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Exact Black Holes and Universality in the Backreaction of non-linear Sigma Models with a potential in (A)dS4

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The aim of the talk is to describe the construction of accelerated, stationary and axisymmetric exact solutions of the Einstein theory with self interacting scalar fields in (A)dS4. To warm up, the backreaction of the (non)-minimally coupled scalar field is solved, the scalar field equations are integrated and all the potentials compatible with the metric ansatz and Einstein gravity are found. With these results at hand the non-linear sigma model is tackled. The scalar field Lagrangian is generic; neither the coupling to the curvature, neither the metric in the scalar manifold nor the potential, are fixed ab initio. The unique assumption in the analysis is the metric ansatz: it has the form of the most general Petrov type D vacuum solution of general relativity; it is a a cohomogeneity two Weyl rescaling of the Carter metric and therefore it has the typical Plebanski-Demianski form with two arbitrary functions of one variable and one arbitrary functions of two variables. It is shown, by an straightforward manipulation of the field equations, that the metric is completely integrable without necessity of specifiying anything in the scalar Lagrangian. This results in that the backreaction of the scalar fields, within this class of metrics, is universal. The metric functions generically show an explicit dependence on a dynamical exponent that allows to smoothly connect this new family of solutions with the actual Plebanski-Demianski spacetime. The remaining field equations imply that the scalar fields follow geodesics in the scalar manifold with an affine parameter given by a non-linear function of the spacetime coordinates and define the on-shell form of the potential plus a functional equation that it has to satisfy. Finally, a general family of (A)dS4 static hairy black holes is explicitly constructed and its properties are outlined.