July 17th 9,00-15,30: EMS/EWM Survey Lectures 2016

9,00-10,00 **Fanny Kassel** (CNRS and Université de Lille)
"Tessellations of the plane and beyond"
Abstract. Tessellations of the plane have been used since antiquity as decorative patterns. With the development of modern mathematics, periodic tilings of R^n have been extensively studied in relation to crystallography; they include Euclidean tilings but also, more generally, tilings whose symmetry group consists of affine transformations. When the tiles are noncompact, the symmetry group may no longer be a group of translations up to finite index, and tilings with interesting nonsolvable symmetry groups have been constructed since the 1980s. We will survey some of the major developments in the field.

10,00-11,00 **Hannah Markwig** (Universität des Saarlandes)
"Tropical geometry"
Abstract. Tropical geometry is a degeneration technique allowing a combinatorial (or, convex geometry) approach to algebraic geometry, and, in particular, enumerative geometry. In enumerative geometry, we count geometric objects (mostly curves) satisfying certain conditions. Such counting problems have been studied by the Ancient Greek already and remain an active area of research. Using tropical geometry, many enumerative problems can be boiled down to combinatorial problems involving graphs. We present recent developments involving tropical curve counts.

11,00-12,00 **Carola-Bibiane Schoenlieb** (University of Cambridge)
"Seeing more in pictures - a mathematical perspective"
Abstract.
Much of what we call big data consists of visual data such as photographs or videos, acquired and stored in various contexts, ranging from online image databases in libraries, security applications such as CCTV or security screening on airports, to clinical imaging data in hospitals. This data needs to be processed, analysed, and classified, and very often is used to inform decisions based on the information extracted. Image data plays a special role in data science, as the information that it encodes is usually very complex and structured, and is prone for access by mathematical models and techniques. Indeed, images are a rich source of beautiful mathematical formalism and analysis.
In this talk we will discuss a collection of mathematical approaches and their use and realisation for solving particular image analysis and processing tasks such as image de-noising, de-blurring and segmentation, object tracking and motion estimation, as well as image classification. The talk is furnished with applications of the introduced models in biomedical and clinical imaging, remote sensing for forest ecology, and restoration of paintings and illuminated manuscripts.

13,30-14,30 **Britta Späth** (University of Wuppertal)
"Representation Theory of finite Groups: Old Conjectures - new Challenges"
Abstract.
Groups describe symmetries of mathematical objects and hence appear in different areas of mathematics. Groups can be studied via representations, that are group morphisms into matrix groups. In the study of representations over fields of positive characteristic p some strong connection between the representation theory of a finite group and that of its p-local subgroups became apparent. More connections were then observed by Brauer, McKay, Alperin and Dade. That lead them to several still open conjectures. In the last decade, a new reduction approach has

offered the hope of a proof of the conjectures by using the classification of finite simple groups. This leads to new problems, essentially related with the representation theory of finite groups of Lie type. In the talk we explain the overall program up to the most recent results.

14,30-15,30 **Sarah Zerbes** (University College London)
"Elliptic curves and the conjecture of Birch and Swinnerton-Dyer"
Abstract.
An important problem in number theory is to understand the rational solutions to algebraic equations. One of the first non-trivial examples, cubics in two variables, leads to the theory of so-called elliptic curves. The famous Birch—Swinnerton-Dyer conjecture, one of the Clay Millenium Problems, predicts a relation between the rational points on an elliptic curve and a certain complex-analytic function, the L-function on an elliptic curve. In my talk, I will give an overview of the conjecture and of some new results establishing the conjecture in special cases.

Chairwoman **Alessandra Celletti** (Università di Roma Tor Vergata)

Wednesday July 20th, 16,30

Public Lecture by **Alessandra Celletti** (University of Roma Tor Vergata)
"Chaotic routes that shaped the universe: a history of some outstanding women scientists".
Abstract.
That planets and satellites orbit, in the 2-body approximation, on regular elliptic trajectories is known since the work of Johannes Kepler. But in the following centuries mathematicians realized that the 3-body problem leads to completely different solutions, possibly chaotic. This was a dramatic change of perspective due to Henri Poincaré, who introduced chaos in science.
That chaos could influence also human life was well described in a play written by Sofia Kovalevskaya. But nobody could imagine that a small group of women, hired by chance at Harvard observatory at the turn of the XX century, could strongly contribute to our present understanding of the universe.

Chairwoman **Carola-Bibiane Schoenlieb** (University of Cambridge)