JOURNAL NOTES

Tracks and Stars

Nuclear stars in photographic plates can only be detected by using a microscope since each prong of the star is merely a dotted line of silver grains less than one micron in diameter. With conventional bright-field illumination the numerical aperture and magnification of the microscope must be high enough so that the individual grains are resolved. The penalties for such magnification (150 to 300 times) are that the width and depth of field are small and that it is continually necessary to focus up and down through the 90-micron thick emulsion. To scan a single 1 x 3 inch plate may take several days. Ordinary dark-field illumination would help enormously except for the myriad randomly located grains comprising the fog, which masks the weaker prongs.

A rotating-azimuth, planar, dark-field illumination method has been developed which largely overcomes this difficulty by selectively revealing linear arrays of grains. By means of a slotted diaphragm beneath the condensing lens, all illuminating rays are stopped except those which are roughly parallel to a single vertical plane and make an angle of from 25 to 45 degrees with the (vertical) axis of the NA 0.17 objective. Grains of a track perpendicular to the single vertical plane now produce scattering with constructive interference in the direction of the objective; the track accordingly appears very bright. Fog grains do not produce constructive interference in this direction, and thus remain relatively dark.

In practice, the diaphragm is rotated slowly by a motor so that each track alternately gleams and disappears. The flashing tracks are so noticeable that low overall magnification (50 times) is possible, giving a 4 millimeter width of field. Effective depth of field is 25 to 100 microns, so that little focussing is required. Entire stars may be seen at a single glance, and minimum ionization plates are scanned in two to four hours. The large working distance (about one centimeter) permits plates to be scanned from the back, and might be useful in scanning two plates together, one on top of the other. W.A.S.

Detection of Tracks and Stars in Nuclear Track Plates. By E. H. Land, G. R. Bird, and W. A. Shurcliff. *J. Opt. Soc. Am., 40: 61, February, 1950.*

New Electron Microscope

This paper describes a new microscope designed for universal application in the field of electron microscopy. The direct range of magnification extends from the optical microscope limit to 100,000 times; further optical enlargement of the photographs is possible when required. The continuous coverage of this large range is made possible by the inclusion of an extra intermediate projector lens. This extra lens allows the instrument to be used as an electron micro-diffraction camera whereby an electron diffraction pattern can be immediately obtained from a small area, 10^{-8} cm^2 or less, of the specimen under observation. Micro-analysis of crystalline specimens or detection of small crystals amongst amorphous material is thus possible.

The design of the new microscope is based on experience gained with an earlier model, the object being to produce a high performance instrument at reasonable cost with a simple design which would permit future improvements to be easily incorporated. Results obtained with the experimental model, the prototype, and early production models have fulfilled expectations. The mechanical rigidity and the relative simplicity of operation enables a much greater proportion of successful micrographs to be obtained than on earlier instruments. Inclusion of an objective lens aperture, which increases image contrast, should make the instrument especially useful in biological and metallurgical applications. R.S.P.

A Three Stage Electron Microscope with Stereographic, Dark Field, and Electron Diffraction Capabilities. By M. E. Haine, R. S. Page, and R. G. Garfitt. *J. App. Phys., 21: 173, February, 1950.*

Bubble

The present paper is a more detailed account of a brief note that appeared in 1946 in the Physical Review (69: 538). It describes a spherical shell model of the nucleus which, for high excitations, has far fewer levels than the "liquid drop" or other current nuclear models.

The model takes the form of a thin, hollow, spherical shell that is positively charged like an electrically charged soap bubble. The frequencies of vibration of the shell, which may easily be calculated by the method used long ago by Lord Rayleigh for the vibration of a water drop, depend upon the mass, charge, and radius of the shell. Vibration levels for the shell model are very nearly equally spaced and each has associated with it a set of rotation levels.

Nuclear radii values calculated for this model agree fairly well with the theory of alpha ray disintegration, but are nearly double those given by the target area for fast neutrons. This may be due to the nuclei being transparent for fast neutrons. H.A.W.

The Spherical Shell Nuclear Model. By H. A. Wilson. *Phys. Rev., 77: 516, February 15, 1950.*

Faraday Effect

In 1846 Michael Faraday discovered that any transparent isotropic medium, which in itself may be optically inactive, would rotate the plane of polarization when placed in a magnetic field. The rotation is proportional to the length of the light path through the medium, to the magnetic field strength, and to the cosine of the angle of the light path and the axis of the field.

The proportionality constant, the Verdet Constant V, is multiplied by the molecular weight and divided by the density of the substance investigated, giving rise to a term called the Molecular Verdet Constant, which is nearly temperature independent, and dependent only upon any electronic shifts in molecular structure. It has been shown that simple dipole association such as solvation and hydrogen-bonding where no changes in electronic configuration are involved will not be evident in the magnetic measurements, but the method will show all those involving electronic shifts of any kind. The Faraday Effect is useful, then, in differentiating between the two types of phenomena involved.

This paper gives in detail the construction of an apparatus for the study of the Faraday Effect, attaining as high a precision as possible by taking advantage of modern equipment, surpassing any others in existence today. With this high precision, fundamental studies of the structure of matter are possible. Briefly, the apparatus consists of a large solenoid magnet situated around the sample to be investigated and producing the rotation of the plane polarized light as determined by the polarimetric system. The dispersion of light is produced by a monochromator placed in the light path. The current actuating the magnet is measured and recorded on a Speedomax recorder by means of a calibrated shunt-potential system. An indication is also made on this current record of either a visual or photoelectric determination of the balance point of the light intensity on the two halves of the field of a polarimeter. Thus when a balance of light intensities is reached for a specified value of the rotation angle, a record of rotation versus current (or magnetic field strength) is obtained at exactly the same moment and the process may be repeated for any number of predetermined times to produce the deviation measure we have set for this work.

The Faraday Effect has already proved its usefulness in showing up compound formation in solution and in the qualitative and quantitative identification of substances in solution. C.E.W.

A Precision Faraday Effect Apparatus. By S. Steingiser, G. Rosenblit, R. Custer, and C. E. Waring., *Rev. Sci. Inst., 21: 109, February, 1950.*

Pressure Balance

In physical and chemical work it is often necessary to use moderately high (10 to 100 atm.) pressures that are reproducible and are accurately known. Conventional techniques for pressure measurement—such as mercury manometers and Bourdon gauges—suffer from the fact that they are either unwieldy or difficult to use accurately. However, a simple piston in cylinder pressure balance, where the pressure is determined by the weight of the piston and its area, is a very simple and absolute method for pressure determination. It offers the additional advantage that the rise and fall of the piston compensates for changes in volume of the system, and thus enables reactions to be studied at constant pressure.

Pressure balances are used to very great accuracies and at very high pressures at a number of laboratories—by Michels at Amsterdam, for instance—and a great deal of skill and experience is necessary to design and use a pressure balance of this type. However, a relatively crude instrument was designed and used in some experiments on the melting curve of helium, and it proved very satisfactory, both as a device for melting pressure measurements and for measurements of the change in volume of the helium on solidification.

With a few modifications, there is no reason why this same simple type of instrument could not be used as a laboratory standard for pressures from 10 to 100 atm., and to accuracies of the order of 0.05 percent. The limit of the accuracy, of course, is mainly determined by the amount of work and time spent on constructing and using the instrument, but this figure seems quite easily attainable. C.A.S.

A Simple Pressure Balance. By C. A. Swenson. *Rev. Sci. Inst., 21:22, January, 1950.*

Integrating Counters

A good crystal counter material must possess a low density of traps and must form large single crystals. The low trap density is necessary so that electrons set free in the crystal can travel far enough before being trapped to induce detectable pulses in the external circuit. The alkali halides have not been effective as counters since the high temperatures at which the crystals are grown make for the formation of a large number of lattice vacancy traps. A crystal with vacancies is uncolored but it takes on color when electrons are released from atoms in the crystal and trapped at negative ion vacancies, forming F-centers. This fact suggests the use of the alkali-halides as integrating counters, the color intensity indicating the total amount of radiation to which the crystal has been exposed.

This paper studies the properties of lithium fluoride, potassium bromide, and sodium chloride as integrating counters for x-rays and cathode rays of energies up to 3 Mev. For heavy exposures (more that 10^4 roentgens) the coloration is determined by illuminating the crystal with white light and measuring the absorption by the F-centers. The results are calibration curves giving F-center concentration as a function of exposure for the different crystals.

The main advantages of this type of counter are the small size, semipermanent storage of data, and the very high dosages which can be measured (larger than 10^7 roentgens). The chief drawback is that 5 to 100 minutes are required to prepare a crystal if it is to be used repeatedly. For high exposures some special preparation is necessary to ensure reproducibility of results. E.P. GROSS

Integrating Crystal Detectors for High Energy Photons and Particles. By R. S. Alger. *J. App. Phys. 21:30, January, 1950.*

Light Intensity

In geometrical optics, light is said to travel along rays, but nothing is said about its intensity. Suppose that along any tube of rays the intensity (which is equal to the energy flux density times the cross sectional area) is constant. Then the ratio of energy flux densities at two points along a tube is the reciprocal of the ratio of the corresponding tube areas. These areas can be determined since the rays forming the tube are given by geometrical optics. Thus the ratio of light intensities can also be determined, since light intensity is proportional to energy flux density. In this article the area ratios are calculated