Exotica II Workshop

Location: Merkin Center, 8th floor of Caltech Hall, 1200 E California Blvd, Pasadena

Day 1: Thursday, November 12, 2026

9:00-10:00: **JungHwan Park (Seoul National University):** *$S^2 \times S^2$ stabilizations*

10:00-10:30: Coffee break

10:30-11:30: **Zoltan Szabo (Princeton University):** *Complex surfaces of general type and smooth 4-manifolds*

11:45-12:30: Organizational meeting

12:30-2:00: Lunch

2:00-3:30: Working groups

3:30-4:00: Coffee break

4:00-5:00: Working groups

5:00-5:30: **Danny Ruberman (Brandeis University):** *Equivalent exotic surfaces in small 4-manifolds*

5:30-6:30: Happy hour

Day 2: Friday, November 13, 2026

9:00-10:00: **Richard Bamler (UC Berkeley):** *Recent progress in 4-dimensional Ricci flow and potential applications to topology*

10:00-10:30: Coffee break

10:30-11:30: **Inanc Baykur (U. Mass Amherst):** *Lefschetz fibrations for exotica*

11:30-1:30: Lunch

1:30-3:30: Working groups

3:30-4:00: Coffee break

4:00-5:00: Working groups

5:00-5:30: **Gheehyun Nahm (Princeton University):** *An irreducible real projective plane in the 4-sphere*

5:30-6:30: Happy hour

Day 3: Saturday, November 14, 2026

9:00-10:00: **Maggie Miller (UT Austin):** *Exotic surface problems*

10:00-10:30: Coffee break

10:30-11:30: **Jin Miyazawa (RIMS, Kyoto University):** *Techniques in real Seiberg-Witten theory*

11:30-1:30: Lunch

1:30-3:30: Working groups

3:30-4:00: Coffee break

4:00-5:00: Working groups

5:00-5:30: **Jennifer Hom (Georgia Tech):** *Heegaard Floer and knot traces*

5:30-6:30: Happy hour

Day 4: Sunday, November 15, 2026

9:00-10:00: **Anthony Conway (UT Austin):** *On the homeomorphism classification of closed 4-manifolds*

10:00-10:30: Coffee break

10:30-11:30: **Qiuyu Ren (Stanford University):** *Khovanov skein lasagna modules and surfaces in 4-manifolds*

11:30-1:30: Lunch

1:30-3:00: Working groups

Organizers: Ciprian Manolescu (Stanford) and Lisa Piccirillo (UT Austin).

Funding comes from the *Simons Foundation* (through the Simons Collaboration Grant in Low Dimensional Topology). We thank Sergei Gukov and the Merkin Center staff for their help.

Abstracts

Richard Bamler
Title: Recent progress in 4-dimensional Ricci flow and potential applications to topology

Abstract: The Ricci flow (with surgery or through singularities) has proven to be a powerful tool in the study of 3-dimensional topology, its most prominent application being the verification of the Poincaré and Geometrization Conjectures by Perelman.

Recent developments suggest that a theory of Ricci flow through singularities in dimension 4 is now within reach. The approach draws on a new compactness and partial regularity theory for Ricci flow, a degree theory for expanding solitons developed jointly with Eric Chen, and the resolution of the mean convex neighborhood conjecture for mean curvature flow in joint work with Yi Lai. Together, these results provide tools for understanding and resolving conical and cylindrical singularities and point toward a construction of a 4-dimensional flow through singularities.

I will begin with a brief overview of Ricci flow in dimension 3 and explain the geometric intuition behind the expected 4-dimensional picture. I will describe the tools that are already available, how they fit into the proposed construction, and the remaining problems and possible approaches to them. Finally, I will discuss potential topological applications and further analysis of the flow, including ways of obtaining stronger geometric control, that may reveal new connections between 4-dimensional topology and geometric analysis.

Anthony Conway
Title: On the homeomorphism classification of closed 4-manifolds

Abstract: The first half of the talk will survey what is known about the classification of closed, orientable 4-manifolds. The second half will instead focus on challenges that impede further progress on the topic. Overall, this will be a survey talk and, while no new results will be presented, another goal will be to convince the audience that (a) much remains unknown and (b) results in the area rarely follow promptly from Freedman's seminal work.

Jennifer Hom
Title: Heegaard Floer and knot traces

Abstract: We show that the numerical invariants \nu and |\epsilon| coming from knot Floer homology are n-trace invariants for any integer n, resolving the remaining case in Hayden-Mark-Piccirillo. This extension allows us to construct new families of exotic pairs of knot traces using Yasui patterns. This is joint work with Shunyu Wan.

Gheehyun Nahm
Title: An irreducible real projective plane in the 4-sphere

Abstract: Until recently, every known knotted real projective plane in the 4-sphere could be expressed as the connected sum of a knotted 2-sphere and an unknotted real projective plane. Such knotted real projective planes are called reducible, or of Kinoshita type, and the Kinoshita conjecture stated that every knotted real projective plane in the 4-sphere is reducible.
I will begin by surveying previous work on knotted real projective planes and discuss why many examples are reducible. Then, I will present an irreducible real projective plane in the 4-sphere. This is joint work with Mark Hughes, Seungwon Kim, and Maggie Miller.

JungHwan Park
Title: $S^2 \times S^2$ Stabilizations

Abstract: I will survey what is known about $S^2 \times S^2$ stabilizations of smooth structures on 4-manifolds.

Qiuyu Ren
Title: Khovanov skein lasagna modules and surfaces in 4-manifolds
Abstract: Skein lasagna module is a skein theory for embedded surfaces in 4-manifolds. We give a survey of existing results in the literature. As an illustration of "lasagna-type" arguments, we discuss a joint work with Fang-Rong Zhan which shows that Khovanov-induced maps are insensitive under rim surgeries on the cobordisms, answering a question of Hayden. We present two proofs, both making essential use of the lasagna theory.

Danny Ruberman
Title: Equivalent exotic surfaces in small 4-manifolds

Abstract: Two S, S' in a 4-manifold are said to be exotic if they are topologically isotopic, but not smoothly isotopic. By the isotopy extension theorem, smoothly isotopic surfaces are smoothly equivalent, ie related by a self-diffeomorphism of the ambient manifold. We give a number of constructions of pairs of surfaces that are topologically isotopic, smoothly equivalent, but not smoothly isotopic. The method shows that they are not even Torelli equivalent (ie related by a diffeomorphism that induces the identity on all homology groups). The ambient manifolds are small: $CP2\#(S2 \times S2)$ and $(S2 \times S2)\#(S2 \times S2)$. We find related examples with boundary; these live in even smaller manifolds, such as a punctured $S2 \times S2$. This is joint work with Dave Auckly, Hokuto Konno, Anubhav Mukherjee, and Masaki Taniguchi.

List of Participants

Valentina Bais (MPIM Bonn)
Richard Bamler (UC Berkeley)
İnanç Baykur (U. Mass Amherst)
Anthony Conway (UT Austin)
Robert Gompf (UT Austin)
Sergei Gukov (Caltech)
Gary Guth (Stanford)
Kyle Hayden (Rutgers)
Kristen Hendricks (Rutgers)
Jennifer Hom (Georgia Tech)
Mark Hughes (Brigham Young University)
Mrunmay Jagadale (Caltech)
Adam Levine (Duke University)
Jiakai Li (Stanford)
Ciprian Manolescu (Stanford)
Maggie Miller (UT Austin)
Jin Miyazawa (RIMS - Kyoto Univ.)
Porter Morgan (UT Austin)
Anubhav Mukherjee (USC)
Gheehyun Nahm (Princeton)
Yi Ni (Caltech)
Paul Orland (Caltech)
Patrick Orson (Cal Poly)
JungHwan Park (Seoul National University)
Lisa Piccirillo (UT Austin)
Qianhe Qin (Caltech)
Qiuyu Ren (Stanford)
Daniel Ruberman (Brandeis)
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Andras Stipsicz (Renyi Institute)
Josef Svoboda (Caltech)
Zoltan Szabo (Princeton)
Michael Willis (Texas A&M)
Ian Zemke (U. Oregon)