

On the space of null geodesics of a spacetime

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Abstract

The space of null geodesics of a spacetime (a Lorentzian manifold with a choice of future) has sometimes the structure of a smooth manifold. When this is the case, it comes equipped with a canonical contact structure. In this talk I will show that this is the case for the family of spacetimes $\{(\mathbb{S}^2 \times \mathbb{S}^1, g_\circ - \frac{1}{c^2} dt^2)\}_{c \in \mathbb{N}^+}$, with g_\circ the round metric on \mathbb{S}^2 and t the \mathbb{S}^1 -coordinate. Their spaces of null geodesics are actually the lens spaces $L(2c, 1)$ together with the pushforward of the canonical contact structure on $ST\mathbb{S}^2 \cong L(2, 1)$ under the natural projection $L(2, 1) \rightarrow L(2c, 1)$. On the other hand, motivated by these examples, I will comment on how Engel geometry can be used to describe the manifold of null geodesics of a certain class of three-dimensional spacetimes, by considering the Cartan deprolongation of their Lorentz prolongation. This is joint work with F. Presas and R. Rubio.