tions we need. Therefore the only thing we have to do is to form the geodesic equations and calculate the motions of particles. It is further found[6] that one has

$$D_\nu t^\nu_\mu = \sigma \partial_\mu g_{\alpha\beta} u^\alpha \mu^\beta / 2$$

which is σ times the right hand side of the geodesic equations. This completes the field-theory interpretation because the equations of motion can now be written,

$$\sigma du_\mu / ds = D_\nu t_\mu{}^\nu,$$

exactly as in field theory. The whole process is generally covariant because the equations are kept, at every stage, form-invariant, that is, coordinate-independent.

The net result of this simple theory of gravitation is that the structure of the space-time physics is turned into a standard field theory of spin-2 particles, although in a space curved partly by its own stress-energy. Several of its desirable features are worthy of special notice. We mention below a few that are easily provable on the simple static metric:

▶ A particle with zero rest-mass has a unique signal velocity $v = V = v_g = c(x) = ce^{-2\phi}$ for *all* wave lengths;[7] v, V, v_g being the particle, phase, and group velocities. This allows a unique operational procedure of space–time measurements for both waves and particles.

▶ With $\phi \rightarrow \phi - \phi'$ the metric is scaled but the scaled metric is still a solution of the original field equations. Thus $x \rightarrow x'$, where x' is the point of observation, leads to a "local" Lorentz metric $g_{\mu\nu} \rightarrow \eta_{\mu\nu}, c(x) \rightarrow c$, although the frame is still non-inertial (not freely falling). Thus in this theory the *observed* value of the velocity of light is always c as in special relativity.

▶ For a particle with nonzero rest-mass $v = v_g, vV = c^2(x) \rightarrow c^2$, also as in special relativity. This permits a generalization of quantum mechanics of particles from flat to curved space–times and thereby allows a detailed analysis of some quantum gravity experiments.[7]

▶ With gauge $c(x) \rightarrow c$, the $t_\mu{}^\nu$ turns out to be a true tensor, not eliminable with any coordinate transformation consistent with that gauge, and reduces *exactly* to the Newtonian field stress–energy of a static gravitational field.

▶ In the strong field limit the theory does not possess an event horizon[4] and does not lead to black-hole behavior as can also be seen from the refractive index analogy $n = e^{2\phi}$. Radially directed light will always escape (redshifted).

It is clear that the theory displays a compelling simplicity and promise and is close to Einstein's original direction of formulating the geometric theory in close correspondence with special relativity. The theory is compatible with a strong principle of equivalence, the wave–particle duality of quantum mechanics ($v = v_g \leftrightarrow$probability postulate), the symmetry of space–time variables, gauge theory, operational procedure of space–time measurements and a local field-theory interpretation of space–time geometry. Due to these a synthesis of space–time with quantum mechanics seems to be possible. The conventional theory is 65 years old and still it has not yielded to such a synthesis.

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6/81

Radio interferometry

Search and Discovery in March (page 21) contains a nice discussion of transcontinental radio interferometry. However, the statement that "No other astronomical technique—existing or proposed—can come within two orders of magnitude of such resolving power" (that is, a fraction of a milli-arcsecond) is not true.

In March 1981, I attended a conference sponsored by the European Southern Observatory on "The Scientific Importance of High Angular Resolution Observations in Optical and Infrared Astronomy." It is clear that the Europeans and, to a lesser extent, the Americans are now achieving high angular resolutions at infrared and optical wavelengths. A 4000-km radio interferometer operating at 1-cm wavelength has the same resolving power as a 400-m optical interferometer at 1 μm wavelength. A French group is currently using a 35-m optical interferometer and has measured double star separations and stellar angular diameters at the 1 milli-arcsecond level. They are now constructing a new interferometer with 10 times this baseline that may produce fringes within a year or two. Various other groups are considering construction of optical interferometers with comparable baselines. There is even a Swedish effort, funded already, I believe, by their equivalent of our NSF, to build a very long baseline intensity interferometer—basically a modern version of Hanbury-Brown's pioneering instrument. With 100-km baselines micro-arcsecond resolutions are possible, in principle.

Finally with the maiden voyage of the Space Shuttle, now history, it would be remiss not to mention the possibility of optical interferometry from space. Contrary to the statement at the very end of the Search and Discovery article that "Transcontinental radio interferometry is the only technique that can resolve [the cores of quasars and radio galaxies] in the foreseeable future," space interferometers could do the job quite nicely using Shuttle-compatible instrumentation.

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Copyright Act

For physicists, the most important consequence of the Copyright Act is the effect it will have on the transfer of scientific information from author to user. For this reason, we believe that the position advocated by H. William Koch, director of the American Institute of Physics, in his Guest Comment (November 1980, page 9), is not in the best interest of physicists. Koch's views best represent the interests of publishers.

Sections 107 and 108 of the 1976 Copyright Act contain two important limitations on the rights of copyright owners, limitations which facilitate access to published information for scholarly purposes. Section 107, for instance, allows a research worker to make a single copy of a journal article for his own use. CONTU (Commission on New Technological Uses of Copyrighted Works) guidelines relating to Section 108 (g) (2) provide for interlibrary photocopying of up to five articles within a calendar year per periodical title published within the preceding 5 years. This "rule of five" has resulted in (1) unreasonable record-keeping costs and (2) frequent delays to researchers in need of vital references. The records of academic and government libraries demonstrate that, for a given periodical, the annual limit of five copies is seldom reached (only in 1-2% of the cases) and, when it is, it is rarely reached again in the following year. Hence, contrary to Koch's assertion, requests for photocopying are not being made in lieu of journal acquisitions, nor are librarians "severely limiting" the photocopying services to comply with fair use.