PHYSICS OF SOCIO-ECONOMIC SYSTEMS
Physik sozio-ökonomischer Systeme (AKSOE)

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OVERVIEW OF INVITED TALKS AND SESSIONS
(lecture room HSZ 03, BAR 205, P2)

Invited Talks

AKSOE 1.1	Mon	09:30	(BAR 205)	**Competition Between Languages**, <u>Dietrich Stauffer</u>
AKSOE 5.1	Tue	09:30	(BAR 205)	**Communities, weak links, and small world: Empirical analysis of a huge network**, <u>Janos Kertesz</u>, Jukka-Pekka Onnela, Jari Saramaki, Jorkki Hyvonen, Gabor Szabo, Albert-Laszlo Barabasi
AKSOE 8.1	Tue	16:00	(HSZ 03)	**An empirical behavioral model for price formation**, <u>Doyne Farmer</u>, Mike Szabolcs
AKSOE 11.1	Thu	09:30	(BAR 205)	**Randomness in consensus formation**, <u>Maxi San Miguel</u>, Victor M. Eguiluz

Sessions

AKSOE 1	**Dynamics of Groups and Organizations I**	Mon	09:30–10:15	BAR 205	AKSOE 1.1–1.1
AKSOE 2	**Financial Markets and Risk Management I**	Mon	10:15–12:45	BAR 205	AKSOE 2.1–2.5
AKSOE 3	**Dynamics of Groups and Organizations II**	Mon	14:00–15:30	BAR 205	AKSOE 3.1–3.3
AKSOE 4	**Social-, Information-, and Production Networks I**	Mon	16:00–18:00	BAR 205	AKSOE 4.1–4.4
AKSOE 5	**Social-, Information-, and Production Networks II**	Tue	09:30–10:15	BAR 205	AKSOE 5.1–5.1
AKSOE 6	**Economic Models and Evolutionary Game Theory I**	Tue	10:15–12:45	BAR 205	AKSOE 6.1–6.5
AKSOE 7	**Financial Markets and Risk Management II**	Tue	14:00–15:30	BAR 205	AKSOE 7.1–7.3
AKSOE 8	**Award Ceremony: Young Scientist Award for Socio- and Econophysics**	Tue	16:00–18:00	HSZ 03	AKSOE 8.1–8.3
AKSOE 9	**Traffic Dynamics, Urban and Regional Systems**	Wed	14:00–16:00	BAR 205	AKSOE 9.1–9.4
AKSOE 10	**Poster Session (posters are expected to be displayed the full day 8:30-18:00)**	Wed	16:00–18:00	P2	AKSOE 10.1–10.71
AKSOE 11	**Dynamics of Groups and Organisations III**	Thu	09:30–10:15	BAR 205	AKSOE 11.1–11.1
AKSOE 12	**Economic Models and Evolutionary Game Theory II**	Thu	10:15–12:45	BAR 205	AKSOE 12.1–12.5
AKSOE 13	**Dynamics of Groups and Organizations IV**	Thu	14:00–15:30	BAR 205	AKSOE 13.1–13.3
AKSOE 14	**Financial Markets and Risk Management III**	Thu	16:00–18:00	BAR 205	AKSOE 14.1–14.4

Symposium: Structure Formation and Self-organization in Non-equilibrium Systems
Fr 10:30-13:30, HSZ 04
see separate program section SYSS

Special Event:
Award Ceremony of the Young Scientist Award for Socio- and Econophysics
Tue 16:00-18:00, HSZ 03
1. Keynote talk: Doyne Farmer, Santa Fe
2. Award Presentation
3. Talk of the Awardee
There will be beer and pretzels in honour of the awardee at the end of the session.

Annual General Meeting of the Section Physics of socio-economic Systems

Wed 18:00–19:00   BAR 205

Tagesordnung:
1. Bericht des Vorsitzenden des AKSOE
2. Diskussion über geplante Aktivitäten
3. Verschiedenes
gez. Stefan Bornholdt

Sessions
– Invited, Contributed Talks and Posters –

AKSOE 1 Dynamics of Groups and Organizations I

Time: Monday 09:30–10:15   Room: BAR 205

Invited Talk   AKSOE 1.1 Mon 09:30 BAR 205
Competition Between Languages — •DIETRICH STAUFFER — Institute for Theoretical Physics, Cologne University, D-50923 Koln, Euroland

Following Abrams and Strogatz 2003 and Patriarca and Leppanen 2004, five other physics groups independently started to simulate the competition of languages, as opposed to the evolution of a human language out of ape sounds, or the learning of a language by a child. This talk concentrates on the models of Christian Schulze et al and of Viviane de Oliveira et al which allow the simulation of a large number of languages, similar to today's 8,000 human languages. The first model deals with a continuous process of random mutations of a language, transfer from and to other languages, and flight away from languages spoken by only a few people. The second model combines these flight and mutation aspects, ignores transfer and describes the colonization of a large geographical region by people starting at one lattice point. The size of a language is defined by the number of people speaking it. The first model gives a realistic log-normal shape for the histogram of language sizes but the numbers are bad. For the second model our Monte Carlo simulations give sizes up to thousand million, but not the nearly log-normal shape. A meeting is planned for mid-September 2006 in Poland.

AKSOE 2 Financial Markets and Risk Management I

Time: Monday 10:15–12:45   Room: BAR 205

AKSOE 2.1 Mon 10:15 BAR 205
Phase Transition Model of Catastrophe Insurance Claims — •GORDON WOO — RMS, 30 Monument Street, London, EC3R 8NB, UK

The evolution of catastrophe insurance modeling has been punctuated by major disasters that expose new loss phenomena, and promote improved understanding of unfamiliar extreme loss regimes. Hurricane Katrina in 2005 is such a disaster. The diversification of insurance risk within a large portfolio relies on sufficient randomness in individual loss experience. The diversification benefit is eroded if randomness transitions to a state of order, as may arise through a variety of disparate factors associated with the pattern of physical damage and the claims stochastic process. Physical damage factors include ancillary hazards, such as fire, flood and environmental pollution. Claims factors diminishing randomness include coarse collective loss adjusting procedures, demand surge arising from the bottlenecking of repairs, and legal and political intervention in the claims settlement process. Hurricane Katrina has demonstrated how the randomness structure of portfolio claims may be significantly altered in a super-catastrophe. This type of phase transition is studied theoretically from an econo-physics perspective, with a dynamical model being developed for local and global interactions.

AKSOE 2.2 Mon 10:45 BAR 205
The Multi-Fractal Model of Asset Returns: Its Estimation via GMM and its Use for Volatility Forecasting — •THOMAS LUX — Department of Economics, University of Kiel, Olshausenstr. 40, 24118 Kiel

Multi-fractal processes have been proposed as a new formalism for modeling the time series of returns in finance. The major attraction of these processes is their ability to generate various degrees of long memory in different powers of returns - a feature that has been found to characterize virtually all financial prices. Furthermore, elementary variants of multi-fractal models are very parsimonious formalizations of the volatility dynamics as they essentially amount to one-parameter families of stochastic processes. The aim of this paper is to introduce a new and versatile estimation method for the causal multifractal of Calvet and Fisher (2001) and to use its parameter estimates in forecasting financial volatility. We use the auto-covariances of log increments of the multifractal process in order to estimate its parameters consistently via GMM (Generalized Method of Moment). Simulations show that this approach leads to essentially unbiased estimates, which also have much smaller root mean squared errors than those obtained from the traditional scaling approach. Our empirical estimates are used in out-of-sample forecasting of volatility for a number of important financial assets.

AKSOE 2.3 Mon 11:15 BAR 205
Risk bubbles and dynamic instability in multi-asset markets — •MATTEO MARSILI[1] and GIACOMO RAFFAELLI[2] — [1]Abdus Salam ICTP, Trieste — [2]Univ. Roma "La Sapienza"

Portfolio theory maintains that investment should be diversified across assets in order to minimize risk. If investment has an impact on prices, it generates correlations between returns of assets, and hence modifies the risk measure which determines the optimal portfolio itself. Hence the correlations enter a feedback loop because they are generated by the very same strategies devised to exploit them. We introduce a simple phenomenological model which takes the impact of investment on the market explicitly into account. We show that the feedback on correlations gives rise to an instability when the impact of optimal portfolio investors exceeds a critical value. Close to the critical point, the model exhibits dynamical correlations very similar to those observed in real markets. Indeed fitting our model to real markets data, we find parameters close to the critical point. These results suggest that financial markets cannot be regarded as frictionless systems and that there is a limit to the amount of investment they are able to cope with.

(see arxiv.org/abs/physics/0508159)

AKSOE 2.4 Mon 11:45 BAR 205
Size matters: parametric non-universality in stock market data — •ZOLTAN EISLER[1] and JANOS KERTESZ[1,2] — [1]Department of Theoretical Physics, Budapest University of Technology and Economics, Budapest, Hungary — [2]Laboratory of Computational Engineering, Helsinki University of Technology, Espoo, Finland

A careful analysis of the high resolution data of New York Stock Exchange and NASDAQ reveals that many characteristics of a stock's trading activity depend monotonously on the capitalization of the underlying company. This applies to the means of traded value per minute and trading frequency. Moreover, the degree of persistence in these quantities is not universal among stocks: their Hurst exponent increases logarithmically with company size. A similar tendency is present in intertrade times, together with multiscaling. These findings indicate, that company size/capitalization acts as a continuous parameter that strongly influences the observed stylized facts.

AKSOE 2.5 Mon 12:15 BAR 205
Endogenous Price Formation: an universal mechanism in financial markets? — •STEFAN REIMANN — IEW University of Zurich Bluemlisaplstrasse 10 CH - 8006 Zurich

Stylized facts can be roughly divided into three classes: the existence and decay of the autocorrelation of powers of (log)-returns, the non-Gaussian character of the distributions of assets, particularly the presence of semi-heavy tails, and the multiscaling of asset returns. As a stylized model of price dynamics, we propose a multiplicative stochastic process with a price dependent stochastic growth rate. This feedback is due to

endogenous price formation generated by demand. This simple model produces the stylized facts mentioned above. Hence it might be deduced that 1.) endogenous price formation is of universal importance on financial markets, while 2.) the stylized facts mentioned today provide too little structure for a more detailed explanation of market mechanisms.

AKSOE 3 Dynamics of Groups and Organizations II

Time: Monday 14:00–15:30   Room: BAR 205

AKSOE 3.1 Mon 14:00 BAR 205

Personal versus economic freedom — •KATARZYNA SZNAJD-WERON — University of Wroclaw, Institute of Theoretical Physics, pl. M. Borna 9, Poland

Modern societies rely heavily on group decision, but the part of what makes for healthy faith communities is a sense that all members feel heard. That is why finding consensus is very important in many branches of social life - from very personal problems (like religion, abortion, etc.) to economic problems (like marketing, investments, etc.). Recently both sociologists and physicists have tried to find out when a complete consensus from initially diverging opinions emerges. In this talk we propose a model which allows to discriminate between two kinds of behavior, connected with areas which we will call personal and economic. It seems that an attitude with regard to the personal area spreads in a different way than that with regard to the economic area. Thus, we assume that each agent tries to influence its neighbors, but in the personal area the information flows inward from the neighborhood (like in most opinion dynamic models), whereas in the economic area the information flows outward from the agent or group of agents to the neighborhood.

AKSOE 3.2 Mon 14:30 BAR 205

Enforcing consensus — •JAN LORENZ[1] and DIEMO URBIG[2] — [1]University Bremen, Department of Mathematics, Bremen, Germany — [2]Humboldt-Universität zu Berlin, Department of Computer Science, Berlin, Germany

We explore possibilities of enforcing consensus in continuous opinion dynamics due to modification of communication rules. We regard the model of Deffuant et al. [1], where n agents adjust their continuous opinions as result of random pairwise encounters whenever their opinions differ not more than a given bound of confidence ϵ. High ϵ leads to consensus, while low ϵ leads to polarization into several opinion clusters.

We drop the random encounter assumption and ask: How low may ϵ be such that consensus is still possible? Mathematical analysis shows that consensus can be reached for drastically lower ϵ than in the random pair wise case. Apart of planning communication for the whole group, we simulate dynamics with simple agent-based strategies. We show that balancing agents that search opinions from different sides to compromise with can raise the chances for consensus as well as curious agents can, who explore opinions in the direction they had previously moved to. Thus, raising the chances for consensus is possible not only due to a great master plan but also to agent-based strategies.

[1] G. Deffuant, D. Neau, F. Amblard, & G. Weisbuch. Mixing beliefs among interacting agents. *Advances in Complex Systems*, 3:87–98, 2000.

AKSOE 3.3 Mon 15:00 BAR 205

On the Emergence of Hierarchies as Governance Structures — •DIANA MANGALAGIU[1] and RADEL BEN-AV[2] — [1]Reims Management School, 59, rue Taittinger, 51061 Reims, France — [2]Racah Institute Of Physics, Givat Ram Hebrew University Jerusalem 91104 Israel

We discuss a model for the emergence of hierarchies and firms. The hierarchy, as governance structure is a contractual construction. It is conceived not as a stand-alone entity, but is to be compared with alternative modes of governance. In our model, the agents represent individuals in the market. They are heterogeneous, cognitive, self-interest and their only goal is to increase their own achievements. Initially, the agents are isolated. The model dynamics allows the use of contracts between agents in order to increase the overall utilization. The model rewards collaboration. The collaboration is achieved through "employment contracts" between the initially isolated agents. There is a limitation on the bandwidth of communication between the agents, which forces the agents to have only a limited number of connections. When an opportunity in the market is optimally executed only with a large number of agents, a hierarchy is bound to appear as a favourable outcome of the dynamics. As a result a tree-graph of relations between agents can emerge. We investigate the contracts that are generated in the model. Some forms of contract facilitate the emergence of hierarchies while others not. In addition, we investigate the emerged hierarchies as a function of the different contract parameters (attributes, renewal interval, incentives intensity).

AKSOE 4 Social-, Information-, and Production Networks I

Time: Monday 16:00–18:00   Room: BAR 205

AKSOE 4.1 Mon 16:00 BAR 205

Does human knowledge live in a small world? — •DIRK GRAUDENZ — Hagenau 61, 22089 Hamburg

I study the link structure of the online encyclopedia Wikipedia, i.e. the network consisting of Wikipedia articles as vertices and references between articles as network links. The analysis has two parts: (a) a study of the statistical and topological properties of the network, in order to gain insights into whether the network is a small world, and (b) an exploration of the community structure of the network with the goal of defining a taxonomy of human knowledge through an automated process.

AKSOE 4.2 Mon 16:30 BAR 205

Credit Chains and Bankruptcies Avalanches in Production Networks — •STEFANO BATTISTON[1], DOMENICO DELLI GATTI[2], MAURO GALLEGATI[3], BRUCE GREENWALD[4], and JOSEPH E. STIGLITZ[4] — [1]Chair of Systems Design, ETH Zurich, CH-8092 Zurich, Switzerland — [2]Univ. Cattolica, Milan, Italy — [3]Univ. Polit. d.le Marche, Ancona, Italy — [4]Columbia University, New York, USA

We present a simple model of failure propagation on a network of firms linked by supply-customer relationships and trade credit relationships. Our aim is to identify the minimal ingredients to simultaneously produce on one hand the main facts of firm demography (like broad distribution of firm size) and, on the other hand, some occasional spontaneous avalanches of defaults accompanied by sudden drops of the total output of the economy. As opposed to previous models in which there is no firm-firm interaction and avalanches result from a global coupling through interest rate and alike, here avalanches are due to the dependence of the output of each firm on delivery from suppliers and payments from customers. In the simplest version of the model, the network has a regular and static structure, but we also investigate which structures are more robust against domino effects and which ones emerge spontaneously in a network evolution. We also discuss under which conditions the system is susceptible to self-organize in a critical state in which small perturbations trigger re-adjustments of trade credit relationships on a long range.

AKSOE 4.3 Mon 17:00 BAR 205

Self-Assembling of Information in Networks — •MARTIN ROSVALL[1,2] and KIM SNEPPEN[2] — [1]Department of Theoretical Physics, Umeå University, 901 87 Umeå, Sweden — [2]Niels Bohr Institute, Blegdamsvej 17, Dk 2100, Copenhagen, Denmark

Communication is essential in systems ranging from human society to mobile telephone- and computer networks. It enables parts of a system to build a global perception, and thereby makes it possible for these parts to overcome the information horizon set by their immediate neighbors. We mimic real-world situations to investigate what limits the local generation of this global perception of the network from multiple communication events. Our approach is to let agents chat in a model system to self-organize distant communication path-ways, and thereby make use of the typical small-world properties of networks. We demonstrate that simple local rules allow agents to build a perception of the system that is robust to dynamical changes and mistakes. In this minimalistic model,

we find that messages are most effectively forwarded in the presence of hubs with funnelling, like in scale-free networks, while transmission in hub-free networks is more robust against misinformation and failures.

AKSOE 4.4 Mon 17:30 BAR 205

The Democracy-Ochlocracy-Dictatorship Transition in the Sznajd Model — •Johannes J. Schneider[1] and Christian Hirtreiter[2] — [1]Institute of Physics, Johannes Gutenberg University of Mainz, Staudinger Weg 7, 55099 Mainz, Germany — [2]Institute of Organic Chemistry, University of Regensburg, Universitätsstr. 31, 93053 Regensburg, Germany

Since its introduction in 2000, the Sznajd model has been assumed to simulate a democratic community with two parties [1]. The main flaw in this model is that a Sznajd system freezes in the long term in a non-democratic state, which can be either a dictatorship or a stalemate configuration. Here we show that the Sznajd model has better to be considered as a transition model, transferring a democratic system already at the beginning of a simulation via an ochlocratic scenario, i.e., a regime in which several mobs rule, to a dictatorship [2], thus reproducing the corresponding Aristotelian theory [3].

[1] K. Sznajd-Weron and J. Sznajd, Int. J. Mod. Phys. C **11**, 1157 (2000).
[2] J. J. Schneider and Ch. Hirtreiter, Physica A **353**, 539 (2005).
[3] Aristoteles, Politica.

AKSOE 5 Social-, Information-, and Production Networks II

Time: Tuesday 09:30–10:15　　　　　　　　　　　　　　　　　　　Room: BAR 205

Invited Talk　　　　　　　　AKSOE 5.1 Tue 09:30 BAR 205

Communities, weak links, and small world: Empirical analysis of a huge network — •Janos Kertesz[1,2], Jukka-Pekka Onnela[2], Jari Saramaki[2], Jorkki Hyvonen[2], Gabor Szabo[3], and Albert-Laszlo Barabasi[3] — [1]Budapest University of Technology and Economics — [2]Helsinki University of Technology — [3]University of Notre Dame

We study data obtained from a major mobile phone provider which contains records of all phone calls aggregated in periods of two weeks. We construct a network from these data where the nodes are the consumers and the links between them are created if they call each other. The duration of the calls is a natural measure of the intensity of the social relationship between two persons. The weighted network obtained this way consists of more than 7 million nodes which is probably the largest social network, which have been analyzed in detail. Using percolation theory as well as concepts of motif intensity and coherence we identify communities in the network. Such communities are connected by links of high weights while they are bridged by weak links, in good agreement with Granovetter's hypothesis. If in a percolation process is carried out by removing the links in the order of their weights starting with the strongest one, there is no percolation transition in the system, while there is a sharp transition if the procedure is started with the weakest link. Although for 95 % of the links the monotonous relationship between the strength and the overlap of neighbors is verified, a considerable role in intercommunity information transfer is played by strong links with low overlap.

AKSOE 6 Economic Models and Evolutionary Game Theory I

Time: Tuesday 10:15–12:45　　　　　　　　　　　　　　　　　　　Room: BAR 205

AKSOE 6.1 Tue 10:15 BAR 205

Evolution rate is crucial for the emergence of cooperation — •Angel Sánchez[1,2], Carlos P. Roca[1,3], and José A. Cuesta[1] — [1]GISC/Matemáticas, Universidad Carlos III de Madrid, 28911 Leganés, Madrid, Spain — [2]Instituto de Biocomputación y Física de Sistemas Complejos (BIFI), Universidad de Zaragoza, 50009 Zaragoza, Spain — [3]Centro Nacional de Biotecnología, 28049 Cantoblanco, Madrid, Spain

A fundamental, profound and broad-ranging unsolved question is how cooperation among animals and humans has evolved. Evolutionary game theory is the mathematical framework that has provided the deepest insights into this issue. Simple games such as the Prisoner's Dilemma, the snowdrift game or the stag-hunt game have been the subject of intense experimental and theoretical work along this line. The emergence of cooperation has been shown to be sensitive to whether populations are well-mixed, such as in replicator dynamics evolution, or spatially structured. Co-evolution of agents and networks and finite population effects are also relevant factors. None of these approaches has considered the influence of different evolution rates. Here we show that the pace at which selection acts on the population is crucial for the appearance and stability of cooperation. Even in non-dilemma games such as Harmony, where cooperation is the only possible rational outcome, defectors may be selected for if population renewal is very rapid. Similar results are found for coordination games such as the stag-hunt, where the basins of attraction of cooperation and defection depend on the evolution rate. Our results point out the necessity to include a discussion of the time scale of evolution in any study about cooperation.

AKSOE 6.2 Tue 10:45 BAR 205

Statistical mechanics of random replicators and matrix games — •Tobias Galla — The Abdus Salam International Centre for Theoretical Physics Trieste, Italy

An important objective of game theory consists in the static study of Nash equilibria. Popular cases are situations in which the payoffs take matrix form, the well-known prisoner's dilemma or the rock-scissors-paper game are simple examples.

Replicator equations on the other hand describe the dynamic evolution of self-reproducing interacting species for example in population dynamics and theoretical biology. In the context of evolutionary game theory these equations correspond to matrix games which are played repeatedly by players, who then reproduce according to their success, passing on their strategies to their children.

In this talk we will apply the methods and concepts of statistical mechanics of disordered systems to study large dynamical replicator systems with random couplings. We will give an overview over their basic phenomenological behaviour and will address different ergodic/non-ergodic phase transitions exhibited by such models. The connection between ergodicity in replicator systems, their attractors and the Nash equilibria in the corresponding games will be discussed.

AKSOE 6.3 Tue 11:15 BAR 205

Learning through social interactions — •Viktoriya Semeshenko[1], Mirta B. Gordon[1], and Jean-Pierre Nadal[2] — [1]Laboratoire Leibniz-IMAG, 46 av Felix Viallet, 38031 Grenoble Cedex 1, France — [2]Laboratoire de Physique Statistique, Ecole Normale Superieure, 24 rue Lhomond, 7231 Paris cedex 05, France

We consider a simple market model in which a population of heterogeneous individuals, subject to local positive externalities, must choose repeatedly either to buy or not a unit of a single homogeneous good, at a price posted by a monopolist [1]. If the weight of externalities is strong enough, there are multiple Nash equilibria, revealing coordination problems. We assume that individuals learn to make their choices repeatedly using deterministic and trembling hand decision rules. We study the performances along the learning path and the reached equilibria for different learning schemes [2]. In the presence of multiple equilibria, coordination on the optimal one through learning is shown to be reached only with some of the learning schemes. The result of the learning rules depends crucially on the learning parameters and the agents' initial beliefs. With a trembling hand dynamics the system is shown to converge to a stationary state, in which the decisions fluctuate close to the optimal ones. This equilibrium has the flavor of (but is not identical to)what is known as a 'Quantal Response Equilibrium' in the economic literature.

[1] Gordon M. B., Nadal J.-P., Phan D., Vannimenus J: Seller's dilemma due to social interactions between customers. *Physica A, 356, Issues 2-4:628-640*, (2005).
[2] Camerer C. F. Behavioral Game Theory. *Princeton Press*, (2003).

AKSOE 6.4 Tue 11:45 BAR 205

Faster-is-slower effects in traffic and production systems — •DIRK HELBING — Institute for Transport and Economics, TU Dresden

The faster-is-slower effect has been first discovered for panicking pedestrians, where evacuation times may increase, when a crowd is in a rush. Similar phenomena have now been discovered for other traffic and production systems. We will present various examples, analytical approaches to intermittent pedestrian flows and methods of self-organized flow optimization. The applications reach from intersecting pedestrian and vehicle streams over chip production upto harbor logistics. We will also address the optimization of productions processes and traffic light scheduling in urban traffic networks. The theoretical challenges of these problems and the economic potentials of related results can hardly be overestimated.

References:

[1] D. Helbing, I. Farkas, and T. Vicsek, Simulating dynamical features of escape panic.Nature 407, 487-490 (2000).

[2] D. Helbing, S. Lammer, and J.-P. Lebacque, Self-organized control of irregular or perturbed network traffic, in: C. Deissenberg and R. F. Hartl (eds.) Optimal Control and Dynamic Games (Springer, Dordrecht), pp. 239-274.

[3] D. Helbing, R. Jiang, and M. Treiber, Analytical investigation of oscillations in intersecting flows of pedestrian and vehicle traffic. Physical Review E 72, 046130 (2005).

AKSOE 6.5 Tue 12:15 BAR 205

The remarkable effects of a finite score memory in Minority Games — •ANDREA DE MARTINO — CNR-ISC, INFM-SMC, Dipartimento di Fisica, Universita' di Roma "La Sapienza", p.le A. Moro 2, 00185 Roma (Italy)

Introducing a finite score memory in Minority Games leads to substantial changes in both the static and the dynamical picture of the model. As expected, the dependence of the stationary state on the initial conditions is removed (which is desirable). However, the dynamics is characterized by anomalous fluctuation outbutsts and volatility clusering. Memory also turns out to affect the emergence of stylized facts and the static properties of Minority Games in a non-trivial way. These models constitute a serious challenge for statistical physics and their characterization requires a combination of analytical and numerical techniques. We will review their phenomenology and address recent progress made in the direction of a deeper theoretical understanding of the nature of these peculiar dynamical regimes.

AKSOE 7 Financial Markets and Risk Management II

Time: Tuesday 14:00–15:30   Room: BAR 205

AKSOE 7.1 Tue 14:00 BAR 205

Nonlinear Dynamics of Housing Prices — •YURI YEGOROV — Institute for Advanced Studies, Stumpergasse 56, A-1060, Vienna, Austria

The housing price dynamics differs across countries and regions, but two patterns dominate: positive trend (with tendency to long run asymmetric cycle) and stable price pattern. The goal of this paper is to find its typical features at least for a subset of cases, to suggest the factors that might be responsible for such behaviour and to suggest a model explaining the possible persistence of positive price trends. The pricing of real estate is a complex process, which has both temporal and spatial patterns. Contrary to financial asset, housing is a durable good, which can be used both for consumption and investment. Housing has much lower liquidity and much higher transaction cost. This leads to different time scale in pricing pattern, eliminates high-frequency volatility and leads to the dominance of two main patterns: constant pricing and positive trend. Each of these market states can persist for some time period. Chartist models in finance are more applicable than fully rational models. In the very short run the dynamics of financial markets has both dynamic and stochastic components, and the same is true for real estate markets. Spatial homogeneity of country's income makes equilibrium state more likely.

AKSOE 7.2 Tue 14:30 BAR 205

Mathematical method for quantitative evaluation of the equity portfolio market risk — •ZHDANOVA TATIANA — tatiana.zhdanova@accenture.com

We discuss a mathematical method for quantitative evaluation of the equity portfolio market risk in a Bank. We implement developed mathematical model in the automated subsystem RC&M to provide estimation of the maximum permissible looses for the equities portfolio on the regular basis as a one of the risk management procedures. We use VaR (Value-at-Risk) characteristic to evaluate quantitatively the market risk. We perform the advantages of the developed method relative to the other

existing VaR estimation methods. The developed method allows getting more accurate estimation of the loses then parametric methods (which are based on profit distribution function parameterization) and the information about each portfolio component weight is performed in difference with the nonparametric methods (these methods use approximation assumptions). An effective risk management system provides the financial company's stability and optimization of capital usage and investing.

AKSOE 7.3 Tue 15:00 BAR 205

Dynamics of Warsaw Stock Exchange index as analysed by the Mittag-Leffler function — •MARZENA KOZLOWSKA and RYSZARD KUTNER — Division of Physics Education, Institute of Experimental Physics, Department of Physics, Warsaw University

We studied the historical Warsaw Stock Exchange (WSE) index (WIG) at a daily time horizon; we expect that its dynamics is typical for an emerging financial market of moderate size. We found that the well developed maxima of the index can be fitted (up to its fluctuations) by an intermediate part of the Mittag-Leffler (ML) function which is a natural generalisation of the exponential one.

Note that the ML function has two characteristic limits: (i) the stretched exponential form or Kohlrausch-Williams-Watts (KWW) law for the initial times, and (ii) the power-law or the Nuttig law for the asymptotic time. These decays are typical for the relaxation of disorder systems.

In other words, the relaxation of the WIG local maxima can be described by the fractional (non-Debye) relaxation equation which has indeed the solution given by the ML function.

Since we found that most of the empirical WIG maxima are well covered by the intermediate part of the ML function, this means that the WSE is a complex system lying between two different types of disordered ones created by stock market investors and described, correspondingly, by two types of relaxation functions (i) and (ii). Unfortunately, this observation does not uniquely define the microeconomical (or microscopic) model which constitutes its basis.

AKSOE 8 Award Ceremony: Young Scientist Award for Socio- and Econophysics

Time: Tuesday 16:00–18:00   Room: HSZ 03

Invited Talk   AKSOE 8.1 Tue 16:00 HSZ 03

An empirical behavioral model for price formation — •DOYNE FARMER[1] and MIKE SZABOLCS[1,2] — [1]Santa Fe Institute — [2]Budapest University of Technology and Economics

Although behavioral economics has demonstrated that there are many situations where rational choice is a poor empirical model, it has so far failed to provide quantitative models of economic problems such as price formation. We make a step in this direction by developing empirical

models that capture behavioral regularities in trading order placement and cancellation using data from the London Stock Exchange. For order placement we show that the probability of placing an order at a given price is well approximated by a Student distribution with less than two degrees of freedom, centered on the best quoted price. This result is surprising because it implies that trading order placement is symmetric, independent of the bid-ask spread, and the same for buying and selling. We also develop a crude but simple cancellation model that depends on

the position of an order relative to the best price and the imbalance between buying and selling orders in the limit order book. These results are combined to construct a stochastic representative agent model, in which the orders and cancellations are described in terms of conditional probability distributions. This model is used to simulate price formation and the results are compared to real data from the London Stock Exchange. Without adjusting any parameters based on price data, the model produces good predictions for the magnitude and functional form of the distribution of returns and the bid-ask spread.

AKSOE 8.2 Tue 17:00 HSZ 03
Presentation of the Young Scientist Award for Socio- and Econophysics — • —

AKSOE 8.3 Tue 17:15 HSZ 03
Awardee's Talk — • —

AKSOE 9 Traffic Dynamics, Urban and Regional Systems

Time: Wednesday 14:00–16:00   Room: BAR 205

AKSOE 9.1 Wed 14:00 BAR 205
An evolutionary approach of pedestrians/cars interactions — •ARNAUD BANOS[1], ABHIMANYU GODARA[2], and SYLVAIN LASSARRE[3] — [1]arnaud.banos@univ-pau.fr — [2]abhimanyu_godara@rediffmail.com — [3]lassarre@inrets.fr

Despite the central and fundamental role pedestrian walking plays within the urban transport system, it still remains a badly known transportation mode. The SAMU prototype has been precisely designed to explore the behaviour of pedestrians in interaction with the motorized traffic, in a virtual city where most of the phenomenon can be mastered and studied. Developed in Netlogo, SAMU integrates both cellular Automata and Agent-Based Modelling approaches to generate a new model of cars behaviours by appropriately modifying earlier NaSch-ChSch rules (Nagel and Schreckenberg, 1992) to take into account pedestrian and also turning movements. While being a work in progress, SAMU already provides an ergonomic platform useful to test the behaviour of the system under different configurations of parameters. Anyway, the number of parameters* combinations is so huge that it doesn't make sense to test them in a very systematic way. Therefore, we propose to explore the possibilities of adding an evolutionary component to our model, based on genetic algorithms, allowing agents (and mainly pedestrians) adapting to given traffic conditions, and finding by themselves the best combinations of their internal parameters that would increase their chance of survival.

AKSOE 9.2 Wed 14:30 BAR 205
Scaling Laws in the Spatial Structure of Urban Road Networks — •STEFAN LÄMMER — Technische Universität Dresden

The urban road networks of the 20 largest German cities have been analysed, based on a detailed database providing the geographical positions as well as the travel-times for network sizes up to 37,000 nodes and 87,000 links. As the human driver recognises travel-times rather than distances, faster roads appear to be 'shorter' than slower ones. The resulting metric space has an effective dimension d>2, which is a significant measure of the heterogeneity of road speeds. We found that traffic strongly concentrates on only a small fraction of the roads. The distribution of vehicular flows over the roads obeys a power-law, indicating a clear hierarchical order of the roads. Studying the cellular structure of the areas enclosed by the roads, the distribution of cell sizes is scale invariant as well.

AKSOE 9.3 Wed 15:00 BAR 205
Probabilistic Description of Traffic Breakdown — •REINHARD MAHNKE[1] and REINHART KUEHNE[2] — [1]Rostock University, Institute of Physics, D-18051 Rostock — [2]German Aerospace Center, Transportation Research, D-12489 Berlin

Traffic breakdowns are described by a balance equation that models the dynamics of jam formation by the following two contributions. There are discharge rate depending on the length of the congestion and an adhesion rate mainly depending on the traffic volume of the considered road section. With this balance equation it is feasible to calculate the dynamics of traffic pattern formation especially the first passage time for a transition from free flow condition to congested traffic including the influence of the parameters affecting the discharge and adhesion rates. As a simple approximation we consider constant attachment rate as well as constant detachment rate.

Starting with the probability density and furtheron with the cumulative probability for breakdowns the change in the incident duration distribution is calculated and qualitatively given. The paper concludes with recommendations for a comprehensive operation improvement and provides necessary steps for a long lasting stabilization of traffic for a given vehicular flow time series pattern.

AKSOE 9.4 Wed 15:30 BAR 205
Traffic on pre-existing ant trails: Comparison with empirical results — •ALEXANDER JOHN[1], ANDREAS SCHADSCHNEIDER[1], DEBASHISH CHOWDHURY[2], KATSUHIRO NISHINARI[3], THRESIAMMA VARGHESE[4], and RAGHAVENDRA GADAGKAR[4] — [1]Institut für Theoretische Physik, Universität zu Köln, 50937 Köln — [2]Department of Physics, Indian Institute of Technology, Kanpur, India — [3]Department of Aeronautics and Astronautics, University of Tokyo, Japan — [4]Centre for Ecological Sciences, Indian Institute of Science, Bangalore, India

We have developed a minimal cellular automaton model for traffic on pre-existing ant trails. The model makes explicit qualitative as well as quantitative predictions. These predictions are compared to empirical data for traffic on existing trails. We will describe an experimental setup including the choice of an appropriate species (Leptogenys Processionalis), as well as the methods of measurement. As we assume some kind of evolutionary generated optimization, measurements were carried out under natural conditions for different scenarios like foraging or migration.

The discussion of results is mainly divided into two parts. First we start comparing on a qualitative level, which includes the spatial distribution of workers on the trail. Clustering phenomena predicted by the theoretical approach seem to play an important role in the empirically observed behaviour. Also certain patterns like the dominance of one direction (e.g. foodbound) over the other one (e.g. nestbound) can be found, which are directly linked to the current task the colony has to perform. On a quantitative level, also the variation of the current is considered.

AKSOE 10 Poster Session (posters are expected to be displayed the full day 8:30-18:00)

Time: Wednesday 16:00–18:00   Room: P2

AKSOE 10.1 Wed 16:00 P2
Increasing market efficiency: Evolution of cross-correlations of stock returns — •BENCE TÓTH[1,2] and JÁNOS KERTÉSZ[1,3] — [1]Department of Theoretical Physics, Budapest University of Technology and Economics, Budafoki út 8, H-1111 Budapest, Hungary — [2]Lagrange Interdisciplinary Laboratory for Excellence in Complexity ISI Foundation, Turin, Italy — [3]Laboratory of Computational Engineering, Helsinki University of Technology, P.O.Box 9400, FIN-02015 HUT, Finland

We analyse the temporal changes in the cross correlations of returns on the New York Stock Exchange. We show that lead-lag relationships between daily returns of stocks vanished in less than twenty years. We have found that even for high frequency data the asymmetry of time dependent cross-correlation functions has a decreasing tendency, the position of their peaks are shifted towards the origin while these peaks become sharper and higher, resulting in a diminution of the Epps effect. All these findings indicate that the market becomes increasingly efficient.

AKSOE 10.2 Wed 16:00 P2

Pattern detection in Continous Double Auction Markets —
•BETTINA HOSER and ANDREAS GEYER-SCHULZ — Chair of Information Services and Electronic Markets; Universität Karlsruhe (TH); 76128 Karlsruhe

In this paper the method of eigensystem analysis of complex Hermitian adjacency matrices is used to analyze accounting patterns in markets such as a political stock market. We model an accounting system of a market as an asymmetric weighted digraph. Depending on the accounting system structure the result of the eigensystem analysis yields different degrees of detail.

If a market is organized such that each trade has to be made via a central market counter party, we see the eigensystem of a bipartite graph with the shares on one side an the traders on the other. It represents the trading behavior within the submarkets but gives almost no information on the trading behavior between the traders. If on the other hand the underlying graph is defined such that a link between two traders is formed if the offer of one trader is matched with the demand of the other (this can be done by an equivalent transformation in the records of the accounting system),the eigensystem yields information on the trading behavior between traders. These two perspective could lead to new insights and invariants on market efficiency and fraud within a market.
[1] M. Franke, A. Geyer-Schulz, B. Hoser: Analyzing Trading Behavior in Transaction Data of Electronic Election Markets; Data Analysis and Decision Support; D. Baier, R. Decker, L. Schmidt-Thieme (eds.); Springer (2005); p.222–230.

AKSOE 10.3 Wed 16:00 P2

Variations of the Bak Asset Market Model — •BORIS BRODDA, JOHANNES J. SCHNEIDER, SEBASTIAN GOLKE, TOBIAS PREIS, and WOLFGANG PAUL — Institute of Physics, Johannes Gutenberg University of Mainz, Staudinger Weg 7, 55099 Mainz, Germany

In the Bak stock market model, several agents buy and sell shares at a virtual stock market. In this model, which can be generalized also to other kinds of assets, the agents update their individual conceptions of the price for buying and selling an asset, respectively, according to the current market price, a drift probability, and an imitative behavior [1].

We introduce several variations of this Bak model by adding new approaches for volatility feedbacks. One approach already mentioned in [1] consists of adapting the individual conceptions according to the price change during some time interval. Another approach focuses on the agents' strategies, which contain profit taking, stop loss orders, and momentum analysis.

In our investigations, we concentrate on some stylized facts of the asset returns, which can e.g. be determined from the autocorrelation function of returns and absolute returns.
[1] P. Bak, M. Paczuski, and M. Shubik, Physica A **246**, 430, 1997.

AKSOE 10.4 Wed 16:00 P2

Introduction and Investigation of a Multi-Agent Based Order Book Model of Financial Markets — •TOBIAS PREIS, SEBASTIAN GOLKE, WOLFGANG PAUL, BORIS BRODDA, and JOHANNES J. SCHNEIDER — Institute of Physics, Johannes Gutenberg University of Mainz, Staudinger Weg 7, 55099 Mainz, Germany

We introduce a new model for simulating financial markets, based on an order book, in which several agents trade assets at a virtual exchange. The agents can place and cancel orders at different rates according to their individual strategies.

The foundation of our model is an order book structure that is close to reality. We provide two types of traders, liquidity providers and liquidity takers with different strategies.

AKSOE 10.5 Wed 16:00 P2

To a local approximation method of time-series short-range predictability of developing assets — •MICHAEL ROMANOVSKY — Vavilov str., 38 119991 Moscow Russia

Two facts permit us to consider assets of developing stock markets as complex dynamical systems (or, at least, "more dynamical" than the respect developed assets): a comparably small quantity of stocks and players and an influence of developed stock markets [1]. The method of short-range forecast is proposed for developing stock markets based on the generalized linear approximation of a day return. The method deals with the daily-recorded time series return of the investigated asset. The first step is the searching of predecessor time series parts, which have sim-

ilar past values in comparison with the present part of the investigated time series. The short-range forecast (for one day and several days) is produced as some mean of these time series parts continued up to the forecast horizon. Thus we increase a redundant information of this time series [2]. The method gives satisfactory good several-days forecast: prediction of investigated time-series return changes (up or down) is larger than 60%, and the ratio of prediction error variation to the time-series variation is normally less than one. 1.T.B.Ersov, M.Yu.Romanovsky. Modern problems of statistical physics, 2, 168-179 (2003). 2.R.N.Mantegna, H.E.Stanley. An introductiion to econophysics. Correlation and complexity in finance. Cambrige University Press (Cambrige 2000).

AKSOE 10.6 Wed 16:00 P2

Multiple time scales and the exponential Ornstein-Uhlenbeck stochastic volatility model — •JOSEP PERELLÓ and JAUME MASOLIVER — Universitat de Barcelona

We study the exponential Ornstein-Uhlenbeck stochastic volatility model and observe that the model shows a multiscale behavior in the volatility autocorrelation. It also exhibits a leverage correlation and a probability profile for the stationary volatility which are consistent with market observations. All these features make the model quite appealing since it appears to be more complete than other stochastic volatility models also based on a two-dimensional diffusion. We present an approximate solution for the return probability density designed to capture the kurtosis and skewness effects. This approximate is also very useful to option pricing. We finally study the smile effect in this model with parameters estimated with the underlying data.

AKSOE 10.7 Wed 16:00 P2

Statistical Analysis of Stock-Market Fluctuations: A Single Parametric Formulation — •PRAGYA SHUKLA — Department of Physics, IIT Kharagpur-721302, West Bengal, India

An understanding of the stock-market dynamics requires a characterisation and quantification of the correlations in the prices of of various stocks at a series of time-steps. To obtain the mutual correlations between N such stocks, therefore, one needs to analyze the correlation matrix "C", with its elements as the correlation function between two stock-prices, represented by the time series. However the complexity of the stock market leads to complicated fluctuation of prices and an exact determination of the associated time-series is not always possible. The correlations can be obtained, therefore, only within a certain distribution, resulting in "C" as a random matrix. The mutual dependence of various stocks and their effect on stock market fluctuations can thus be characterized by the nature of the associated correlation matrix, that is, by its eigenvalue and eigenvector statistics. Our analysis of the correlation matrices of various stock markets reveals the existence of a deep level of universality underlying their statistical behavior.
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AKSOE 10.8 Wed 16:00 P2

Interacting Gap Model — •ANDREJ SVORENČÍK[1] and FRANTIŠEK SLANINA[2] — [1]Dept. of Theoretical Physics and Didactics of Physics, Faculty of Mathematics, Physics and Informatics Comenius University, Mlynska Dolina, 842 48 Bratislava, Slovak Republic — [2]Institute of Physics, Czech Academy of Sciences, Na Slovance 2, CZ-182 21 Prague, Czech Republic

The interacting gap model is one of the theoretical attempts to reconcile various numerical and theoretical results about the limit-order market models of financial markets. We firstly formulate a kinetic equation which describes the dynamics of this model. Secondly, numerical and partial analytical solution is provided. Lastly, we relate these new results to the power law tail of the return-distribution of stock-market fluctuations.

AKSOE 10.9 Wed 16:00 P2

The socioeconomic equation of state, structural interest rates, employment, and growth — •H G DANIELMEYER — Inst. f. Neuro- and Bioinformatics, Luebeck, Ratzeburger Allee 160

In the 1980ies the G7 reached the state where intelligent use became as important for growth as intelligent production. The input variables labor and physical capital (K) are complemented by introducing spare time and user potential (UP) as output variables. An exact socioeconomic equation of state (SES) is obtained that yields the working and spare time, gross domestic product (GDP), K, and UP in analytically closed form without any adjustable parameter. The continuous agreement with the real per capita data from 1850 to date is perfect for coherent phases of

G7 growth, including recovery and convergence dynamics of post war Germany and Japan. The values obtained for the UP per capita agree with the value of human capital per capita as computed from the cost of national education systems. For the first time an interest rate can be obtained from extensive economic variables: The long-term dynamic structural rate Z=(dK/dt)/UP.It agrees well with Germany's post WWII bond rates: K/UP is a valid measure of investment risk. For the G7, the limits to growth are spare time and education for UP, no longer working time and K.

AKSOE 10.10 Wed 16:00 P2

The pace of networking technical and social innovation may be genetically stabilized — •H G Danielmeyer — Inst f. Neuro- und Bioinformatik, Lübeck, Ratzeburger Allee 160

The evolution of the leading nation's real gross domestic products per capita from the UK of 1750 to the G7 of 2000 fits a simple S-curve with half time in 2040 and exponential decay rate of 1/60 p. a. Only a very basic process can stabilize the pace of innovation over 10 generations. The first explanation assumed that networking technical and social innovations requires generally the sum of the average lifetime of our physical capital of F=25 years and a postulated social reaction time against change of M=35 years. The second uses the result that the corresponding life expectancies yield the same S-function (preceding the evolution by 30 years). The hereditability of longevity (A. M. Herskind et al., Hum Genet (1996) 97: 319-323)shows that some experiences made in life can be passed on to the next generation. For this process the reproduction biology yields indeed the sum F+M, but now with a genetic instead of a sociotechnical meaning: The pace of the industrial evolution may be genetically stabilized and therefore predictable.

AKSOE 10.11 Wed 16:00 P2

Dynamics of correlations from a FTSE100 portfolio — •Ricardo Coelho, Stefan Hutzler, Przemyslaw Repetowicz, and Peter Richmond — School of Physics, Trinity College, University of Dublin

In the last years many studies were made about Financial Markets and their topology. We study time series of daily data of stocks belonging to FTSE100 and compute the correlations between them. Using the concept of distance introduced by Mantegna [1], we then compute Minimal Spanning Trees for this data. We find these trees much less clustered than the Minimal Spanning Trees that we obtained from treating the logarithmic returns as random numbers from a Gaussian distribution. We also study the mean correlation and variance of the correlations as a function of time and with varying window sizes. As in [2] we find that these two moments appear to be strongly correlated with each other. This may be understood with the help of a simple analytic model based on the concept of moving averages.
[1] R. N. Mantegna, Eur. Phys. J. B **11**, 193 (1999)
[2] J.-P. Onnela, A. Chakraborti, K. Kaski, J. Kertesz and A. Kanto, Phys. Rev. E **68**, 056110 (2003)

AKSOE 10.12 Wed 16:00 P2

Feedback between market return and excess demand of heterogeneous interacting traders — •Fernando Pigeard de Almeida Prado — f,p

We introduce an agent-based model for the price dynamics of financial assets.

In this model each trader evaluates the fundamental value of the asset differently from each other. Each trader is also influenced by the opinion of some local trusted peers.

For uniformly distributed evaluations of the fundamental value of the asset we find a dynamical critical point of the price evolution which is determined by the competition of social susceptibility and the trader's heterogeneity. Below the critical point we compute exactly the approach to equilibrium of the market return in terms of an average over realizations of the stochastic dynamics.

Non-rigorous treatment of the critical point suggests the occurrence of price oscillations with a frequency determined the ratio of return rate and social heterogeneity.

For a more sharply peaked heterogeneity distribution we prove that the invariant measure of the decision process is an Ising measure on the network. Here equilibrium criticality is determined by the network structure and the strength of social susceptibility.

AKSOE 10.13 Wed 16:00 P2

Portfolio optimization with respect to different risk types. — •Urszula Skornik-Pokarowska[1] and Arkadiusz Orlowski[1,2] — [1]Katedra Ekonometrii i Informatyki SGGW, Nowoursynowska 159, 02-787 Warszawa — [2]Instytut Fizyki PAN, al. Lotników 32/46, 02-668 Warszawa

There are many risk types, such as inflation risk, credit rates risk, ect. Some of them can be estimated based on macroeconomic indicators. We show an example of portfolio optimization done for Warsaw Stock Exchange with respect to different risk types.

AKSOE 10.14 Wed 16:00 P2

Examples of risk measures and their application to portfolio optimization — •Urszula Skornik-Pokarowska[1] and Arkadiusz Orlowski[1,2] — [1]Katedra Ekonometrii i Informatyki SGGW, Nowoursynowska 159, 02-787 Warszawa — [2]Instytut Fizyki PAN, Al. Lotnikow 32, 02-668 Warszawa

In the paper we present and compare some examples of risk measures such as VaR, CVaR, Hurst exponent and some traditional measures based of coefficient of variation or standard deviation. Experimental analysis made for Warsaw Stock Exchange shows how useful the measures can be for investment portfolio optimization.

AKSOE 10.15 Wed 16:00 P2

A subjective approach to the risk measurement — •Piotr Jaworski — Institute of Mathematics, Warsaw University, ul.Banacha 2, 02-097 Warszawa, Poland

Decision making in finance is decision making under uncertainity. A natural question is how to measure risk. In my talk I would like to present a subjective point of view on risk measurement.

If a financial institution has a risky position then it has to prepare some reserves to secure its position. It is natural to consider the optimal level of reserves as a risk measure of the position. Furthermore we assume that the "risk-bearers"are "rational". Their decisions depend on their subjective preferences. In our model these preferences are described by two non-decreasing, weakly convex functions L_1 and L_2. The first one measures the cost of keeping reserves, and the second the loss when the reserves are not sufficient. Let the random variable $\mathcal{X}$ describe the liabilities, and the function

$$L(\mathcal{X}, r) = L_1(r) + L_2((\mathcal{X} - r)^+)$$

costs. The risk-bearer, whom we assume to be rational, chooses the optimal level of reserves r^*, i.e. such that no other level r gives better outcome

$$\forall r \quad V(r, r^*) = E(L(\mathcal{X}, r) - L(\mathcal{X}, r^*)) \geq 0.$$

The optimal r^* becomes a measure of the risk associated with $\mathcal{X}$. Note, that for any fixed r such r^* is a minimizer of the expected relative costs $V(\cdot, r)$.

AKSOE 10.16 Wed 16:00 P2

Investigation on optimization of portfolios by different methods — •uli willibald spreitzer and vladimir reznik — Dr. Dr. Heissmann GmbH, Abraham-Lincoln-Str. 22, 65191 Wiesbaden

Using portfolios consisting of shares and bonds we investigate different optimization methods and the effects on the portfolios. The optimization methods we used were the standard optimization (maximization of rate of return minus (λ times volatility or variance)) and rate of return minus (κ times the expected loss (or premium to safeguard this loss)). The later one, the lower partial moments method, is based on works of Fishburn [1] and our works [2]. The standard method results in portfolios which have a lower rate of return of the portfolio (for large λ) or have more risk (for small λ) compared to portfolios which are optimized by the lower partial moments method. This can be shown for different kind and shares and bonds.
[1] Fishburn, P., Mean-risk analysis with risk associated with below-target returns; American Economic Review; 1977; 67, 116-26
[2] Reznik, V., Spreitzer U. W.; An investigation of a portfolio-loss under CAPM; Proceedings of the 15th AFIR colloquium Zuerich CH; 6-9, 2005, Session B6: pensions

AKSOE 10.17 Wed 16:00 P2

Investigation on CAPM-portfolios built by agents with insufficient knowledge of the market — •Vladimir reznik and uli willibald spreitzer — Dr. Dr. Heissmann GmbH, Abraham-Lincoln-Str. 22, 65191 Wiesbaden

In the CAPM model [1] and the 'standard' optimization the portfolio is optimized with respect to the rate of return minus κ times the volatility or variance. The quality of the optimization depends from the knowledge of the characteristics of the assets (shares, bonds etc.) within the portfolio. Assuming a market of two agents, who assume wrong values of the assets - nevertheless both agents together are in accordance with the market - we investigate the portfolios, they built caused by these wrong assumptions. Assuming, that the two agents represent a market, we investigate this 'wrong' portfolio of the market compared to a portfolio, which is built according to CAPM and correct assumptions on the assets. Considering this at different times and for different wrong assumptions, we calculate the differences of the composition and the rate of return of the portfolio and the effect on the assets.

[1] Sharpe, W.F.: Capital Asset Prices: A Theory of Market Equilibrium under conditions of risk. The Journal of finance Vol. 19. S. 425-42

AKSOE 10.18 Wed 16:00 P2

Random matrix theory, elliptical distributions and correlations in incomplete financial data — •UWE JAEKEL[1] and GABRIEL FRAHM[1,2] — [1]C&C Research Laboratories, NEC Europe Ltd, Sankt Augustin — [2]Lehrstuhl für Statistik und Ökonometrie, Universität zu Köln

Recently (e.g. [1,2]) random matrix theory (RMT) has been applied to financial data with interesting implications for the identification of driving factors in financial markets. We discuss complications resulting from the observed non-normality and tail-dependence of financial data. Both facts together limit the applicability of random matrix theory for sample correlation matrices obtained for market data time series since classical theorems assume either normality or componentwise independence of the time series. We show that for the large class of generalized elliptical distributions – consistent with the so-called stylized facts of empirical finance – a covariance matrix estimator (which turns out to be Tyler's M-estimator [3]) can be derived that allows the application of standard RMT. Another practical problem in the analysis of financial time series is that parts of the data can be missing due to errors, different trading times, index re-compositions, and for various other reasons. We show how RMT can be applied also to incomplete time series by an observed data maximum likelihood approach.

[1] Laloux, L. et al., RISK Magazine, 12, 69 (March 1999)
[2] Plerou, V. et al., PRL 83, 1471 (1999)
[3] Tyler, D.E., Annals of Statistics 15, 234 (1987)

AKSOE 10.19 Wed 16:00 P2

Analyzing Memory Effects of Complex Systems from Time Series — •DANIEL T. SCHMITT and MICHAEL SCHULZ — Department of Theoretical Physics, University of Ulm, Germany

Observables of complex systems show more or less pronounced memory effects. This can be rigorously derived within the Mori-Zwanzig Theory in Statistical Physics. In a recent paper [1] we have developed an algorithm to quantitatively characterize memory effects by analyzing one time series of such an observable. Using this algorithm we analyze the short- and long-term structure memory kernel calculated from observables. Observables include absolute price changes and signum of price changes in major stock markets, wind strength and wind direction, and temperature data. The memory kernel allows to characterize the dynamics of complex systems and also to study changes in the dynamics over time.

[1] Daniel T. Schmitt, Michael Schulz, Analyzing Memory Effects of Complex Systems from Time Series, Physical Review E, submitted

AKSOE 10.20 Wed 16:00 P2

Methods of claim reserving and Monte Carlo Simulation — •MAGDA SCHIEGL — Haydnstr. 6, D-84088 Neufahrn

Claims reserving is an important topic for P&C insurance companies both for product pricing and reporting, especially as new reporting and solvency standards will be introduced within the next years. Claim reserves are necessary to cover the liabilities arising from insurance contracts written in the presence and past. They are calculated for homogenious portfolios of insurance contracts via mathematical methods which are well known form actuarial literature. The Chain Ladder method is one famous example.

In reality the claim process consists of claims occurrence, reporting and run off. All classical methods reduce this process to a two dimensional run-off-matrix and estimate on that basis the reserves* expectation value.

We model the realistic claim process by the help of Monte Carlo sim-

ulation. The variables of the model are: Number of claims and claim payments. The expectation value and the variance of the reserve are given analytically. The reserve distribution can be calculated numerically. This makes risk measures as VaR or expected shortfall accessible. The performance of the classical reserving methods can be reconsidered in the framework of our model. Thins concept enables investigations if the projection into a two dimensional space, as used for application of classical methods, is appropriate.

AKSOE 10.21 Wed 16:00 P2

Point processes models for the trading activity — •BRONISLOVAS KAULAKYS, MIGLIUS ALABURDA, and VYGINTAS GONTIS — Institute of Theoretical Physics and Astronomy of Vilnius University, A. Gostauto 12, LT-01108 Vilnius, Lithuania

Point processes models generating the multifractal time series with the power-law distributions of the signal intensity and of the power spectrum will be presented. The developed [1] multiplicative point processes models of 1/f noise may be used for analysis and modeling of stochastic processes in different systems with the power-law distributions of the interpulse, interevent, interarrival, recurrence or waiting times, with the power-law distribution of the signal intensity or of the counting statistics. Further, we analyze the financial markets where the stock volatility, trading activity and trading volume usually fluctuate as 1/f noise, as well [2]. The model reproduces spectral properties of the real markets and explains the mechanism of the power-law distribution of the trading activity [3]. The study indicates that the statistical properties of the financial markets are related with the statistics of the time intervals between the trades.

We acknowledge support by the Lithuanian State Science and Studies Foundation.

[1] B. Kaulakys, V. Gontis and M. Alaburda, Phys. Rev. E **71**, 051105 (2005).
[2] X. Gabaix et al., Nature **423**, 267 (2003).
[3] V. Gontis and B. Kaulakys, Physica A **343**, 505 (2004); **344**, 128 (2004).

AKSOE 10.22 Wed 16:00 P2

Phase diagrams for an evolutionary Prisoner's Dilemma game on different random regular graphs — •JEROMOS VUKOV[1] and GYÖRGY SZABÓ[2] — [1]Department of Biological Physics, Eötvös University, H-1117 Budapest, Pázmány P. stny. 1/A., Hungary — [2]Research Institute for Technical Physics and Materials Science P.O. Box 49, H-1525 Budapest, Hungary

We studied an evolutionary Prisoner's Dilemma (PD) game with players located on random regular graphs. Systematical Monte Carlo simulations and dynamical cluster techniques were performed to analyse the effects of changing the payoffs and the noise (temperature) upon the maintenance of cooperation. The system exhibits second order phase transition from mixed state of cooperators and defectors to absorbing state where only defectors remain alive. Plotting the critical points on the temperature-b (temptation to defect) plane, we have determined the phase boundaries. In comparison to the phase diagrams of two-dimensional lattices, in the high temperature limit, cooperation consists on random regular graphs in a much wider parameter range than on two-dimensional lattices. Thus (in this limit) the maintenance of cooperation needs rather fixed neighborhood than spatial structure.

AKSOE 10.23 Wed 16:00 P2

The Problem of Relativity in Economic Models — •BODO HERZOG — Wittelsbacherstr. 33, 65 189 Wiesbaden

The paper studies the evolution of relativity in economic systems and models. We use new and innovative ideas by combining economic and physical systems of agents. Our main objective is to find new insights in economic models and systems with interdisciplinary approaches. The paper shows several new insights in many respects: First, we show some limitations in economic models, which focusing only on pure economic systems without any connection to other systems. Second, we try to model a new system and incorporating the problem of relativity in economic models. Thereafter we derive some conclusions for the design of institutions mainly for the macroeconomic and European level.

<More details later in our paper.>

AKSOE 10.24 Wed 16:00 P2

Nongaussian Fluctuations arising from finite populations: Exact results for the evolutionary Moran process — •Jens Christian Claussen[1] and Arne Traulsen[2] — [1]Institut für Theoretische Physik und Astrophysik, Christian-Albrecht-Universität Kiel, Germany — [2]Center for Evolutionary Dynamics, Harvard

The appropriate description of fluctuations within the framework of evolutionary game theory is a fundamental unsolved problem in the case of finite populations. The Moran process recently introduced into this context defines a promising standard model of evolutionary game theory in finite populations for which analytical results are accessible. We derive the stationary distribution of the Moran process population dynamics for arbitrary 2×2 games for the finite size case. In contrast to the common approach to mimic finite-size fluctuations by Gaussian distributed noise, the finite size fluctuations can deviate significantly from a Gaussian distribution.
[1] J.C. Claussen & A. Traulsen, Phys. Rev. E 71, 025101(R)

AKSOE 10.25 Wed 16:00 P2

The Missing Exchange Rate of Banking — •Dieter Braun — Noether Group on Dissipative Microsystems, Applied Physics, Ludwig Maximilians Universität München, Amalienstr. 54, 80799 München, Germany

A bank accepts deposits and grants credits. Using a Feynman-graph representation of bookkeeping, we show that the bookkeeping of a bank actually creates two competing currencies, one for deposits and one for credits. Both are fully separated by bank bookkeeping. The market can demand that prices are split into deposit price levels and credit price levels. A free floating exchange rate between deposit units of account and credit units of account is the result.

Such a generalized bookkeeping allow markets to judge the value of bank assets versus bank liabilities in real time, even at zero interest rates. We give scenarios by applying quantity theory to the proposed bicurrency banking. Market interplay is simulated in a physically motivated random exchange economy model. Both indicate that two-currency banking reduces the impact of interest rates and transforms the profit mechanism of a bank.

AKSOE 10.26 Wed 16:00 P2

Strong wealth condensation in stochastic transfer potential economy models — •Dieter Braun — Noether Group on Dissipative Microsystems, Applied Physics, Ludwig Maximilians Universität München, Amalienstr. 54, 80799 München, Germany

We analyze wealth condensation for a wide class of stochastic economy models on the basis of the economic analog of thermodynamic potentials, termed transfer potentials. The economy model is based on three common transfer modes of wealth: random transfer, profit proportional to wealth and motivation of poor agents to work harder.

The economies never reach a steady state. Wealth condensation is the result of stochastic tunneling through a metastable transfer potential. In accordance with reality, both wealth and income distribution transiently show Pareto tails for high income subjects.

All studied metastable transfer economies show exponential wealth condensation as a robust feature. The simplest model with 10 % annual profit leads to a situation where 1% of the population owns 50 % of the wealth after 50 years. The time to reach such a strong wealth condensation is a hyperbolic function of the annual profit rate.

AKSOE 10.27 Wed 16:00 P2

Random fragmentation with inequality constraint: A model of income distribution — •Aparna Basu — Institute of Genomics and Integrative Biology, (at TCGA) 254 Okhla Industrial Estate-Phase 3, New Delhi 110020, INDIA

The unequal distribution of wealth in society is a universal feature that has been noted and quantified fairly early. In 1897 Wilfredo Pareto observed a power law distribution of income relating the fraction f(x) of the population earning income x, to x. Another curve frequently used to represent income inequality is the Lorenz curve connecting the proportion p of total income earned by individuals earning less than or equal to x to the proportion q of persons in this income group. The qualitative features of economic inequality typified by these relationships appear to be universal, holding across a wide variety of social, economic and political structures. Moreover, similar distributions are seen in other areas such as language, species diversity, etc. This suggests that the observed regularity may be statistical in character. In this paper, we have used the

fragmentation of the unit line as a statistical model of the distribution of wealth in society, with an added constraint that forces the fragments to be unequal, thereby incorporating the observed inequality of incomes as a property of the model. The most probable distribution obtained is a variant of the Lorenz curve, and is represented by the equation P=(Q-QlnQ)^b (where Q and P are 1-q and 1-p respectively, and b is a free parameter.) We compare model results with observed data on income distribution.

AKSOE 10.28 Wed 16:00 P2

Equilibrium Econophysics — •Tânia Sousa and Tiago Domingos — Instituto Superior Tecnico (DEM-SAE). Av. Rovisco Pais, n 1, 1049-001 Lisboa PORTUGAL

We provide a unified conceptual structure for Equilibrium Econophysics, i.e., the use of concepts and tools of equilibrium thermodynamics in neoclassical microeconomics and vice-versa. Within this conceptual structure the results obtained in microeconomic theory are: (1) the definition of irreversibility in economic behavior, (2) the clarification that the Engel Curve and the offer curve are not descriptions of real processes dictated by the maximization of utility at constant endowment, (3) the establishment of a relation between elasticities, (4) the proof that *Giffen Goods* do not exist in a market stable equilibrium, (4) the establishment that 'economic integrability' is equivalent to the Generalized Le Chatelier Principle and (5) the definition of a phase transition of first order. In thermodynamics a relationship is estabished between the sign of the adimensional thermodynamic coefficients and the increase or decrease in the potentials defined by the Legendre transforms.

AKSOE 10.29 Wed 16:00 P2

Statistical Properties of U.S. Output Growth-Rate Distributions — •Andrea Roventini[1,2], Giorgio Fagiolo[3], and Mauro Napoletano[1] — [1]Sant'Anna School of Advanced Studies, Laboratory of Economics and Management - Piazza Martiri della Libertà, 33 - 56127 PISA (Italy) — [2]Department of Social, Cognitive and Quantitative Sciences, University of Modena and Reggio Emilia — [3]Department of Economics, University of Verona

The paper investigates the statistical properties of U.S. output growth-rate distributions by employing both parametric and non-parametric techniques. Many empirical contributions have recently pointed out that growth rates follow a Laplace distribution at different levels of aggregation (e.g., at firm-, industry- and country-level). Following this line of research, we test whether U.S. output growth rates can be approximated by a Laplace distribution. Furthermore, we ask whether our results are robust to alternative ways of detrending output series. Indeed, it is well-known that different detrending techniques (e.g., first difference, Hodrick-Prescott and bandpass filters) affect both qualitative and quantitative stylized facts of the business cycle. Finally, we compare the results for the U.S. to different countries (e.g. U.K.). Preliminary results show that output growth-rate distributions are not Gaussian and are well proxied by fat-tailed, tent-shaped densities. Moreover, we find that different detrending techniques do affect output growth-rate distributions.

AKSOE 10.30 Wed 16:00 P2

Econo-Thermodynamics: The Nature of Economic Interactions — •Jürgen Mimkes — Physics Department, Paderborn University, Germany

Physicists often model economic interactions like collisions of atoms in gases: by interaction one agent gains, the other loses. This leads to a Boltzmann distribution of capital, which has been observed in wealth distributions of different countries. However, economists object: no economic agent will attend a market in which he gets robbed! This conflict may be resolved by writing basic laws of economics into terms of calculus. In these terms the daily struggle for survival of all economic systems turns out to be a Carnot cycle that is driven by energy: heat pumps and economic production depend on oil, GNP and oil consumption run parallel for all countries. Motors and markets are based on the same laws of calculus (macro-economics) and statistics (micro-economics). Economic interactions mean exploiting a third party (nature) and are indeed close to robbing! A baker sells bread to his customers, but the flour comes from nature. Banks sells loans to investors, but the money comes from savers. Economic interactions are Carnot cycles.

AKSOE 10.31 Wed 16:00 P2

Stabilization of chaotic dynamic in micro-economical model of competing firms — •Maria Davidich[1] and Aleksandr Losku-tov[2] — [1]davidich@itp.uni-bremen.de — [2]loskutov@polly.phys.msu.ru

We propose a method, which allows to realize the stabilization of chaotic dynamic in a simple micro-economical model of competing firms. Our model consists of two firms competing on the same market of goods. The firms perform active and asymmetric investment strategies, i.e. their temporary investments depend on their relative positions on the market. Under certain parameter values the given model exhibits the properties of dynamical chaos that consists of continuous power spectrum and positiveness of Lyapunov exponents.

We show that by means of weak external direct parametric excitations it is possible to suppress chaos and stabilize the prescribed periodical orbits. As control parameters we choose such values that describe the investment values of both firms. With economical point of view this means, that we may realize a quite simple control and present a way of increasing profit.

AKSOE 10.32 Wed 16:00 P2

A Stochastic Theory of Geographic Concentration and the Empirical Evidence in Germany — •Thomas Brenner — Max-Planck-Institute of Economics, Kahlaische Str. 10, 07745 Jena

A stochastic model of the evolution of the firm population in a region and industry is developed. This model is used to make predictions about the expected probability distribution of the firm number in regions and their dynamics. Data on the spatial distribution of firms in Germany is used to check the predictions and estimate the parameters of the model. This is done for each industry separately.

AKSOE 10.33 Wed 16:00 P2

Modeling framework for railway stations in regional systems — •Dominik E. Reusser[1] and Peter Loukopoulus[1,2] — [1]Swiss Federal Institute of Technology, Zürich — [2]Göteborg University, Sweden

Railway stations are an important part of a regional system and we need a better understanding of the relationship between a railway station and its surroundings. This need is potentially greater given historical trends of diminishing patronage and railway station closures. The poster presents a conceptual framework for a model which allows to assess medium and long term dynamics of railway station development together with the connected regional system. The framework includes the description of the behavior of the main actors. This allows a deeper understanding of the dynamic of railway stations, which is also vital if the trends with respect to patronage and closures are to be halted and reversed.

An existing integrated model for railway stations is enhanced to include information for decisions concerning railway development. An appropriate methodology is agent-based modeling linked to a system dynamic model comprised of a system boundary and system elements together with the relationships between system elements.

At a later stage, the presented framework will be discussed at round tables with stakeholders to select relevant agents to be included in the model; together with existing behavioral theories and expert interviews, these will be used to obtain knowledge about the perceptions, internal states and anticipated actions of agents in the railway-station-related actor network.

AKSOE 10.34 Wed 16:00 P2

Phase Transition in Density between Urban and Rural Areas, Commuting and Perubanization — •Yuri Yegorov — Institute for Advanced Studies, Stumpergasse 56, A-1060, Vienna, Austria, yegorov@ihs.ac.at

Mathematical model is proposed to explain the emergence of spatial pattern with heterogeneous density and phase transition between urban and rural areas. There are three types of agents: workers who live in a city, farmers who live in a rural area and workers-commuters from rural area to city. In equilibrium they are indifferent between occupation and residence. Indifference across locations for a priori identical agents implies the shape of land rent. The model is in continuous two-dimensional space. There is phase transition between urban and rural population densities due to the difference in land-use intensity for industrial and agricultural technologies. The whole spatial pattern changes as the reaction to change in different model parameters (transport cost, prices of output, population, etc.). Split of rural residents into commuters and farmers depends on road infrastructure development. Under

certain conditions per urbanization occurs: farmers convert themselves into new ring of commuters beyond city border. Different bid rent shapes for farmers and commuters make their spatial coexistence problematic in equilibrium, while it can exist in the transition period.

AKSOE 10.35 Wed 16:00 P2

Analysis of dynamic processes on air traffic networks — •Marcus Rauhut[1] and Michael Schulz[2] — [1]marcus.rauhut@uni-ulm.de — [2]michael.schulz@physik.uni-ulm.de

Many real networks present a bounded scale-free degree-distribution with connectivity cut-off due to physical constraints. Models of epidemics (susceptible-infected-susceptible and susceptible-infected-removed) exhibit an epidemic threshhold one order of magnitude smaller for bounded scale-free networks than for their homogeneous counterparts. Networks in air traffic have exactly, this bounded scale-free structure and are additionally well documented. The extensive records of north-american air traffic make it therefore, besides the internet, an ideal subject to examine dynamic processes on networks. Furthermore, inefficiencies and delays in air-traffic can cause enormous costs, i.e. 1999 delays in the european air traffic caused damages to the EU-members of about 150 to 200 billion euros. Therefore exists also an economic interest in the better understanding of the interaction of topology and dynamics. In our work we investigate if delays can spread similiar to an epidemics behaviour on networks and try to forecast the development of delays with methods of non-equilibrium statistics, regarding the predicted growth of flight traffic in the future.

AKSOE 10.36 Wed 16:00 P2

Time Series Analysis of the NGSIM-Vehicular-Dataset — •Christof Liebe[1], Reinhard Mahnke[1], and Peter Wagner[2] — [1]Institute of Physics, Rostock University, D-18051 Rostock — [2]German Aerospace Center, Institute of Transport Research, D-12489 Berlin-Adlershof

Within the american Next Generation Simulation Program (NGSIM) several datasets were made, where the trajectory of every single car on a highway segment of 1000 m were measured. These datasets build a good basis of time-series-analysis. The method how to analyze the trajectories in a probabilistic way and investigate quantities which discribe the situation on the observed road will be presented.

AKSOE 10.37 Wed 16:00 P2

Propagation of Traffic-Related Information on Freeways via Inter-Vehicle Communication — •Martin Schönhof[1], Martin Treiber[1], Arne Kesting[1], and Dirk Helbing[1,2] — [1]Institute for Transport & Economics, Technische Universität Dresden, Andreas-Schubert-Str. 23, D-01062 Dresden, Germany — [2]Collegium Budapest — Institute for Advanced Study, Szentháromság u. 2, H-1014 Budapest, Hungary

A freeway with vehicles transmitting traffic-related messages via short-range radio is a technological representation for a complex network: A dynamical process runs on a network with dynamical topology. Here the network dynamics can strongly influence the message propagation because it is of the same timescale. In addition, if the cars generate the messages concerning irregularities in the traffic flow and also react to such information generated by other cars, the system has a feedback loop from the network topology to the *generation* of messages and from the message propagation to the network topology. The complexity of this system is restricted by its one dimensionality, i.e., the network nodes are distributed in one dimension, but moving in different directions. By microscopic simulation of congested freeway traffic, where a certain fraction of cars are equipped with inter-vehicle-communication facilities, we investigate how the equipment level influences the efficiency of transmitting traffic related information such as the position of jam fronts.

AKSOE 10.38 Wed 16:00 P2

Impact of automated driving strategies on future traffic dynamics — •Arne Kesting, Martin Treiber, Martin Schönhof, and Dirk Helbing — Technische Universität Dresden, Institute for Transport & Economics

Adaptive cruise control (ACC) automatically accelerates or decelerates a vehicle to maintain a selected time gap, to reach a desired velocity, or to prevent a rear-end collision. Furthermore, an increasing market penetration of ACC systems will make an impact on the traffic dynamics, and, therefore, leads to interesting questions about the future traffic flows consisting of human drivers and automated longitudinal control.

Microscopic traffic modelling is an appropriate approach to investigate the traffic dynamics. Furthermore, sufficiently high equipment levels of ACC systems provide an interesting option to enhance the traffic performance by automated driving strategies that are designed to increase the capacity and stability of traffic flows. We propose a driving strategy for ACC that adapts the driving style dynamically to the overall traffic situation. We analyse this driving strategy by means of simulation and show how the system's performance depends on the equipment level. Remarkably, we find that already a small amount of ACC-equipped cars and, hence, a marginally increased free and dynamic capacity, can lead to a drastic reduction of traffic congestion.

AKSOE 10.39 Wed 16:00 P2

Can Urban Clusters Trace Political Changes? — •EFRAT BLUMENFELD-LIEBERTHAL[1], IRIS ARAVOT[1], LUCIEN BENGUIGUI[2], and DANIEL CZAMANSKI[1] — [1]Faculty of Architecture and Towm Planning, Technion - IIT — [2]Department of Physics and Solid State Institute, Technion - IIT

This paper presents a relatively new approach to understanding the spatial behavior and structure of cities. According to this approach, based on the work of Schweitzer and Steinbrink (1997), cities are viewed as physical objects characterized by morphologies. Instead of data organized according to political units, such as municipalities, cities are comprised of urban clusters. Clusters are defined as contiguous built-up urban areas.

By means of historic maps from 1935 to 2000 of the Tel-Aviv metropolis we present cluster statistics and analyses of their dynamics. We present characteristics of clusters, including their number, area, rank-size distribution, and morphology, along with area-perimeter relations. We examined the characteristics of the entire metropolis in general and of the biggest cluster specifically. The findings of our analysis present significant anomalies in the 1960s and in the 1980s.

For the anomalous years we examined historical events. We suggest that the development of the Tel Aviv metropolis in terms of morphology can be divided into 3 stages that are associated with socio-economic trends and processes: (1) 1930s - 1960s (2) 1960s - 1980s (3) 1980s - 2000s.

AKSOE 10.40 Wed 16:00 P2

An agent-based modelling approach of Plague transmission: the SIMPEST prototype — •DOMINIQUE BADARIOTTI[1], ARNAUD BANOS[2], VINCENT LAPERRIÈRE[3], and JEAN-PIERRE MÜLLER[4] — [1]dominique.badariotti@univ-pau.fr — [2]arnaud.banos@univ-pau.fr — [3]vincent_laperriere@yahoo.fr — [4]jean-pierre.muller@cirad.fr

Since European settlers and traders brought plague to Madagascar, research on this re-emergent disease has been focusing on the main processes of transmission between the main host (rats) and humans via a vector, fleas. Although modalities of disease' transmission at the individual level are now well known, the question of their control and reduction is far from being solved, due to the complexity of spatio-temporal patterns emerging at the population's level. Therefore, it becomes crucial to improve our understanding of the functional relationships that link fleas, rats and humans. In such a perspective, we propose an agent-based prototype, SIMPEST, allowing running "what-if scenarios". Basically, rats, fleas and human agents are located on a spatial grid that represents a village and its surrounding land. Demographic dynamics of the three populations are introduced. Every population is characterized by a life expectancy and a reproductive rate that govern individuals' birth and death. Then, agents move according to their own goals, in a dynamic environment (seasonal flooding of rice fields and crops are integrated).We will then present this prototype, developed using Netlogo, before highlighting the first results obtained on specific scenarios. Finally, we will focus on a strategy we retained to analyze the behaviour of the model, based on a systematic combination of its main parameters.

AKSOE 10.41 Wed 16:00 P2

Crowd Dynamics; Modeling, Calibraton, and Empirical Findings — •ANDERS JOHANSSON and DIRK HELBING — Institute for Transport and Economics, TU Dresden

In the field of pedestrian modeling, a variety of models are used. These models are differently accurate and based on different assumptions and approximations. In this contribution we present a quantitative study of properties of crowds, extracted from empirical trajectory data. From these properties, we discuss which have a large impact on the overall crowd dynamics, and which might be neglected in a simulation model.

Parallel to this, we present a new generic method, based on an Evolutionary Algorithm, for calibrating pedestrian models to empirical trajectory data. As a special case, we present a calibration of an updated Social-Force Model.

AKSOE 10.42 Wed 16:00 P2

Traffic Flow by Cellular Automata: Effect of Maximal Car Velocity — •DANUTA MAKOWIEC and WIESLAW MIKLASZEWSKI — Institute of Theoretical Physics and Astrophysics, Gdansk University, 80-952 Gdansk, ul.Wita Stwosza 57, Poland

The effect of maximal car velocity on the fundamental diagram in the Nagel-Schreckenberg model of traffic is studied. The car density giving the maximal flow and so-called jamming transition parameters are investigated by computer simulations. The basic model is modified by the assumption that for each car an individual velocity limit is assigned. One can give many reasons supporting this assumption: high diversity of vehicles, namely, from sport-cars to scrap-cars, and rather common driver's habit of breaking the speed limit. However, if each driver is assigned his/her own maximal driving speed at random, then the stationary state is determined by the slowest vehicles. Therefore, following hints from Polish roads, the slowest driver is forced to change his/her behavior. In simulation, the self-organization of the traffic is observed when the maximal velocity of the slowest moving vehicle is changed in diferent ways.

AKSOE 10.43 Wed 16:00 P2

Interaction Spaces: a general method to derive differential equations from multi-agent and cellular automata models — •PAOLO GIORDANO, SERGIO ALBEVERIO, DENISE ANDREY, and ALBERTO VANCHERI — USI, via Canavée, Mendrisio, Switzerland

A new kind of model for complex systems (CS) including cellular automata (CA) and multi-agent models (MM), named Interaction Spaces (IS), is proposed. The state of interacting entities are described by continuum variables. The time evolution is defined through a counting process with a given intensity for each type of interaction, and a continuum probability giving the variation of state variables. The intensities depend on the configuration of a suitable set of interacting entities called 'neighbourhood of the interaction'. The use of a continuum state space permits to prove that the time dynamics of extensive state variables fulfil a system of random DE (RDE) using the concept of forward mean derivative (Nelson, Quantum Fluctuations, 1985). We prove that this RDE reduces, for small stochastic fluctuations, to an ODE for the expected values obtainable using a master equation's approach. The general definition of IS is illustrated using an urban growth model. In this case the counting processes are Poisson distributed and their intensities are defined using fuzzy logic. The extensive use of a CA and MM-like language permits to easily construct a detailed and realistic model of the CS, but IS can also be studied like continuum dynamical systems, including memory effects and random fluctuations. These results permit to guess the possibility to extend Synergetic's methods to the wide class of CS described by CA or MM. See www.mate.arch.unisi.ch/ACME for references.

AKSOE 10.44 Wed 16:00 P2

A dynamic model for city size distribution — •LUCIEN BENGUIGUI[1] and EFRAT BLUMENTFELD-LIEBERTHAL[2] — [1]Solid State Institufe, IIT- Technion 32000 Haifa Israel — [2]Faculty of Architecture and Town Planning IIT-Technion 32000 Haifa Israel

We present a model of urban evolution, which yields all kinds of City Size Distributions (CSD). In order to describe the Zipf's law as well as cases that are represented by downward curves on a logarithmic plot, a new positive exponent alpha is introduced. This exponent corresponds to Zipf's law only when it is equal to 1. The model is based on a random growth of the city population and on the variation of the number of cities in the system. The results of the model are surprising as they indicate a chaotic behavior of the model which is only statistically deterministic. We found that both the rate of the growth of new cities and the number of steps affect the final result of the model. The values of exponent alpha include all possible cases in reality, i.e. it may be larger, smaller or equal to 1.

AKSOE 10.45 Wed 16:00 P2

Stability of steady state solutions in balanced vehicular traffic — •FLORIAN SIEBEL and WOLFRAM MAUSER — Department of Earth and Environmental Sciences, University of Munich, Luisenstraße 37, D-80333 Munich

We investigate a continuum model for vehicular traffic flow, which can be motivated by including a finite reaction time of drivers in the traffic model of Aw, Rascle and Greenberg. The model can be written as a hyperbolic system of balance laws. We analyze the steady state solutions and their stability properties. In addition to the equilibrium flow curve the trivial steady state solutions form two additional branches in the flow-density diagram. We show that the characteristic structure excludes parts of these branches resulting in the reverse λ shape of the flow-density relation. The upper branch is metastable against the formation of synchronized flow for intermediate densities and unstable for high densities, whereas the lower branch is unstable for intermediate densities and metastable for high densities. Moreover, the model reproduces the characteristic properties of wide moving jam formation and propagation.

AKSOE 10.46 Wed 16:00 P2

Filtering tools for correlation networks — ●Jan Nagler[1,2], Philipp Weber[2], Shlomo Havlin[2,3], and H. Eugene Stanley[2] — [1]Institute for Theoretical Physics, Bremen University, Bremen, Germany — [2]Center for Polymer Studies, Boston University, Boston, USA — [3]Minerva Center and Dept of Physics, Bar-Ilan University, Ramat-Gan, Israel

We present a novel method for filtering information from cross-correlation data. The key point of our method is a reconstruction process of the original cross-correlation matrix from a filtered correlation network. In order to recover the original correlation matrix we theoretically derive a procedure capable to estimate unknown correlation coefficients from known ones. We apply the method to correlation networks of stock market returns. First, we compare clustering with standard stock sector classification schemes. Second, we check whether our proposed procedure is taylored to evaluate other filtering methods (e.g. Minimal Spanning Tree based methods or approaches applying percolation schemes).

AKSOE 10.47 Wed 16:00 P2

Correlations of centrality metrics on complex networks — ●Magnus Jungsbluth and Alexander K. Hartmann — Institut für theoretische Physik, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany

The study of complex networks plays a crucial role in understanding systems like metabolic pathways, collaborations and computer networks. A popular task is to identify the most important nodes of a network. There are several definitions, often called centrality measures, which lead to different results. The most prominent centrality measure is the *degree* of a node which is easy to obtain. For many real-world networks, the degree distribution follows a power law and hence these networks are often called *scale-free*. Another frequently used measure is the *betweeness centrality* which is based on calculating shortest-paths. Recently other centrality measures have been proposed, based on *random walks* or on participation in *subgraphs*. Yet it is not clear under what circumstances which measure is most appropriate and what the relations between these measures are.

Here we study correlations between the above mentioned four measures on different random-graph models like Erdös-Renyi, Small-World and Barabasi-Albert and on several real graphs to get a thorough comparasion and to be able to identify which measure is the best suited one for each individual situation. Since at least the last two measures are expensive to calculate (running time slightly above $O(n^3)$ for n nodes) we look at how accurate approximations are if only a small subset of the whole network is considered.

AKSOE 10.48 Wed 16:00 P2

Scaling Laws for the Lifetimes of Governments — ●Christian Hirtreiter[1] and Johannes J. Schneider[2] — [1]Institute of Organic Chemistry, University of Regensburg, Universitätsstr. 31, 93053 Regensburg, Germany — [2]Institute of Physics, Johannes Gutenberg University of Mainz, Staudinger Weg 7, 55099 Mainz, Germany

We investigate the lifetimes of governments in the original and a randomized one-dimensional Sznajd model [1]. We find various scaling laws for the lifetime of a democracy and for the reigning time of governments in this model, depending on the system size N [2]. We compare our results with the lifetimes of governments in the Western democracies.
[1] K. Sznajd-Weron and J. Sznajd, Int. J. Mod. Phys. C **11**, 1157 (2000).
[2] J. J. Schneider and Ch. Hirtreiter, Int. J. Mod. Phys. C **16**, 157 (2005).

AKSOE 10.49 Wed 16:00 P2

Proactive robustness control of heterogeneously loaded networks — ●Mirko Schäfer — Institut für Theoretische Physik, Justus Liebig Universität Gießen, Heinrich-Buff-Ring 16, D-35392 Gießen

The introduction of a load-dependent metric increases the robustness of networks against cascades of overload failures. It also reduces respective investment costs. These findings are of relevance for critical infrastructures like communication networks and power grids.

AKSOE 10.50 Wed 16:00 P2

IPD network creation games — ●Jan Scholz — Institut für Theoretische Physik, Justus Liebig Universität, Heinrich-Buff-Ring 16, 35392 Gießen, Germany — Frankfurt Institute for Advanced Studies and Frankfurt International Graduate School for Science, Johann Wolfgang Goethe Universität, Max-von-Laue-Straße 1, 60438 Frankfurt am Main, Germany

Motivated by the possible application to technical communication networks, we study a game-theoretical approach to network structure formation. A short introduction to game theory with focus on the iterated prisoners dilemma and the concept of (network) Nash equilibria is given. Results on various generic couplings of the IPD game dynamics with network structure evolution are presented and shown to lead to various different selforganizing network topologies.

AKSOE 10.51 Wed 16:00 P2

Impact of observational incompleteness on the structural properties of protein interaction networks — ●Mathias Kuhnt[1,2], Ingmar Glauche[3], and Martin Greiner[2] — [1]Institut für Theoretische Physik, Technische Universität Dresden, D-01062 Dresden, Germany — [2]Corporate Technology, Information & Communications, Siemens AG, D-81730 München, Germany — [3]Institut für Medizinische Informatik, Statistik und Epidemiologie, Universität Leipzig, Härtelstr. 16/18, D-04107 Leipzig, Germany

The observed structure of protein interaction networks is corrupted by many false positive/negative links. This observational incompleteness is abstracted as random link removal and a specific, experimentally motivated (spoke) link rearrangement. Their impact on the structural properties of gene-duplication-and-mutation network models is studied. For the degree distribution a curve collapse is found, showing no sensitive dependence on the link removal/rearrangement strengths and disallowing a quantitative extraction of model parameters. The spoke link rearrangement process moves other structural observables, like degree correlations, cluster coefficient and motif frequencies, closer to their counterparts extracted from the yeast data. This underlines the importance to take a precise modeling of the observational incompleteness into account when network structure models are to be quantitatively compared to data.

AKSOE 10.52 Wed 16:00 P2

Statistical significance of community structures in complex networks — ●Jörg Reichardt and Stefan Bornholdt — Institute for Theoretical Physics, University of Bremen, Otto-Hahn-Allee, 28359 Bremen, Germany

The community structure of complex networks, i.e. the assignment of nodes into groups, (communities, modules) that have high inner and low outer link density, has been a major research focus in the last years. It is of interest for exploratory data analysis in many disciplines. Many algorithms to detect community structure have been developed using a variety of different approaches. We will show, that the problem of finding communities in a network can be mapped onto finding the ground state of a spin glass [1,2]. We can calculate expected community structures for random networks, which can be used for comparisons with real world data. We show the influence of degree correlations on the modularity of networks and investigate the theoretical limits of community detection.
[1] J.R. S.B, Phys. Rev. Lett., **93**, 21, 218701
[2] J.R. S.B. preprint, arxiv:physics/0503138

AKSOE 10.53 Wed 16:00 P2

Dynamics of language competition: bilingualism and local effects. — ●Xavier Castelló, Victor M. Eguíluz, and Maxi San Miguel — IMEDEA (CSIC-UIB), Universitat Illes Balears, E-07122 Palma de Mallorca, Spain

Several models have been proposed to study the dynamics of competition between languages [1]. Starting from the model of Abrams and Strogatz for the dynamics of endangered languages [2], the models pro-

posed by Mira and Paredes, and Minett and Wang [3] address the issue of bilingualism. Along these lines we consider the dynamics of language use, allowing for bilingualism, within a social network, in the case where the languages are equivalent. Understanding this case seems a necessary first step to describe the more general case of an endangered language competing against another one with a higher status. Local effects are analyzed, studying the interface dynamics and growth laws of the system. We observe that the interface density and bilingual population density decay following a power law. The system reaches an absorbing state where one of the languages dominates, and the other language together with the bilingual community disappears. We also study the stability of the bilingual communities, which suggests possible explanations for the difficulty of coexistence of languages in the long term.

[1] Schulze, C., Stauffer, D. (2005) Simulation of language competition by physicists, Preprint cond-mat/0511049.

[2] Abrams, D.M., Strogatz, S. H. (2003). Nature 424, 900.

[3] Mira, J., Paredes, A. (2005). Europhysics Letters 69, 1031; Minett, J. W., Wang, W. S-Y. (unpublished).

AKSOE 10.54 Wed 16:00 P2

The Network of Inter-Regional Direct Investment Stocks across Europe — •Joao M. Rodrigues[1], Stefano Battiston[1], and Hamza Zeytinoglu[2] — [1]Chair of Systems Design, ETH Zurich, CH-8092 Zurich — [2]Clarifix Ltd., Suite 302, 95 Wilton Road, London SW1V 1BZ, UK

We study the dynamics of inter-regional investment flow in Europe from a complex networks perspective. The network of investment stocks in Europe is investigated at two different levels: the level of firms, based on ownership shares and number of employees; and the level of regions in Europe, by aggregating the ownership network of firms, based on their headquarter location. We focus on statistical distributions and scaling laws of activity, investment stock and connectivity degree both at the two levels. We find that investment stock of firms is power law distributed with an exponent very close to the one found for firm activity. On the other hand investment stock and activity of regions turn out to be log-normal distributed. At both levels we find scaling laws relating investment to activity and connectivity. In particular, we find that investment stock scales with connectivity in a similar way as has been previously found for stock market data.

AKSOE 10.55 Wed 16:00 P2

Evolutionary Design of Robust Signal Transduction Networks — •Pablo Kaluza and Alexander S. Mikhailov — Fritz-Haber-Institut der Max-Planck-Gesellschaft

Signal transduction networks of a living cell can retain their functions despite noise and mutations. This suggests that their architecture is optimized in the process of biological evolution not only with respect to a particular function, but also to increase their robustness. In our theoretical study, a toy pipeline model of transduction networks is considered. By running an artificial evolution process, we design robust functional networks with predefined, randomly generated response patterns. The robustness of a network, optimized during its evolution, is estimated as the fraction of all test mutations leaving the response within a certain tolerance window. The signal transduction networks which are robust with respect to deletion of either a single node or of a single link are thus constructed. In an extension of this study, we design transduction networks that are robust with respect to static noise, modelled as random variations of connection weights. The statistical analysis of a large ensemble of designed functional networks allows us to detect characteristic features of the network architecture, implied by the robustness with respect to noise and various mutations.

AKSOE 10.56 Wed 16:00 P2

Directory trees created by computer users: Individuality vs. universality — •Konstantin Klemm[1], Victor M. Eguiluz[2], and Maxi San Miguel[2] — [1]Dept. of Bioinformatics, Leipzig University, Germany — [2]IMEDEA (CSIC-UIB), Palma de Mallorca, Spain

We describe the topological structure and the underlying organization principles of the directories created by users of a computer cluster when storing their own files. For each of the 63 observed users, the branching ratio (number of directories with the same parent) exhibits a broad, typically scale-free distribution with a non-universal exponent. Thus users can be distinguished by the degree exponent of the scale-free trees they create. The size distribution of the branches (subtrees below the root) decays algebraically with a universal exponent -2. These scaling prop-

erties and further observations are captured by a model of incremental tree growth [1]. The single parameter of the model interpolates between agglomeration into star-like structures and fully random attachment that leads to deep hierarchies. The alignment between model and empirical trees reveals the universal features of trees created independently and unrestrictedly by different users. Individual differences of tree construction boil down to a single real-valued parameter that is extracted by the alignment.

[1] Konstantin Klemm, Victor M. Eguiluz, Maxi San Miguel, Phys. Rev. Lett. 95, 128701 (2005).

AKSOE 10.57 Wed 16:00 P2

Material and Information Flows in Production Networks — •Karsten Peters[1] and Dirk Helbing[1,2] — [1]Institute for Transport & Economics, Dresden University of Technology, Andreas-Schubert-Str. 23, 01062 Dresden, Germany — [2]Collegium Budapest – Institute for Advanced Study,Szentháromság u. 2, 1014 Budapest, Hungary

Production and supply networks are complex networks of nonlinear dynamical elements designed to fulfill certain functional requirements. By using recently developed models we study the interaction and dynamics of production units exchanging material and information in such network structures. Whereas the directed flow of materials introduces a coupling between nearest neighbours in a supply network, the accompanying information network can involve even long range interactions. The stability and robustness under demand variations with respect to the topology of the underlying network structures is investigated. Surprisingly, even small changes in network topology can lead to different dynamics. Furthermore, for a fixed material flow network, the stability and dynamical behaviour of the system can be influenced significantly by changing the structure of the sub-network for information exchange. These results can be used to optimize the structure of the material flow network and the information network in order to obtain more reliable, stable and robust supply networks.

AKSOE 10.58 Wed 16:00 P2

Initiating a Mexican wave: An instantaneous collective decision combining short and long range interactions — •Illes Farkas and Tamas Vicsek — Biol. Phys. Res. Group of HAS and Dept. of Biol. Phys., Eotvos Univ., Pazmany P. stny. 1A, H-1117 Budapest, Hungary

The Mexican wave (La Ola) emerges through the coordinated behavior of spectators in a stadium as they stand up and then sit down again following those to their left (or right) with a short delay. Since its spontaneously selected direction of motion is the result of a rapid collective decision, it can serve as a paradigm for processes with limited complexity of the interaction. The global patterns of collective opinion formation in more complex situations are of considerable interest and have recently been studied with success using the methods of statistical physics. Guided by the extensive observations of volunteers filling out our online questionnaire, we use a simple, but still realistic model of the Mexican wave to explain how the combined effect of the local and global interaction terms produces a spontaneous symmetry breaking. The symmetric solution containing two waves (one moving left and one right) is replaced by a single wave (one of the two possible directions of propagation is selected and the other is suppressed). We find that this transition has features reminiscent of discontinuous transitions. After the spontaneous symmetry breaking the two directions of propagation are still statistically equivalent. We investigate also how this remaining symmetry is broken in real stadia by a small asymmetrical term in the perception of spectators.

AKSOE 10.59 Wed 16:00 P2

Dynamics of Social Systems: Cooperation and Free-Riding — •Yiping Ma[1,2], Mirta B. Gordon[1], and Jean-Pierre Nadal[3] — [1]Laboratoire Leibniz-IMAG, Grenoble, France — [2]Department of Physics, Hong Kong University of Science and Technology, Hong Kong — [3]Laboratoire de Physique Statistique, Ecole Normale Supérieure, Paris.

We study the mean field dynamics of a model introduced in [1] of a social community. The N agents may choose between three strategies: either to join the community or not, and in the case of joining it, either to cooperate or to behave as a free-rider. Individuals' preferences have an idiosyncratic willingness to join, and a social component that depends on the fractions of cooperators and free-riders. Cooperators bear a fixed cost whereas free-riders support an idiosyncratically weighted cost proportional to the number of cooperators. We study the dynamics of this

model analytically in the large N limit for both parallel and sequential updating. The resulting 2-d map in parallel updating, and 2-d flow in sequential updating, are analyzed within the framework of dynamical systems. As one varies one of the parameters, the phase diagram experiences a rich class of bifurcations. Noticeably, a stable limit cycle is shown to exist in both parallel and sequential updating, under certain parameter settings. We illustrate these results by computer simulations exhibiting examples of fixed points and of limit cycles, reached both through parallel and sequential updating. Comparison with the analytical predictions reveals however strong finite size effects.

[1] D. Phan, R. Waldeck, M. B. Gordon and J.-P. Nadal, WEHIA 2005 [http://perso.univ-rennes1.fr/denis.phan/papers/pgnw2005.pdf]

AKSOE 10.60 Wed 16:00 P2

Fairness state with plastic preferences — ●Elena Ramirez Barrios[1] and Juan Guillermo Diaz Ochoa[2] — [1]eramirez@economics.uni-kiel.de — [2]diazochoa@itp.uni-bremen.de

The definition of preferences is a concept that concerns decision making in social systems (for instance in vote systems) and economics. We are interested in the phenomena of efficient choice and economic fairness. In Arrow's theorem this situation is expressed as an impossibility of aggregate preferences among agents without running into unfairness. This situation was also analyzed in a previous model in a network of agents with a random allocation. Both researchs are based on static preferences.

In a real society the individuals are confronted to exchanges of information that can modify the way they think. In particular, the preferences of each person are influenced by this exchange. This consideration is not enough realistic and is not able to make an accurate analysis of the fairness state when the preferences are changing. The aim of this research is to consider the coupling of two systems: the first one consider the formation of preferences and a second stage, where an allocation of goods is done.

AKSOE 10.61 Wed 16:00 P2

Skiba thresholds in a model of controlled migration — ●Feichtinger Gustav — Vienna University of Technology

This paper presents a dynamic optimization model of a central challenge of US housing policy: deconcentrating poverty via housing mobility programs without inducing middle-class flight. We explore two versions both with and without the possibility that poor families assimilate into the middle class. Both demonstrate multiple equilibria with a Skiba point separating initial conditions for which the optimal strategy leads to substantial flight from those leading to a stronger middle-class population. We also find an interesting mathematical phenomenon of a "lens" focusing the trajectories in a sense that allows for the coexistence of three saddles and an unstable equilib

AKSOE 10.62 Wed 16:00 P2

Persistence problem in a socio-econo dynamics of the diluted Ising ferromagnet in high dimensions — ●Takuya Yamano[1] and Sudhir Jain[2] — [1]Institut für Theoretische Physik, Otto-Hahn-Allee, Universität Bremen, Germany — [2]School of Engineering & Applied Science, Aston University, Birmingham, United Kingdom

The spins in a system which does not flip up to some time t is called the persistence problem. The Glauber dynamics at zero-temperature in the cases of Ising model, disordered, higher dimensions, q-state Potts model and so forth have been studied in the literature. In this presentation, we report the results obtained in a socio-dynamics model with finite temperature on hypercubic lattice (up to 5 dimension) and determine the exponent of the decay of the persistence probability $P(t)$. The model we treat is based on a social local field which contains a magnetization at time t and we impose a $\pm J$ model, thai is, a quenched random interaction for pairs, which is drawn from the binary distribution as a function of bonds concentration p. We argue whether or not the *blocking* phenomena in $P(t)$ exists and implications for the social and economic context.

AKSOE 10.63 Wed 16:00 P2

Metrics for a physics of organizational decision-making — ●Bill Lawless — Paine College, Augusta, GA 30901

Agent dynamics (behavior) are guided by self-observations (static information) that converge into a stable worldview, whether in human-social or computational-agent or organizational reality. Examples of convergent worldviews among human and organizational agents abound as single-sided stories, religious beliefs, and political perspectives. The successful ones of these simple, linear rational descriptions of phenom-

ena stabilize into cultural heuristics. But the computational question arises in how effective this knowledge of the common interaction for human agents translates to the bi-sided perspectives of actual interactions, which until now have remained mathematically intractable. We believe that only bi-sided computational agents will be capable of replicating social phenomena such as the dynamics of human agents, including the more difficult problem of organizational decision-making.

AKSOE 10.64 Wed 16:00 P2

Collaborative Tagging and Semiotic Dynamics — ●Ciro Cattuto[1,2], Vittorio Loreto[2], and Luciano Pietronero[2] — [1]Museo Storico della Fisica e Centro Studi e Ricerche "Enrico Fermi", Compendio Viminale, 00184 Roma, Italy — [2]Dipartimento di Fisica, Universita' di Roma "La Sapienza'", P.le A. Moro, 2, 00185 Roma, Italy

A new paradigm has been quickly gaining ground on the WWW: Collaborative Tagging. In web applications like Del.icio.us, Flickr, Connotea, users manage their personal collection of online resources by enriching them with semantically meaningful information in the form of freely chosen tags. Despite the anarchic nature of users' behavior, the global dynamics of these systems leads to a self-organised categorization ("folksonomy") of a large and evolving body of online resources. Here we collect data from a popular online system and select a semantic context by extracting all the resources associated with a given tag. On studying the distribution of tags co-occurring with the selected one, we find a heavy-tailed behavior and observe properties that point to an emergent hierarchy of tags. We introduce a stochastic model embodying two main aspects of collaborative tagging: (i) a multiplicative character related to the exposure of users to each other's activity; (ii) a notion of long-term memory. Remarkably, our model is able to account quantitatively for the measured properties of tag association. This is a clear indication that collaborative tagging is able to recruit the uncoordinated actions of web users to create a coherent and predictable semiotic dynamics at the emergent level.

AKSOE 10.65 Wed 16:00 P2

Needs and decisions in ghetto — ●Krzysztof Kulakowski — Faculty of Physics and Applied Computer Science, AGH UST, Cracow, Poland

We consider ghetto as a social group of people ruled by an external power; members of the group feel that their laws are broken; however, attempts to leave ghetto make their situation worse. We discuss the relation of ghetto inhabitants to the ruling power, in the context of their needs organized according to the Maslow hierarchy. Decisions how to satisfy successive needs are undertaken in cooperation with or defection the ruling power. This issue allows to construct a tree of decisions and an adaptation of the tree pruning technique from the game theory. Dynamics of the decisions can be described within the formalism of fundamental equations. The result is that the strategy of defection is stabilized by the estimated payoff.

AKSOE 10.66 Wed 16:00 P2

Modelling a public investment game: a dynamical approach — ●Silvio R. Dahmen[1], Roberto da Silva[2], Ana L.C. Bazzan[2], and Alexandre Baraviera[3] — [1]Instituto de Fisica, UFRGS, Brazil — [2]Instituto de Informatica, UFRGS, Brazil — [3]Instituto de Matematica, UFRGS, Brazil

In this paper we deal with a public investment game, where each agent may contribute with a quantity in the interest of the wealth of the group of investors. Interactions among agents happen in a neighborhood and depend on the motivation level (insider information, economy prospects). Several scenarios are investigated. In the deterministic case, we focus on the existence of periodic behavior for the profit of the group, whereas in the stochastic case we analyze the behavior of the global persistence. Our simulations show that this quantity has a robust power law updating behavior, indicating that this can be used to model emerging collective behavior. We have also performed simulations with heterogeneous agents, including deceiver and conservative agents. Finally we have performed simulations for the local persistence exploring two different versions of this concept: the probability of a particular agent not going bankrupt and the probability of a particular agent not losing money. Different power-law behaviors are also observed in these two situations.

AKSOE 10.67 Wed 16:00 P2

An analytical solution of a wealth exchange model — •Przemyslaw Repetowicz and Peter Richmond — Department of Physics, Trinity College Dublin 2

We solve analyticaly a toy version of a Boltzmann model with applications in economics. This model was first proposed by [1,2] and analysed numericaly in [3,4,5]. The authors studied variants of the model and claimed that in one case the steady state corresponds to a Gamma function [3,4] and in another case that it corresponds to a distribution with a power law with index unity [5] in the high end.It was suggested that the existence of equillibria and the power law exponent of unity are universal features of the model. More recent [6,7] analytical calculations revealed that the Gamma function is only a approximation to a steady state solution.In this work we analyze the existence of equillibrium and the rate of convergence to it. Our approach rest on a body of other work published many years ago [8] and more recently studies using probabilistic tools [9,10].

[1] Chatterjee A et al, Physica Scripta T **106**, p 36-38 (2003) and cond-mat/0311227
[2] Chatterjee A et al, Physica A 335 155–163 (2004)
[3] Patriarca M et al, preprint cond-mat/0312167
[4] Patriarca M et al, preprint cond-mat/0402200
[5] Patriarca M et al, preprint cond-mat/0504153
[6] Repetowicz P et al, Physica A, 356 (2005) 641-654
[7] Chatterjee A et al, preprint cond-mat/0407770
[8] Wild E, Proc. Camb Phil Soc 47 (1951) 602-609
[9] Ferland R et al, Stochastics Rep. 35 (1991) 23-33
[10] Carlen E A et al, Jour. Func. Analysis

AKSOE 10.68 Wed 16:00 P2

A model for social dynamics with controlled mass media. — •Juan Carlos González-Avella — juancarlos@imedea.uib.es

We study the effect of mass media, modeled as an applied external field, on a social system based on Axelrod's model for the dissemination of culture. The numerical simulations show that the system undergoes a nonequilibrium phase transition between an ordered phase (homogeneous culture) specified by the mass media and a disordered (culturally fragmented) one. The critical boundary separating these phases is calculated on the parameter space of the system, given by the intensity of the mass media influence and the number of options per cultural attribute. Counterintuitively, mass media can induce cultural diversity when its intensity is above some threshold value. The nature of the phase transition changes from continuous to discontinuous at some critical value of the number of options

AKSOE 10.69 Wed 16:00 P2

Reactions to extreme events: moving threshold model — •Eduardo G. Altmann, Sarah Hallerberg, and Holger Kantz — Max Planck Institute for the Physics of Complex System, Dresden - Germany

The occurrence of unexpected large events is a common feature of complex dynamical systems considered in physical (earthquakes, extreme weather conditions), biological (heart attacks, epileptic seizures), and sociological (stock market crashes) contexts. The harmful effects of such extreme events are due to the overcome of the preventive barriers, what results not only from its extreme character, i.e., large fluctuation of some scientifically relevant observable, but also from its unpredictable nature. An event is thus defined to be *extreme* if it exceeds a given threshold that corresponds to the preventive barriers, which account for the expected events and typically change in time. These barriers usually increase drastically right after the occurrence of extreme events, but steadily decay in their absence. We consider in this presentation a simple model that mimics the evolution of the protection barriers to study the efficiency of the system's reaction to extreme events and how it changes our perception of the sequence of extreme events itself. We obtain that the usual method of fighting extreme events introduces a periodicity in their occurrence and is generally less efficient than the use of a constant barrier. On the other hand, it shows a good adaptation to the presence of slow non-stationarities.

[1] E. G. Altmann, S. Hallerberg, H. Kantz, arXiv: physics/0508170, Physica A.

AKSOE 10.70 Wed 16:00 P2

From small world to hierarchic business information networks by reorganizations - a real world study of a failure — •Markus Christen[1], Georges Bongard[2], Attila Pausits[3], and Ruedi Stoop[1] — [1]Institute of Neuroinformatics, University / ETH Zürich, Winterthurerstrasse 190, 8057 Zürich, Switzerland — [2]Swisscom IT Services AG, 3050 Bern, Switzerland — [3]Center for Telematics, Donau Universität Krems, Dr.-Karl Dorrek-Strasse 30, 3500 Krems, Austria

Business units in large enterprizes are frequently objects of reorganizations. These change the social network of the unit, expressed by the flow of information between the employees that is necessary for performing business processes. Reorganizations usually intend to increase the efficiency of the unit, measured in terms of the speed of business processes performed by the unit. We take a real-world example and investigate the change of the information-flow induced by a reorganization that transformed a small-world type into a hierarchical type network. We show that the robustness, determined in terms of how the business processes are affected by an outage of nodes in the information-flow, is a critical parameter that tends to counteract the intended gain in efficiency. The example demonstrates that reorganizations should not only focus efficiency in terms of classical business studies, but should include an analysis of the robustness of the information-flow network within a business unit as well. Otherwise, theoretically expected gain in efficiency may not be achievable in practice.

AKSOE 10.71 Wed 16:00 P2

Taxing Principles and their influence on Economy — •Alexei Vasilev[1] and Alexander Chalyi[1,2] — [1]Taras Shevchenko Kiev University, Department of Theoretical Physics, 2 Glushkov Prosp., Building 1, 03680 Kiev, Ukraine — [2]National Medical University, Department of Physics, 13 Shevchenko Blvd., 01601 Kiev, Ukraine

The efficiency of different schemes of taxing is investigated. For this purpose the mathematical model is proposed. The dependence of the government income on average taxing rate is received analytically. It is shown that this dependence coincides with the law of Laffer curve. It is found also that this dependence takes place when economic system is in the stable stationary state only while the instability of stationary state causes the deviation from the law of the Laffer curve. Moreover special investigation is carried out and it is shown that the model used is structurally stable.

AKSOE 11 Dynamics of Groups and Organisations III

Time: Thursday 09:30–10:15   Room: BAR 205

Invited Talk   AKSOE 11.1 Thu 09:30 BAR 205

Randomness in consensus formation — •Maxi San Miguel and Victor M. Eguiluz — IMEDEA, Ed. Mateu Orfila, Campus Universitat Illes Balears, 07122 Palma de Mallorca, Spain

A main issue of consensus problems is to determine when the dynamics of a set of interacting agents that can choose among several options lead to a consensus in one of these options, or when a state with several coexisting social options prevail. This dynamics is very sensitive to random events (noise) that can either disorder the system or be a useful mechanism to escape from frozen polarized states. This general question will be discussed in two examples: a) A model of cultural dynamics in a social network that co-evolves with the agents dynamics; b) Bounded confidence models of opinion formation.

AKSOE 12 Economic Models and Evolutionary Game Theory II

Time: Thursday 10:15–12:45 — Room: BAR 205

AKSOE 12.1 Thu 10:15 BAR 205

A Network Model of Company Growth — •MICHAEL KOENIG, STEFANO BATTISTON, and FRANK SCHWEITZER — Chair of Systems Design, ETH Zurich,CH-8092 Zurich,Switzerland

We study a network model of company growth in which each node represents a company. Growth of a company is described by means of a differential equation that includes a stochastic auto-catalytic term as well as terms for the interaction with other companies. These interactions contribute positively to growth and can be interpreted as the sharing of knowledge. Global couplings stand for limited resources and external conditions, e. g. market restrictions imposed by governmental institutions.

We test several local rules of network formation which specify how companies choose other companies to cooperate with. All these rules assume selfishness and bounded rationality, the latter meaning that each company has only local information on the network topology and makes decision on a trial and error basis.

By means of computer simulations we investigate the conditions for the emergence of non-random structures. We observe that some specific rules lead to the appearance of alliances of cooperating companies, the formation of hubs (companies that are highly connected) and structures with a hierarchy of size levels. We find that during the evolution of the network starting from a random graph, the clustering coefficients and other quantities related to the length of cycles display abrupt changes reflecting the appearance of hierarchical structures.

AKSOE 12.2 Thu 10:45 BAR 205

Stock markets as adaptive controllers — •KLAUS PAWELZIK and ROLAND ROTHENSTEIN — Inst. f. Theor. Physik, Otto-Hahn Allee, D-28334 Bremen

Price time series from large speculative markets exhibit power law distributions of returns and temporal correlations of fluctuation amplitudes (volatility clusters). These 'stylized facts' appear to reflect 'irrationalities' of the market's participants which challenges the hypothesis that the price dynamics cannot be exploited for making arbitrage profits. We reformulate this 'efficient market hypothesis' as successful control. Our investigations of a simple market model with nonadaptive agents indeed demonstrate that already the redistribution of goods by trade via an order book suffices to realize adaptation of the overall system which rapidly compensates the effect of predictable external drives on the price. The residual fluctuations, however, are found to remain non-gaussian if the market is dominated by speculative agents. To understand the origin of these power law fluctuations we analyse the dynamics of an optimal adaptive controller with very short memory when applied to an unstable one-dimensional system. We find that this system is attracted to a state in which the external noise is critically amplified. Analysis demonstrates that this 'self-organized critical control' generally causes power law fluctuations of the residuals. Our results suggest that the large fluctuations of returns observed in real markets rather are the neccessary consequence of successful control than reflecting inefficiencies.

AKSOE 12.3 Thu 11:15 BAR 205

Individual strategies and group dynamics in complementarity games — •JUERGEN JOST and WEI LI — Max Planck Institut fuer Mathematik in den Naturwissenschaften, Inselstr.22, 04229 Leipzig

We introduce and study a complementarity game where members of a population play repeated games with different, randomly drawn members of the opposite (symmetric population), and the populations are recomposed according to evolutionary schemes like genetic algorithms after fixed numbers of rounds. We can then break the symmetry between the two populations by assigning them different strategy spaces, for example building their move upon the outcomes of their previous encounters or rather on the experience of their successful neighbors in a specified or evolvable network. This leads to an interesting interplay between individual strategy adaptation and group level dynamics. the rules of the game are the following: A member of population A (called buyers) and one of member B (sellers), randomly drawn from their respective population, make each an offer k_A and k_B, between 0 and some K (e.g.=100). When k_A > k_B, a deal is concluded, and the buyer pays k_A and the seller receives k_B. If not, the seller pays K, and the buyer receives 0. When, for example, the members of A play a consistent strategy of making low offers, they can force a less organized seller population into accepting such low offers eventually. The question then is how such a strategy that is good for the population as a whole can evolve from the individual gain maximizing strategies of the individual members. We present systematic comparisons and results.

AKSOE 12.4 Thu 11:45 BAR 205

Inverse Statistics in the Stock Market: The gain/loss asymmetry. — •MOGENS H. JENSEN — Niels Bohr Institute, Blegdamsvej 17, DK-2100 Copenhagen.

We have consider inverse statistics of the Dow Jones Industrial Averaged (DJIA) and argue that the natural candidate for such statistics is the investment horizons distribution. This is the distribution of waiting times needed to achieve a predefined level of return obtained from de-trended historic asset prices. By considering equal positive and negative levels of return, we have found a quantitative gain/loss asymmetry which is most pronounced for short horizons. In the case of individual stocks in the DJIA, we show that this gain/loss asymmetry established for the DJIA surprisingly is not present in the time series of the individual stocks. The most reasonable explanation for this fact is that the gain/loss asymmetry observed in the DJIA as well as in the SP500 and Nasdaq are due to movements in the market as a whole, {\it i.e.}, cooperative cascade processes (or synchronization) which disappear in the inverse statistics of the individual stocks. We present an asymmetrical synchronous model for this observation where the market as a whole exhibits a gain/loss asymmetry but where all the individual stocks are symmetric.

AKSOE 12.5 Thu 12:15 BAR 205

The working of circuit breakers within percolation models for financial markets — •GUDRUN EHRENSTEIN[1] and FRANK WESTERHOFF[2] — [1]Institute for Theoretical Physics, Cologne University — [2]Department of Economics, University of Osnabrueck, Rolandstrasse 8, D-49069 Osnabrueck, Germany

We use a modified Cont-Bouchaud model to explore the effectiveness of trading breaks. The modifications include that the trading activity of the market participants depends positively on historical volatility and that the orders of the agents are conditioned on the observed mispricing. Trading breaks, also called circuit breakers, interrupt the trading process when prices are about to exceed a pre-specified limit. We find that trading breaks are a useful instrument to stabilize financial markets. In particular, trading breaks may reduce price volatility and deviations from fundamentals.

AKSOE 13 Dynamics of Groups and Organizations IV

Time: Thursday 14:00–15:30 — Room: BAR 205

AKSOE 13.1 Thu 14:00 BAR 205

Efficiency and evolution of hierarchical organizations — •MARCO LAMIERI [1] and DIANA MANGALAGIU [2] — [1]University of Turin, Piazza Albarello 8, Torino Italy — [2]Reims Management School, 59, rue Taittinger, 51061 Reims, France

We focus on the agent-based modelling of an organization considering the interplay between three views of it: a formal, a process and a social view. The formal view is the organizational hierarchy; the process view is the way the organization performs a complicated task; the social view represents the informal relations between the agents. Each view of the firm is dynamic and is modelled as a network, where the nodes represent the agents. The process emerges from the interaction between formal and social network and it affects the economic performance of the simulated organization. Each agent is autonomous, has skills and is able to perform a part of a task. The task is performed through agents' interaction until completion. The process network ties are defined by an evolutionary al-

gorithm that reinforces the links used the most frequently and lowers the strength of the less used links. We investigate the influence of the three structures on the organization efficiency and the organization dynamics in different market conditions. We identify the emergence of a stable shape of the structure under particular market conditions and we test its robustness to exogenous shocks like movements of demand and product differentiation.

AKSOE 13.2 Thu 14:30 BAR 205

Shrinking World. The comparison of distance and entropy analysis. — •JANUSZ MISKIEWICZ[1] and MARCEL AUSLOOS[2] — [1]Institute of Theoretical Physics, University of Wroclaw, pl. M. Borna 9, 50-204 Wroclaw, Poland — [2]S.U.P.R.A.T.E.C.S., B5 Sart Tilman, B-4000 Liège, Euroland

The analysis of similarities in development patterns of the leading world (mainly European) countries is performed. The economical situation of each considered country is described by its total GDP normalised to the GDP level of US dollar in 1999. For comparing cases, the yearly GDP increment time series are considered. The similarities between country developments are investigated by means of a statistical correlation distance and a distance based on Theil index, which could be considered as an entropy measure. The calculations are performed for a time window constant size, which is moving along the time axis.

Next the time distance matrix is obtained and analysed by constructing two networks: the locally minimal spanning tree and the bidirectional minimal length path.

The time evolution of the mean distance between countries is investigated and the economy globalisation process thereby observed. The analysis is repeated for all possible time window sizes; a resonance time window size is then found; the latter could be interpreted as a globalisation time scale.

AKSOE 13.3 Thu 15:00 BAR 205

On the nature of business cycles — •H G DANIELMEYER — Inst. für Neuro- und Bioinformatik, Lübeck, Ratzeburger Allee 160

The four business cycles of the USA between 1961 and 1992 are analyzed with non-linear market-coupled first order differential rate equations for one consumer and one supplier with different but constant planning horizons (PHs). The base period of this system's cycles turns out to be 2Pi times the square root of the product of their PHs. Agreement with the periods and asymmetry of the cycles is obtained with the calendar year for both PHs but different anticipation and damping attitudes in positive (the so-called Phillips curve) and negative cycle phases, resp. Each correction is generally causing the next. Business cycle policies are not improving long term structural growth.

AKSOE 14 Financial Markets and Risk Management III

Time: Thursday 16:00–18:00   Room: BAR 205

AKSOE 14.1 Thu 16:00 BAR 205

Application of Zhangs Square Root Law and Herding to Financial Markets — •FRIEDRICH WAGNER — Institut fuer theoretische Physik, Universitaet Kiel, Leibnizstr.15, D-24098 Kiel

We apply an asymmetric version of Kirman's herding model to volatile financial markets. In the relation between returns and agent concentration we use the square root law proposed by Zhang. This can be derived by extending the idea of a critical mean field theory suggested by Plerou et al. We show that this model is equivalent to the so called 3/2-model of stochastic volatility. The description of the unconditional distribution for the absolute returns is in good agreement with the DAX independent whether one uses the square root or a conventional linear relation. Only the statistic of extreme events prefers the former. The description of the autocorrelations are in much better agreement for the square root law. The volatility clusters are described by a scaling law for the distribution of returns conditional to the value at the previous day in good agreement with the data.

AKSOE 14.2 Thu 16:30 BAR 205

Herding behaviour and persistence probabilities in the financial market — •STEFFEN TRIMPER[1] and BO ZHENG[2] — [1]Fachbereich Physik, Martin-Luther-Universität, Friedemann-Bach-Platz, 06108 Halle — [2]Zhejiang Institute of Modern Physics, Hangzhou, China

Economic systems such as financial markets are similar to physical systems far from equilibrium in that they are compromised of a large number of interacting agents. Therefore, methods established in statistical mechanics can be applied useful to describe certain aspects of financial systems. Here we concentrate us to three points. (i) The recently discovered two-phase phenomena in financial markets is examined with the German index DAX. We show that also an interacting herding model is able to produce the two-phase behaviour. (ii) A generalized dynamic herding model with feedback interactions is introduced within the Eguiluz-Zimmermann model. Here the transmission of information at time t is assumed to be dependent on the variation of the index at a former time. Both the static and the dynamic behaviour of the correlation function are discussed. Moreover, we present a detailed analysis of the persistence probability of the German DAX and the Shanghai Index. (iii) Within daily and minutely data of the DAX and the Chinese Index we analyse the return-volatility correlation function, and find a leverage effect for the German market while an anti-leverage effect for the Chinese market. B.Zheng, F.Ren, S.Trimper, and D.F Zheng, Physica A343, 653 (2004); F. Ren, B.Zheng, H.Lin, and S.Trimper, Physica A 350, 439 (2005), B.Zheng, T. Qui,F. Ren, and S. Trimper, Leverage and

anti-leverage effects in financial markets.

AKSOE 14.3 Thu 17:00 BAR 205

Statistical properties of online auctions — •ANDREAS SCHADSCHNEIDER and ALIREZA NAMAZI — Institut für Theoretische Physik, Universität zu Köln, 50937 Köln

Online auction sites like eBay have become increasingly popular over the last years. They use so-called 'second price auctions' where the final price is determined by the second highest bid. We have analyzed the statistical properties of a large number of auctions run on eBay.de. It is found that many observables (number of bids placed etc.) follow rather simple distributions. Also relations between variables typically are described by power-laws, e.g. in the case of the dependence of the final price on the number of submitted bids. We show that these properties help to identify a rather common form of fraud known as 'shill bidding'. Furthermore we analyze the distribution of bid submission times in order to determine the different strategies used by the agents.

AKSOE 14.4 Thu 17:30 BAR 205

Geometric motion in prices, and its limited validity. — •ALESSANDRO SAPIO — LEM - Sant'Anna School of Advanced Studies - Piazza Martiri della Liberta' 33 - 56127 Pisa (Italy)

In research on speculative and commodity market dynamics, log-linear price models have been widely applied (e.g. Geometric Brownian Motion, multiplicative diffusion processes). Yet, recent studies on wholesale power markets cast doubts on the general validity of the log-linear property. Linear models outperform log-linear ones (Lucia and Schwartz, 2001, Review of Derivative Research), and the returns volatility goes like the inverse of price (Bottazzi, Sapio and Secchi, 2005, Physica A).

This paper explores the limits to application of log-linear price models, and contributes with new insights on risk measurement and derivative pricing in markets with different institutional and technological features.

Spot pricing equations implied by periodic and continuous double auction settings are specified, and some conditions behind linear and log-linear price fluctuations are deduced. Geometric Motion emerges when individual orders are shaped by past prices (e.g. through forecasting rules, or as purchasing costs). This may not occur in power markets: trading is only based on current revenues and costs, because of non-storability.

Results are compared with predictions based on an alternative view - the efficient markets hypothesis - and the merits of the suggested framework are discussed.