# DY 19: Physics of Contagion Processes II (joint session SOE/DY)

Time: Tuesday 10:00–10:45 Location: ZEU 260

DY 19.1 Tue 10:00 ZEU 260

**Explosive Epidemics** — •Georg Börner[1], Malte Schröder[1], Davide Scarselli[2], Nazmi Burak Budanur[2,3], Björn Hof[2], and Marc Timme[1,4,5] — [1]Chair for Network Dynamics, Center for Advancing Electronics Dresden (cfaed) and Institute of Theoretical Physics, Technische Universität Dresden, Dresden 01062, Germany — [2]Institute of Science and Technology Austria, Klosterneuburg, Austria — [3]Max Planck Institute for the Physics of Complex Systems, Dresden, Germany — [4]Cluster of Excellence Physics of Life, Technische Universität Dresden, Dresden 01062 Germany — [5]Lakeside Labs, Lakeside B04b, 9020 Klagenfurt, Austria

Standard epidemic models exhibit one continuous, second order phase transition to macroscopic outbreaks. However, interventions to control outbreaks may fundamentally alter epidemic dynamics. We reveal how such interventions modify the type of phase transition. In particular, we uncover three distinct types of explosive phase transitions for epidemic dynamics with capacity-limited interventions. Depending on the capacity limit, interventions may (i) leave the standard second-order phase transition unchanged but exponentially suppress the probability of large outbreaks, (ii) induce a first-order discontinuous transition to macroscopic outbreaks, or (iii) cause a secondary explosive yet continuous third-order transition. These insights highlight inherent limitations in predicting and containing epidemic outbreaks. More generally our study offers a cornerstone example of a third-order explosive phase transition in complex systems.

DY 19.2 Tue 10:15 ZEU 260

**Large-deviations of the SIR model under the influence of Lockdowns** — Leo Patrick Mulholland[1], •Yannick Feld[2], and Alexander K. Hartmann[2] — [1]Queen's University Belfast, United Kingdom — [2]Institute of Physics, Carl von Ossietzky University, Oldenburg, Germany

Due to the high real-wold impact of diseases, the modelling of its dynamics has long since become an important aspect of various disciplines. Statistical physics is one of them as it gives us the tools investigate the fundamental processes through which a disease spreads throughout a population.

The transmission of a disease is affected by a lot of different factors. For example in response to the SARS-CoV 2 pandemic many governmental bodies imposed interventions to impede the spread of disease. One of the earliest non-pharmaceutical interventions (NPIs) that most countries used were lockdowns.

Motivated by that, we numerically [1] study the dynamics of the susceptible-infected-recovered (SIR) model with lockdowns on small-world networks by using a large-deviation approach, which was previously used to study the case of an unimpeded spread [2]. This allows us to obtain the probability density function of the cumulative fraction of infected nodes down to very small probabilities like $10^{-55}$. The density exhibits remarkable discontinuities of the first derivative.

[1] A.K. Hartmann, *Big Practical Guide to Computer Simulations* (World Scientific, 2015)

[2] Y. Feld, A. K. Hartmann, Phys. Rev. E **105** 17 (2022)

DY 19.3 Tue 10:30 ZEU 260

**Short messages spread wider in online social networks** — Patryk A. Bojarski, •Krzysztof Suchecki, and Janusz A. Holyst — Faculty of Physics, Warsaw University of Technology, Warsaw, 00-662 Poland

We explore the behavior of an online message spreading model, that includes mutable message content, user opinions and limited processing capacities. The model shows robust power-law distribution of the number of shares for different messages and that the tail of the distribution is composed almost entirely of very short messages. The possibility to modify message content by spreaders makes already popular, short messages even more popular if the users are selective about what content they spread, but not too much. The distribution of message variants is also a power-law, in agreement with real message spreading in Facebook. The behavior of the model is robust against model parameters and network topology variations and offers an explanation as to why services focused on short messages, such as Twitter, are popular.