Monday

13:00-14:00 ***Registration and coffee***

14:00-14:45 **Christian Hirsch**

Large Deviation Principle for Geometric and Topological Functionals and Associated Point Processes

We prove a large deviation principle for the point process associated to k-element connected components in R^d with respect to the connectivity radii $r_n \to \infty$. The random points are generated from a homogeneous Poisson point process, so that $(r_n)_{n\geq 1}$ satisfies $n^k r_n^{d(k-1)} \to \infty$ and $nr_n^d \to 0$ as $n \to \infty$ (i.e., sparse regime). The rate function for the obtained large deviation principle can be represented as relative entropy. As an application, we deduce large deviation principles for various functionals and point processes appearing in stochastic geometry and topology. As concrete examples of topological invariants, we consider persistent Betti numbers of geometric complexes and the number of Morse critical points of the min-type distance function.
This talk is based on joint work with Takashi Owada.

15:00-15:45 **Marie-Colette van Lieshout**

State estimation for aoristic models

Aoristic data can be described by a marked point process in time in which the points cannot be observed directly but are known to lie in observable intervals, the marks. We consider Bayesian state estimation for the latent points when the marks are modelled in terms of an alternating renewal process in equilibrium and the prior is a Markov point process. We derive the posterior distribution, estimate its parameters and present some examples that illustrate the influence of the prior distribution. The model is then used to estimate times of occurrence of interval censored crimes. Finally, we briefly discuss generalisations to marks modelled in terms of an inhomogeneous semi-Markov process.
This talk is based on joint work with Robin Markwitz.

16:00-16:45 **Sergei Zuyev**

Limits of superpositions of point processes: branching stability and selfdecomposablility

Limit theorems for superposition of independent point processes (PPs) must involve an operation that makes them “thinner” so that a limit of superposition of their growing number exists. It is analogous to scaling for random variables, but to preserve a PP framework, this “scaling” of a PP must be stochastic acting independently on the PP’ points. We show that the most general such operation on a PP is independent subcritical branching of its points. The easiest example is given by pure-death process that is equivalent to independent thinning of points. Given such an operation, one can formulate limit theorems for superposition of independent PPs aiming to characterise all possible limits. The processes which may arise as a limit are selfdecomposable (SD) PPs which are a strict subclass of infinitely divisible (ID) PPs. At the same time, it is strictly larger than the class of strictly stable PPs which arise as a limit of scaled superposition of i.i.d. PPs. Since SD PPs are also ID, their distribution is characterised by Levy measure (also known as KLM measure in PP context) and it has a special integral representation from potential theory and the theory of general Markov processes. We generalize known results for stable and SD random variables to the PP setup, including the LePage representation and stochastic integral form of SD PPs.

16:45- **Poster session and welcome drinks**

Tuesday

9:00-9:15 ***Coffee***

9:15-10:00 **Tobias Müller**

Percolation on hyperbolic Poisson-Voronoi tessellations

I will discuss percolation on the Voronoi tessellation generated by a homogeneous Poisson point process on the hyperbolic plane. That is, we colour each cell of the hyperbolic Poisson-Voronoi tessellation black with probability p and white with probability 1-p, independently of the colours of all other cells. We say that percolation occurs if there is an infinite connected cluster of black cells.

Hyperbolic Poisson-Voronoi percolation was first studied by Benjamini and Schramm about twenty years ago. Their results show that there are some spectacular differences with the corresponding model in the Euclidean plane.

I will sketch joint work with the recently graduated doctoral candidate Ben Hansen that resolves a conjecture and an open question, posed by Benjamini and Schramm, on the behaviour of the ``critical probability for percolation'' as a function of the intensity parameter of the underlying Poisson process. (Unlike in Euclidean Poisson-Voronoi percolation, this critical value depends on the intensity of the Poisson process.)

Based on joint work with Benjamin Hansen.

10:15-11:00 **Mathew Penrose**

Some new results on random geometric graphs

The random geometric graph (RGG) is obtained by placing a Poisson(n) number of vertices uniformly at random in a the unit cube in R^d and connecting any two vertices distant at most r apart. We discuss two new results on large-n asymptotics with $r = r(n)$ a specified sequence.

1. Consider the soft RGG where each edge of the RGG is retained with fixed probability p. When $d = 2$ and $r = r(n)$ taken so $nr^2 = b$ for some fixed b, the proportion of vertices in the largest component converges in probability to a deterministic limit, namely the percolation probability in the corresponding random connection model with Poisson intensity b.

2. Suppose $nr^d \to \infty$ and $n\,r^d/log\,n \to 0$ as $n \to \infty$. For any fixed positive integer k,

The asymptotic number of vertices in components of order k in the RGG is determined.

11:00-11:30 ***Coffee break***

11:30-12:15 **Rob van den Berg**

A forest fire process beyond the critical time

We study forest fire processes on a planar lattice, where vacant vertices independently switch from vacant to occupied at rate 1, and any connected component of occupied vertices ``is burnt'' (its vertices become instantaneously vacant) as soon as its cardinality crosses a certain threshold N. Initially all vertices are vacant.

We prove the somewhat counterintuitive result that there is a time t strictly larger than t_c (the time at which an infinite occupied cluster would arise in the model without fires) such that the probability that the origin burns before time t tends to 0 as $N \to \infty$. This provides a negative answer to an open problem by Van den Berg and Brouwer in Comm. Math. Phys.(2006).
Informally speaking, the result can be interpreted in terms of the emergence of fire lanes of which the total density is negligible (as N tends to ∞), but which nevertheless are sufficiently robust with respect to recoveries.
To prove the above mentioned property, we substantially extend key results by Kiss, Manolescu and Sidoravicius (2015), and use these to show that a deconcentration result by van den Berg, Kiss and Nolin (2018) for volume-frozen percolation (a model without recoveries) also holds for the forest-fire process.
The talk is based on joint work with Pierre Nolin (City Univ. of Hong Kong).

12:15-14:30 ***Lunch***

14:30-15:00 **Bas Lodewijks**
Bernoulli percolation on the random geometric graph
Given $\lambda > 0$, $p \in [0,1]$ and a Poisson Point Process Po(λ) in R^2 with intensity λ, we consider the random graph $G = G(\lambda, p)$ with vertex set Po(λ) in which every pair of vertices at distance at most 1 forms an edge with probability p, independently of other pairs. Our study is motivated by the question of locality for bond percolation on the standard random geometric graph $G(\lambda, 1)$.
We show that for a large class of graphs converging locally to $G(\lambda, 1)$ in a suitable sense, the corresponding critical percolation thresholds converge to that of $G(\lambda, 1)$.
The proof is based on a finite volume criterion. In this direction, we strengthen recent results of Penrose by showing that the size of the largest component rescaled by n converges almost surely to a constant, and providing sharp bounds for the size of the second-largest component.

15:00-15:30 **Daniel Willhalm**
Limit theory of sparse random geometric graphs in high dimensions
We study topological and geometric functionals of high-dimensional l_∞ -random geometric graph in a sparse regime, where the expected number of neighbors decays exponentially in the dimension. More precisely, we establish moment asymptotics, central limit theorems and Poisson approximation theorems for certain functionals that are additive under disjoint unions of graphs. For instance, this includes simplex counts and Betti numbers of the Rips complex, as well as general subgraph counts of the random geometric graph. We also present multi-additive extensions that cover the case of persistent Betti numbers of the Rips complex.
Joint work with Gilles Bonnet, Christian Hirsch and Daniel Rosen.

15:30-16:00 ***Coffee break***

16:00-16:30 **Joost Jorritsma**
Cluster sizes in kernel-based spatial random graphs
We study component sizes in a large class of spatially-embedded supercritical random graphs that includes long-range percolation, continuum scale-free percolation, and the

age-dependent random connection model. That is, for $CC(0)$ being the component in the infinite graph that contains a vertex at the origin, we show that, for some $\zeta \in (0,1)$, $P(k \leq |CC(0)| < \infty) = e^{(-k^{\zeta+o(1)})}$ as k tends to infinity. In this talk, we will heuristically identify a formula for ζ as the maximum of four terms with respect to the model parameters. Moreover, I will highlight the intimate relation between sub-exponential decay of the cluster-size distribution and the size of the second-largest component when the graph is restricted to the vertices in a box of volume $\Theta(n)$.
If time permits, we will explore the key difficulties in a proof for the regime where the graphs are similar to continuum scale-free percolation.
Based on joint work with Júlia Komjáthy and Dieter Mitsche.

16:30-17:00 **Neeladri Maitra**
Scaling of the clustering function in spatial inhomogeneous random graphs
In this talk, we consider an infinite model of spatial inhomogeneous random graphs that interpolates between popular spatial random graphs like the Hyperbolic Random Graph, Geometric Inhomogeneous Random Graph and the Age-dependent random connection model. We study the clustering function of a typical vertex in this model - in particular, how it scales, as the degree of the typical vertex grows to infinity. It is known from earlier work that the Hyberbolic Random Graph exhibits a phase transition of this scaling in terms of the model parameters - but it was unclear what drives this phase transition. In this talk, we will get some explanation of this phase transition. Moreover, we will see a further phase transition to a regime where the clustering function is a constant, while decaying like the square of log at the boundary of this phase transition.

17:00- **Workshop dinner**
Gezana Eritrean Restaurant
Willemstraat 37, 5611HC Eindhoven, The Netherlands

Wednesday

9:00-9:15 ***Coffee***

9:15-10:00 **Luisa Andreis**
Spatial coagulation processes: hydrodynamic limits and gelation
Interacting particle systems where particles interact via coagulation are of great interest for their various behaviours. In particular, interesting phenomena can occur, depending on the structure of the kernel which is giving a rate to each coagulation. Among these phenomena there is the famous phase transition that goes under the name of gelation, i.e. the appearence of one (or multiple) giant particle(s).
Although fluid limits are known for the rescaled version of stochastic coag- ulation processes (convergence to the Smoluchowski coagulation equation and its modification) when the particles are well mixed in space and the coagula- tion does not depend on the spatial component, very few is known in the case in which the position of particles plays a role. In this talk we will present a first approach to deal with spatial positions in coagulation processes, sufficient conditions for gelation and hydrodynamic limits.
This is based on ongoing joint works with Wolfgang K˙onig (WIAS and TU Berlin), Tejas

Iyer (WIAS), Heide Langhammer (WIAS), Elena Magnanini (WIAS) and Robert Patterson (WIAS).

10:15-11:00 **Alessandra Cipriani**
Scale-free percolation mixing time
Scale-free percolation is a spatial inhomogeneous random graph model which features three fundamental properties that are often present in real-world networks: (1) scale-free: the degree of the nodes follows a power law; (2) small-world: two far-away nodes have typically a small graph distance; (3) positive clustering coefficient: two nodes with a common neighbour have a good chance to be linked. We study the mixing time of the simple random walk on this structure in one dimension and depict a rich phase diagram in the parameters of the model, in particular we show that the presence of hubs can speed up the mixing of the chain. Joint work with Michele Salvi (Università di Tor Vergata).

11:00-11:30 ***Coffee break***

11:30-12:15 **Dieter Mitsche**
Tail bounds for detection times in mobile hyperbolic graphs
Motivated by Krioukov et al.'s model of random hyperbolic graphs for real-world networks, and inspired by the analysis of a dynamic model of graphs in Euclidean space by Peres et al., we introduce a dynamic model of hyperbolic graphs in which vertices are allowed to move according to a Brownian motion maintaining the distribution of vertices in hyperbolic space invariant. For different parameters of the speed of angular and radial motion, we analyze tail bounds for detection times of a fixed target and obtain a complete picture, for very different regimes, of how and when the target is detected: as a function of the time passed, we characterize the subset of the hyperbolic space where particles typically detecting the target are initially located.
We overcome several substantial technical difficulties not present in Euclidean space, and provide a complete picture on tail bounds. On the way, we obtain also new results for the time more general continuous processes with drift and reflecting barrier spent in certain regions, and we also obtain improved bounds for independent sums of Pareto random variables.
Joint work with Marcos Kiwi and Amitai Linker.

12:15-14:30 ***Lunch***

14:30-15:00 **Marco Seiler**
On the contact process in a evolving random environment
Recently, there has been an increasing interest in interacting particle systems on evolving random graphs, respectively in time evolving random environments. We are particularly interested in the contact process in an evolving (edge) random environment on (infinite) connected and transitive graphs. We assume that the evolving random environment is described by an autonomous ergodic spin systems with finite range, for example by dynamical percolation. This background process determines which edges are open or closed for infections.
In particular, we discuss the phase transition of survival and the dependence of the

associated critical infection rate on the random environment and on the initial configuration of the system. For the latter, we state sufficient conditions such that the initial configuration of the system has no influence on the phase transition between extinction and survival. We show that this phase transition coincides with the phase transition between ergodicity and non-ergodicity and discuss conditions for complete convergence. At the end of the talk we consider the special case of a contact process on dynamical percolation as an application.

15:00-15:30 **John Fernley**

The Contact Process on a Graph Adapting to Infection Density

We prove a phase transition for the contact process, a simple model for infection without immunity, on a homogeneous random graph which reacts dynamically to the infection to try to prevent an epidemic. This graph initially has the distribution of an Erdos-Rényi network, but is made adaptive via updating in only the infected neighbourhoods, at constant rate. Under these graph dynamics, the presence of infection can help to prevent the spread and so many monotonicity-based techniques fail; instead we show an upper bound by coupling to the local limit of the graph around an outbreak which is a dynamic forest, and putting a particular reversible stochastic upper bound for the infection on each local tree.

Joint work with Peter Mörters and Marcel Ortgiese.

15:30-16:00 ***Coffee break***

16:00-16:30 **Ali Khezeli**

Unimodular Continuum Spaces

The scaling limit of various discrete models in probability theory are random pointed metric spaces that satisfy some kind of mass transport principle. With this motivating example, we will introduce the notion of unimodular continuum measured metric spaces. This notion is, in some sense, a common generalization of (the Palm version of) stationary point processes, (the Palm version of) stationary random measures, unimodular graphs and unimodular discrete spaces. In addition, we define the notions of stationary point processes and random measures on a unimodular continuum space. In this general setting, we will extend the notions of intensity, Palm theory and some related tools of stochastic geometry. This allows us to define various notions of `equivariant dimension' for a unimodular continuum space.

16:30-17:00 **Anh Duc Vu**

Nontrivial Phase Transition on the Manhattan Grid

Our model of interest is the following rectangular tesselation of R^2:

Generate infinitely long vertical lines whose coordinates are given by a 1-dimensional Poisson point process on the x-axis. Then, generate infinite horizontal lines in the same way. We will call these lines "streets". This results in our random "Manhattan grid" environment. We now randomly put pedestrians on the streets, i.e. points of a Poisson point process. Two pedestrians are connected to each other if their distance is below some fixed constant. Our main question is whether there is an infinite connected component of pedestrians or not.

The random environment features infinitely long-ranged dependencies, so a lot of standard percolation techniques are not applicable. Identifying super- and subcritical regimes also turns out to be hard. Surprisingly enough, we will deal with both cases using the so called randomly stretched lattice.
Based on joint work with Benedikt Jahnel and Sanjoy Kumar Jhawar.

Thursday

9:00-9:15 **C*offee***

9:15-10:00 **Hanna Döring**
Poisson cylinder sets for modelling mobile telecommunication networks
One way to model telecommunication networks are static Boolean models. However, dynamics such as node mobility have a significant impact on the performance evaluation of such networks. Consider a Boolean model in the plane and a random direction movement scheme. Take time as the third dimension, we model these movements via cylinders. Applying Stein's method, we derive central limit theorems for functionals of the union of these cylinders. The volume, the number of isolated cylinders and the Euler characteristic of the random set are considered and give an answer to the achievable throughput, the availability of nodes, and the topological structure of the network. I will also present two further cylinder models.
This is joint work with Carina Betken, Stephan Bussmann and Lianne de Jonge.

10:15-11:00 **Alexandre Stauffer**
Mixing time of random walk on dynamical random cluster
We consider a random walk jumping on a dynamic graph (that is, the graph changes at the same time as the walker moves) given by Glauber dynamics on the random cluster model. In this model, the edges of the graph change their state, between open and closed, via a dynamics with unbounded dependences. We derive tight bounds on the mixing time when the density of open edges is small enough. For the proof, we construct a non-Markovian coupling using a multiscale analysis of the environment.
This is based on joint work with Andrea Lelli.

11:00-11:30 ***Coffee break***

11:30-12:15 **Alexander Drewitz**
Percolation, long-range correlations and critical exponents on transient graphs
Percolation models have been playing a fundamental role in statistical physics for several decades by now. They had initially been investigated in the gelation of polymers during the 1940s by chemistry Nobel laureate Flory and Stockmayer. From a mathematical point of view, the birth of percolation theory was the introduction of Bernoulli percolation by Broadbent and Hammersley in 1957, motivated by research on gas masks for coal miners. One of the key features of this model is the inherent stochastic independence which simplifies its investigation, and which has lead to deep mathematical results. During recent years, the investigation of the more realistic and at the same time more complex situation of percolation models with long-range correlations has attracted significant attention.

We will exhibit some recent progress for the Gaussian free field with a particular focus on the understanding of the critical parameters in the associated percolation models. What is more, we also survey recent progress in the understanding of the model at criticality via its critical exponents as well as the universality in the local geometry of the underlying graph.
This talk is based on joint works with A. Prévost (U Geneva) and P.-F. Rodriguez (Imperial College).

12:15-14:30 ***Lunch***

14:30-15:00 **Gioele Gallo**
Percolation of the Gaussian free field on Galton-Watson trees
The study of Gaussian free field level sets on supercritical Galton-Watson trees has been initiated by Abächerli and Sznitman in *Ann. Inst.Henri Poincaré Probab.Stat., 54(1):173--201, 2018*. We continue this investigation by means of entirely different tools and generalize their main result on the positivity of the associated percolation critical parameter h_* to the setting of arbitrary supercritical offspring distribution and random conductances. A fortiori, this gives a positive answer to the open question raised at the end of the aforementioned article and. What is more, it also provides a rigorous proof in our setting of the mantra, established in the physics literature, that positive correlations facilitate percolation when compared to the independent case. Our proof proceeds by constructing the Galton-Watson tree through an exploration via finite random walk trajectories. This exploration of the tree progressively unveils an infinite connected component in the random interlacements set on the tree, which is stable with respect to small random noise. Using a Dynkin-type isomorphism theorem we then infer the strict positivity of the critical parameter h_*. As a byproduct of our proof we obtain transience of the random interlacement set and the level sets of the Gaussian free field above small positive levels on such Galton-Watson trees.

15:00-15:30 **Alice Callegaro**
Branching annihilating random walk with local self-regulations
Branching annihilating random walks are interacting particle systems that appear as a natural mathematical tool to model the spread of a population competing for spatial resources. The classical methods for proving survival heavily rely on monotonicity properties of the system and are therefore not applicable in this context. We consider a model on the lattice in which particles branch, perform jumps within a certain radius of their parent and are killed whenever they occupy the same site. We study the extinction and survival of the system under different parameter regimes and prove results about the particle density on the survival cluster.
The talk is based on ongoing joint works with Nina Gantert (TU Munich), Matthias Birkner (University of Mainz), Jiri Cérny (University of Basel) and Pascal Oswald (University of Basel).

15:30-16:00 ***Coffee break***

16:00-16:30 **Minwei Sun**
Interlacement limit of a stopped random walk trace on a torus

In this talk, we will consider a simple random walk on the d-dimensional integer lattice to start at the origin and stop on its first exit time from $(-L, L)^d$. Write L in the form $L = mN$ with $m = m(N)$ and N, an integer going to infinity in such a way that $L^2 AN^d$ for some real constant $A > 0$. The main result is that for dimensions higher than and equal to 3, the projection of the stopped trajectory to the N-torus locally converges, away from the origin, to an interlacement process at level $Ad\sigma_1$, where σ_1 is the exit time of a Brownian motion from $(-1,1)^d$ that is independent of the interlacement process.
The talk is based on joint work with Antal A. Jarai.

16:30-17:00 **Léo Régnier**

Complete visitation statistics of 1d random walks

Random walks are often used to describe exploration processes of a spatial domain, such as dynamics on the web or relaxation in disordered media. One of the most fundamental observable to describe this process is the number of distinct sites visited up to time t, $N(t)$. This quantity has been extensively studied in the physical and mathematical literature: its average, variance, single time distribution $\mathbb{P}(N(t))$, or even its covariance Cov$(N(t_1), N(t_2))$ have been characterized. However, little was known about the multiple time distribution which is crucial to fully describe the exploration process.
In my talk, I will present the results given in [1], in which we determine the complete statistical behavior of the stochastic process $\left(N(t)\right)_{t\geq 0}$, namely the probability that n_1, n_2, n_3, ... distinct sites are visited at times t_1, t_2, t_3, ...
From this multiple-time distribution, we show that the visitation statistics of 1d random walks are temporally correlated and we quantify the non-Markovian nature of the process. We exploit these ideas to derive unexpected results for the two-time trapping problem and also to determine the visitation statistics of two important stochastic processes, the run-and-tumble particle and the biased random walk.

Friday

9:00-9:15 **C*offee***

9:15-10:00 **François Baccelli**

Recent results on unimodular networks

We will first introduce unimodular random graphs and present several examples which will serve as illustration throughout the talk. These examples come from the theory of point processes, branching processes, random walks and self-similar discrete random sets.
Our first focus will be on deterministic dynamics on such graphs. Such a dynamic can be seen as a set of navigation rules on the nodes of the graph, when the rules are functions of the local geometry of the rooted graph. We will give a classification of these dynamics based on the properties of their stable manifolds.
The second focus will be on two new notions of dimension for such graphs, namely their unimodular Minkowski and Hausdorff dimensions. A toolbox will

be presented for the analysis of these dimensions, with in particular unimodular analogues of Billingsley's lemma and Frostman's lemma. Several further results of general interest will also be established, like for example unimodular extensions of classical results of Palm calculus and ergodic theory.
This survey is based on a series of articles in collaboration with M.-O. Haji-Mirsadeghi and A. Khezeli. This research is supported by the NEMO ERC grant 788851 to INRIA.

10:15-11:00 **Bartek Blaszczyszyn**
Limit theory for asymptotically de-correlated dynamic spatial random models
We consider statistics of spatially dependent interacting particle systems in R^d, $d \geq 1$, in which there are two sources of randomness, namely the random set of locations (sites) of the particles and, possibly evolving, states of the particles at these sites. Each site has a random interaction neighborhood with a radius determined by the choice of the model and the spatial locations of nearby sites. The radii of the interaction neighborhoods are a.s. finite (but not necessarily bounded), the initial states may be dependent, and the sites may be given by a spatially dependent point process.
Each site is equipped with a Poisson clock which updates the state of the particle at the site and all other states of particles in the interaction neighborhood. We restrict the particle system to the window W_n of volume n and establish the asymptotic normality, expectation, and variance asymptotics of statistics of the system evolution as W_n increases up to R^d. The limit theory for statistics of these particle systems follows from general theorems for statistics of a class of spatially dependent random structures based om marked point processes, in which states (marks) and sites (points) dynamically interact but their dependencies become asymptotically de-correlated over the spatial domain W_n.
Particle systems considered here include continuum versions of exclusion models, generalized random sequential adsorption and ballistic deposition models, finite time-horizon epidemic and voter models, divisible sandpile models, and majority models.
Joint (ongoing) work with D. Yogeshwaran and J. E. Yukich.

11:00-11:30 ***Coffee break***

11:30-12:15 **Peter Gracar**
The contact process on scale-free geometric random graphs
We study the contact process on a class of geometric random graphs with scale-free degree distribution, defined on a Poisson point process on $\mathbb{R}^d$. This class includes the age-dependent random connection model and the soft Boolean model. In the ultrasmall regime of these random graphs we provide exact asymptotics for the non-extinction probability when the rate of infection spread is small and show for a finite version of these graphs that the extinction time is of exponential order in the size of the graph.
Joint work with Arne Grauer.