Journal notes

Apparent Size of Small Objects

Studies of small objects such as bacteriophage with the electron microscope show that the image sizes of objects before and after shadowing are different by a larger factor than can be accounted for by the actual thickness of the metal layer and by the greater contrast provided by shadow coatings.

Since particles of Dow polystyrene latex No. 580G were reported to have remarkably uniform sizes it was decided to investigate, and if possible to explain, this effect. Taking into account the known causes of image size variation such as an increase in size on shadowing, contamination in the shadowing chamber and in the electron microscope, and possible magnification variations from one exposure to another, the unshadowed particles still appeared to be about ten percent smaller than the shadowed particles.

A possible explanation of this phenomenon has been based on the idea that objects under electron bombardment can become charged. It is assumed that unshadowed polystyrene and phage particles, for example, take on a negative charge and in consequence act as very small "negative lenses". The size increase can be accounted for by the dissipation of the charge when the particles and supporting membrane surfaces are made conducting by the metallic film. Support is lent to this assumption by some observation on the optics of image formation of shadowed and unshadowed particles.

However, many questions remain. One of the more obvious has to do with the magnitude of a charge necessary to produce such an effect. One also wonders if such a charge can be produced by electron bombardment. If so, it becomes necessary to determine whether the image size of all objects is a function of the amount of charge carried by the object during observation. S.F.K., R.A.K.

The Size of Objects as Determined from Electron Microscopy. By Stanley F. Kern and R. A. Kern. *J. App. Phys., 21: 705, July, 1950.*

Cosmic Ray Telescope

Since the initial measurements of the east-west asymmetry of cosmic radiation by B. Rossi, T. H. Johnson, and J. C. Street, many elaborate instruments have been employed to determine the nature of asymmetry and associated phenomena. One characteristic which is common to many measurements is that the data are obtained over a relatively short period time interval. Other measurements have been handicapped by the need for manual operation. In order, therefore, to obtain a versatile instrument for directional cosmic ray studies and to investigate possible correlations of the components of cosmic radiation with the present cosmic ray burst studies and solar studies being carried on at the University of Colorado, a dual cosmic ray counter telescope was constructed.

The instrument consists of two banks of Geiger counters, each bank containing 5 trays of counters and each tray containing 9 counters. The trays are connected in triple coincidence schemes with coincidences 1–2–3, 2–3–4, and 3–4–5 being recorded for each telescope bank. In order that the characteristics of the soft, medium, and hard components of the radiation can be investigated, lead blocks 8 centimeters in thickness are mounted between trays 3 and 4 and between 4 and 5.

The operation of the telescope is fully automatic. The banks are positioned in zenith at 15 degree intervals from the vertical to 75 degrees from the vertical, and in azimuth at two positions 180 degrees apart. The recording of the operation of the telescope is accomplished by photographing the instrument panel.

Calculation of the east-west asymmetry and the variation of intensity with zenith angle can be made directly from the readings of the telescope. However, directional intensities are calculated from the telescope data by means of the measured counting efficiency and a mathematical analysis of Witmer and Pomerantz which enables the reduction of the wide angle indications of the telescope to directional intensity.

At the present time only a part of the data has been analyzed and these are to be reported elsewhere. J.E.C.

Instrument for Directional Studies of Cosmic Ray Intensity. By H. W. Boehmer and J. E. Coolidge. *Rev. Sci. Inst., 21: 633, July, 1950.*

Spin and Angular Correlation

One of the main interests of experimental nuclear spectroscopy has been the determination of the spins (i.e. angular momenta) of atomic nuclei, for this information is important for any theory of nuclear structure. Thus far the most effective techniques for this purpose have been the molecular beam and magnetic resonance methods. These rather intricate techniques have been useful, however, only with stable isotopes or with long-lived, excited states of nuclei. Recently a new type of experiment for obtaining information about spins of very short-lived, excited nuclear states has been made practicable by the development of high efficiency counters. This is the *angular correlation* experiment, in which all that one measures is the relative number of coincidence counts between the successive radiations emitted in cascade nuclear transitions as a function of the angle between their respective directions of emission.

In this paper a general theory of angular correlations is developed which, properly specialized, may be applied to natural or induced alpha, beta, or gamma radioactivities as well as to nuclear reactions. It is shown how the directional correlations for the emitted particles depend on the angular momenta of the nuclear states involved and of the radiations emitted in the successive transitions.

The results of the theory are of quite general validity, being based almost wholly on the requirement that angular momentum be conserved in all nuclear processes.
D.L.F.

Directional Correlation of Successive Nuclear Radiation. By D. L. Falkoff and G. E. Uhlenbeck. *Phys. Rev., 79: 334, July 15, 1950.*

Stratified

During the past decade multilayer arrangements of films have been found increasingly useful as a means of reducing reflection from glass, and of filtering polychromatic radiation. Several analyses of the propagation of electromagnetic waves through such multilayers have been published. These range from limited treatments of specific arrangements to general analyses which are marked by excessive mathematical complexity and meager physical content.

In this paper, which takes its title from a paper dealing with a related acoustical situation that was published by Lord Rayleigh almost forty years ago, a comprehensive analysis is developed from Maxwell's equations. The number and properties of the layers are unrestricted, and the applied wave may be incident at any angle. By using methods developed for solution of related problems in electrical communications, the analysis is presented in a form which lends itself to use of available numerical aids such as reflection and impedance charts; algebraic complications are thereby minimized and physical insight enhanced.

The general methods and results have proved useful for some years in the analysis and solution of a variety of optical and allied radio problems. Their utility is illustrated by applying them to two elementary problems; these are solved much more concisely than by the usual treatments to be found in the literature. In addition a useful theorem is derived, which expresses the necessary relations between refractive indexes of any number of quarter-wave and half-wave films comprising a multilayer system used for reduction of reflection.
B.S.

Propagation of Electromagnetic Waves through a Stratified Medium, I. By Bernard Salzberg. *J. Opt. Soc. Am., 40: 465, June, 1950.*

Space Time Optics

The author considers such general physical problems as the generalization of the problems of optics, if extended to the space time continuum. Optics can be considered in three phases: geometrical optics, diffraction optics, and emission and absorption.

Geometrical optics determines the possible paths of light rays and wave surfaces, based upon Fermat's principle. A general field theory, based upon Hamilton's principle, governs the motion of *physical* entities and their wave surfaces in space time. It is shown that general relativity is contained as a special case on this level.

Diffraction optics is based upon the assumption of point disturbances sending out periodic impulses along the corresponding wave surfaces. The paper explains the physical meaning of these point disturbances, which create a field (or better, a superposition of a finite number of fields) which can be split up into their electromagnetic and gravitational components.

The reinterpretation of Schroedinger's equation in the emission and absorption theory assumes that a disturbance emits radiation of discrete frequencies. The absorption process is then equivalent to a resonance phenomenon in which only certain well defined energy amounts lead to stable solutions.

This attempt to explain all physical phenomena in a pseudoclassical way originated from research which the author started in 1933 to explain the diverging experimental evidence in the theory of the image formation in the microscope. A thorough study of all the literature on diffraction and interference made him suspect that the classical interpretation of optical phenomena is more suitable than the quantum-theoretical aspect, and that for instance, Heisenberg's indeterminacy principle, though correct, can be interpreted in a different way. An attempt was made to transfer the ideas of W. R. Hamilton, who showed the unity between geometrical optics and mechanics, to the diffraction and absorption theory. The author feels that an indiscriminate use of imaginary quantities to describe real phenomena has frequently obscured the simple existing laws.
M.H.

An Optical Model of Physics. By M. Herzberger. *J. Opt. Soc. Am., 40: 424, July, 1950.*

Fast Camera

The velocity of the transients involved in the study of detonation and shock waves close to the edge of explosive charges is of the order of 8 millimeters per microsecond. In order to study these high speed transients, successive photographs taken at rates of between 10^7 and 10^8 frames per second are required. Large frames are also desired to maintain definition for measuring at moderate magnifications.

To meet these requirements a camera was developed which can be used to obtain successive frames at rates which can be varied from 10^3 to 10^9 frames per second. These ultra high speeds are obtained by the combination of a multi-slit focal plane shutter "framing grid" and a rotating mirror.

The event (detonation) to be photographed is imaged on the multi-slit focal plane shutter, and an image of the combined event-shutter is moved across the film plate by a rotating mirror. The mirror is only required to move the image the distance between two successive slits to expose the entire picture area. By using a very narrow slit the distance between slits can be kept small for a given number of frames (where the number of frames is the ratio of slit width to space between slits). The exposed plate is reviewed through the grid, and each successive frame is selected by moving the grid one slit width per frame. Each picture, therefore, is composed of a series of lines, and the amount of discontinuity across each frame is a function of the slit width and the number of frames.