



Cosmological model with black-holes-hedgehogs and two degenerate vacua of the Universe

C. R. Das^{1,a}, L. V. Laperashvili^{2,b}, H. B. Nielsen^{3,c} and B. G. Sidharth^{4,d}

¹ Bogoliubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research, Joliot-Curie 6, 141980 Dubna, Moscow region, Russia

² The Institute of Theoretical and Experimental Physics, National Research Center “Kurchatov Institute”, Bolshaya Cheremushkinskaya, 25, 117218 Moscow, Russia

³ Niels Bohr Institute, Blegdamsvej, 17-21, DK 2100 Copenhagen, Denmark

⁴ International Institute of Applicable Mathematics and Information Sciences, B.M. Birla Science Centre, Adarsh Nagar, 500063 Hyderabad, India

e-mail: ^a das@theor.jinr.ru, ^b laper@itep.ru, ^c hbeck@nbi.dk, ^d birlasc@gmail.com

Abstract. We suggest a cosmological model of the Universe based on the two discoveries: ① cosmological constant is very small, and ② the Universe has two degenerate vacua, “false” and “true” ones. After the Big Bang, the Universe is presented by a Bubble with the de-Sitter spacetime metric inside, having a “false vacuum” with the VEV $\sim 10^{18}$ GeV. We show that black-holes-hedgehogs (BHH) are topological defects of this vacuum. Considering the Gravi-Weak Unification, we obtained a solution of the BHH giving its mass $M_{BH} \sim 10^{18}$ GeV, radius $R_{BH} \sim 10^{-21}$ GeV⁻¹ and horizon radius $r_h \approx 2.29R_{BH}$. We demonstrated that the cooling of the Universe leads to a new phase transition transforming the first universal bubble into the new bubble with the FLRW spacetime metric inside. This bubble has “the true vacuum” with new topological defects of the $U(1)_{(el-mag)}$ group. The noncommutative geometry of the vacua spacetime explains an almost zero cosmological constants. In this model, we predict a stability of the EW-vacuum, and a new physics producing at LHC the triplet $SU(2)$ Higgs bosons at energies $E \sim 10$ TeV. At the end of this paper, we discuss the problem what comes beyond the standard model.

Keywords: multiple point principle, degenerate vacua, gravi-weak unification

MSC numbers: 83E99

References

- [1] B.G. Sidharth, Proc. of the 8th Marcell Grossmann Meeting on General Relativity, Jerusalem, May 1997, ed. T. Piran, (World Scientific, Singapore, 1997) pp. 476-479
- [2] B.G. Sidharth, Int. J. Mod. Phys. A **13** (1998) 2599 [[arXiv: quant-ph/9808031](#)]
- [3] S. Perlmutter *et al.*, Nature **391** (1998) 51
- [4] D.L. Bennett and H.B. Nielsen, Int. J. Mod. Phys. A **9** (1994) 5155 [[arXiv:hep-ph/9311321](#)]
- [5] C.D. Froggatt and H.B. Nielsen, Phys. Lett. B **368** (1996) 96 [[arXiv:hep-ph/9511371](#)]
- [6] C. Patrignani et al. (Particle Data Group), Chin. Phys. C **40** (2016) 100001 and 2017 update
- [7] G. Degrassi, S. Di Vita, J. Elias-Miro, J.R. Espinosa, G.F. Giudice, G. Isidori and A. Strumia, JHEP **1208** (2012) 098 [[arXiv:1205.6497](#)]
- [8] D. Buttazzo, G. Degrassi, P.P. Giardino, G.F. Giudice, F. Salab, A. Salvio and A. Strumia, JHEP **1312** (2013) 089 [[arXiv:1307.3536](#)]
- [9] M. Barriola and A. Vilenkin, Phys. Rev. Lett. **63** (1989) 341
- [10] L.V. Laperashvili, H.B. Nielsen and A. Tureanu, Int. J. Mod. Phys. A **30** (2015) 1550044 [[arXiv:1411.6456](#)]
- [11] C.R. Das, L.V. Laperashvili and A. Tureanu, Int. J. Mod. Phys. A **28** (2013) 1350085 [[arXiv:1304.3069](#)]
- [12] D.L. Bennett, L.V. Laperashvili and H.B. Nielsen, *Finestructure constants at the Planck scale from multiple point principle*, in: Proceedings of the 10th Workshop on *What Comes Beyond the Standard Model*, Bled, Slovenia, 17-27 September, 2007, eds. M. Breskvar et al. (Bled Workshops in Physics, Vol. 8, no. 2, pp.. 1-30, DMFA-Zaloznistvo, Ljubljana, 2007) [[arXiv:0711.4681](#)]
- [13] L.V. Laperashvili, Phys. Atom. Nucl. **57** (1994) 471, [Yad. Fiz. **57** (1994) 501]
- [14] G. 't Hooft, Nucl. Phys. **B79** (1974) 276.
- [15] A.M. Polyakov, JETP Lett. **20** (1974) 194 [Pisma Zh. Eksp. Teor. Fiz. **20** (1974) 43]
- [16] E.I. Guendelman and A. Rabinowitz, Phys. Rev. D **44** (1991) 3152

- [17] *Thermodynamical Analysis of a Black Hole with a Global Monopole Within a Class of a $f(R)$ Gravity*, F.B. Lustosa, M.E.X. Guimaraes, C.N. Ferreira and J.L. Neto, [[arXiv:1510.08176](#)]
- [18] O. Delice, JHEP **0311** (2003) 058 [[arXiv:gr-qc/0307099](#)].
- [19] Xin Shi and Xin-zhou Li, Class. Quant. Grav. **8** (1991) 761 [[arXiv:0903.3085](#)]
- [20] A.A. Abrikosov, Soviet JETP **32** (1957) 1174 [Zh. Eksp. Teor. Fiz. **32** (1957) 1442]
- [21] H.B. Nielsen and P. Olesen, Nucl. Phys. B **61** (1973) 45
- [22] B.G. Sidharth, A. Das and A.D. Roy, Int. J. Theor. Phys. **55** (2016) 801
- [23] B.G. Sidharth, Nuovo. Cim. B **116** (2001) 735 [[arXiv:physics/0106051](#)]
- [24] H.S. Snyder, Phys. Rev. **72** (1947) 68
- [25] B.G Sidharth, Int. J. Mod. Phys. E **19** (2010) 79
- [26] V.A. Belavin, M.N. Chernodub and I.E. Kozlov, Nucl. Phys. **B748** (2006) 524 [[arXiv:hep-lat/0512030](#)].
- [27] B.G. Sidharth, C.R. Das, L.V. Laperashvili and H.B. Nielsen, Int. J. Mod. Phys. D **27** (2018) 1850022
- [28] *Black Holes-Hedgehogs and Strings as Defects of the Universal Vacua*, B.G. Sidharth, C.R. Das, L.V. Laperashvili and H.B. Nielsen, [arXiv:1703.05594](#)
- [29] C.D. Froggatt, L.V. Laperashvili and H.B. Nielsen, Phys. Atom. Nucl. **69** (2006) 67 [Yad. Fiz. **69** (2006) 3] [[arXiv:hep-ph/0407102](#)]
- [30] *Degenerate Vacua of the Universe and What Comes Beyond the Standard Model*, B.G. Sidharth, C.R. Das, C.D. Froggatt, H.B. Nielsen and Larisa Laperashvili, [arXiv:1801.06979](#)
- [31] B.G. Sidharth, Invited talk at Frontiers of Fundamental Physics International Symposium No.15, Orihuela, Spain, November 2017
- [32] C.D. Froggatt and H.B. Nielsen, *Trying to understand the Standard Model parameters*. Invited talk by H. B. Nielsen at the “XXXI ITEP Winter School of Physics, Moscow, Russia, 18-26 February 2003, Surveys High Energy Phys. **18** (2003) 55-75 [[arXiv:hep-ph/0308144](#)]
- [33] C.D. Froggatt, H.B. Nielsen and L. V. Laperashvili, Int. J. Mod. Phys. A **20** (2005) 1268 [[arXiv:hep-ph/0406110](#)]
- [34] B.G. Sidharth, *The Chaotic Universe: From the Planck to the Hubble Scale* (Nova Science, New York, 2001)

- [35] C.D. Froggatt and H.B. Nielsen, Phys. Rev. D **80**, 034033 (2009)
[arXiv:0811.2089]
- [36] Z. Berezhiani, *Through the looking-glass: Alice's adventures in mirror world*, in: Ian Kogan Memorial Collection "From Fields to Strings", Eds. M. Shifman et al., World Scientific, Singapore, Vol. 3, pp. 2147-2195, 2005
[arXiv:hep-ph/0508233]
- [37] R. Foot, Int. J. Mod. Phys. A **29** (2014) 1430013 [arXiv:1401.3965]
- [38] L. Bento and Z. Berezhiani, Phys. Rev. Lett. **87** (2001) 231304
[arXiv:hep-ph/0107281]
- [39] L. Bento and Z. Berezhiani, Fortsch. Phys. **50** (2002) 489