High Energy Physics - Theory

Calabi-Yau Manifolds, Hermitian Yang-Mills Instantons and Mirror Symmetry

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We formulate six-dimensional Euclidean gravity as SU(4)=SO(6) Yang-Mills gauge theory. For that purpose we devise a six-dimensional version of the 't Hooft symbols which realizes the isomorphism between SO(6) Lorentz algebra and SU(4) Lie algebra. As the SO(6) Lorentz algebra has two irreducible spinor representations, there are accordingly two kinds of the 't Hooft symbols depending on the chirality of SO(6) Weyl representation, which leads to a topological classification of Riemannian manifolds according to the Euler characteristic. The K\"ahler condition can be imposed on the 't Hooft symbols which are projected to U(3)-valued ones and results in the reduction of the gauge group from SU(4) to U(3). After imposing the Ricci-flat condition, the gauge group in the Yang-Mills gauge theory is further reduced to SU(3). Consequently, we find that six-dimensional Calabi-Yau manifolds are equivalent to Hermitian Yang-Mills instantons in SU(3) Yang-Mills gauge theory. The classification of six-dimensional Riemannian manifolds according to the chirality of SO(6) Weyl representation leads to an interesting picture about the mirror symmetry of Calabi-Yau manifolds and its generalization.

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