Singularities in Gravitational Theory

I. L. Zhogin *

Abstract

One may guess that the problem of singularities of solutions in generally covariant theories is a local one, so a local and covariant approach should be developed to deal with the problem. In this paper, in addition to General Relativity (GR) and R^2 equations, the second order compatible equations of Absolute Parallelism (ie, AP-covariant systems of partial differential equations of frame field) are considered. The local and covariant test of compatibility is extended (covariantly, ie, without special choice of coordinates) to the case when co-frame matrix $h^a{}_\mu$ is singular or degenerated, being finite (co-singularities).

One can observe that in the AP theory all equations, with the exception of the only game in town, the *unique equation*, remain to be compatible (or at least maintain the compatibility of their main terms) if $\operatorname{rank} h^a_\mu = D - 1$. (Further observations concerning another sort of singularities, contra-singularities, lead for unique equation (UE) to the unique choice of space-time dimension: D=5; see gr-qc/0203008; so, we believe that solutions (of general position) to the UE in D=5 are free of arising singularities.)

Although non-lagrangian, the unique equation leads to the (symmetrical, "covariantly conserving") energy-momentum tensor where the key role belongs to the second order differential covariant f, which looks like electromagnetic field (however, there are no gradient symmetry in the theory). We note that a wave-packet of this energy-transferring f-component (there are solutions with f=0 in the theory) should move along usual riemannian geodesics – as in GR; however the spin or polarization evolution should depend also on rank three skew-symmetric tensor $S_{\mu\nu\lambda}$, which is certainly absent in GR. (Neglecting extra dimension and using the unique equation, one may introduce pseudoscalar ϕ : $\phi_{,\mu} = h\epsilon_{\mu\nu\alpha\beta}S^{\nu\alpha\beta}$. The presence of dipole-like ϕ-field near rotating Earth could be of interest in view of forthcoming results of GP-B mission – relating to some unknown forces.)

J. Russian Physics, V. 35 (1993) 647 (450kB, scan.pdf)

*E-mail: zhogin@inp.nsk.su