PHYSICS

Chairman: MALCOLM E. HULTS, Physics Department, Ball State University, Muncie, Indiana 47306

TORSTEN ALVAGER, Department of Physics, Indiana State University, Terre Haute, Indiana 47809 was elected Chairman for 1972

ABSTRACTS

Effects of Pressure on Electronic Properties of Bismuth. UWE J. HANSEN Department of Physics, Indiana State University, Terre Haute, Indiana 47809, and ELVIN M. COMPY, US Naval Research Lab, Washington, D.C. 20390.——Experiments which study changes of electronic properties with variation in interatomic spacing are critical in their support of energy band calculations. The research reported here involves the first observation of cyclotron resonance and Alfvén wave propagation in Bismuth under pressures to 3 kilobars (Rev. Sci. Instr. 42:1215). The experiments are carried out at a temperature of 4°Kelvin using a standard 35 GHz bridge circuit. Effective mass decreases of the order of 6 per cent per kilobar are observed.

Photoelectric Photometry of an Eclipsing Binary Star System. RONALD KAITCHUCK and NEWTON G. SPRAGUE, Department of Physics, Ball State University, Muncie, Indiana 47306.——Many of the stars comprising our galaxy are members of a system of two stars in orbit about each other. The vast majority of these systems are far enough from the earth so as to appear only as a single point of light even in the largest of telescopes. However, if the orbital plane is seen edge-wise by an observer on the earth, during some portion of the orbital period an eclipse of one component will cause a drop in the observed light output.

The eclipsing binary system V566 Ophiuchi was studied in detail during the summer of 1971. Data were collected with a photoelectric photometer and the 12-inch Cassegrain telescope of the Ball State University Observatory. A complete light curve was obtained in two different spectral regions. The observations indicate that some event during the last 5 years has caused a change in the orbital period. There is also some indication that the color of the system is not as stable as was previously observed. It is hoped that the light curve will yield information as to the orbital elements. Standardization of the photometer system should yield the surface temperatures of the two stars.

Neutron Activation Cross Sections Using 2.8 MeV Neutrons. DWIGHT E. MICHAEL and LEON M. REYNOLDS, Department of Physics, Ball State University, Muncie, Indiana 47306.——A low-voltage type neutron generator-accelerator producing 2.8 MeV neutrons has been used to study neutron activation cross sections in a number of elements. There is a scarcity of good data in the literature because of the generally small values of these cross sections and special methods are required to increase the number of reactions occurring.

A relative measure of the neutron flux was made using indium standards. The efficiency of the detection system was experimentally measured by the use of standardized radioisotopes.

The product isotopes, produced by (n,γ) or (n,n'γ) reactions, and their measured activation cross section were: ^{116m}In - 104 ± 5mb; ^{137m}Ba - 459 ± 45 mb; ^{139}Ba - 5.48 ± 0.47 mb; ^{128}I - 38.5 ± 3.0 mb; ^{56}Mn - 4.28 ± 0.34 mb; and ^{87m}Sr - 219 ± 26 mb. Errors from 4.8 per cent for ^{116m}In to 12 per cent for ^{87m}Sr were determined.

The Numerical Lathe Fabrication and Theoretical Evaluation of an Electron Lens. JOHN SWEZ and JAMES WESTGARD, Department of Physics, Indiana State University, Terre Haute, Indiana 47809, and LARRY PLEW, Quality Evaluation Section, Crane Naval Ammunition Depot, Crane, Indiana.——The construction of an electron lens similar to that reported by A. V. CREWE (Quart. Rev. Biophys. 3:145) was attempted utilizing a numerical lathe. A computer program (APTURN) developed by the Cincinnati Research Corporation and used to generate control tapes for numerical lathes was modified to accept the equation used to generate the nonspherical surface of the lens. Although the optical properties of such a lens have been evaluated by A. N. Butler (Proc. 6th Int. Congr. for E. M., 1966), a partial evaluation of the optical properties was reported here. Computer calculated parameters were displayed on an oscilloscope interfaced to a PDP 8/I Computer.

Tayex: A Taylor Expansion Equation Solver. JAMES B. WESTGARD and DAVID G. PITTS, Department of Physics, Indiana State University, Terre Haute, Indiana 47809.——A digital computer program was written to implement a method of solving nonlinear simultaneous differential equations. The method was based on the Taylor expansion with an algorithm for finding the coefficients. It is extremely easy to use so that it should be useful in giving students confidence in being able to handle differential equations as they appear in course work. It will be especially useful for Lagrangian mechanics.

D-17B Minuteman Missile Computer Interfacing. C. T. WUNKER and P. R. ERRINGTON, Department of Physics, Ball State University, Muncie, Indiana 47306.——Ball State University has recently acquired via government excess property a type D-17B Minuteman missile guidance control computer. Hundreds of these mini-computers are being made available to colleges and universities throughout the United States. These computers, as received from the government, do not have usable input and output interfacing. To be useful as a teaching or research computer, interfacing must be designed and constructed. The computers and the interfacing now in use at Ball State University were described.

Growth of Single Crystals of Alkali Niobates. D. L. DEMOSS and C. C. SARTAIN, Department of Physics, Indiana State University, Terre Haute, Indiana 47809.——Single Crystals of lithium niobate and potassium niobate were grown from compounds made by solid state diffraction of the alkali carbonate with Nb_2O_5. The compounds were melted and single crystals were pulled from the melt. Many experimental problems such

as phase separation of the melt and cracking of the crystal on cooling through its Curie temperature arose in our study. Our solution to these problems was discussed.

A Critical Study of the Various Factors Limiting Resolution in Solid State Detectors. K. E. WRIGHT and C. C. SARTAIN, Department of Physics, Indiana State University, Terre Haute, Indiana 47809.——A measurement of the intrinsic Fano factor for a particular Si (Li) detector was necessary to compare with theory. The Fano factor is defined as $<(N-\overline{N})^2> = F\,\overline{N}$, where N, $(\overline{N})$ is the (average) number of produced ionized pairs; $\overline{N} = E/\epsilon$, where E is the initial energy of the ionizing particle. The value of the intrinsic Fano factor was determined from the relation $\gamma^2 = \gamma^2_{ion} + \gamma^2_{col} + \gamma^2_{noise}$ and by linear extrapolation of γ^2 for the infinite field strength from the dependence of γ^2 on the reciprocal detector voltage. This measured value of the intrinsic Fano factor will ultimately determine whether or not carbon x-rays (277 ev) can be detected. The Si (Li) detector will provide chemical analysis composition when coupled to an scanning electron microscope.

Calculus Without Differentials. PHILLIP S. MARCUS, Department of Mathematics, Indiana University at South Bend, South Bend, Indiana.——The differential notation of Leibniz has recently been superceded in popularity among mathematicians by the dot-prime notation of Newton and LaGrange, and the abstract operator D notation of Cauchy. Leibniz differentials are still used in integral calculus. Karl Menger showed that differentials can be replaced by the unbelievably simple device of giving an explicit symbol—j—to the identity function. Examples were given of definite and indefinite integrals and seperable differentiable equations which were usually integrated by manipulation of differentials, but the usual manipulation of differentials was replaced by Menger's improved notation for substitution of functions.

NOTE

Neutron Activation Analysis of a Metal Button from the Site of Fort Harrison. TORSTEN K. E. ALVAGER and RALPH A. LLEWELLYN, Department of Physics, and ROBERT E. PACE, Department of Anthropology, Indiana State University, Terre Haute, Indiana 47809.——Among the artifacts recovered by the archeologists from the apparent site of the Fort Harrison Cemetery were 7 metal buttons. Severe corrosion had destroyed those features that might otherwise reveal unit, rank, and date of manufacture. With the view of searching old metal specification records, the metallic composition of the best preserved of the buttons was examined by the non-destructive technique of neutron activation analysis. Preliminary analysis using the ISU 2-curie Pu-Be neutron source indicated that more complete examination would be of interest. The detailed analysis was performed by irradiating the button for 48 hours in the General Atomics 10-curie Pu-Be neutron source in San Diego, California. Following irradiation, the gamma-ray activity produced was analyzed using a 36 cc Ge (Li) detector and a 4096 channel analyzer.

On the basis of the observed gamma-ray energies, the elements positively identified as being present in the button are: Cu, Zn, Au, and As. It is estimated that copper makes up 89 per cent of the button, zinc and arsenic a few per cent each, and gold less than 1 per cent. What appear to be gold flecks are visible on the surface of the button, indicating that the gold may have been used as a plating or gilting. The button seems to be constructed in layers with zinc overlying a copper base. This observation together with the relatively higher copper content indicates the button was probably not made of alloyed copper and zinc (brass). Tests are currently underway using an electron microprobe to "map" the distribution of metals in the button in order to obtain additional composition details.

The presence of arsenic is not particularly surprising, but the relatively large amount, perhaps as much as 5-7 per cent, is. Arsenic occurs with copper in some ores, and it may be that the high arsenic percentage could serve to identify either the source of the ore or the refining process. While no investigation along these lines has as yet been started, a preliminary search of old metal specification records has been conducted. Unfortunately, no satisfactorily close match has been found; thus, at this writing we are not able to positively identify the button analyzed as being associated with Fort Harrison. However, the examination is continuing and may lead to additional results later.

OTHER PAPER READ

The Decay of 71As. A. E. RAINIS and J. R. VAN HISE, Department of Physics, Tri-State College, Angola, Indiana.