

TOPOLOGICAL FIELD THEORY INTRODUCTION

Fizyka Plus, Winter term 2014-2015, USOS code: 1100-3`TFT
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PROBLEMS AND QUESTIONS

1. Topological invariants, Euler characteristic
2. Formulations of Quantum Field Theory (path integrals, operator formalism)
3. Topological Quantum Field Theories (Schwarz and Witten type)
4. QFT in $d=0$ – Feynman diagrams for cubic action
5. Grassmann variables – definition, Gaussian integrals, path integrals
6. Supersymmetric action in $d=0$
7. Localization principle
8. Landau-Ginzburg theory in $d=0$
9. Chiral ring (for Landau-Ginzburg theory in $d=0$)
10. Supersymmetric quantum mechanics (action, operator algebra, Hilbert space)
11. Witten index
12. Witten index for SUSY quantum mechanics with various potentials
13. Harmonic oscillator in SUSY quantum mechanics (partition function, Witten index)
14. SUSY quantum mechanics on a Riemannian manifold
15. $N=(2,2)$ QFT in $d=2$ – superspace, supersymmetry algebra
16. Chiral rings and 3-point functions in $N=(2,2)$ theories
17. $N=(2,2)$ theories and topological twisting (A-twist, B-twist)
18. A-twisted sigma model on Kähler manifolds – structure of observables
19. Quantum cohomology ring in \mathbf{CP}^1 sigma model
20. Chern-Simons action, gauge transformations
21. $U(1)$ Chern-Simons theory and linking number
22. Chern-Simons theory in various dimensions, Chern characters
23. Perturbative solution of Chern Simons theory, 't Hooft large N expansion
24. Non-perturbative solution of Chern-Simons theory, surgery of 3-manifolds
25. Knot invariants: Jones polynomial and HOMFLY polynomial, SKEIN relations