PHYSICS

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ABSTRACTS

Magnetic Fields in the Solar Atmosphere.[1] MALCOLM CORRELL, DePauw University.—The various ways of obtaining knowledge about magnetic fields in the solar atmosphere have been reviewed. One of the most promising is to measure a composite map of the prominence trajectories that occur over an active region during a period of time. This report covers an analysis of the well-observed prominence of CMP April 13, 1950 at N 13° heliographic latitude. If a magnetic dipole were buried 0.03 solar radii beneath the solar surface, with its axis tilted $\pm$ 50° from the plane of projection, the trajectories and the lines of force nicely concurred. There is evidence that a radio noise storm at meter wavelengths was associated with the region and was emitted parallel to the dipole axis. A geomagnetic disturbance was so timed that it could have resulted from solar particles emitted parallel to the dipole axis.

Experimental Comparison of A-C Powered Diode and Hydrogen Ion Gauge Circuits for Leak Detection in a High Vacuum System. ROBERT H. L. HOWE, Eli Lilly and Company.—The efficiency of an a-c powered diode circuit and an a-c powered hydrogen ion gauge circuit for leak detection in a high vacuum system was compared experimentally. The circuits used are modified by the author and P. L. Hartman from those suggested by R. B. Nelson and R. L. Sproull respectively. Experiments were conducted at Cornell University Department of Physics.

In this work the vacuum system employed consists of: (1) a mercury diffusion pump, backed by a mechanical fore pump, (2) a mercury cut-off with shunt arms of different diameters, (3) a pre-calibrated McLeod Gauge, (4) a liquid air trap, and (5) a glass vessel which is provided with connections to a glass tubing serving as a part of the variable leak to be detected, and also to the diode and the hydrogen ion gauge. The total volume of system was approximately 2.20 liters.

The hydrogen ion gauge tube was "R.C.A. 1945". It was sealed to the vacuum system and its terminals were connected to the detector circuit.

The diode tube was "R.C.A. 1949" which was also employed as an ionization gauge tube for measuring the "size" of leakage in the vacuum system. Its terminals were connected to the circuit.

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When the a-c powered diode leak detector circuit was in operation, hydrogen and then oxygen (at 5 liters per min.) were applied over the general location of the leak and the steady emission current change (due to the contamination of the filament by the gas) from that when there was no leak observed. Different sizes of leaks were provided and detection results obtained.

With the hydrogen ion gauge circuit on for leak detection, only hydrogen (at 5 liters/min.) was applied over the leak. The change in ion current indicating the passage of hydrogen through the particular size of leak was observed. Different sizes of leaks were provided and detection results obtained.

The a-c powered ionization gauge circuit using the "R.C.A. 1949" tube was employed to measure the rate (size) of leakage, pressure in the vacuum system being determined from the pre-calibrated McLeod Gauge and the rate being calculated from the equation, $Q = \triangle PV/t$. Q is the rate of leakage in micron-liters per hour, $\triangle p$ the change of pressure in microns Hg, V the predetermined volume of the vacuum system, and t the time interval in hours.

Experimental results indicated that the diode circuit could detect leaks as small as 0.010 micron-liters/hour and the hydrogen ion gauge could detect leaks as small as 0.10 micron-liters/hour, the former being almost ten times more sensitive than the latter. However, the latter is relatively independent of leak size and time-saving to operate. With proper modifications, both the a-c powered diode and hydrogen ion gauge circuits would be very efficient for leak detection in a high vacuum system.

Absolute Measurement of Beta-Activities Using Sources of Saturation Thickness. H. FISCHBECK, Indiana University.—A method will be described which makes it possible to calculate the specific activity of sources of saturation thickness to an accuracy within 5%, if the number of emitted Beta-particles is measured in 2π—geometry. The calculation makes use of the practical range of electrons in Al and a factor, a, which depends surprisingly little on the beta-energy E and the atomic number Z of the source material. The factor, a, and its dependence on E and Z has been studied experimentally over a wide range. The method described can be used on almost all beta-emitters, where the decay scheme and spectrum is known.

Alpha Particle Irradiation of Germanium at 4.2°K.[1] G. W. GOBELI and K. LARK-HOROVITZ, Purdue University.—Employing a sealed polonium-210 alpha-particle source with an effective energy of 3.7 Mev, degenerate n-type and p-type germanium samples were irradiated at 4.2°K. Samples held for long periods at 4.2°K following irradiation showed no thermal recovery. Carrier concentration changes were linear with the flux and removal rates calculated from Hall coefficient give 2.84×10^4 electrons/alpha particle-cm and 0.662×10^4 holes/alpha particle-cm respectively for n-type and p-type samples. A calculation of the lattice

[1] Work supported by U.S.S.C.

displacements, employing a displacement threshold energy of 30 ev, yields 2.79×10^4 displacements/alpha particle-cm. Isochronal annealing indicates no measurable thermal recovery occurs below 22°K. After warming to 78°K it was found that thermal recovery in n-type and p-type samples was essentially the same, (25% and 22%). Resistivity measurements taken while the samples warmed to 78°K indicate two distinct regions of thermal recovery, with maximum rates occurring near 32°K and 66°K. Isothermal annealing indicates the lower temperature process follows a first order reaction with an activation energy of about .02 ev. The higher temperature process does not yield to simple analysis.

Minority Carrier Lifetime in Indium Antimonide.[1] R. A. LAFF and H. Y. FAN, Purdue University.—The lifetime of excess carriers in single crystal specimens of pure p-type InSb has been measured in the temperature range from 84°K to 180°K. The lifetime is determined from either the infrared light photoconductivity or from the diffusion length of the optically excited excess carriers as measured in the photoelectromagnetic effect. In the temperature range from 130°K to 180°K, both methods are in agreement, and the lifetime decreases exponentially with decreasing temperature. Below 130° K, the lifetime as measured by photoconductivity rises, while the PEM effect indicates a decreasing lifetime. Drift mobility measurements show that below 130° K there is trapping of minority carriers. The delay time between the collector signal and the emitter pulse is about 70 times the expected transit time.

(d,p) Reactions in Lead. H. J. MARTIN, Indiana University.—Angular distributions, Q-values, and absolute cross-sections have been measured for (d,p) reactions leading to states in Pb^{207}, Pb^{208}, and Pb^{209}. Nearly all of the angular distributions have peaks between 60 and 120 degrees and fall off rapidly at forward angles. The distribution for the ground and first excited states of Pb^{207} and for the ground state of Pb^{208}, all involving a neutron angular momentum transfer $1_n = 1$, are very similar. This similarity will be used to allow comparison with True and Ford's theoretical calculations of the Pb^{206} states.

Information Handling and Numerical Machine Control. H. B. THOMPSON, General Electric Company, Evendale, Ohio.—The need for improved means of handling vast quantities of information for human and machine use has become obvious in the last 10 years. Considerable work has been done to meet this need. Mechanical data handling is common; coding has been started for handling library work, electronic component procurement, and translation.

Defense equipment has become more complicated and more expensive to the point that lead time and human error are of extreme importance. This means that mechanical handling of information for machine tools is virtually a necessity. Several machine tools are in production and use which control position for drilling, boring, etc. A few contour milling machines have been made and several are between the design stage and the finished product.

[1] Supported by an Office of Naval Research Contract.

Both of these uses of mechanical information handling are going to have a profound influence on our way of life. However, numerical control of machine tools is a present reality and has arrived ahead of educational facilities to prepare the various areas (drafting, planning, maintenance, and operating) for them. This situation needs to be rectified as soon as possible.

Resistance Anomalies in Binary Alloys at Low Temperatures. A. N. GERRITSEN, Purdue University.—A short survey will be given about the anomalous resistance effects at temperatures below 20°K in dilute alloys of a noble metal and a transition metal as a solute. The connection between these resistance anomalies and other properties will be indicated.

An Investigation of Luminescence Excited by Vacuum Ultraviolet Radiation. RICHARD L. CONKLIN (introduced by R. E. MARTIN), Hanover College.—A vacuum spectrograph and light sources for spectral investigations in the extreme ultraviolet (100-1500 A) are described briefly. A survey of the responses of several representative crystal phosphors to these wavelengths has been made, and certain types have been found to increase in quantum efficiency as the exciting wavelength decreases. It is suggested that this increase may be due to one or more stages of ionization within the crystal.

Lorentz-Covariance of Commutation Relations. F. J. BELINFANTE, Purdue University.—New elementary particles call for new wave fields of which they are the quanta. Relativity theory is useful as a criterion that any acceptable field theory should satisfy. Usually it is easy to see whether the field equations of a proposed field theory are covariant or not. Many workers in field theory are satisfied with verifying the covariance of these equations under Lorentz transformations. Standard procedures are available for generalizing a Lorentz-covariant theory to a general-relativistic theory if necessary. The problem arises whether any Lorentz covariant theory can be quantized by the naive prescriptions $qp \pm pq = (ih/2\pi)\underline{1}$. Although some authors have maintained this, it is well known that actually this is not the case. The question then is how one should quantize, and how one can prove that those quantum rules to be imposed will show relativistic covariance. A second question is whether Tomonaga-Schwinger's method of the interaction representation is applicable to such theories. For some types of field theories both questions have been answered in the positive. We have been investigating cases where we have a definite answer to the first question, but the question about the interaction representation which is of paramount importance has been answered only for individual cases and no "general" proof is known, contrary to statements by various authors.

The Measurement and Shapes of Beta Spectra. JOSEPH H. HAMILTON, Indiana University.—With the realization of parity non-conservation, the information that is obtainable from the detailed study of beta spectra must be re-examined. Whatever form the new theory takes, it must explain the shapes of beta spectra. For shapes to be meaningful, all possible sources of instrumental distortion of spectral shapes must be considered. The problem of minimizing distortions in magnetic spectrometer studies is presented. The beta spectrum of Pr^{143} which exhibits a non-allowed, non-unique shape is discussed. Anomalies reported in the beta spectra of In^{114}, P^{32}, Y^{90} are re-examined in light of new data on the beta spectrum of Na^{22}.

Beta Decay of Ru^{103}. R. L. ROBINSON, Indiana University.—In an earlier investigation the intense inner beta spectrum of Ru^{103} was observed to have an anomalous shape corresponding to a deficiency of electrons at low energy. This shape cannot be explained by the generally accepted theory of beta decay. Using a 4π beta-ray scintillation spectrometer, this beta group was observed in coincidence with a 495-kev gamma ray. The Fermi plot is now found to be linear down to 37 kev.

The beta spectrum in coincidence with the 610-kev gamma ray was also measured. By comparison of the total decay energies of the inner beta groups and their cascading gamma rays, it was deduced that the 610- and 495-kev gamma rays decay to the same energy level.

The measured endpoint energies of the two beta groups in coincidence with the 495- and 610-kev gamma rays were respectively 227 $\pm$ 4 and 118 $\pm$ 4 kev.

Surface Investigations in Germanium. R. BRAY and R. W. CUNNINGHAM, Purdue University.—Gold doped germanium has such a high resistivity at low temperature (approximately 10^6 ohm-cm at 80°K) that it becomes a sensitive detector of changes in surface properties. This property has been used to advantage in the study of surface conductance stimulated by light, magnetic, and electric fields. Very interesting effects are found when the surface is oxidized. When light is used as a stimulus, ordinary photoconductivity is observed at wavelengths in the visible region of the spectrum. However, as the wavelength is made shorter (in the near ultra-violet) it is found that an excess conductivity is produced which lasts for days after the light is shut off. Typical build-up and decay curves do not follow an exponential behavior, and at a single wavelength may take days to reach a steady value. Using an external electric field as a probe, it has been found that there is a strongly p-type layer on the surface. Magneto-conductance measurements indicate the mobility is reduced and external electric field measurements indicate the layer becomes more p-type as the surface becomes more highly conducting. These observations are explained in the following way: the light shining on the surface creates electron-hole pairs near the surface; electrons have sufficient energy to jump over the oxide barrier and become trapped in so-called "slow" surface states. This leaves free holes beneath the surface creating a p-type accumulation layer. In order for the conductance to decay back to its initial value the trapped electrons must return to the interior and then recombine with the holes in the accumulation layer.