THE UNIVERSITY   **OF HONG KONG**

Institute of Mathematical Research
Department of Mathematics

MINI COURSE

Hyper-Kähler categories

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Summary: The goal of these lectures is to introduce the notion of hyper-Kähler categories, study some construction techniques and see how these new objects may help to give answers to classical questions coming from moduli theory and algebraic geometry.

Lecture 1:   Classical hyper-Kähler manifolds
April 15, 2016 (Friday), 3:00 – 4:00pm

Abstract: I will recall the definition of hyper-Kähler manifolds, their importance as building blocks of manifolds with trivial canonical bundle (Beauville-Bogomolov theorem). I will talk about construction techniques (namely moduli spaces of sheaves on K3 and abelian surfaces). I will also explain why these techniques fail to produce new examples (namely: bad singularities).

Lecture 2:   Categorical crepant resolutions of singularities
April 15, 2016 (Friday), 4:00 – 5:00pm

Abstract: I will give an overview of the theory of categorical/non-commutative crepant resolutions of singularities as developped by Kuznetsov and Van den Bergh. I will focus on their relations with classical birational geometry and some existence results of categorical crepant resolutions for Gorenstein varieties with rational singularities. Many examples will be discussed. In this and the following lectures, I will assume some basic knowledge of derived categories of coherent sheaves on algebraic varieties.

Lecture 3:   Hyper-Kähler categories
April 19, 2016 (Tuesday), 4:00 – 5:00pm

Abstract: I will introduce the notions of hyper-Kähler categories. I will describe their relations to classical hyper-Kähler manifolds and to the Homolgical Mirror Symmetry conjecture of Kontsevich. I will focus on some constructions techniques using the theory of categorical crepant resolutions of singularities. I will also discuss the deformation theory of such categories.

Lecture 4:   Examples and applications of the theory of hyper-Kähler manifolds
April 21, 2016 (Thursday), 4:00 – 5:00pm

Abstract: I will apply the theory of hyper-Kähler categories to describe in detail two new objects lying at the boundary of representation theory and algebraic geometry:
-   non-commutative Hilbert scheme of points on a K3 surfaces,
-   minimal compactifications of moduli spaces of symplectic bundles on a K3 surfaces.
I will especially focus on examples.

Lecture 5:   Examples and applications of the theory of hyper-Kähler categories
April 22, 2016 (Friday), 3:00 – 4:30pm

Abstract: I will apply the theory of hyper-Kähler categories to describe in detail two new objects lying at the boundary of representation theory and algebraic geometry:
-   non-commutative Hilbert scheme of points on a K3 surfaces,
-   minimal compactifications of moduli spaces of symplectic bundles on a K3 surfaces. I will especially focus on examples.

Room 210, Run Run Shaw Bldg., HKU

All are welcome