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SEMINAR ZAVODA ZA TEORIJSKU FIZIKU

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

Weyl semimetals in 3D optical lattices, and synthetic gauge fields in strongly interacting 1D Bose gases

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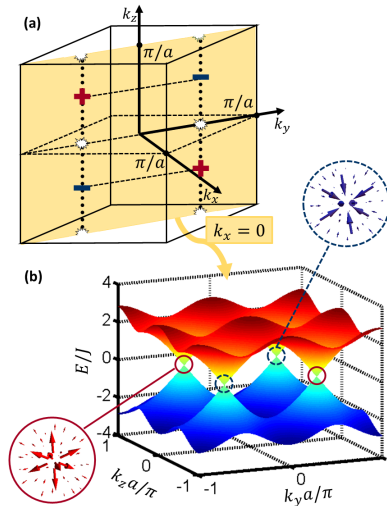
Datum: srijeda, 12. travnja 2017.

Vrijeme : **14:00 sati c.t.**

Mjesto: IRB, predavaona I krila

Abstract:

We discuss two important directions of research of synthetic topological quantum matter [1]: (i) topological phases in 3D optical lattices, more specifically Weyl semimetals in ultracold atomic gases [2], and (ii) strongly interacting Bose gases in synthetic gauge fields [3]. Interacting Bose gases in synthetic magnetic fields [1] hold great potential for discovering and exploring novel topological states of matter [4], in a similar fashion as the fractional quantum Hall effect for electrons in strong magnetic fields. Here we investigate laser assisted tunneling in a strongly interacting one-dimensional Bose gas [3] (the Tonks-Girardeau gas [5]) in optical lattices. We find that the stroboscopic dynamics of the Tonks-Girardeau gas in a continuous Wannier-Stark-ladder potential, supplemented with laser assisted tunneling, effectively realizes the ground state of one-dimensional hardcore bosons in a discrete lattice [6] with nontrivial hopping phases. Next, we show that, in three-dimensional optical lattices, laser assisted tunneling can be used for realizing a Hamiltonian with Weyl points [3]. Weyl points



are synthetic magnetic monopoles that exhibit a robust, three-dimensional linear dispersion, identical to the energy-momentum relation for relativistic Weyl fermions [3], which are not yet discovered in particle physics. Relation to analogous studies in optics will be mentioned [8].

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