

**New Trends in Representation  
Theory:  
The Impact of Cluster Theory in  
Representation Theory**

LMS-CMI Research School  
University of Leicester

Monday 19th June - Friday 23rd June 2017

Research School Guide

Organisers: Karin Baur and Sibylle Schroll

We thank the London and Mathematical Society (LMS) and the Clay Mathematics Institute (CMI) for their generous support as well as the Heilbronn Institute for Mathematical Research (HIMR) and the University of Leicester.

# Schedule

## Monday 19th June

*8.30 Coffee and registration*

**09.00 - 10.00** L1 (Lidia Angeleri Hügel): *Lectures on infinite dimensional representations*

*10.00 - 10.30 Coffee*

**10.30 - 11.30** L2 (Sophie Morier-Genoud): *Lectures on integrable systems and friezes*

**11.30 - 12.30** L3 (Peter Jørgensen): *Lectures on  $n$ -representation theory*

*12.30 - 13.30 Lunch*

**13.30 - 14.30** Self-Study

**14.30 - 15.00** Coffee

**15.00 - 16.00** Pierre-Guy Plamondon: *Group actions on quivers from triangulated surfaces with punctures*

*16.00 - 17.30 Tutorial*

## Tuesday 20th June

**09.00 - 10.00** L2 (Sophie Morier-Genoud)

*10.00 - 10.30 Coffee*

**10.30 - 11.30** L3 (Peter Jørgensen)

**11.30 - 12.30** L1 (Lidia Angeleri Hügel)

*12.30 - 13.30 Lunch*

**13.30 - 14.30** Self-Study

**14.30 - 15.00** Coffee

**15.00 - 16.00** Martin Herschend, *Higher preprojective algebras*

*16.00 - 17.30 Tutorial*

## Wednesday 21st June

**09.00 - 10.00** L3 (Peter Jørgensen)

*10.00 - 10.30 Coffee*

**10.30 - 11.30** L1 (Lidia Angeleri Hügel)

**11.30 - 12.30** L2 (Sophie Morier-Genoud)

*12.30 - 13.30 Lunch*

## Thursday 22nd June

**09.00 - 10.00** L2 (Sophie Morier-Genoud)

*10.00 - 10.30 Coffee*

**10.30 - 11.30** L3 (Peter Jørgensen)

**11.30 - 12.30** L1 (Lidia Angeleri Hügel)

*12.30 - 13.30 Lunch*

**13.30 - 14.30** Self-Study

**14.30 - 15.00** Coffee

**15.00 - 16.00** Mike Prest: *Definable categories*

**16.00 - 17.30** *Tutorial*

**19.00** *Research school dinner: Barceloneta*

## **Friday 23th June**

**09.00 - 10.00** L1 (Lidia Angeleri Hügel)

**10.00 - 10.30** *Coffee*

**10.30 - 11.30** L2 (Sophie Morier-Genoud)

**11.30 - 12.30** L3 (Peter Jørgensen)

**12.30 - 13.30** *Lunch*

**13.30 - 14.30** Self-Study

# Participants

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# Lecturers, TA's and Organisers

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# Titles (and Abstracts)

**Martin Herschend** (Uppsala) – **Higher preprojective algebras**

**Pierre-Guy Plamondon** (Orsay) – **Group actions on quivers from triangulated surfaces with punctures**

**Mike Prest** (Manchester) – **Definable categories**

**Lidia Angeleri Hügel** (Verona) – **Lectures on infinite dimensional representations**

Tutorials by Jorge Vitoria

The work of Aihara-Iyama and Adachi-Iyama-Reiten shows that mutation in cluster theory can be studied in terms of the notion of a silting complex. In this lecture series we will consider non-compact silting complexes over an arbitrary ring. As in the compact case, such complexes are in bijection with certain t-structures and co-t-structures in the derived module category. We will focus on silting modules, the module theoretic counterparts of 2-term silting complexes. They generalise tilting modules over an arbitrary ring, as well as support  $\tau$ -tilting modules over a finite dimensional algebra. We will discuss their role in approximation theory and localisation theory. For example, for hereditary rings or finite dimensional algebras of finite representation type, silting modules parametrize universal localisations and wide subcategories of finitely presented modules. As a consequence, we will see that the homological ring epimorphisms of a finite dimensional hereditary algebra form a lattice which completes the poset of noncrossing partitions. We will also discuss some constructions of infinite dimensional representations over finite dimensional hereditary or canonical algebras that lead to classification results for silting, tilting, or pure-injective modules.

**Peter Jørgensen** (Newcastle) – **Lectures on  $n$ -representation theory**

Tutorials by Gustavo Jasso

The course will cover the definitions of  $n$ -abelian and  $n$ -angulated categories due to Jasso and Geiss-Keller-Oppermann. The main examples will arise from  $n$ -representation finite algebras as defined by Iyama, and the higher Auslander-Reiten theory of these algebras will be explained. We will also consider higher APR tilting and higher cluster categories in Dynkin type A and explain the resulting combinatorics in terms of cyclic polytopes; this is due to Iyama-Oppermann and Oppermann-Thomas. Higher torsion classes and higher  $t$ -structures will be introduced and it will be explained how there is a bijection between the two types of structures generalising the classic bijection due to Happel-Reiten-Smalø.

**Sophie Morier-Genoud** (Paris) – **Lectures on integrable systems and friezes**

Tutorials by Max Glick

The notion of integrability, which goes back to Euler and Jacobi, is a central one in mathematics. Integrable systems appear in many areas of mathematics, unifying diverse ideas in algebra, geometry, and physics. The course will focus on particular systems

exhibiting mutation dynamics as in the recent theory of cluster algebras of Fomin and Zelevinsky. Frieze patterns defined by Coxeter in the 1970s give a simple concrete example of such systems. The course will present recent developments around the notion of friezes in connection with representation theory and cluster integrability.

## Food and Local Information

The research school will take place in the Ken Edwards building which is right next to the Student Union which has a shop and a Starbucks. All of the scheduled events will take place in Lecture Theatre 2. We have also access to room 324 (in the same building) as an additional study and work option.

### Lunch on campus

There will be a selection of sandwiches and other handy lunch food available in the foyer in front of the lecture room.

Alternatives to the provided lunch are: A cafeteria style self-service eatery is available in the Charles Wilson building on the first floor. This offers a choice of hot meals (including a vegetarian option), soups, sandwiches and salads along with many gluten free options. Alternatively, there are many other places on campus where one can buy lunch. Also located in the Charles Wilson building on the ground floor is Chi, a contemporary cafe restaurant with an international theme; and delic!ous, which has a deli style sandwich and baguette bar and a self-service salad bar, along with many gluten free options.

### Workshop dinner

The workshop dinner will be held on Thursday at 18.30. The dinner will take place at Barceloneta which is located on Queens Road and serves Spanish tapas.

### Eating in town

There are numerous pubs, bars and restaurants in or near the town centre where one would be able to order food. Leicester is known to have a large number of Indian curry houses and there are multiple places to choose from along Granby street and London road. In particular, Kayal tends to be a popular choice amongst members of the department. There are also plenty of vegetarian restaurants in Leicester. Mirch Masala, which can be found on Market Street (near the end of New Walk) serves a variety of cuisines, including Indian, Indo-Chinese, Italian and Mexican. Shivali serves vegetarian Indian buffet-style food and can be found on Welford road.

Should one prefer pizza, The Criterion is a pub on Milestone Lane that offers a selection of real ales along with a wide variety of (stone-baked) pizzas. They have an extensive array of ingredients in storage, which allows for plenty of flexibility should one wish to customise their pizza. Peter Pizzeria (located on Welford Place, opposite the end of New Walk) is a fairly quirky new addition to the Leicester dining experience, which serves a variety of authentic Italian pizzas and, amongst many other weird and wonderful features, has a few 'game rooms' with table tennis, table football and several board games.

There are of course many other places further in town where food is available, google and tripadvisor are usually good guides.

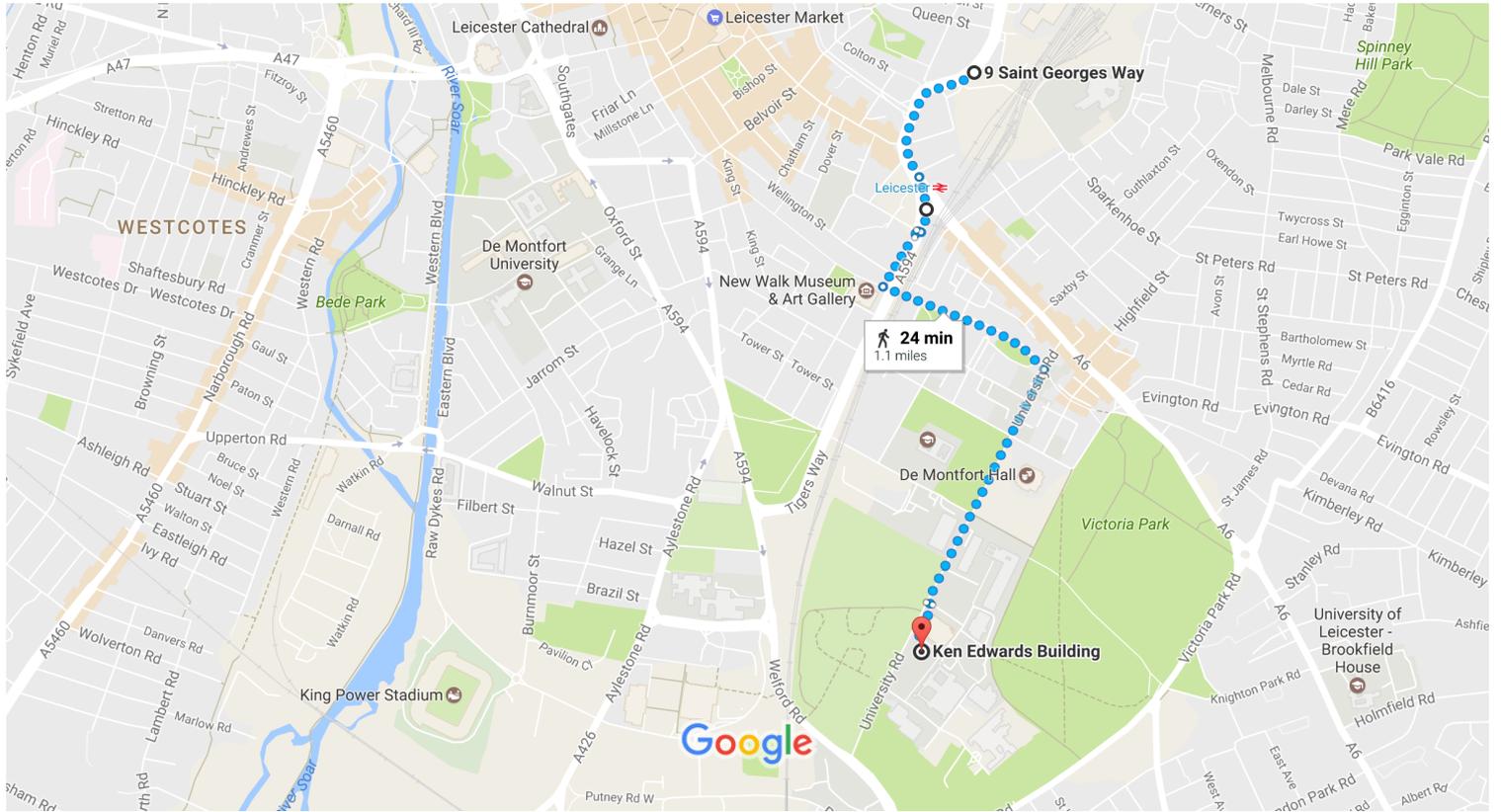
### Getting to the University

On the following page is a map with an indicated way to walk from the Ibis (the Premier Inn is also located on St George's Way, about 200 yards closer to the Uni than the Ibis). This way of walking goes along the pedestrian only New Walk (including a pedestrian only bridge across Tigers Way), which is a more pleasant way to walk than going along London road.



# 9 St Georges Way, Leicester LE1 1PL to Ken Edwards Building, Leicester

Walk 1.1 miles, 24 min



Map data ©2017 Google 200 m



via A594 and University Rd  
Mostly flat

24 min  
1.1 miles