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E8xE8’

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1 Introduction

The Standard Model of particle physics is the theory describing three of the four known fundamental forces (the electromagnetic, weak, and strong interactions, and not including the gravitational force) in the universe, as well as classifying all known elementary particles. String theory is a candidate for theory of everything that describes all fundamental forces and forms of matter.

In this theory particles presented as one-dimensional object called strings. String theory describes how strings propagate through space and interact with each other. On distance scales larger than the string scale, a string will look just like an ordinary particle, with its mass, charge, and other properties determined by the vibrational state of the string. In this way, all of the different elementary particles may be viewed as vibrating strings.

Superstring theory includes supersymmetry which allows to input also fermion strings. There is five versions of superstring theories.

The type I string has one supersymmetry in the ten-dimensional sense (16 supercharges). This theory is special in the sense that it is based on unoriented open and closed strings, while the rest are based on oriented closed strings.

The type II string theories have two supersymmetries in the ten-dimensional sense (32 supercharges). There are actually two kinds of type II strings called type IIA and type IIB. They differ mainly in the fact that the IIA theory is non-chiral (parity conserving) while the IIB theory is chiral (parity violating).

The heterotic string theories are based on a peculiar hybrid of a type I superstring and a bosonic string. There are two kinds of heterotic strings differing in their ten-dimensional gauge groups: the heterotic E8xE8 string and the heterotic SO(32) string. (The name heterotic SO(32) is slightly inaccurate since among the SO(32) Lie groups, string theory singles out a quotient Spin(32)/Z2 that is not equivalent to SO(32).)

2 Compactification and symmetry breaking

Initially, symmetry supposed between ordinary world(E8) and mirror world(E8'). 26 dimensional strings are reduced to 10-dimensional gravity with the E8xE8' gauge group by compactification of 16 internal dimensions on the torus.

Gauge symmetry is broken by compactification into Calabi-Yau manifolds or orbifolds.

The mechanism of gauge symmetry breaking as a result of compactification on Calabi – Yau manifolds or orbifolds leads to the prediction of homotopically stable solutions with a mass $m_\alpha = r_c/\alpha'$, where r_c – radius of compactification, α' – string tension.

The homotopically stable particles are "sterile" with respect to the charges of strong, weak, and electromagnetic interactions and participate only in the gravitational interaction. Therefore the possibilities of verifying the existence of these particles are related exclusively to their cosmological manifestations.

After compactification E8 is broken to E6 and E8' remained not broken. Therefore symmetry between "ordinary" and "mirror" world is broken, and it leads to existence of "shadow" world which interact with ordinary matter only by gravity.

3 Generations of fermions

The Eulerian characteristic of the topology of compactified 6 dimensions determines the number of generations of quarks and leptons, which can be either 3 or 4. The difference in the ranks of group symmetry of grand unification and the standard model group means that there is at least one conserved charge may be associated with quarks and leptons of the fourth generation. This may explain the Dirac nature of the 4th generation neutrino mass and the stability of this massive neutrino. If a new conserved charge is a gauge, and a neutrino is the lightest fermion of the 4th generation, then the 4th neutrino, possessing a new charge like an electric one, must be absolutely stable, just as the lightest electrically charged particle — an electron.

4 Inflation

5 Baryogenesis. Affleck – Dine – Linde mechanism

Baryon asymmetry can be explained by the processes with the B- and CP-violation.

Affleck – Dyne – Linde mechanism is considered in the model which consistent supersymmetry. New hypothetical scalar fields(SUSY-partners of ordinary particles) carries the baryon(lepton) number. Affleck – Dyne – Linde mechanism is suggest that some superpositions of these scalar fields have large fluctuations in amplitude and phase, and then in potential appears the components which violate B- and CP-invariance. The decay of these fields after inflation leads to the formation of baryon(lepton) asymmetry. The Affleck – Dine – Linde mechanism is an example of non-thermal baryogenesis.

6 Shadow matter

After symmetry breaking between ordinary and mirror world appears "shadow" world which consist 248 fields of matter and interactions which connected with ordinary particles only by gravity. They may be candidates for the shadow matter.

Contribution to the shadow matter can give also 4th generation of heavy neutrino and neutralino which appears in the supersymmetry theories.

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