JB17. AFMR in MnO From NMR Observations. B. D. GUENTHER, C. D. CHRISTENSEN, and A. C. DANIEL, *Redstone Arsenal*—The field dependence of two nuclear resonance frequencies of Mn^{55} in antiferromagnetic MnO have been observed from 0 to 57 kOe at 4.2 K. The lower frequency resonance has a large frequency pulling suggesting that an AFMR exists at a frequency well below the AFMR observed in the far infrared. This low frequency AFMR is probably due to the small in-plane anisotrophy in MnO. The field dependence of these lines suggest that weak ferromagnetism may be present in MnO. Structure in the lower frequency NMR line has been associated with T domains in MnO.

Session JC

SATURDAY MORNING AT 8:30

Room 243

(S. S. PRASAD, presiding)

Gravity, Relativity, Plasmas and Atmospheric Physics

JC1. Absolute Gravity Measurement Apparatus. O. K. HUDSON, *Marshall Space Flight Center, Huntsville, Alabama*—A novel method for the measurement of absolute gravity by a free fall apparatus based on a laser interferometer is described. Both theoretical and experimental results will be presented. Extraordinary accuracy and precision seem possible.

JC2. Measurement of the Gravitational Constant G.* R. D. ROSE, H. M. PARKER, R. A. LOWRY, and J. W. BEAMS, *University of Virginia*—Preliminary measurements of the Newton gravitational constant G give a value of $G = (6.674 \pm .012) \times 10^{-11}\ N\,m^2/Kg^2$ where .012 is 3 standard deviations. The method[1] consists in experimentally measuring the constant angular acceleration of a small quartz fiber supported cylindrical rod due to a constant torque produced by the gravitational pull of two 10.16 cm diam. tungsten spheres. The two spheres are symmetrically mounted on a rotary table in such a way that their centers lie on a line passing through the axis of rotation and the center of the suspended cylinder. The cylinder is suspended at its center by a quartz fiber which hangs in the axis of rotation and is fastened to the top of a gas tight chamber mounted on the rotary table. The angle $\theta \cong 45°$ between the line of centers of the spheres and the axis of the cylinder is maintained constant by a servo-system which drives the rotary table. Refinements in the technique should further increase the accuracy by at least one and probably two orders of magnitude.

* Work supported by a grant from NASA.
[1] J. W. Beams, A. R. Kuhlthau, R. A. Lowry, and H. M. Parker, Bull. Am. Phys. Soc. II, *10*, 249 (1965).

JC3. Spatial Diffusion of Gravitationally Orbiting Particles. G. A. OTTEN and ROBERT W. FLYNN, *University of South Florida*—We consider an ensemble of particles orbiting in a central force field and subjected to a weak randomly fluctuating non-central force. Under some circumstances a Fokker-Planck equation describes the evolution of the ensemble averaged distribution function and in some physical situations strong resonant diffusion may occur. Applicability of this model to the problem of Kirkwood Gaps is discussed.

JC4. Some Solutions to the Current Carrying Solenoid in General Relativity. J. L. SAFKO, *University of South Carolina*—The relativistic analogue of an infinite solenoid current with an internal axial magnetic field and no external "leakage" field is solved using the Rainich Already Unified Field Theory.[1] Such solenoids must in principle be of finite thickness. A modified form of the Marder[2] metric is used to consider some explicit examples of current distribution.

[1] Written, L.; In *Gravitation: An Introduction to Current Research*, ed. L. Witten, Wiley: New York (1962).
[2] Marder, L.; Proc. Roy. Soc. (London) *A244*, 524 (1958).

JC5. A Rigorous Solution of Einstein's Field Equations for a Multi-Particle Positive and Negative Mass Static Distribution. T. L. FERRELL, *Maryville College*—A mass distribution is considered that is basically composed of two positive masses situated symmetrically on either side of a negative mass. Appropriate choice of the magnitude of the central mass guarantees a static distribution. Axial symmetry allows use of the Weyl metric in finding a rigorous solution of Einstein's Field Equations in General Relativity Theory.

JC6. Stopping Power of Matter for Deuterons at Extreme Relativistic Energies.* R. B. VORA† and J. E. TURNER, *Oak Ridge National Laboratory*—The stopping power of matter for deuterons at extreme relativistic energies ($\leq$2000 GeV) has been calculated. The structure and spin of the particle are taken explicitly into account. The ultrarelativistic effects reduce the stopping power by about 8% at the highest energies considered. These effects are analyzed numerically as a function of energy and compared with the density correction. A stopping power table for deuterons in aluminum is presented.

* Research sponsored in part by the U. S. Atomic Energy Commission under contract with Union Carbide Corp.
† World Health Organization Fellow, Permanent Address: Directorate of Radiation Protection, Bhabha Atomic Research Centre, Bombay-74, India.

JC7. The Motional Electric Field Generator. W. J. HOOPER, *Principia Coll.**—This invention generates a motional electric field in the space surrounding it which is not electrostatic nor magnetic. The exciting property of this field is its apparent immunity to shielding. These three properties shared in common with the gravitational field make it unique, and suggests its possible kinship. This device holds promise of affording instrumentation for directly measuring electron drift velocities in metals as well as experimentally determining the number of conduction electrons available at various temperatures; thus affording an experimental method of investigation into the realm dealt with by the Fermi-Dirac statistics. Theoretically, this device holds exciting possibilities of utility at very low temperatures. If sufficiently intense fields can be obtained by the use of superconducting materials in our generator at low temperatures, the phenomenon of attraction and polarization of materials by this field can be studied. This would immediately bring into the realm of possible experimental demonstration such effects as weightlessness, artificial gravity, and anti-gravitational effects.

* Prof. Emeritus. Currently, Director of Research, Electrodynamic Gravity, Inc., Sarasota, Florida.

JC8. Dispersion of Surface Plasmons in Dielectric-Metal Coatings on Concave Diffraction Gratings.* JAMES J. COWAN† and E. T. ARAKAWA, *Oak Ridge National Laboratory*—Recently, anomalies in the intensity of p-polarized light from concave diffraction gratings have been analyzed in terms of a photon-surface plasmon interaction in layers of Al and layers of Au on the grating surface.[1] This work has been extended to include MgF_2, Al_2O_3, and diffusion pump oil layers on an Al substrate in the wavelength region from the visible to the vacuum-uv (7500—500Å). Surface plasmon dispersion curves including retardation have been obtained for dielectric-metal layers which compare favorably with the experimental results. Also considered are some aspects of the reflected and off-blaze first-order spectrum.

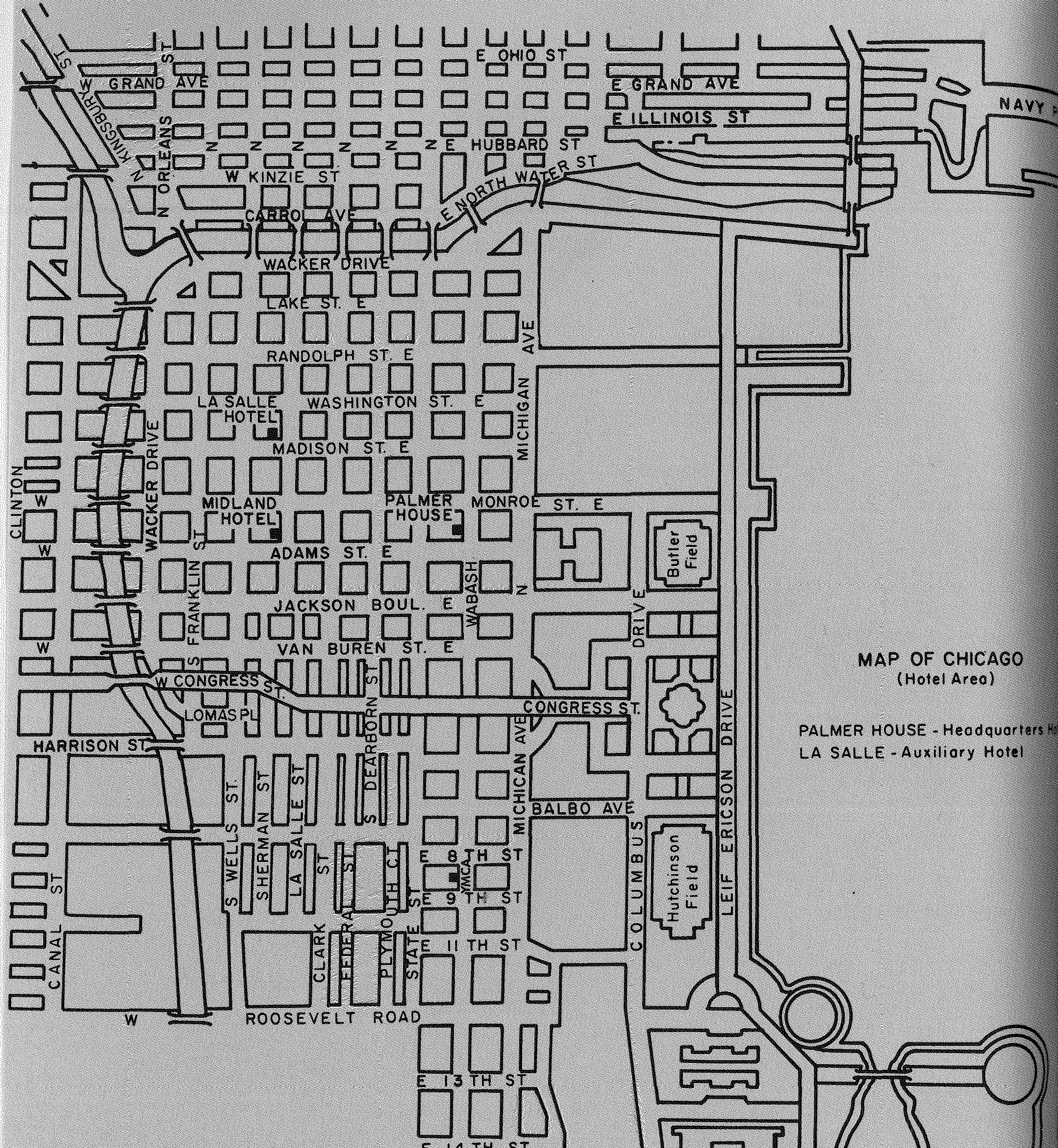
* Research sponsored by the U. S. Atomic Energy Commission under contract with Union Carbide Corporation.
† Radiological Health Physics Fellow, Univ. of Tennessee.
[1] R. H. Ritchie, E. T. Arakawa, J. J. Cowan, and R. N. Hamm, Phys. Rev. Letters *21*, 1530 (1968).

JC9. Plasma in a Short, Vacuum, Spark Gap.* F. C. TODD,† *University of Alabama in Huntsville*—From the use of a short spark gap to calibrate devices to study plasmas in a vacuum, the mean conditions in the spark plasma are also clarified. The spark was about a mm in length and was between partially rounded electrodes of spectroscopically pure aluminum. Measurements were made of the far ultraviolet spectrum, of the light emission in the visible and in the ultraviolet[1] and of the initial velocity of the metastable atoms and ions. These measurements were compared with an analytical solution for an expanding sphere of plasma,[2] which assumed LTE. It is found that the ultraviolet radiation escapes from the plasma with little disturbance. LTE may then be assumed for the analytical treatment of the early stages of plasma formation. Expansion continues in the later stages with turbulence.

* Supported by NASA through Marshall Space Center.
† Formerly at Oklahoma State University.
[1] V. D. Brown and F. C. Todd, Bull. APS *13*, 1704 (1968).
[2] R. E. Bruce and F. C. Todd, Bull. APS *14*, 106 (1969).

JC10. Quadrupole Mass Filter Analysis of Laser Induced Aluminum Plasmas.* H. WAYNE WILLIS† and F. C. TODD,† *University of Alabama in Huntsville*—A quadrupole mass filter was designed to determine the characteristics of dense, transient, aluminum plasmas. Such a plasma is produced from the incidence of the giant pulse from a laser on an aluminum plate in a vacuum. Time of flight measurements with the quadrupole indicate maximum ion velocities of the order of 10^7 cm/sec. If this velocity were random and this was the peak of a Maxwellian distribution of velocities, the equivalent Boltzmann temperature would be of the order of 10^7 K. The electron-multiplier detector for the quadrupole system gives the uv light emission from the plasma as approximately 2 microseconds. This time is significant as indicating the time for the uv to escape from the plasma. The data includes the uv light, Al ions and metastable Al atoms.

* Supported by NASA through Marshall Space Center.
† Formerly at Oklahoma State University.
[1] W. G. Robinson, Paper at this meeting.



MAP OF CHICAGO
(Hotel Area)

PALMER HOUSE - Headquarters Hotel
LA SALLE - Auxiliary Hotel

bulletin

OF THE AMERICAN PHYSICAL SOCIETY

FEBRUARY 1970

BULLETIN OF THE AMERICAN PHYSICAL SOCIETY

The BULLETIN of The American Physical Society is published 13 times a year (monthly except twice in December) at Prince and Lemon Streets, Lancaster, Pa. 17604. Correspondence should be addressed to The American Physical Society, 335 East 45 Street, New York, N. Y. 10017

Subscription price: Domestic: \$12.00 per year: Foreign: \$13.50 per year
Back-number prices: \$8 for the Membership List: \$2 for other issues

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BULLETIN OF THE AMERICAN PHYSICAL SOCIETY

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