

Solutions of the hyperbolic Ernst equation

Monday 6 July 2026 12:45 (20 minutes)

Ernst-type equations are elegant reformulations of Einstein's vacuum equations of general relativity when the existence of two commuting Killing vector fields is assumed. Axisymmetric, stationary spacetimes such as rotating black holes and planar gravitational waves are examples of solutions of the Ernst-type equations.

An important mathematical feature of the Ernst-type equations is that they are integrable nonlinear differential equations, allowing the application of methods developed for solving integrable systems. In particular, the inverse scattering method leading to the dressing method enabled to generate n -soliton solutions on the Kasner background [1,2].

We will use the method that dates back to Bianchi's work i.e. and is based on a Bäcklund transformation and a nonlinear superposition principle [3,4]. We will compare the two methods showing differences between two soliton solutions. We will also present some solutions without singularities.

References

- [1] V. A. Belinsky and V. E. Zakharov, Sov. Phys. JETP, 48:985–994, 1978.
- [2] Belinski V, Verdaguer E. Gravitational Solitons. Cambridge University Press; 2001.
- [3] L. Bianchi. Memorie della Societ'a Italiana delle Scienze, detta dei XL, 13:261–289, 1905.
- [4] M. Nieszporski. The multicomponent Ernst equation and the Moutard transformation. Physics Letters A, 272(1):74–79, 2000.

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