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Geodesics and the Einstein nonlinear wave system. (English) [Zbl 1072.58021]

Summary: The system under consideration is Einstein’s equation $R_{\mu\nu}(g) - g_{\mu\nu}R(g)/2 = 8\pi G T_{\mu\nu}$ for a pseudo-Riemannian metric $g$ coupled to a semi-linear wave equation for a complex function $\varphi$. Assume that this wave equation on Minkowski space admits a stable solitary wave of the type known as non-topological solitons. The system is studied in the scaling limit in which the solitons have small size $\varepsilon$ and amplitude $\delta$ with $\delta \leq \delta_0\varepsilon^{7/4}$. It is proved that, for $\varepsilon$ sufficiently small, given a solution of the vacuum Einstein equation, i.e., a Ricci flat pseudo-Riemannian metric $\gamma$, there exists a finite time interval, independent of $\varepsilon, \delta$, on which there is a solution of the full system $(g, \varphi)$ with $(g - \gamma)$ small and $\varphi$ close to a non-topological soliton centred on a time-like geodesic (in appropriate Sobolev norms).

MSC:
- 58J45 Hyperbolic equations on manifolds
- 35L70 Second-order nonlinear hyperbolic equations
- 83C05 Einstein’s equations (general structure, canonical formalism, Cauchy problems)

Keywords:
- Geodesic
- Nonlinear wave equations on manifolds
- Solitons

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