3rd National Congress on Physical Sciences, 29 Sep. – 2 Oct. 2016, Sofia
Section: Mathematical Physics

Natural Dynamical Generation of Electro-Weak Spontaneous Symmetry Breaking in the Post-Inflationary Universe

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Abstract. In a remarkable paper from 1986 J. Bekenstein proposed the intriguing idea about a gravity-assisted spontaneous symmetry breaking of electro-weak (Higgs) type without invoking unnatural (according to Bekenstein's opinion) ingredients like negative mass squared and a quartic self-interaction for the Higgs field.

Motivated by Bekenstein's idea, in the present talk we will discuss a new non-standard model of gravity coupled to a neutral scalar "inflaton", as well as to a $U(1)$-charged $SU(2)$ iso-doublet scalar field with a standard positive mass squared and no self-interaction, and to $SU(2)\times U(1)$ gauge fields. Recall that the $SU(2)\times U(1)$ scalar and gauge fields constitute the bosonic part of the electro-weak particle sector. The essential non-standard feature of our model is employing the formalism of non-Riemannian space-time volume forms – alternative generally covariant integration measure densities defined in terms of auxiliary antisymmetric tensor gauge fields independent of the pertinent Riemannian metric.

Although being pure-gauge degrees of freedom, the non-Riemannian space-time volume forms trigger a series of important features unavailable in ordinary gravity-matter models with the standard Riemannian volume-form (given by the square-root of the determinant of the Riemannian metric): (i) The "inflaton" developes a remarkable effective scalar potential in the Einstein frame possessing an infinitely large flat region for large negative values describing the "early" universe evolution; (ii) In the absence of the $SU(2)\times U(1)$ iso-doublet scalar field, the "inflaton" effective potential has another infinitely large flat region for large positive values describing the "late" (post-inflationary) universe; (iii) Inclusion of the $SU(2)\times U(1)$ iso-doublet scalar field introduces a drastic change in the total effective scalar potential in the post-inflationary universe – the total effective scalar field potential acquires exactly the celebrated electro-weak Higgs-type spontaneous symmetry breaking form.

The talk is based on an essay http://arxiv.org/abs/1603.06231, which received a *honorable mention in 2016 Gravity Research Foundation Competition for Essays on Gravitation* (http://www.gravityresearchfoundation.org/pdf/2016_Awards.pdf).