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Scale Invariance in Cosmology and Particle Physics using metric independent measures of integrations in the action

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Abstract The use of a metric independent measure of integration in the action opens new possibilities for constructing globally scale invariant theories, since the new measure can be assigned a different scaling transformation than the usual metric dependent measure sqrt(-g). There are various ways to construct a density that can serve as a metric independent measure of integration, from the derivatives of 4 scalar fields or the derivative of a three index tensor field contracted with the alternating symbol. The integration of the equations of motion of these "measure fields" leads to the spontaneous breaking of the scale invariance. A dilaton field with exponential potentials is added and coupled to the different measures. In the effective Einstein frame, potentials for the dilaton with flat regions appear, if curvature square terms are introduced, two flat regions appear, one capable of describing inflation and the other describing the slowly accelerated phase of the present universe. These models allow non singular cosmologies of the emergent type. In the context of the late universe, it is shown that the scale invariance is responsible for the avoidance of the 5th force problem that could have appeared in connection with the nearly massless dilaton. Also a see saw cosmological mechanism that could explain the smallness of the present vacuum energy can be formulated. Finally these techniques have been used to formulate scale invariant extensions of the Standard Model.

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