WEDNESDAY MORNING, 24 APRIL 1968 ARLINGTON ROOM AT 9:00 A.M.

(T. FULTON presiding)

Theoretical Physics III

GJ1. Generalization of Relativistic Theories. M. Z. v. KRZYWOBLOCKI, *Michigan State University.*—There are more than 1 unsolved dilemmas in the theory of relativity. Is the general theory of relativity a theory of relativity or a theory of gravitation? Does the theory of relativity, in particular the general 1, belong to physics or to mathematics, applied at least? Do those who work in the theory of relativity do so because of its mathematical beauty rather than to make statements which could or could not be verified by experiments? Is the Mach principle 1 of the fundamentals of the general theory of relativity or its boundary conditions? What one should use: Mach principle or its generalization, energy principle? Is it justifiable to generalize theories of relativity to regions where the speed of light is effected by a gravitational field? The author presents some remarks particularly on the latter problems, with a special reference to the relativistic hydrodynamics.

GJ2. Inconsistency of Special Relativity. SUSUMU ISHIWATA, *Fairleigh Dickinson University.*—The invariance of interval is 1 of the hypotheses in the special relativity. Mathematically speaking, it is a perfectly consistent generalization. However, it has not been realized that the hypothesis is physically incompatible with the concept of 4-dimensional continuum, except when the interval vanishes; that is, except when the Lorentz transformation is applied to the light. A thorough examination of this limitation in the applicability of the Lorentz transformation discloses a crucial fact that, should the limitation be overlooked and the Lorentz transformation be applied to others than the light as in the special relativity, there no longer exists non-0 relative velocity v that satisfies Einstein's symmetry requirement, $k(v) = k(-v)$, in 4-dimensional space. Once these facts are fully understood, it cannot be denied that the special relativity is physically inconsistent and various experimental results, which have been considered to prove the correctness of the theory, have nothing to do with it. For, there is absolutely no relationship between the relative velocity the experimentalists consider in practical measurements and the relative velocity in the special relativity, the existence of which has just been denied.

GJ3. A Scalar Theory of Gravitation Compatible with Observations. J. P. WESLEY, *University of Missouri at Rolla.*—To predict the motion of a particle moving in the presence of stationary masses Newtonian theory is modified to include the special-relativistic mass equivalence of the gravitational potential energy. The gravitational red shift, the gravitational deflection of a light ray, and the precession of the perihelion of Mercury are correctly predicted. In addition, the cosmological red shift is predicted to within the correct order of magnitude for a nonexpanding universe without any additional assumptions. No singularities (such as the Schwarzchild singularity) occur, so that large mass concentrations (such as are apparently needed to explain the observations of quasars) may be postulated.

GJ4. Gravitational Coupling of Negative Matter. D. PEAK (introduced by A. Inomata) and A. INOMATA, *State University of New York at Albany.*—There would be no doubt about the universal coupling of positive matter to the gravitational field. If negative mass exists, it is conceivable that the sign of its gravitational coupling is opposite to that of positive mass.[1] To support this, a model universe with the Dirac source is considered, in which the negative mass field corresponds to the negative ener[gy] state. The source field considered distributes uniforml[y] with a constant energy density, confining the universe to be of positive constant curvature.[2] Einstein's field equa[tion] then dictates that the energy density multiplied by the co[u]pling constant must remain positive definite. As a resu[lt] the negative energy source requires the negative gravita[]tional coupling and so does the negative matter in this model. The equivalence principle would perhaps genera[lize] the negative coupling to all negative sources. This resu[lt] seems to indicate that the extra-ordinary motion of the positive mass chased by the negative is not possible.

[1]S. Deser and F. A. E. Pirani, Ann. Phys. (N. Y.) 43, 436 (1967).
[2]A. Inomata, Nuovo Cimento 46, 132 (1966).

GJ5. Significance of Measuring the Gravitational to In[]ertial Mass Ratio of Massive Bodies. K. NORDTVEDT, *Montana State University.*—Several experiments to mea[]sure the m_g/m_i ratio of astronomical bodies are sugges[ted]. It is shown that such measurements would test gravitati[onal] theories in a manner different from all past gravitational experiments. The significance of m_g/m_i measurements [of] massive bodies for the scalar–tensor theory of Brans a[nd] Dicke are discussed.

GJ6. Neutron–Proton Mass Difference by an *S*-Matri[x] Method. LANCE HEIKO, *Tech. Ops., Inc., Burlington.*—[The] neutron–proton mass difference is treated as a problem [of] symmetry-breaking in the reciprocal bootstrap. The nu[cleon] is considered a bound state in the coupled π-N and γ-N c[han]nels. A static, cutoff-dependent perturbation theory is u[sed].

GJ7. Determination of Large Angular Momentum Part[ial] Wave Amplitudes. ARTHUR W. MARTIN, *Rutgers—The State University.*—The general assumption of the validit[y of] the Mandelstam representation is shown to lead to preci[se] predictions for large angular momentum partial-wave a[m]plitudes. The real parts of the amplitudes are determin[ed] in the elastic and some of the inelastic region simply in terms of the crossed-channel scattering lengths. The im[ag]inary parts are determined everywhere in the physical [re]gion. One application is the question of whether models, such as the Regge-pole model, are consistent with the M[an]delstam representation. This question will be comment[ed] upon. Another application concerns the experimental ver[i]fication or rejection of the Mandelstam representation.

GJ8. Low-Energy Theorems for Pion Nucleon Scatter[ing] and Photopion Production.* KUNIO YAMAMOTO (introd[uced] by A. P. Balachandran), *Syracuse University.*—Assumin[g] the Lorentz and parity invariances, crossing symmetry, [] change independence, and the analytic properties of the s[cat]tering amplitude, we derive the sum rule

$$a_{0+}^{(+)}/2M + 2M[a_{1-}^{(+)} - a_{1+}^{(+)}] = -g^2/(4\pi M\mu)$$

to hold within the error of $0(\mu)$, where a is the scatteri[ng] length for pion nucleon scattering in standard notation. [The] experimental values of the right- and left-hand sides ar[e] -2.19 and -2.60 in pion mass unit, respectively. Assu[ming] further gauge invariance besides the assumption stated