Algebraic Geometry and Topology (Canada/Korea)
Géométrie algébrique et topologie (Canada/Corée)
(Org: **Alejandro Adem** (UBC) and/et **Jong Hae Keum** (KIAS))

HANS BODEN, McMaster University
Metabelian $\mathrm{SL}(n, C)$ representations of knot groups

In this talk, which is a report on joint work with Stefan Friedl, I will explain why, for n prime (or more generally n a prime power), every irreducible metabelian $\mathrm{SL}(n, \mathbb{C})$ representation of a knot group factors through a finite group. It is a consequence that every such representation is conjugate to an $\mathrm{SU}(n)$ representation and that there are only finitely many (up to conjugation). I will present a simple formula for this number in terms of the Alexander polynomial of the knot. This result is the natural $n > 2$ generalization of a result of Nagasato on metabelian $\mathrm{SL}(2, \mathbb{C})$ representations of knot groups.

PATRICK BROSNAN, UBC

JAE CHOON CHA, POSTECH
Torsion in link concordance and Hirzebruch-type invariants from iterated p-covers

We obtain invariants of topological homology cobordism of 3-manifolds and link concordance from iterated p-covers. Our invariants have values in certain L-groups and can detect torsion which is invisible via signature invariants. We also show that the invariants can extract information from arbitrarily higher terms of the derived series of the fundamental group. Applications include the first proof of the conjecture that the Bing double of the figure eight knot is not slice.

OCTAV CORNEA, University of Montreal, Montreal, QC
Numerical Invariants for Lagrangian Submanifolds

We show that the understanding of certain natural algebraic invariants associated to a class of Lagrangian submanifolds (called wide) is intimately related to certain number theoretic questions via the theory of quadratic forms. This relation is significant because it offers a conceptual perspective on the definition of some enumerative invariants involving genus zero pseudo-holomorphic curves with boundary.

This talk is based on joint work with Paul Biran.

LISA JEFFREY, Mathematics Dept., University of Toronto
Real loci of based loop groups

The based loop group is an infinite-dimensional analogue of a coadjoint orbit. It can be equipped with an antisymplectic involution. It is possible to prove a form of Duistermaat's convexity theorem in this situation, and to study the cohomology ring (with Z_2 coefficients) of the fixed point set of the involution.

Joint work with Augustin-Liviu Mare.

JOEL KAMNITZER, University of Toronto
Categorical $\mathrm{sl}(2)$ actions and equivalences of categories

Actions of the Lie algebra $\mathrm{sl}(2)$ on vector spaces arise naturally in combinatorics, geometry, and algebra. Such an action consists of a sequence of vector spaces with linear maps between them satisfying certain relations.

From this perspective, one can define an action of $\mathrm{sl}(2)$ on a category to be a sequence of categories with functors between them satisfying certain relations. Such actions were studied by Chuang–Rouquier in the context of representations of the symmetric group in positive characteristic. More recently, Cautis, Licata, and the speaker studied an action of $\mathrm{sl}(2)$ where the categories involved were derived categories of coherent sheaves on cotangent bundles to Grassmannians. Following the ideas of Chuang–Rouquier, we used this $\mathrm{sl}(2)$ action to construct an equivalence of derived categories between different cotangent bundles of Grassmannians.

JONGHAE KEUM, KIAS, Hoegiro 187, Seoul 130-722, Korea
Rational homology projective planes

A normal projective complex surface is called a rational homology projective plane (rhpp) if it has the same Betti numbers with the complex projective plane. It is known that a rhpp with quotient singularities has at most 5 singular points. So far all known examples have at most 4 singular points. In this talk, we prove that such a rhpp has at most 4 singular points except one case. The exceptional case comes from Enriques surfaces with a special configuration of 9 smooth rational curves. This answers a question posed by J. Kollár.

We also obtain a similar result in the symplectic orbifold case.

This is related to a conjecture posed by D. Montgomery and C. T. Yang in the 1970s about differentiable circle actions on the 5-dimensional sphere S^5 with finitely many non-free orbits. Some progress on this problem will also be discussed.

YOUNG-HOON KIEM, Dept of Math., Seoul National University, Seoul 151-747, Korea
Virtual wall crossing formulas for simple flips

The wall crossing formula for simple C^*-flip was established by Jeffrey and Kirwan and by Guillemin and Kalkman. In this talk, I will discuss virtual analogues of the wall crossing formula. If $M+$ and $M-$ are two suitable proper separated Deligne–Mumford stacks, which are open in the quotient stack $[X/C^*]$, where X is a separate DM C^*-stack equipped with an equivariant perfect obstruction theory, a formula for the difference of the virtual intersection numbers on $M+$ and $M-$ with respect to the induced perfect obstruction theories will be given via the virtual localization formula. When the obstruction theory is strongly symmetric (which means formally the local defining equation is an exact 1-form), a more precise formula for the difference in the virtual invariants will be provided in terms of the weights on the normal spaces at fixed components.

This is a joint work with Jun Li (Stanford).

YONG-GEUN OH, University of Wisconsin, Department of Mathematics, 480 Lincoln Drive, Madison, WI 53706, USA
Seidel's long exact sequence on Calabi–Yau manifolds

In this talk, we will explain how construction of Seidel's long exact sequence of Floer cohomology under the symplectic Dehn twists can be extended to general, especially closed, Calabi–Yau manifolds. The highlight of the talk is our usage of the notion of "anchored Lagrangian submanifolds" and some study of compactness issue of the moduli space of pseudo-holomorphic sections in the setting of symplectic Lefschetz fibrations.

JONGIL PARK, Department of Mathematical Sciences, Seoul National University, 599 Gwanak-ro, Gwanak-gu, Seoul 151-747, South Korea
Symplectic 4-manifolds with $b_2^+ = 1$ versus complex surfaces with $p_g = 0$

One of the fundamental problems in the study of 4-manifolds is to find a new family of simply connected smooth (symplectic, complex) 4-manifolds. Though many interesting 4-manifolds have been constructed using techniques such as fiber sum, rational blow-down, knot surgery, Luttinger surgery and so on, it is still very hard to find a new family of 4-manifolds with small Euler characteristic.

Since I discovered a new simply connected symplectic 4-manifold with $b_2^+ = 1$ and $c_1^2 = 2$ in 2004 using a rational blow-down surgery, many new simply connected 4-manifolds with small Euler characteristic have been constructed and now it is one of

most active research areas in 4-manifolds theory to find a new family of 4-manifolds with $b_2^+ = 1$ (equivalently $p_g = 0$ in complex category).

The aim of this talk is to review recent development in the construction of 4-manifolds with small Euler characteristic. In particular, I'd like to survey the existence problems of simply connected symplectic 4-manifolds with $b_2^+ = 1$ and complex surfaces of general type with $p_g = 0$.