is also described. Concentration dependence of some of the chemical shifts, notably those of the proton resonances of the amino groups, are described and interpreted in terms of a rapid exchange of protons between the hydrogen sites of these groups and of the solvent molecules.

The Interaction of an Electromagnetic Field with a Finite Plasma. J. G. WOLFE, Indiana State Teachers College.—The interaction of a plane electromagnetic wave with a parallelepiped-shaped neutral plasma of length L and sides a, b such as might be produced by a hypersonic missile in the earth's atmosphere is considered. It is assumed that the positive and negative particle densities are zero outside of the plasma which would be approximately true for the plasma wake of a missile in the lower atmosphere. As the plane wave enters the plasma, charge separation occurs and a pure electric field is produced in opposition to the driving field. The differential equation for this internal field is derived from Maxwell's equations and the solution is obtained. With this information the radiation field of the excited plasma and the reflection coefficient is calculated.

Half-Lives of Some Nuclear Energy States in the $m\mu$ -Sec Region.¹ T. D. NAINAN, Indiana University.—By using a fast time-to-pulse height converter in conjunction with a 100 channel analyzer, the life-times of several short-lived nuclear states have been measured. The apparatus uses a single channel pulse height analyzer in each branch. The results fall into two classes: (a) Half-lives on which there is disagreement between several investigators or which have only been measured by other techniques. (b) New results. Under class (a) the values are as follows:

- 124 kev state of Cs¹³¹ $4.10 \pm 0.05 \times 10^{-9}$ sec;
- 323 kev level of V⁵¹ $0.29 \pm 0.04 \times 10^{-9}$ sec;
- 123 kev level of Gd¹²¹ $1.15 \pm 0.07 \times 10^{-9}$ sec.

1. Supported by the Office of Naval Research and the U. S. Atomic Energy Commission.

(b) New results: 555 kev level of Mn^{52} $1.85 \pm 0.05 \times 10^{-9}$; 155 kev level of Sb^{110} (from Te^{110}) $0.84 \pm 0.05 \times 10^{-9}$ sec.

246 kev level in Se^{77} $1.30 \pm 0.08 \times 10^{-9}$ sec;

1490 kev level in Co^{57} $1.0 \pm 0.05 \times 10^{-9}$ sec.

An Artist's Response to the Land Color Theory. JAMES R. ADAMS, Manchester College.—Color as a sensation is discussed in relation to the Land experiments in color vision. Simple ocular experiments are described whereby implications of the Land experiments can be verified without special equipment. It is suggested that the scientist re-evaluate the color experience of the artist.

Proton Polarization Measurements. WILLIAM P. JOHNSON¹, Indiana University.—Counters and electronics have been developed to measure the polarization of protons produced in various types of nuclear reactions. This proton polarimeter is placed at the focus of a heavy-particle magnetic spectrometer. Proton groups corresponding to nearby states in the residual nuclei under investigation can be resolved and their polarizations measured. Measurements of the polarization of protons produced in elastic scattering of alpha particles from hydrogen will be reported. Preliminary studies of the polarization of protons produced in (d,p) reactions on several targets will also be described.

Satellite Telescopes and Meteorites. PAUL E. STANLEY, Purdue University.—Since the earth's atmosphere is at best only semi-translucent to a large portion of the electromagnetic spectrum, considerable interest is evidenced in the possibility of orbiting astronomical observatories operating far above the atmosphere. Numerous obstacles to such an operation exist, not the least of which is possible damage to the reflecting surface by meteorites impacting upon it. An analysis of the best data on the nature of meteorites and their flux in the vicinity of the earth as well as the phenomena associated with high velocity impact indicates that the damage is very dependent upon the size of the smallest meteorite particles. If no particles smaller than 10^{-11} grams exist, little damage is anticipated in less than several months.

Shape of Beta Spectra of Once Forbidden Transitions in the Decays of Ga^{72} , La^{140} , Eu^{152} , Eu^{154} , and Sb^{124} . D. R. SMITH and L. M. LANGER, Indiana University.—Magnetic spectrometer studies were made on the beta spectra of Ga^{72} , La^{140} , Eu^{152} , Eu^{154} , and Sb^{124} . The highest energy beta group of each of these transitions has an abnormally long comparative half-life and probably is a once forbidden decay from a 3— initial state to a 2+ final state. For all, the highest energy beta spectrum was found to have a nonstatistical, nonunique shape. On the assumption that the B_{11} matrix element dominates the decay, the experimental shape factors were fitted empirically by $C = q^2 + \lambda p^2 + D$. The best fits were obtained for values of D equal to 15, 10, 5, 20 and 15 for Ga^{72} , La^{140} , Eu^{152} , Eu^{154} , and Sb^{124} , respectively.

1. Supported by the Office of Naval Research and the U. S. Atomic Energy Commission.

Student Experiments in Neutron Physics. M. M. BRETSCHER, Valparaiso University.—Since 1958 Valparaiso University has operated a sub-critical nuclear training reactor made possible by assistance from the Atomic Energy Commission. Experiments now performed in the reactor physics laboratory include: albedo determinations of water and paraffin for thermal neutrons, angular distribution of thermal neutrons diffusing from a paraffin surface, thermal neutron diffusion length measurements, age to indium resonance for Pu-Be neutrons in water, absolute thermal flux measurements by beta-gamma coincidence method in gold, mean lifetime of thermal neutrons in water, determination of neutron resonance energies, the exponential experiment, neutron scattering and absorption cross sections, neutron temperature measurements, neutron source calibration. A unique method for determining the diffusion length of thermal neutrons in light water using a Pu-Be neutron source has been developed. Axial and radial flux distributions are measured with a small BF_3 probe in a water moderator having cylindrical geometry with the neutron source located on the axis of the system at its base. The effect of the source term, arising from the slowing down of fast neutrons into the thermal group, in the one velocity diffusion equation is eliminated by a cadmium difference technique. The Fourier-Bessel coefficients in the series expansion of the thermal neutron flux are experimentally determined, thereby making it possible to correct the results for the harmonic effect. In this manner the diffusion length of thermal neutrons in light water was measured and found to be 2.84 ± 0.11 cm. Values quoted in the recent literature vary from 2.67 to 2.88 cm.