THE LOW-DIMENSIONAL PRINCETON-CAMBRIDGE EXCHANGE GATHERING
SCHEDULE AND ABSTRACTS

WEDNESDAY, APRIL 2 - FRIDAY APRIL 4, 2025

Wed, April 2	Day 1	MIT Building 2
9:30 - 10	Morning gathering	MIT 2-4 terrace
10:00 - 11:00	Cooper Kofron	MIT 2-361
11:00 - 11:15	15min break	
11:15 - 12:15	Nathan Geist	MIT 2-361
12:15 - 2	105min break	
2 - 3	Thomas Massoni	MIT 2-449
3 - 3:15	15min break	
3:15 - 4:15	Yonghwan Kim	MIT 2-449
Thu, April 3	**Day 2**	**MIT Building 2**
9 - 9:30	Morning gathering	MIT 2-4 terrace
9:30 - 10:30	Alison Tatsuoka	MIT 2-449
10:30 - 10:45	15min break	
10:45 - 11:45	Mary Stelow	MIT 2-449
11:45 - 1:45	120min break	
1:45 - 2:45	Joye Chen	MIT 2-449
2:45	Outing begins	
Fri, April 4	**Day 3**	**Harvard Science Center**
9 - 9:30	Morning gathering	Harvard SC-4 terrace
9:30 - 10:30	Ollie Thakar	Harvard SC-530
10:30 - 10:45	15min break	
10:45 - 11:45	Gheehyun Nahm	Harvard SC-530
11:45 - 1:30	105min break	
1:30	Harvard CDM begins	

Cooper Kofron — The combinatorics of the ribbon concordance poset

4/2 10:05AM - 11:05AM @MIT 2-361

In 1983, Gordon defined the notion of ribbon concordance as a means of better understanding the slice-ribbon conjecture. He posed a series of notoriously difficult questions, including the conjecture that ribbon concordance forms a partial ordering on the set of all knots. This problem went unsolved for 40 years, until Agol discovered a remarkable 6 page proof using ideas from real algebraic geometry and hyperbolic geometry. The beauty of this result is that it gives us a canonical way of ordering knots!

In this talk, we will survey the many remarkable properties of this poset, and emphasize the importance of combinatorial methods as a means of discovering new properties. We focus on another of Gordons original conjectures, that any chain of ribbon concordances eventually stabilizes. Dix recently proved that Gordons conjecture holds for any chain of 2-bridge hyperbolic knots, using results from hyperbolic geometry. Using combinatorial methods, we extend this result to any chain of quasi-alternating knots. Using similar ideas, we construct a new infinite family of ribbon concordance minimal knots, and we pose some new conjectures in the style of Gordon.

Nathan Geist — Tight contact structures through open book decompositions

4/2 11:15AM - 12:15PM @MIT 2-361

In 2002 Giroux established a deep connection between contact structures on 3-manifolds and equivalence classes of open book decompositions. In this expository talk I will describe some of the practical consequences of his theorem for a basic problem in 3-dimensional contact topology: when is a contact structure tight or overtwisted? Early work of Goodman and Honda-Kazez-Matic gives conditions for being overtwisted in terms of how the monodromy acts on a single arc. I will then define a helpful (and computable!) numerical invariant introduced by the latter which is known as the fractional Dehn twist coefficient. Finally, I will describe more recent techniques developed by Wand and the open book foliations of Ito-Kawamuro.

Thomas Massoni — Liouville rainbows of taut foliations

4/2 2PM - 3PM @MIT 2-449

For a suitable taut foliation $\mathcal{F}$ on a 3-manifold M, I will describe an associated Liouville structure on the thickening $[-1,1]\times M$ which I call the *Liouville rainbow* of $\mathcal{F}$. Its boundary contact structures are positive and negative contact approximations of $\mathcal{F}$ constructed by Eliashberg and Thurston. The main result is that Liouville rainbows are *topological* invariants: C^0-conjugate taut foliations yield equivalent Liouville rainbows. In particular, their symplectic and Floer-theoretic invariants coincide. This is based on joint work in preparation with Jonathan Bowden.

Yonghwan Kim — Whitehead torsion and the Fukaya category

4/2 3:15PM - 4:15PM @MIT 2-449

The celebrated h-cobordism theorem of Smale states that every h-cobordism on a simply connected closed manifold of dimension at least 5 is trivial. But what happens when we allow our manifold to be non-simply connected? In this talk, I will first introduce the s-cobordism theorem, which provides a complete answer to this question. I will then discuss the key concepts of Whitehead torsion and simple homotopy types. Toward the end, I will highlight some recent developments in symplectic geometry where Whitehead torsion plays a role.

Alison Tatsuoka — Splitting Spheres for S^2s in S^4

4/3 9:30AM - 10:30AM @MIT 2-449

If $K_1 \sqcup K_2$ is a split link in S^4, a splitting sphere for K is an S^3 in S^4 such that K_1 lies in one connected component of $S^4 \setminus S^3$, and K_2 lies in the other. We show that there exist infinitely many pairwise non-isotopic splitting spheres for two unlinked, unknotted S^2s in S^4. Along the way, we introduce barbell diffeomorphisms of 4-manifolds, as constructed by Budney-Gabai in their paper "Knotted 3-balls in S^4".

Mary Stelow — Skein Lasagna primer

4/3 10:45AM - 11:45AM @MIT 2-449

Skein lasagna homology is new-ish four manifold invariant coming from gl_N link homology. It has recently been shown to detect exotic phenomena by work of Ren and Willis. In this talk, I will give an expository introduction to skein lasagna, and speak about the results of Manolescu-Neithalath and Manolescu-Walker-Wedrich describing the skein lasagna module in terms of the handle decomposition of a four manifold. Disclaimer: I am not an expert in this area!

Joye Chen — Rational homotopy theory primer

4/3 1:45PM - 2:45PM @MIT 2-449

Homotopy groups are notoriously difficult to compute, but work of Quillen and Sullivan shows that the *rational* homotopy groups $\pi_*(X) \otimes \mathbb{Q}$ are significantly more tractable. In fact, there is a beautiful equivalence between the rational homotopy category of simply-connected spaces and the homotopy category of minimal differential graded algebras. In this talk, I will explain where the equivalence comes from with an emphasis on differential-geometric points of view. I will also survey some applications to topology, for example, the classification of Kähler manifolds in dimensions ≥ 6 up to diffeomorphism and their diffeomorphism groups, etc.

Ollie Thakar — The moduli space of multi-monopoles on a Riemann surface

4/4 9:30AM - 10:30AM @Harvard SC-530

The Seiberg-Witten equations with 2 spinors are a simple generalization of the Seiberg-Witten equations which have been originally motivated by making more powerful gauge-theoretic invariants of 3- and 4-manifolds, as well as understanding associative submanifolds of Riemannian 7-manifolds with G2 holonomy. On a Riemann surface, however, these equations admit an algebro-geometric interpretation as describing a generalization of Brill-Noether varieties. In this talk I will describe the moduli space of solutions to this equation on a Riemann surface and its complex-geometric interpretation. Then, I will resolve a question of Doan which is to compute the Euler characteristics of these spaces.

Gheehyun Nahm — Secret!

4/4 10:45AM - 11:45AM @Harvard SC-530

You'll find out...

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