MATH 6260 Geometry of Quantum Fields
Course Projects

Fall 2021

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1. Classification of Topological Field Theories after J. Lurie
2. The Gronewold–van Hove Theorem
3. The hydrogen spectrum after W. Pauli
4. Peierl's bracket
5. The geometric description of Berry's phase including the Aharanov-Bohm effect (Anthony)
6. Representation theory of $SU(3)$ and quarks
7. The theorem of Stone, Naimark, Ambrose, and Godement and its application to algebraic QFT (Daniel)
8. Chern-Simons theory
9. Topological phases of matter
10. Quantum information theory and entanglement
11. A geometric proof of Wigner's Theorem using the Fubini-Study metric
12. The Osterwalder-Schrader axioms and euclidean field theory (this could also be a collaborative project)
13. Representations of the Poincarè group
14. The noncommutative standard model
15. BRST quantization
16. Deformation Quantization (Jacob)
17. Geometric quantization à la Kostant–Souriau
18. Symplectic reduction (Rebecah)
19. Conformal Field Theory and the Virasosro Algebra (Xiaoyang)
20. Factorization Algebras in Quantum Field Theory (Ezz)
21. Causal perturbation theory à la Epstein-Glaser, Schwarf, Dütsch, Fredenhagen, etc. (Chao)

22. Quantum groups and quantum symmetries
23. Cutting and pasting manifolds and TQFTs
24. Information-geometric approach to renormalization group
25. Pro-measures and a mathematically rigorous treatment of Feynman path integrals
26. Connes–Kreimer approach to renormalization via Hopf algebras