Título: BACH-FLAT MANIFOLDS AND CONFORMALLY EINSTEIN STRUCTURES

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Resumen: Einstein manifolds are especially relevant in many physical applications because they form the central axis of Field Equations in the theory of general relativity. On the other hand, since a conformally structure of space-time is invariant under conformal transformations, the possibility of obtaining Einstein's metrics as representatives of a given class has a high interest that goes beyond purely mathematical questions. These aspects of the work represent the most geometric part of it. It will undoubtedly be necessary to analyze questions related to the metric signature (Walker and Brinkmann structures) as well as the possible physical applications that can be derived from the analysis of the Lorentzian situation. The condition conformally Einstein is mathematically governed by a system of partial derivative equations on manifolds which makes its analysis more

complex. The situation corresponding to dimension four is especially relevant, not only for its physical applications, but also for the existence of topological obstructions for the existence of Einstein metrics. On the other hand, the origin of the Bach tensor is in an integrability condition for a four-dimensional space to be conformal to an Einstein space. The Bach tensor is a tensor built up from pure geometry, and thereby captures necessary features of a space being conformally Einstein in an intrinsic way. The system of underlying equations to the conformally Einstein manifolds results over determinated many times. Since it is a non linear system of equations with trace and divergence null, its analysis is very complex. These facts make necessary the implementation of numerical methods, and tensorial analysis of algebraic objects constructed from the possible solutions and/or symmetries (Lie Theory of partial differencial equations) of the equation.