Electronic Structure Calculation of Icosahedral B-12

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The "Heavy Air" Illusion: Fun with Archimedes' Principle, C. W. Wilson III and R. D. Burcan, Univ. of Akron.--We recently conceived and built a simple apparatus which demonstrates Archimedes' Principle. It consists of a lab balance (scale) plus a nearby lab stand which supports some copper tubing. Pan A of the balance holds a large (4-liter) glass beaker, containing water; this is balanced by metal weights placed on Pan B. One end of the copper tubing, to which a toy rubber balloon is attached, extends beneath the water surface of the large beaker (without, however, touching the beaker); to the other end of the copper tubing is attached a rubber hose, through which air can be blown to inflate the submerged balloon. Initially, an excess 200 g weight is placed on Pan B. By blowing air into the balloon, the scale can again be balanced. The illusion is that 200 g of air has been added to the balloon by puffing a few breaths into it. The correct explanation involves Archimedes' Principle. Some students rightly conclude that the lab stand and copper tubing play a more crucial role than at first suspected. A demonstration will be given.

A Pictorial Representation of Electric Potential Developed Using Batteries and Bulbs, C. F. Griffin, Univ. of Akron.--Many students have difficulty with the formal concept of electric potential difference. Even students with a BS or MS in physics often cannot predict relative bulb brightnesses in battery and bulb circuits because of this difficulty. A pictorial representation of electric potential has been developed for students interested in electricity via batteries and bulbs in an elementary physics course. The presentation will include: (1) justification for the model and (2) the model and examples of its use.

Reaction Time in Sports. David F. Griffin, Miami University.--Whether an athlete is competitive may be determined by his reaction time, the time separating response from stimulus. Depending on the sport, a number of factors contribute to reaction time. Among others, factors such as anticipation and the methods employed to measure the stimulus and response times will be discussed. Applications in sprinting, swimming, ice hockey, golf, baseball, and drag racing are included.

SESSION D: CONTRIBUTED PAPERS
Saturday morning, 12 May 1979
Room 1108, Cawshwe Hall at 8:00 A.M.
Richard A. Titon, presiding.

Polymer Chain Microstructure of Polyvinylidene Fluoride (PVF2) by 19F NMR. C. W. Wilson III and F. T. Lin, Univ. of Akron.--Earlier (1965) high-resolution 19F NMR studies of PVF2 by Wilson and Saneei at 56 MHz interpreted polymer microstructure near "backwards," or head-to-head, monomer additions in terms of 5-carbon sequences along the polymer chains (equivalent to triads of monomer units). Recent studies at 282 MHz, particularly those utilizing FT techniques, have resolved numerous new spectral peaks in addition to the 4 (or 5) peaks identified previously by Wilson, et al. These have been collated by improved solvent systems at various sample temperatures. In most cases, interpretation is possible in terms of 9-carbon sequences (pentads of monomer units) although in a few special instances 11- or 13-carbon sequences (hexads or heptads) can be determined. The assignment of these sequences with each of these new peaks has been identified, and quantitative measurements of spectral intensities have been made. It now appears that all observed spectral peaks can be explained by various sequences of "normal" plus "backwards" monomer units in the PVF2 chains; there is no evidence of chain-branching from the 282 MHz 19F NMR spectra.


Induction Spectrometer Powder Patterns: Zeeman Nuclear Quadrupole Resonance. R. B. Creel and S. S. Dennion, Univ. of Akron and H. R. Brooker and D. E. Rio, Univ. of South Florida.--Modified Bloch equations and solutions were derived for the combined nuclear quadrupole + Zeeman interaction. These solutions, an extension of the theory by Bloom, et al., allow for complex matrix elements which appear for arbitrary orientations of magnetic field and coil arrangement with respect to quadrupole axes. The solutions give the nuclear magnetization as a function of time for a particular transition. The theory was applied to derive induction spectrometer powder patterns for I = 3/2, with finite asymmetry parameter, treating the magnetic interaction as a perturbation on the quadrupole interaction.

Reaction Time in Sports. David F. Griffin, Miami University.--Whether an athlete is competitive may be determined by his reaction time, the time separating response from stimulus. Depending on the sport, a number of factors contribute to reaction time. Among others, factors such as anticipation and the methods employed to measure the stimulus and response times will be discussed. Applications in sprinting, swimming, ice hockey, golf, baseball, and drag racing are included.
boron. Comparison is also made to the early molecular-orbital calculations of Longuet-Higgins and Roberts for this cluster.

*Supported by NASA-Lewis Research Center under grant NSG 3240.

D6 A Modified Classical Vortex. JAMES R. CLOW, Miami University. A discussion of a simple vortex model is presented. Such a model applied to superfluid helium leads to an unusual result: zero net circulation; with non-zero curl, and quantized energy and angular momentum. A short discussion is presented concerning whether the model is a physical one.

D7 TDPAC as a Technique for Evaluation of Crystal Quality for Ferromagnetic Compounds. JOSEPH W. NERENK and GLENN M. JULIAN, Miami U., (Ohio), S. JHA*, U. of Cincinnati, JAMES W. BLUE and DAVID C. LIU, NASA-Lewis Research Center. -- Time Differential Perturbed Angular Correlation (TDPAC) can be used to measure the hyperfine magnetic field (hmf) at the site of a radioactive probe nucleus which emits gamma rays $\gamma_1$ and $\gamma_2$ in cascade. The hmf at each site in a ferromagnetic compound is determined by the crystal structure; imperfection produces a distribution of hmf values. The more perfect the crystal, therefore, the more unique the prescission frequency of TDPAC probe nuclei in the crystal. Because of the penetrating power of the $\gamma$ rays, this technique of evaluating crystal quality may be used where more conventional techniques are not usable, e.g. deep in thick single crystals. This technique is illustrated with Heusler alloy Co$_2$MnSn ($T_c=830^\circ$K); the constituent elements can give numerous ferromagnetic impurities. The hmf at Cd-111 probe at Sn site is measured as $175 \pm 6$ kG at 293K and $183 \pm 3$ kG at 77K. For comparison, x-ray powder diffraction spectra are correlated with TDPAC spectra, and with Mössbauer spectra, which give the hmf of $114 \pm 5$ kG at Sn-119 in Co$_2$MnSn absorber at 293K.

*Supported by NASA Grant NSG 3091.

D8 Measurements of Coefficients of Thermo Expansion for High Temperature Polymers*. F. L. Bouquet, W. A. Edmiston and W. M. Rowe**, Jet Propulsion Laboratory, C.I.T., Pasadena, CA 91109. Measurements of the thermal coefficient of expansion have been made over a large temperature range, $-200^\circ$C to $+200^\circ$C, for five high temperature, thin film polymers. The materials tested were (a) fiberglass, (b) Teflon, (c) Kapton, (d) Kapton H and (e) Teflon. In addition, the mechanical properties of elastic moduli, Poisson's ratio, and the stress-strain behavior up to failure were measured. These data are directed toward prediction of failures for solar cell arrays for both space and terrestrial applications.

*Work supported by NASA
**Submitted by F. L. Bouquet


Measurements have been performed on ultra-thin high-temperature polymeric films for use in space. Thicknesses were measured on laboratory samples as well as production rolls, for both metallized and uncoated films. Polymer thicknesses from 0.05 ml (1.2µm) to 0.3 ml (7.62µm) were measured by various techniques. The film variations for the different methods will be presented.

*Research supported by NASA
**Submitted by F. L. Bouquet

SESSION E: CONTRIBUTED PAPERS
Saturday morning, 12 May 1979
Room 1104, Cushing Hall at 9:00 A.M.
William E. Wells, presiding

F1 A New Look at $A$, $B$, $Q$, and $O$-meson system. S. ONEDA, University of Maryland, and J. S. RNO, University of Cincinnati.--In this paper we study the asymptotic SU(3) and the chiral SU(3) x SU(3) charge algebras to answer the following questions: (i) Can one predict the $Q$-$Q$ relations for $Q_1$ and $Q_0$? (ii) Can one derive the $Q_0$-$Q_1$ mixing angle in terms of observable masses? (iii) Can one explain the observed decoupling of $Q_0$ from the $K^*$ mode and of $Q_1$ from the $k$ and $u$ mode? (iv) What is implied for the parameters of elusive $A$, resonance from the data of the $Q_0$-$Q_1$ system? Our predictions are in good agreement with experiments.

SESSION F: CONTRIBUTED PAPERS
Saturday morning, 12 May 1979
Room 1103, Cushing Hall at 9:00 A.M.
Ronald G. Tabak, presiding

F2 Construction of a Thermal Density Matrix For a Scalar Field Near the Big Bang. B.K. BERGER, Oakland U. ---Although procedures for constructing complete sets of states for a quantized scalar field in a classical background universe are well-known, a reasonable choice for the actual state of the field near the cosmological singularity remains arbitrary. Here Hawking’s Random-metric Principle is used to construct a plausible initial density matrix for the field. It is first shown that a coherent state representation most closely follows the classical behavior near the singularity. For each mode of the field, the coherent state is characterized by a complex number $\lambda$ which may take any value. The choice of initial conditions thus reduces to a selection of preferred $\lambda$’s. (0 is the vacuum state.) An ignorance of actual conditions near the singularity is reflected then by choosing for each mode a random distribution in $\lambda$ to yield a thermal density matrix rather than a pure state.

*Supported by an Oakland University Faculty Research Fellowship.

F3 Derivation of the Velocity-Dependent Mass Formula for a Particle. DAVID S. MOOT, Kent State University--Jackson--gives a derivation of the well-known velocity-dependent mass formula for two colliding, identical particles for the special case in which the angle $\theta$ between the directions of the velocities of the particles in the center-of-mass system before and after collision is very small. He uses the laws of conservation of energy and momentum and the Lorentz transformation properties of the four momentum in his derivation. With the help of the same conservation laws, the Lorentz transformation properties of the four momentum and the relationships between various Lorentz contraction factors ($\gamma$'s) which involve $\theta$, we have derived the same velocity dependent mass formula, $m(v) = \sqrt{m^2 - (v/c)^2}$ for any angle $\theta$.


F4 Photographic and Visual Observations of the Feb. 26, 1979 Total Solar Eclipse. W. STEVE COLLIER, DAHN HOOKE, JAMES W. SEUBERT, MARVIN D. KEMPLE, and F. W. KLEINHANS, Indiana Univ.-Purdue Univ. at Indiana-polis. --Results of the IUPUI Eclipse Expedition to Arborg, Manitoba will be presented. Photographically excellent color shots were obtained using 200-1200 mm focal length lens and ASA 64-400 films. Extensive prominence detail, polar plumes, and a large coronal loop are visible. Using a Nikon R10 at 70 mm f.1 with Kodachrome 40, polar plumes were demonstrated and the second diamond ring captured. Visually, promineces and coronal detail were of course detected, but the shadow cone and shadow bands were not seen.

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