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# From hyperheavenly spaces to complex and real, twisting type [N]x[N] spaces

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Recently, the existence of gravitational waves has been confirmed in experiments. It is worth then to analyze once again one of the most intriguing open problems of the general theory of relativity: the problem of vacuum type N with twist. It is well known that according to the "peeling off theorem" the graviational radiation far away from a bounded source is of the type N. All vacuum type N metrics can be divided into four classes. Three classes are explicitly known. They are characterized by the vanishing of the twist (parameter which describes the properties of the congruences of the null geodesics). All of them have singularities and this is the reason why they cannot be treated as a model of the gravitational radiation. Among the metrics with nonzero twist only one solution is known explicitly (Hauser, 1974). This solution has singularities as well. Plenty different approaches to the twisting vacuum type N problem have been presented for last 40 years. Existence of the Killing vectors (KV) or homothetic Killing vectors (HKV) simplify the problem a little. Nevertheless, even two KV or one KV and one HKV enable us to reduce the field equations to the strongly nonlinear and complicated ODE of the third order. A few forms of such equations have been proposed by different authors. For some values of the homothetic parameter these equations become easier and shorter, but we are still far from the finding the explicit solutions other than the Houser's one. In what follows we present the approach to the twisting vacuum type N problem by studying hyperheavenly spaces equipped with two KV or one KV and one HKV. The field equations are reduced to the nonlinear ODE of the fifth order. Our considerations remain valid in all 4-dimensional real spaces of arbitrary signature, as well as in the complex spaces. Finally, some new family of the metrics which admit two Killing vectors is presented. It seems, that this family does not admit any Lorentzian real slice.

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