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TOPICAL REVIEW

How many new particles do we need?

Mikhail Shaposhnikov

École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland

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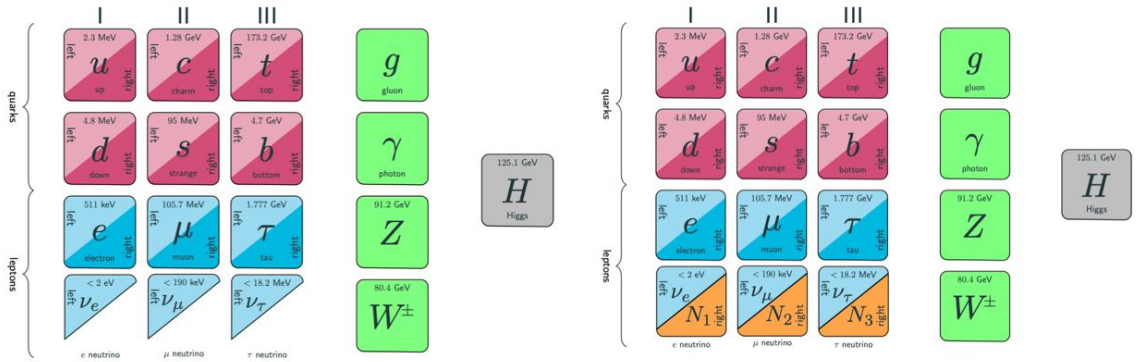
Author introduction

Mikhail Shaposhnikov studied at Moscow University and got his Ph.D. degree from the Institute for Nuclear Research (INR) of Russian Academy of Sciences in 1982. From 1982 to 1991 he was a research scientist at INR. During 1991-1998 he was a staff member at European Council for Nuclear Research (CERN), Geneva. In 1998 he moved to the University of Lausanne. During 2003-2021 he was a full professor at École Polytechnique Fédérale de Lausanne (EPFL), leading the Laboratory for Particle Physics and Cosmology. Since 2021 he is a professor emeritus. He works in the field of theoretical particle physics and cosmology.



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Abstract The Standard Model of particle physics (SM) and Einstein general relativity are extremely successful in describing almost all phenomena observed in Nature so far, spanning distances from a fraction of Fermi to thousands of megaparsec (Mpc). In this review article, the author deliberates on the question formulated in the title, given that the SM does not allow neutrino oscillations, does not have a candidate for dark matter in the Universe, and does not explain the observed cosmological dominance of matter over antimatter.

Keywords physics beyond the standard model, neutrino physics, baryon asymmetry of the Universe, dark matter, strong CP problem, dark energy

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E-mail: mikhail.shaposhnikov@epfl.ch

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