PHYSICS

Chairman: C. HIRE, Indiana University

C. M. Zieman, Wabash College, was elected chairman for 1952.

ABSTRACTS

Design of a sensitive dew-point instrument. MARVIN ADELBERG, J. E. BROCK and Y. TOULOUKIAN, Purdue University.— The design and construction of a sensitive dew-point instrument is described. The principle of operation is simple and basic, and relatively small samples of air are required.

Essentially the meter consists of a temperature controlled gold plated condensing surface, the temperature of which is measured by three thermocouples embedded just beneath its surface. Dew formation is detected by a balanced photocell arrangement, sensitive to light reflected from the condensing surface.

New terms in the spectrum of germanium (Ge I). K. L. ANDREW and K. W. MEISSNER, Purdue University.—By means of a quartz arc lamp employing electrodes of pure germanium which were covered with pure germanium dioxide it was possible to excite about 150 new germanium lines between 10460 A and 4735 A. The wave lengths of these lines were measured with a 30 foot concave grating and partially with a Perot-Fabry interferometer. These measurements permitted several contributions to the term analysis of Ge I. Of special interest is the appearance of a group of lines which indicates the excitation of an f-electron.

Electronic states in crystals under large overall perturbations[1]. PAULA FEUER and HUBERT M. JAMES, Purdue University.—Solutions of the three-dimensional Schroedinger equation are considered for a periodic potential modified by a perturbing potential. A method of Slater[2] has been modified and used to develop the theory of large overall perturbations, such that the energy lies close to one permitted band in one region of the crystal and close to a second permitted band in another. The solution of the perturbed periodic Schroedinger equation is expressed as

$$\psi = \sum_i [\phi_1 (r_k)\, a_1 (r - r_k) + \phi_2 (r_k)\, a_2 (r - r_k)]$$

where $a_1(r - r_k)$ and $a_2(r - r_k)$ are functions localized about the kth atom of the crystal, appropriate to the first and second permitted bands, respectively. Difference equations are derived for the coefficients ϕ_1

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[1] Work supported in part by the Signal Corps.

[2] J. C. Slater, Phys. Rev. **76**, 1952 (1949)

and ϕ_2. The theory has been applied to a one-dimensional crystal in a uniform electric field, using the narrow band approximation; an expression has been obtained for the probability for an electron to cross a forbidden energy band.

Approximate treatment of order disorder transitions in the triangular Ising lattice. L. FOSDICK and H. M. JAMES, Purdue University.—Last year we reported on a new approximate treatment of order-disorder transitions in an Ising lattice. The method was then applied to a two-dimensional square array[1]. This method has now been applied to a triangular array, with similar results. The Curie Point is in good agreement with the exact result of Wannier, the error being about 8%. The triangular lattice shows a finite jump in the specific heat at the Curie Point as in the case of the square lattice. The large specific heat jump indicates that the approximation gives a relatively good representation of the behavior of the system in the neighborhood of the Curie Point.

Calculations have been started on the hexagonal lattice. The Curie Point given by this method is in error by only 5.5%.

Range-energy relations for α-particles and deuterons in the Kodak NTB emulsions.[2] O. GAILAR and L. SEIDLITZ, Purdue University.—The range-energy relations for α-particles and deuterons in Kodak NTB plates, emulsion No. 434,313-9 (100μ), have been determined. The α-particles from Th and Po were utilized for energies below 9 Mev, a camera having been constructed for exposing the plates to these radiations in vacuum. In addition, plates were soaked in a solution of $Th(NO_3)_2$ in alcohol and were developed at the end of three weeks, after being rapidly dried. For energies between 6 and 18 Mev, α-particles from the Purdue Cyclotron were used. Their energy was both measured and varied by a rotating Al-foil holder. After being scattered through an angle of 90° by a 0.0001 inch gold foil, the particles impinged on an NTB plate at an angle of 5°. The same method was used for deuterons with energies between 2 and 9 Mev. The results agree with those of Lattes, Fowler and Cuer[3] for Ilford plates, but indicate a higher stopping power than those of Richards et al[4] for NTA plates, which may be due to different humidity conditions. Since there may be small differences in the stopping power of different batches of emulsion, the camera will be used to calibrate NTB plates with the other emulsion numbers.

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[1] Later calculations showed a finite specific heat jump at the Curie Point rather than an infinite specific heat jump as reported.

[2] Supported by the Atomic Energy Commission and Eastman Kodak Fellowships.

[3] Lattes, C. M. G., P. H. Fowler and P. Cuer, Proc. Phys. Soc. (London) 59:883 (1947).

[4] Richards, H. T., V. R. Johnson, F. Ajzenberg and M. J. W. Laubenstein, Phys. Rev. 83:994 (1951).

Radiations from Ge^{69}. CHARLES M. HUDDLESTON and ALAN B. SMITH, —The radiations from Ge^{69} (39.6h) have been studied with the help of a magnetic lens spectrometer. Gamma-rays of energies 0.090, 0.388, 0.576, 0.870, 1.12, 1.34, and 1.61 Mev have been found. The positron spectrum is complex and can be analyzed into three groups of end point energies 1.215 (88%), 0.610 (10%), and 0.220 (2%) Mev. Coincidence studies have also been made. A tentative energy level scheme is presented.

Electrical analog circuits as applied to heat conduction problems. E. O. P. KLEIN, J. R. EATON, and Y. S. TOULOUKIAN, Purdue University. —The solution of some problems involving distributed parameter systems is possible only through the use of approximation methods. One such method makes use of electrical analog circuits.

The mathematics suggests, for example, that one-dimensional, transient, heat-conduction problems can be solved by using a properly designed analogous distributed-parameter electrical transmission cable. However, in the application of electrical analogs to the more complex heat flow problems, analogous distributed-parameter electrical systems are not possible; and the lumping procedure, similar in principle to the artificial line, must be used.

The lumping of parameters of a distributed-parameter system introduces what might be called a lumping error; and thus, only an approximate solution of the problem is possible.

By comparing the results obtained analytically for a given distributed-parameter system, with the results, also obtained analytically, from a lumped-parameter representation of the distributed-parameter system, it can be seen that the accuracy of analog results is a function of the number of lumped section used in the analog representation, the relative position of the point in question, and of time. The results obtained from an experimental study, using similar networks, can not be expected to be more accurate than the limiting accuracy indicated by the analytical comparison of results.

Metastable atoms in rare gases. K. W. MEISSNER and W. F. MILLER, Purdue University.—Irradiation of a glow discharge in pure helium or neon with a second source containing the same gas raises the Voltage-current characteristic of the irradiated discharge, as was shown by K. W. Meissner and R. M. Russell. The present investigation confirms their results and shows that the same effect is present in the rare gases argon, krypton, and xenon. The effect is much greater for argon than for the other gases. By means of filters it could be shown that for helium the entire effect is due to irradiation with the strongly absorbed wave length 20582 A, whereas the other strongly absorbed wave length 10830 A produces no detectable effect.

These results can be explained on the basis of the role of metastable atoms in the glow discharge. In all rare gases, irradiation with strongly absorbed radiation diminishes the concentration of metastable atoms and removes them as a source of secondary ionization. The strong effect obtained for argon is explained by the long mean life of metastable argon atoms. The filter experiments carried out with helium can be understood by considering the possible transitions in excited helium atoms. Absorption of the 10830 A radiation raises the absorbing metastable helium atom to a state from which it can not return to the normal state. They return to the former metastable state and remain a source of secondary ionization. Absorption of the 20582 A line leads to an excited state from which the atom can return to the ground state and become ineffective as a source of secondary ionization.

Total cross sections of heavy nuclei for fast neutrons[1]. D. W. MILLER,[2] C. K. BOCKELMAN, and R. K. ADAIR, University of Wisconsin.—The total cross sections of twenty-three heavy elements for fast neutrons were determined as a function of neutron energy from 0.05 to 3.2 Mev. Neutrons were obtained by bombarding thin lithium or zirconium-tritium targets with protons accelerated by the Wisconsin electrostatic generator. The elements investigated ranged in mass from iron to bismuth, including nine elements consisting primarily of nuclei with closed shells in neutrons. It was found that the observed total cross sections of a majority of the elements investigated do not agree with the predictions of the continuum theory formulated by Feshbach, Peaslee, and Weisskopf. A very broad maximum appears in the total cross sections of thirteen of the elements studied. This maximum appears to move to higher neutron energies with increasing mass number.

How a fever thermometer works. BRADFORD NOYES, Butler University.—Many physicists have a somewhat hazy idea of the manner in which a maximum registering (clinical) thermometer operates. The idea of surface tension and the degradation of energy may be illustrated by such a thermometer. The aging of glass and the strains left after working will be discussed and illustrated.

The angular correlation of the Cd^{114} gamma rays. ROLF M. STEFFEN, Purdue University.—According to recent measurements, the 72 sec ground state of In^{114} decays not only by β^--emission into Sn^{114} but also by K-capture and β^+-emission into an excited state of Cd^{114} from which two successively emitted gamma rays of 0.548 and 0.615 Mev energy lead to the ground state. A very weak gamma ray of 1.26 Mev quantum energy has been interpreted as due to a cross-over transition.

By measuring the angular correlation of the two successively emitted gamma rays the angular momenta of the two excited levels of Cd^{114} have been investigated. The measured points follow, within experimental error, the angular correlation function $f(\Theta) = 1 + 0.125 \cos^2 \Theta + 0.042 \cos^4\Theta$ which is characteristic for two quadrupole transitions between states of angular momenta of 4, 2 and 0. The angular momentum 4 of the 1.26 Mev level strongly supports the assumption

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[1] Work supported by the AEC and the Wisconsin Alumni Research Foundation.

[2] AEC predoctoral fellow; now at Indiana University.

that this level is reached directly from the 50-d isomer. The ft value, 3×10^8 sec, of this K-decay suggests a first forbidden transition involving a spin change of one and parity change.

The dielectric constant of dry air at wavelength 3.2 cm. CLAYTON M. ZIEMAN, Wabash College.—A cavity comparison method was used to make 50 measurements of the dielectric constant of dry air at a wave length of approximately 3.2 cm. The result, corrected for permeability, and reduced to S. T. P., is

$$(\epsilon_0 - 1) \times 10^4 = 5.754 \pm 0.021.$$