

Spring 2023 Learning Group on State Sum Models and Invariants of 3-Manifolds.

Via Zoom (see email for link). Facilitated by Chelsea Walton (Rice)

Wednesdays, 1:15pm - 2:30pm Houston Time. [Set-Up] 1:15pm-1:20pm. [Talk I] 1:20pm-1:50pm. [Break] 1:50pm-2:00pm. [Talk II] 2:00pm-2:30pm.

Main Reference: [Meu] C. Meusburger, State sum models with defects based on spherical fusion categories, ArXiv preprint 2205.06874v1.

Accompanying References:

- [BW] J. Barrett and B. Westbury, Invariants of piecewise-linear 3-manifolds, Trans. AMS, 1996.
 [EGNO] P. Etingof, S. Gelaki, D. Nikshych, V. Ostrik, Tensor categories, Textbook, 2015.
 [Lis] F. Lischka, Generalised 6j symbols over the category of G-graded vector spaces, Masters thesis, 2021.
 [Meu-slides] C. Meusburger, Turaev-Viro-Barrett-Westbury, EQUAL lecture slides, November 7, 2022.
 [TV] V. Turaev and O. Viro, State sum invariants of 3-manifolds and quantum 6j-symbols, Topology, 1992.
 [TV-book] V. Turaev and A. Virelizier, Monoidal categories and topological field theories, Textbook, 2017.
 [Wal] C. Walton, Symmetries of Algebras, Textbook in progress, <https://math.rice.edu/~notlaw/symalgbook.html>.

Participants: 1. Reeshad Arian (NCSU), 2. Alexander Betz (NCSU), 3. Quan Chen (Ohio State), 4. Daniel Flores (Elon U.), 5. Sam Hannah (Cardiff),
 6. Hongdi Huang (Rice), 7. Fernando Liu Lopez (Rice), 8. Emily McGovern (NCSU), 9. Sean Sanford (Ohio State), 10. Guillermo Sanmarco (Iowa State),
 11. Kylan Schatz (NCSU), 12. Kürşat Sözer (McMaster), 13. Benjamin Spencer (Indiana), 14. Vincent Thompson (Rice), 15. Kent Vashaw (MIT),
 16. Abigail Watkins (Indiana), 17. Harshit Yadav (Rice) [all full]

Date	Speaker(s)	Topics	References (in order of priority)
January 18, 2023	1. Chelsea Walton	1. Introduction to topic, especially state sum models.	1. [TV, Introduction, Section 1] [BW, Introduction, Section 1] [Meu, Introduction]
	2. Chelsea Walton	2. Monoidal categories, monoidal functors, (bi)module categories, and (bi)module functors. Strictness and coherence. Graphical calculus. Vec_G^ω , and representations of Hopf algebras as a source of examples.	2. [Wal, Sections 3.1-3.5] [Lis, Sections 2.1-2.2, 3.1] [TVbook, Sections 1.1-1.4, 2.1-2.2] [EGNO, Sections 2.1-2.5, 2.8-2.9, 5.3]
January 25, 2023	3. Emily McGovern	3. Rigid, pivotal and (trace-)spherical categories categories. Spherical Hopf algebras. Graphical calculus as needed. Highlight Vec_G^ω .	3. [Meu, Section 1.1, 2.1] [Lis, Sections 3.2] [Wal, Sections 3.6-3.8] [BW, Section 6] [TV, Sections 2.5-2.7]
	4. Abigail Watkins	4. Linear monoidal categories, non-degeneracy, fusion categories, tensor categories, more on module categories, Use Vec_G^ω as a running example.	4. [Meu, Sec 1.1-1.3 not covered in Lecture 2] [Wal, Sections 3.9-3.10 without FP-dimension] [TV, Sections 4.1-4.4] [Lis, Sections 4.2-4.3]
February 1, 2023	5. Kürşat Sözer	5. TV state sum models (without defects)	5. [TV-book, tba - chosen by speaker]
	6. Kürşat Sözer	6. BW state sums models (without defects): symmetries of simplicial invariants	6. [BW, Sections 1 and 3] [Meu-slides, page 2]
February 8, 2023	7. Guillermo Sanmarco	7. (TV)BW state sum models (without defects): PL manifolds and invariants of manifolds (start)	7. [BW, Section 4, start Section 5] [Meu-slides, page 2]
	8. Guillermo Sanmarco	8. (TV)BW state sum models (without defects): Invariants of manifolds (finish), connection to spherical Hopf algebras.	8. [BW, finish Section 5, chose snippet of Section 6] [Meu-slides, page 2]
February 15, 2023	9. Vincent Thompson	9. 2-categories, with examples Cat, Schumann's (bi)module categories with traces	9. [Meu, Section 1.4] (and internal references to Schumann if needed) [EGNO, Section 2.12] [Meu-slides, page 3,4]
	10. Hongdi Huang	10. Diagrams for (bi)module categories, functors, and natural transformations	10. [Meu, Section 2.2] [Meu-slides, page 5,6]
February 22, 2023	11. Alexander Betz	11. Polygon diagrams	11. [Meu, Section 2.3] [Meu-slides, page 7,8]
	12. Reeshan Arian	12. Gluing polygon diagrams	12. [Meu, Section 3] [Meu-slides, page 9]
March 1, 2023	13. Sam Hannah	13. State sum models with defects: Triangulated 3-manifolds with defects, labeling of the triangulation	13. [Meu, Sections 4.1-4.2] [Meu-slides, page 10]
	14. Benjamin Spencer	14. State sum models with defects: Generalized 6j symbols.	14. [Meu, Section 4.3] [Meu-slides, pages 11-12]
March 8, 2023	15. Quan Chen	15. State sum models with defects: Generalized 6j symbols (finish material from last time), examples over Vec_G^ω .	15. [Meu, Section 4.3] [Meu-slides, pages 11-12] [Lis, Section 6.3]
	16. Quan Chen	16. State sum models with defects (and recovering TVBW case without defects)	16. [Meu, Section 4.4] [Meu-slides, page 13]
March 15, 2023 (Break)	--	--	--
March 22, 2023	17. Sean Sanford	17. Topological invariance: Moves between triangulated PL manifolds, neighborhoods of defect surfaces	17. [Meu, Sections 5.1-5.2]
	18. Daniel Flores	18. Topological invariance: State sums with defect discs	18. [Meu, Sections 5.3] [Meu-slides, pages 14-15]
March 29, 2023	19. Kent Vashaw	19. Triangulation independence, especially the set-up for [Meu, Theorem 5.16]	19. [Meu, Section 5.4]
	20. Kent Vashaw	20. Triangulation independence, esp. [Meu, Theorem 5.16]	20. [Meu, Section 5.4] [Meu-slides, page 16]
April 5, 2023	21. Fernando Liu Lopez	21. Recap of material + Unknotted 3-ball without defects example	21. Various material for recap. [Meu, Example 6.1] [Meu-slides, page 17]
	22. Kylan Schatz	22. Cylinder with defect surface example	22. [Meu, Example 6.2] [Meu-slides, page 17]
April 12, 2023	23. Harshit Yadav	23. Genus g defect surface in 3-ball example + Torus embedded in S^3 example (if time permits)	23. [Meu, Example 6.3 (and Example 6.4)] [Meu-slides, page 18]
	24. All	24. Closing discussion : 2 minute elevator chats about one's work (research, studies, stage, etc.)	24. n/a