Harmonic fields on mixed Riemannian-Lorentzian manifolds

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Abstract

The extended projective disc is Riemannian at hyperbolic points, Lorentzian at ideal points, and singular on the absolute. The Hodge equations on this metric come with a natural gauge theory. Characteristic lines in the hyperbolic region of the equations have a geometric interpretation in terms of polarity. Boundary-value problems for harmonic fields tend to be over determined on the Lorentzian part of the domain. Nevertheless, it is possible to show the existence of solutions to such problems in a suitable sense. We give a variety of sufficient conditions for solutions and indicate extensions to other singular Riemannian-Lorentzian manifolds. In particular, we discuss how these ideas arise in quantum cosmology.