Institut Ruđer Bošković
ZAVOD ZA TEORIJSKU FIZIKU
Bijenička c. 54
Zagreb, Hrvatska

SEMINAR ZAVODA ZA TEORIJSKU FIZIKU

(Zajednički seminari Zavoda za teorijsku fiziku,
Zavoda za eksperimentalnu fiziku IRB-a i Fizičkog odsjeka PMF-a)

Do we have a chance for renormalizable and unitary quantum gravity?

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Datum: četvrtak, 13. srpnja 2017.
Vrijeme : **11 sati s.t.** (TOČNO)
Mjesto: IRB, predavaona I krila

Abstract:

The main difficulty of perturbative quantum gravity (QG) in D=4 is the conflict between renormalizability and unitarity of the theory. The simplest version of QG is based on General Relativity and is non-renormalizable. One can construct renormalizable and even superrenormalizable versions of QG by introducing higher derivatives, but then we meet the unphysical higher-derivative massive ghosts. The non-polynomial models of QG have no ghosts at the tree level, but taking loop corrections into account one meets infinite amount of ghost-like complex states. The same is true for the string-induced gravitational action, which requires an infinite amount of fine-tuning to remain free of ghosts. We descrive the recent proposal of the polynomial superrenormalizable versions of QG with complex poles. These models have an attractive feature to be unitary within the Lee-Wick approach, at both tree and perturbative quantum levels. Furthermore, these theories have unambiguous and exactly calculable beta-functions and even can be made finite. One of the interesting open question is whether these theories can be tested experimentally. Another (and in fact related) important aspect is to understand what remains from the quantum corrections in these theories in the IR.

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