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(G) Kaluza-Klein SO(4)-Monopoles on Exotic 7-Spheres and Physical Effects of Exotic Smooth Structures

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In physics, Spacetime is always assumed to be a smooth $4-$manifold with a fixed (standard) differential structure. Two smooth $n-$manifolds are said to be exotic if they have the same topology but different differential structures. S. Donaldson showed that there exist exotic differential structures on $\mathbb{R}^4$. In the compact case, J. Milnor and M. Kervaire classified exotic differential structures on $n-$spheres $\mathbb{S}^n$. A fundamental question now remains to be answered : do exotic differential structures on spacetime play any role in physics ? The possibility of the applications of exotic structures in physics was first suggested by E. Witten in his article "Global gravitational anomalies". Trying to give a physical meaning of exotic spheres, Witten conjectures that exotic $n-$spheres should be thought as gravitational instantons in $n-$dimensional gravity and should give rise to gravitational solitons in $(n+1)-$dimensions. In this talk, we will address these questions in two steps. First we construct Kaluza-Klein $SO(4)-$monopoles on Milnor's exotic $7-$spheres (solutions to the 7-dimensional Einstein equations with cosmological constant). Secondly, taking exotic $7-$spheres as models of spacetime, we address physical effects of exotic smooth structures on the energy spectra of elementary particles. Finally we discuss other possible applications of exotic $7-$spheres in other areas of physics.

Keyword-1

Exotic smooth structures

Keyword-2

Kaluza-Klein theory

Keyword-3

Gravitational monopoles

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