Ehlers-Kundt conjecture about Gravitational Waves and Dynamical Systems

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ABSTRACT

Ehlers-Kundt conjecture is a physical assertion about the fundamental role of plane waves for the description of gravitational waves. Mathematically, it becomes equivalent to a problem on the Euclidean plane $\mathbb{R}^2$ *with a very simple formulation in Classical Mechanics: given a non-necessarily autonomous potential* $V(z,u)$, $(z,u) \in \mathbb{R}^2 \times \mathbb{R}$, *harmonic in* z *(i.e. source-free), the trajectories of its associated dynamical system* $\ddot{z}(s) = -\nabla_z V(z(s), s)$ *are complete (they live eternally) if and only if* $V(z,u)$ *is a polynomial in* z *of degree at most* 2 *(so that* V *is a standard mathematical idealization of vacuum). Here, we show a proof of the conjecture in the significative case that* V *is bounded polynomially in* z *for finite values of* $u \in \mathbb{R}$. *The mathematical and physical implications of this* polynomial EK conjecture*, as well as the non-polynomial one, are discussed beyond their original scope.*

References

[1] J.L. Flores, M. Sánchez, *Ehlers-Kundt conjecture about Gravitational Waves and Dynamical Systems*. Preprint 2017. Available at arXiv:1706.03855.