SOE 22: Social Systems, Opinion and Group Dynamics II

Time: Friday 11:15–12:45 Location: GÖR 226

SOE 22.1 Fri 11:15 GÖR 226

Chemistry of Social Bonds: Cooperation, Integration, Segregation, Aggression — •Juergen Mimkes — Physics Department, U. Paderborn, Germany

Relatives mix like water and wine, enemies separate like water and oil. This chemical model of integration and segregation by Empedocles (490 to 430 BC) is discussed for regular binary solutions like sugar in tea or foreigners in Germany: The amount of sugar that can be dissolved, depends on the temperature of the tea and the cohesive forces of sugar. The amount of foreigners that can be integrated in Germany, depends on the German standard of living and on the cohesive forces of the foreign group due to differences in religion, language, ethnicity, etc. In alloys the model parameters lead to cooperation (NaCl), integration (CuNi), segregation (FePb) or aggression (H2,O2). In societies sympathy leads to cooperation and order, tolerance or indifference to integration and disorder, preference to segregation and ghettos, antipathy to aggression and social conflict. The degree of integration is a thermometer of tolerance of a society. The model has been tested by intermarriage data in different binary societies: Germans and foreigners, Catholics and non-Catholics in Germany and Northern Ireland, Blacks and Whites in USA, Muslims and non-Muslims in Germany and Bosnia.

SOE 22.2 Fri 11:30 GÖR 226

Disease Dynamics on the Road and Sea Network of the Roman Empire — •Daniel Löb and Michael Ditter — Institut für Festkörperphysik, TU Darmstadt

In the latter half of the second century A.D., a pandemic known as the Antonine Plague ravaged the Roman Empire. Although it is known that it claimed on the order of millions of lives and killed at least one emperor, its severeness and therefore its contribution to the decline of the Empire are still a subject of controversy among historians.

We propose a stochastic model of disease dynamics on the travel network of the Roman Empire to solve some of the open questions surrounding the plague that historiography alone cannot answer.

Our travel network was composed using data from Roman road maps (mostly Itinerarium Antonini) and the historiographic literature, so as to get an adequate representation of the most important land and sea routes. All results are benchmarked using the surviving literary and archaeological evidence.

SOE 22.3 Fri 11:45 GÖR 226

Opinion formation and cyclic dominance in adaptive networks — •Güven Demirel[1], Roshan Prizak[2], Nitish Reddy[2], and Thilo Gross[1] — [1]Max-Planck-Institut für Physik komplexer Systeme, Dresden — [2]Department of Electrical Engineering, Indian Institute of Technology , Bombay, Powai, Mumbai, India

The Rock-Paper-Scissors(RPS) game is a paradigmatic model for cyclic dominance in biological systems. We consider this game in the social context of competition between opinions in a networked society. In our model, every agent has an opinion which is drawn from the three choices: rock, paper or scissors. In every timestep a link is selected randomly and the game is played between the nodes connected by the link. The loser either adopts the opinion of the winner or rewires the link. These rules define an adaptive network on which the agent's opinions coevolve with the network topology of social contacts. We show analytically and numerically that nonequilibrium phase transitions occur as a function of the rewiring strength. The transitions separate four distinct phases which differ in the observed dynamics of opinions and topology. In particular, there is one phase where the population settles to an arbitrary consensus opinion. We present a detailed analysis of the corresponding transitions revealing an apparently paradoxial behavior. The system approaches consensus states where they are unstable, whereas other dynamics prevail when the consensus states are stable.

SOE 22.4 Fri 12:00 GÖR 226

Unifying physical approaches to Schelling's model of segregation — •Tim Rogers and Alan McKane — School of Physics & Astronomy, The University of Manchester, Schuster Building, Manchester, M13 9PL, UK

Schelling's model of segregation is one of the first and most influential models in the field of social simulation. Over the last 40 years the model has been studied extensively, first in the fields of sociology and economics, and more recently from the perspective of statistical physics. Thus far, the interest of the physics community in Schelling's model has largely been limited to drawing tentative parallels with certain physical systems, and the proposal and simulation of variants of the model. This approach has led to a somewhat fragmented physics literature on the subject.

In this talk, I will present a unified framework for the study of Schelling model and its many variants in the context of statistical physics. A simple metamodel is introduced and its range of behaviours is studied from analytical and numerical perspectives. This methodology is useful two regards: firstly, it provides a provides a tool to differentiate between phenomena which are unique to a particular variant of the Schelling model and those which are universal; secondly, these universal phenomena may be understood in more depth through analytic studies of simpler forms of the model.

SOE 22.5 Fri 12:15 GÖR 226

Analytical calculation of fragmentation transitions in adaptive networks — •Gesa Boehme and Thilo Gross — Max-Planck-Institute for the Physics of Complex Systems, Dresden, Germany

In many adaptive networks fragmentation transitions have been observed, where the network breaks into disconnected state-homogeneous components. In network models which are based on contact processes and therefore contingent on the presence of links connecting different states (active links) this is an absorbing state. Especially models for opinion formation in social communities frequently display a phase transitions from a global homogeneous consensus state to a fragmented state. The critical parameter set, where the fragmentation transition occurs, is well known from numerical simulations, but hard to compute analytically. Moment closure approximations capture the phase transition qualitatively reasonable, but fail with respect to a precise prediction for the critical parameter values. In this talk we present an approach for determining the critical point of the fragmentation transition, which is based on ideas from percolation theory. We demonstrate the proposed approach for the example of an adaptive voter model and find a very good agreement between analytical calculations and numerical results.

SOE 22.6 Fri 12:30 GÖR 226

Bibliometric observation of a melting-like transition in the cooperation behaviour of scientists within former Yugoslavia — •Marcus John, Frank Fritsche, and Stefan Rescke — Fraunhofer-Institut für Naturwissenschaftlich-Technische Trendanalysen, Appelsgarten 2, 53879 Euskirchen, Germany

It is generally accepted that scientific work and scientific cooperation are sensitive to the societal and economic environment. But how exactly are they affected by the outbreak of social, economic or ethnic crises? To elucidate this question we have analysed the publication and cooperation behaviour of scientists in former Yugoslavia by means of a bibliometric approach treating the last 30 years. In most cases a simple gravity model describes the strength of cooperation between two republics reasonably well. We observe that this strength decreases significantly with the outbreak of ethnic conflicts at the beginning of the 1990s. Surprisingly, the state before the crisis is not restored after the conflicts have come to an end. Instead, the observerd cooperation system remains in a less strongly bound state. We conjecture that this is not due to continuing animosity between the republics, but that partners who have broken up their cooperation in the course of the crisis orientated themselves towards new cooperation partners. Thus there seems to be no need to restore the historic cooperation network after the end of the civil wars. We want to clarify this point by using techniques derived from network analysis.