Workshop: "Francesca Romana Nardi: A life in probability, building communities across Europe"

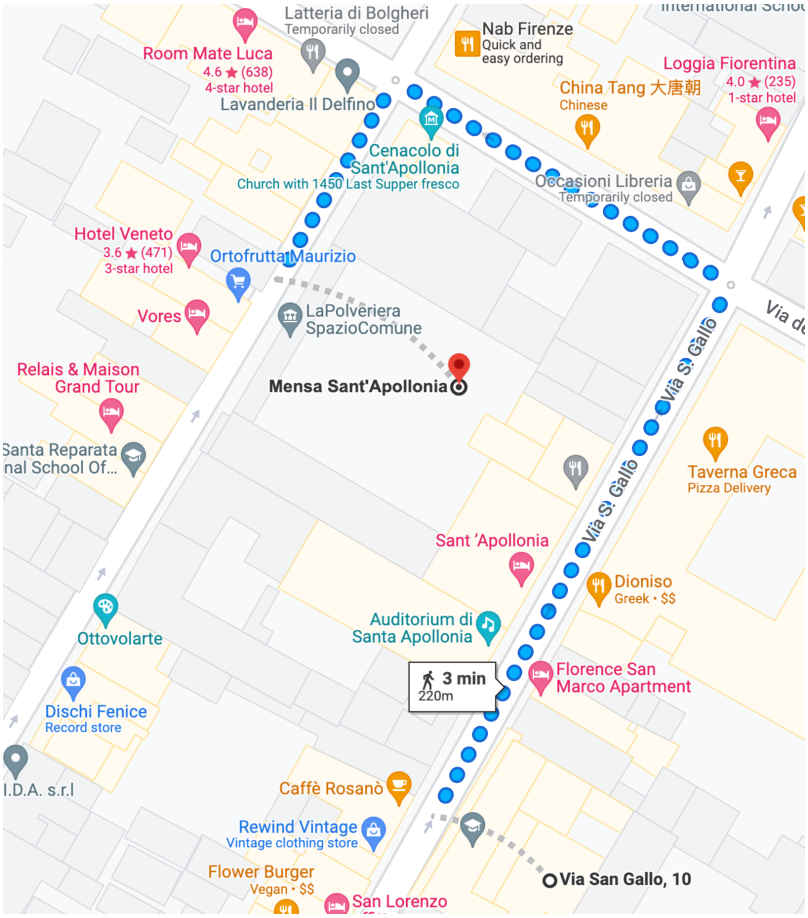
July 18-22, 2022, Firenze

Conference Venue:

Università di Firenze, Via S. Gallo 10, 50129 Firenze (Google Maps link)
The room is Aula Magna, located at the first floor.

Lunch venue:

Mensa Sant'Apollonia, Via S. Reparata 12, 50129 Firenze (Google Maps link)
This is located at 200m from the conference venue, see map below.



Conference Program

	Morning sessions				
09:00			Frank den Hollander		
09:45	Arrival and coffee	Emilio Cirillo	Matteo Quattropani	Nina Gantert	Remco v.d. Hofstad
10:30	Opening session	30 min break	30 min break	30 min break	Fabio Coppini *ends at 11:15*
11:00	Paolo dai Pra	Alessandra Faggionato	Valentina Apollonio	Cristian Spitoni	30 min break *11:15 – 11:45*
11:45	Alessandra Bianchi	Giada Basile	Benedetto Scoppola	Wioletta Ruszel	Luisa Andreis
12:30	Lunch break	Lunch break	Lunch break	Lunch break	Maria E. Vares *ends at 13:15*
	Afternoon sessions				Lunch break
14:30	Roberto Fernandez	Alessandro Zocca	Elena Pulvirenti	Siamak Taati	
15:15	Vanessa Jacquier	Matteo Sfragara	Alessio Troiani	Gianmarco Bet	
16:00	30 min break	30 min break	Free afternoon	30 min break	
16:30	Simone Baldassarri	Alexandre Gaudillere		Memorial session	
17:15	Anna Gallo	Milos Zahradnik			
20:00				Conference dinner	

Conference dinner (Thursday July 21st, 20:00)

The dinner will take place at **Serre Torrigiani, Via Gusciana 27, 50124 Firenze** (Google Maps link)

Memorial session (Thusday July 21st, 16:30)

Speakers who wants to share some memories or stories about Francesca are encouraged to do so during their talk. All other participants who may want to share something can do so using this dedicated memorial session. Please let any of the organizers know ahead of time.

For those who want to join the memorial session virtually, the details are as follows:

Zoom meeting clickable link
Zoom Meeting ID: 695 4139 0649
Passcode: 64025257

Book of abstracts

Paolo Dai Pra

Università degli Studi di Verona

Phase transition in mean-field Ising Games

We consider a system of interacting spins whose time evolution is determined by a non-cooperative minimization of individual energy functions (Nash equilibrium). For any finite number of spins this minimization determines uniquely the dynamics. In the formal thermodynamic limit this uniqueness is lost: several macroscopic equilibria seem to emerge. We investigate the details of this thermodynamic limit in the case of the energies corresponding to the (disordered) Curie-Weiss model.

Alessandra Bianchi

Università degli Studi di Padova

Random walks on a Lévy-type random media

We consider a one-dimensional process in random media that generalizes a model known in the physical literature as Levy-Lorentz gas. The medium is provided by a renewal point process in which the inter-distances between points are i.i.d. heavy-tailed random variables, while the dynamics is obtained as the linear interpolation of - possibly long jump - random walks on the point process. These models have been used to describe phenomena that exhibit superdiffusion, and the main focus of this investigation is on the derivation of the scaling behavior of the process as a function of the parameters that enter its definition. We give an account on a number of recent theorems, which include non-standard functional limit theorems for the process in discrete and continuous time, and a comparison between the annealed and the quenched settings.

Roberto Fernandez

NYU Shangai

High-temperature cluster expansion for classical and quantum spin lattice systems with multi-body interactions

We develop a novel cluster expansion for finite-spin lattice systems subject to multi-body quantum – and, in particular, classical – interactions. Our approach is based on the use of "decoupling parameters", advocated by Park, which relates partition functions with successive additional interaction terms. Our treatment, however, leads to an explicit expansion in a β-dependent effective fugacity that permits an explicit evaluation of free energy and correlation functions at small β. To determine its convergence region we adopt a relatively recent cluster summation scheme that replaces the traditional use of Kikwood-Salzburg-like integral equations by more precise sums in terms of particular tree-diagrams.

Vanessa Jacquier

Scuola Normale Superiore

Critical droplets and sharp asymptotics for Ising model on the hexagonal lattice

We consider the Ising model on the hexagonal lattice evolving according to Metropolis dynamics. We study its metastable behavior in the limit of vanishing temperature when the system is immersed in a small external magnetic field. We determine the asymptotic properties of the transition time from the metastable to the stable state up to a multiplicative factor and study the mixing time and the spectral gap of the Markov process. We give a geometrical description of the critical configurations and show how not only their size but their shape varies depending on the thermodynamical parameters. Finally we provide some results concerning polyiamonds of maximal area and minimal perimeter.

Simone Baldassarri

Università degli Studi di Firenze

Nucleation for the metastable Kawasaki dynamics with strongly anisotropic interactions

In this talk we analyze nucleation in the context of the metastable Kawasaki dynamics for the two-dimensional Ising lattice gas at very low temperature. Let $\Lambda \subset \mathbb{Z}^2$ be a finite box. Particles perform simple exclusion on Λ, but when they occupy neighboring sites they feel a binding energy $-U_1 < 0$ in the horizontal direction and $-U_2 < 0$ in the vertical one. We consider the parameter regime $U_1 > 2U_2$, also known as the strongly anisotropic regime, and the asymptotic regime corresponding to finite volume in the limit as $\beta \to \infty$. We determine the asymptotic properties of the transition time from empty (metastable state) to full (stable state) up to a multiplicative factor and we investigate how the nucleation takes place, with particular attention to the critical configurations that asymptotically have to be crossed with probability one. This is based on joint works with F.R. Nardi.

Anna Gallo

IMT Lucca

Tunneling behavior of the $q-$state Potts model with zero external magnetic field

In this talk we focus on the ferromagnetic q-state Potts model with zero external field in a finite volume evolving according to Glauber-type dynamics described by the Metropolis algorithm in the low temperature asymptotic limit. The analysis concerns the multi-spin system that has q stable equilibria. Focusing on grid graphs with periodic boundary conditions, we study the tunneling between two stable states and from one stable state to the set of all other stable states. In both cases we identify the set of gates for the transition and prove that this set has to be crossed with high probability during the transition. Moreover, we identify the tube of typical trajectories and prove that the probability to deviate from it during the tunneling transition is exponentially small.

Emilio Cirillo

Università di Roma "La Sapienza"

Metastability for three-state systems

In three-state systems coexisting metastable states an be observed. In my long collaboration with Francesca we had the chance to study this phenomenon both in Probabilistc Cellular Automata and in lattice spin systems. In this talk I will review some of the results that we proved in the framework of the Blume-Capel model and I will discuss some open problems that I am now investigating with V. Jacquier and C. Spitoni.

Alessandra Faggionato

Università di Roma "La Sapienza"

Random resistor networks on simple point processes and Mott's law

We consider random resistor networks with nodes given by a simple point process on $\mathbb{R}^d$ and with random conductances. The length range of the electrical filaments can be unbounded. We assume that the randomness is stationary and ergodic w.r.t. the action of the group G, given by $\mathbb{R}^d$ or $\mathbb{Z}^d$. Under very basic and minimal assumptions we prove that a.s. the suitably rescaled directional conductivity of the resistor network along the principal directions of the effective homogenized matrix D converges to the corresponding eigenvalue of D times the intensity of the simple point process. We further focus on the Miller-Abrahams random resistor network for conduction in amorphous solids as doped semiconductors and derive the celebrated Mott's law.

Giada Basile

Università di Roma "La Sapienza"

Large deviations for binary collision models

I will present some recent results on large deviation asymptotics of stochastic models with binary collisions that preserve energy. The paradigmatic model is the Kac's walk, that, in the kinetic limit, is described by the homogeneous Boltzmann equation. I will discuss the large deviation principle and I will exhibit some paths, with probability exponentially small in the number of particles, that violate energy conservation.

This is a joint work with L. Bertini, D. Benedetto and E. Caglioti.

Alessandro Zocca

Vrije Universiteit Amsterdam

A tale of tunneling times

In this talk I will survey several results about tunneling times between the stable states of finite-volume interacting particle systems we obtained together with Francesca. I will start with the original problem that made us interested in tunneling times, that is the study of the performance of certain random-access protocols for wireless networks. After having presented the main theoretical results obtained in the low-temperature limit, I will then give an overview of the several model-specific results and highlight their dependence on the geometry of the considered lattices.

Based on joint work with F.R. Nardi, S.C. Borst, and J.S.H. van Leeuwaarden.

Matteo Sfragara

Stockholm University

Competing first passage percolation on the configuration model

In this talk we will discuss competing first passage percolation on graphs generated by the configuration model, where two infection types compete to invade the vertices in the graph. Initially, two uniformly chosen vertices are infected with type 1 and type 2 infection, respectively, and the infection then spreads via nearest neighbors. The time it takes for the type 1 (resp. 2) infection to traverse an edge e is given by a random variable $X_1(e)$ (resp. $X_2(e)$) and, if the vertex at the other end of the edge is still uninfected, it then becomes type 1 (resp. 2) infected and immune to the other type. We first introduce the mathematical model, assuming that the degrees follow a power-law distribution with exponent τ, and present some known results in the case of finite variance ($\tau > 3$) and in the case of finite mean but infinite variance ($2 < \tau < 3$.) We then focus on the case of infinite mean ($1 < \tau < 2$) and show that, with high probability as the number of vertices n tends to infinity, one of the infection types occupies all vertices except for the starting point of the other type. Moreover, both infections have a positive probability of winning regardless of the passage times distribution. The result is also shown to hold for the erased configuration model and when the degrees are conditioned to be smaller than n^α for some $\alpha > 0$.

This talk is based on joint work with Mia Deifen (Stockholm University) and Remco van der Hofstad (Eindhoven University of Technology).

Alexandre Gaudillere

Centre National Recherche Scientifique (CNRS)

Looking at frogs and forests with Francesca

I will first tell how Francesca and I started exploring frog models to deal with a conservative metastable dynamics. Next I will recall how Francesca's cycle paths are rooted in the theory of Wentzell's graphs or random forests. I will eventually explain how the idea that one could grow a random forest by looking at frogs going to sleep led us to prove that many sleepy frogs in a finite space form a metastable system in all dimensions. This last part is based on joint works with Nicolas Forien and Amine Asselah.

Milos Zahradnik

Charles University in Prague

Resummation of cluster expansion and self-avoiding trees

Take a standard cluster expansion of a polymer model where clusters are collections of polymers equipped with a connected graph (subgraph of the complete graph of all incompatible pairs). We want to exploit the many cancellations appearing in these expansion sums. The (possibly new?) resummation method we propose converts the sums over clusters containing a polymer P into sums over "umbel" structures we call self-avoiding circular trees (SCT), which are rooted - simply or multiply - in polymer P. A simply rooted SCT has branches of the type $P, Q, R, ...$ where polymers Q etc. may appear as multiple ones but always ordered in a (unique w.r.t. the predecessor P) circle $P, Q, ..., Q, P$. Moreover, polymers of SCTs "avoid" (in a sense that is made precise using an auxiliary ordering of polymers) the polymers preceding them in their corresponding branch. Such resummations of cluster expansion sums open a way for simple, sharp estimates for their convergence and also are, in modified form suitable for models where compatibility of polymers means disjointness of the supports, a suitable prerequisite for further analytical investigation of these sums in the case of exactly solvable models.

This is joint work with Oliver Nagy.

Frank den Hollander

Leiden University

Metastability for the Widom-Rowlinson model with grains of general shape

We consider the Widom-Rowlinson model on $\mathbb{R}^d$, $d \geq 2$, with grains that have a general shape, possibly random in size and in orientation. We consider both a static and a dynamic version of the model. In the static version, the grains are distributed according to a Gibbs measure in which the reference measure is a Poisson process with unit intensity, allowing the grains to overlap, and the interaction Hamiltonian depends on the total volume of the union of the grains, called the halo. In the dynamic version, grains disappear at unit rate and reappear at a rate that depends on the interaction Hamiltonian, in such a way that the static model is the reversible equilibrium of the dynamic model (= heat-bath dynamics). Grains once created do not move. We show that the static model has a liquid-gas phase transition. We show that the dynamic model exhibits metastable behaviour close to the phase transition curve, in the limit of high intensity and low temperature. With the help of large deviation principles for the halo, we derive the leading term in the asymptotics of the average metastable crossover time for the transition from gas to liquid when the system is supersaturated but starts in the gas phase (= condensation). This term is controlled by the volume of the halo. We further formulate a conjecture for the correction term in the asymptotics, which is controlled by the surface of the halo. We identify how both terms scale with the parameters of the model.

Joint work with S. Jansen (Munich), R. Kotecký (Warwick), E. Pulvirenti (Bonn), D. Yogeshwaran (Bangalore).

Matteo Quattropani

Leiden University

Exponential hitting times for rapidly mixing Markov chains

In the talk I will present an alternative proof of the so called "First Visit Time Lemma" (FVTL), introduced by Cooper and Frieze in '05. Essentially, the lemma states that if a Markov chain mixes sufficiently fast and the stationary distribution is sufficiently well-spread, then the hitting time of a given state - starting at stationarity - is (roughly) exponential. The utility of the FVTL is twofold: on the one hand it allows to control the exponential approximation up to multiplicative corrections (so to provide first order estimates even for very long times) and, on the other hand, it allows to identify explicitly the rate of the approximating exponential. Compared to the proof of Cooper and Frieze, based on complex analysis arguments, our proof is completely probabilistic and is based on classical tools such as strong stationary times and quasistationary distributions.

Based on a joint work with F. Manzo and E. Scoppola.

Valentina Apollonio

Università degli Studi di Roma Tor Vergata

Shaking the square box: a PCA approach to the Ising model

The shaken dynamics is a reversible Markovian parallel dynamics for spin systems on arbitrary graphs with nearest neighbors interaction given by a Hamiltonian function $H(\sigma)$. The transition probabilities of this dynamics are defined in terms of a pair Hamiltonian $H(\sigma, \tau) = \sum_x h_x(\sigma)\tau_x$. More precisely, for each vertex x the local field $h_x(\sigma)$ depends on the value of the spins in a neighborhood of x and on the value of the spin at site x itself through a self-interaction parameter $q > 0$. The aim of this talk is to introduce the definition of the shaken dynamics and to discuss some interesting features concerning its invariant measure both from a static and a dynamical point of view.

The results that I will present are a joint work with R. D'Autilia, B. Scoppola, E. Scoppola and A. Troiani.

Benedetto Scoppola

Università degli Studi di Roma Tor Vergata

On the Blume-Emery-Griffiths model

We describe the Blume-Emery-Griffiths model, and we study the structure of the ground states at the ferromagnetic-antiquadrupolar-disordered (FAD) interface. We present a MCMC sampler, showing numerically that at FAD for T=0 the model exhibits spontaneous magnetization for D=3, while in D=2 the spontaneous magnetization vanishes. We prove rigorously the result for D=2. Joint work with Paulo Lima, Riccardo Mariani and Aldo Procacci.

Elena Pulvirenti

Delft University of Technology

Metastability for Glauber dynamics with inhomogeneous coupling disorder

We study the metastable behaviour of a spin glass model subject to a Glauber dynamics where spins flip according to Metropolis rates at inverse temperature β. In particular, we consider an inhomogeneous model where the coupling coefficients are conditionally independent random variables and whose distribution depends on the pair of spins. Assuming metastability of the model where the couplings are averaged out (called annealed model), we give sufficient conditions for the random model to be metastable. Moreover, we give sharp bounds on the random average time the system takes to reach the set of more stable states, when it starts from a certain probability distribution on the metastable state (called the last-exit biased distribution), in the limit when the number of spins tends to infinity. In particular, we obtain for the ratio of this random hitting time and the corresponding hitting time of the annealed model estimates on the asymptotic tail behaviour of the distribution and on the moments. Our results hold for very general interaction coefficients and can be applied to a variety of models such as the Ising model on inhomogeneous dense random graphs or the randomly dilute Hopfield model. The proof uses the potential-theoretic approach to metastability and McDiarmid's concentration inequality. We rely on the definition of metastability and results by Schlichting and Slowik.

Joint work with Anton Bovier, Frank den Hollander, Saeda Marello and Martin Slowik.

Alessio Troiani

Università di Roma "La Sapienza"

Lonely Planets and Lightweight Asteroids: A Statistical Mechanics Model for the Planetary Problem

We propose a notion of stability, that we call ϵ-stability, for systems of particles interacting via Newton's gravitational potential, and orbiting a much bigger object. For these systems the usual thermodynamical stability condition, ensuring the possibility to perform the thermodynamical limit, fails, but one can use as relevant parameter the maximum number of particles that guarantees the ϵ-stability. With some judicious but not particularly optimized estimates, borrowed from the classical theory of equilibrium statistical mechanics, we show that our model has a good fit with the data observed in the Solar System, and it gives a reasonable interpretation of some of its global properties. In particular, we show that this notion of stability is consistent with the observed power law distribution of the masses of the asteroids in the main belt and provides a "thermodynamical" justification to the "Titius-Bode" law for the distances of planets from the Sun. Moreover we show that to have ϵ-stability the total mass of the objects orbiting the star must go to zero as their number grows to infinity.

Nina Gantert

Technische Universität München

Biased random walk on dynamical percolation

We study the biased random walk for dynamical percolation on the d-dimensional lattice. We establish a law of large numbers and an invariance principle for the random walk using regeneration times. Moreover, we verify that the Einstein relation holds, and we investigate the speed of the walk as a function of the bias. While for $d = 1$ the speed is monotone increasing, we show that this fails in general dimension d.

Based on joint work (in progress) with Sebastian Andres, Dominik Schmid and Perla Sousi.

Cristian Spitoni

Utrecht University

Metastability for synchronous dynamics

In this talk I will discuss the impact of a synchronous updating rule on the first excursion from a metastable state to the stable one. Despite the general formalism is similar, the parallel dynamics is utterly more puzzling due to the very intricate structure of the paths typically followed by the system. The talk will be a review of the results obtained during the years with Francesca, for a class of reversible Probabilistic Cellular Automata.

Wioletta Ruszel

Utrecht University

Random field induced order in 2d

In this talk we will discuss random field induced ordering. In particular we shall prove that a classical O(2) model subjected to a weak i.i.d. Gaussian field pointing in a fixed direction exhibits residual magnetic order on the square lattice $\mathbb{Z}^2$ and moreover aligns perpendicular to the random field direction. This type of transition is also referred to as of spin-flop type. Our approach is based on a multi-scale Peierls contour argument developed.

This is joint work with N.Crawford (Technion, Israel)

Siamak Taati

American University of Beirut

Some problems around probabilistic cellular automata

I will present some open problems on probabilistic cellular automata (PCA) and related models, and discuss the progress made in each case. The problems concern the notion of ergodicity, the invariant measures, and the connection between PCA and Gibbs measures.

Gianmarco Bet

Università degli Studi di Firenze

Weakly interacting oscillators on dense random graphs

We consider a class of weakly interacting particle systems of mean-field type. The interactions between the particles are encoded in a graph sequence. We establish a Law of Large Numbers for the empirical measure of the system that holds whenever the graph sequence is convergent in the sense of graph limits theory (i.e. it converges to a so-called graphon). The limit is shown to be the solution of a nonlinear Fokker-Planck equation weighted by the (possibly random) graphon limit. We also characterize the sequences of graphs, both random and deterministic, for which the associated empirical measure converges to the mean-field limit, i.e., to the solution of the classical McKean-Vlasov equation.

Remco van der Hofstad

Eindhoven University of Technology

The surprises of first-passage percolation on complete graphs

Imagine a world in which information can travel along edges, with edge passage times that are independent and identically distributed. Assume that the graph on which the information flows is complete. How long will it take for information to flow between vertices, and how many vertices will lie on the optimal paths? This is the problem of first-passage percolation on the complete graph. We investigate how the structure of optimal paths depends on the properties of the i.i.d. traversal times. We illustrate the surprisingly diverse behaviour based on the simple example of powers of exponential random variables, where paths can be extremely short, as well as remarkably long. An intriguing relation to the minimal spanning tree appears in profound work with Francesca, as well as Maren Eckhof and Jesse Goodman.

Fabio Coppini

Università degli Studi di Firenze

Central Limit Theorems for global and local empirical measures of diffusions on Erdős-Rényi graphs

We address the issue of the Central Limit Theorem for (both local and global) empirical measures of diffusions interacting on a possibly diluted Erdős-Rényi graph. Special attention is given to the influence of initial condition (not necessarily i.i.d.) on the nature of the limiting fluctuations. We prove in particular that the fluctuations remain the same as in the mean-field framework when the initial condition is chosen independently from the graph. We give an example of non-universal fluctuations for carefully chosen initial data that depends on the graph. A crucial tool for the proof is the use of extensions of Grothendieck inequality.

Luisa Andreis

Università degli Studi di Firenze

Large deviations for coagulation processes: An approach via graphs

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 coagulation processes (convergence to the Smoluchowski coagulation equation and its modification), very few is known about large deviations and rare events in this framework. In this talk we will explore some connections of these processes with random graphs and how to use this connection to attack the problem of studying large deviations. This also allows a comparison with the phase transition in graphs, where a giant component appears. Some remarks about the possible generalization to coagulation kernels that depend on spatial position will be given.

This is based on ongoing joint works with Wolfgang Konig (WIAS and TU Berlin), Tejas Iyer (WIAS), Heide Langhammer (WIAS), Elena Magnanini (WIAS) and Robert Patterson (WIAS).

Maria E. Vares

Federal University of Rio de Janeiro

On the contact process with dynamic edges or under renewals

The talk will focus on a class of interacting systems which is built on a percolative structure similar to that used by T. Harris for the graphical construction of the contact process. This has been object of recent research by several authors (see [1] and references therein). After a brief discussion of a robust renormalization argument for the investigation of conditions that guarantee extinction, I will discuss how we apply these ideas to obtain results on the phase diagram of the Contact Process with Dynamic Edges introduced by Linker and Remenik in [2].

This is based on joint work with M. Hilário, D. Ungaretti, and D. Valesin.

[1] L. R. Fontes, T.S. Mountford, D. Ungaretti, M. E. Vares (2021). *Renewal Contact Processes: phase transition and survival.* arXiv:2101.06207.

[2] A. Linker, D. Remenik (2020). *The contact process with dynamic edges on* $\mathbb{Z}$. Electron. J. Probab., 25.

[3] M. Hilário, D. Ungaretti, D. Valesin, M. E. Vares (2022). *Results on the contact process with dynamic edges or under renewals.* Electron. J. Probab. (to appear)