



## EXYSTENCE Thematic Institute and Workshops

### From Many-Particle Physics to Multi-Agent Systems

• July 19 - September 17, 2004 •

#### Scientific Coordinators:

##### EXYSTENCE Thematic Institute

Eshel Ben-Jacob   Dirk Helbing   Frank Schweitzer  
Tel Aviv University   TU Dresden   ETH Zürich

#### Topical Workshop I (July 26 - 30, 2004):

##### Driven Many-Particle Systems - Hopping Particles, Granular Media, and Colloidal Systems

Jason A.C. Gallas   Hans J. Herrmann  
Universidade Federal do Rio Grande do Sul,   Universität Stuttgart  
Porto Alegre

#### Topical Workshop II (August 30 - September 3, 2004):

##### Multi-Agent Systems - Swarms, Ecology, and Society

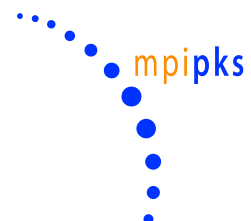
Iain Couzin   Frank Schweitzer  
Oxford University   ETH Zürich

#### Local Organization:

Claudia Pönisch  
MPI PKS Dresden



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# **EXYSTENCE Thematic Institute: From Many-Particle Physics to Multi-Agent Systems**

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The Thematic Institute (TI) - together with the two accompanying Topical Workshops (TW I / II) - is part of the activities of the European Network of Excellence (NoE) “Complex Systems” (EXYSTENCE). It takes place at the Max-Planck Institute for the Physics of Complex Systems (MPI PKS) in Dresden from Monday, 19 July 2004, to Friday, 17 September 2004, and is jointly financed by EXYSTENCE and the MPI PKS.

EXYSTENCE is funded by the European Commission within the Future Emerging Technologies (FET) Programme of the Information Society Technologies (IST) Programme of the Fifth Framework (IST-2001-32802) from March 2002 until September 2005. The NoE aims to develop collaboration among European researchers interested in Complex Systems, from fundamental concepts to applications, and involving academia, business and industry.

TI/TW of the NoE have to focus on issues of Complex Systems from a broader perspective. They should cover transdisciplinary aspects of Complex Systems, in order to develop a commonality of concepts and methods applicable to different fields.

The TI “From Many-Particle Physics to Multi-Agent Systems” matches these conditions in various respects. It aims at a transfer of methods developed primarily in statistical physics to deal with many-particle systems in other scientific areas, such as biology, artificial intelligence, or social sciences. Certainly, the basic entities in these fields differ from physical “particles” in that they already have an intermediate complexity themselves. Therefore, these entities today are commonly denoted as agents. This term means a subunit of the system that may already have internal degrees of freedom to allow certain activities, such as (active) movement, and interaction with other agents.

Systems comprised of a (usually large) number of (usually strongly) interacting agents (entities, components, ...) are denoted as Complex Systems, because the system behavior cannot be simply inferred from the behavior of the components. That is, self-organization and emergent properties play an important role in determining the resulting spatio-temporal patterns, or the collective “behavior” on the macroscopic level.

In order to gain insight into the interplay between microscopic interactions and macroscopic features in complex systems, it is important to find a modeling level, which on one hand considers specific features of the system and is suitable to reflect the origination of new qualities, but on the other hand is not flooded with microscopic details. In this respect microscopic, i.e. particle-based and agent-based models have become a very promising approach to investigate and to simulate complex systems. A commonly accepted theory of multi-agent systems that also allows analytical investigations is however still pending. It will be a multi-disciplinary challenge to improve this situation, in which also statistical physics needs to play its part, both by contributing concepts and formal methods. Its long lasting experience in describing many-particle systems, to deduce the structure, properties and dynamics of matter from microscopic interaction laws, may serve as a paragon also for other scientific areas, where one would finally like to explain the observed macroscopic dynamics based on non-linear interactions among a large number of different agents.

The TI/TW want to contribute to this development, by bringing together scientists from different fields who deal with many-particle and multi-agent systems, to allow mutual interaction and new insights - both for physicists who want to apply their methods to interdisciplinary problems, and for scientists from other fields interested in formal methods developed for interacting particle systems.

# Topical Workshop I: Driven Many-Particle Systems - Hopping Particles, Granular Media, and Colloidal Systems

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The workshop primarily focuses on particle-based models of collective interaction in systems that are driven far from equilibrium, either by external or by internal forces.

In externally driven many-particle systems, the ongoing competition between the driving forces and the dissipative friction forces leads to a spatio-temporal redistribution of energy, which produces a great variety of self-organization phenomena. This results from non-linearities in the equations of motion, which allow small initial perturbations to be enhanced and non-equilibrium patterns to be dynamically stabilized. In fluids, this may lead to the formation of waves or vortices, while in vibrated granular media, one can find emergent convection patterns, collective oscillating states (so-called oscillons), spontaneous segregation of different granular materials or self-organized criticality with power-law distributed avalanche sizes.

Other kinds of phenomena such as “freezing by heating” or noise-induced ordering are observed in self-driven many-particle systems, where the driving force is not of external origin (exerted from outside), but associated with each single particle and self-produced. This requires each particle to have some kind of internal energy reservoir. Self-driven “particles” are nowadays a paradigm for many active or living systems, where they are a simplified and abstract representation of the dynamic behavior of cells, animals, or even humans.

While most many-particle systems have to be studied numerically, particle hopping models allow for analytical insights into their basic properties and non-equilibrium phase transitions due to the simplifying (minimal) model assumptions they make. In recent years, also experimental studies of self-driven many-particle systems other than traffic systems are carried out, for example, in gravitationally driven granular flows, flows of charged granular particles, or colloidal particles in suspensions exposed to electrical fields.

# Program<sup>1</sup>

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
09:00 – 09:10	<b>Opening: Schweitzer/Fulde</b>			
09:10 – 09:50	<b>Grassberger</b>	<b>Brey</b>	<b>Schreckenberg</b>	<b>Gonzalez</b>
09:50 – 10:30	<b>Droz</b>	<b>Barthelemy</b>	<b>Arcangelis</b>	<b>Beims</b>
10:30 – 11:00	Coffee Break	Coffee Break	Coffee Break	Coffee Break
11:00 – 11:40	<b>Slanina</b>	<b>Janosi</b>	<b>Sokolowski</b>	<b>Peruani</b>
11:40 – 12:00	<b>Treiber</b>	<b>Hoogendoorn</b>	<b>Schweitzer</b>	Lunch (11:46 – 13:30)
12:00 – 12:20	<b>Denysov</b>	<b>Herrmann</b>	<b>Börner</b>	
12:30 – 14:00	Lunch	Lunch	Lunch	
15:00 – 15:40	<b>Santos</b>	Guided City tour + Museum visit + Dinner at the Restaurant Waldschlösschen	<b>Pöschel</b>	Departure
15:40 – 16:00	<b>Barat</b>		<b>Angel</b>	
16:00 – 16:30	Coffee Break		Coffee Break (16:30-17:10) <b>Puglisi</b> (17:10-17:30) <b>Sanders</b>	
16:30 – 17:30	<b>MULTI04 Colloquium: Luding</b>			
17:30 – 17:50	<b>Swift</b>			
18:30	Dinner		Dinner	

<sup>1</sup>Abstracts available at <http://www.mpipks-dresden.mpg.de/~multi04/>

# Program<sup>1</sup>

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Sun, 25 July	18:30	Registration
	19:30	Welcome Buffet
Mon, 26 July	09:00 - 09:10	Frank Schweitzer/Peter Fulde <i>Opening</i>
	09:10 - 09:50	Peter Grassberger <i>Sequential sampling with bias and re-sampling: Reaction-diffusion systems, sequence alignment, and lattice animals</i>
	09:50 - 10:30	Michel Droz <i>Mesoscopic model for spontaneous symmetry breaking in shaken granular material</i>
	10:30 - 11:00	Coffee Break
	11:00 - 11:40	Frantisek Slanina <i>Efficiency of interacting Brownian motors</i>
	11:40 - 12:00	Martin Treiber <i>Modelling multi-anticipative driving strategies of human drivers</i>
	12:00 - 12:20	Sergey Denysov <i>Particle with internal dynamical assymetry: Self-propulsion and turning</i>
	12:30 - 14:00	Lunch
	15:00 - 15:40	Andres Santos <i>The penetrable-sphere model: A fluid of ghost particles</i>
	15:40 - 16:00	Ana Barat <i>Monte Carlo models of dissolution of multi-component tablets in the USP paddle apparatus</i>
	16:00 - 16:30	Coffee Break
	16:30 - 17:30	MULTI04 Colloquium: Stefan Luding <i>Driven and cooling granular gases</i>
	17:30 - 17:50	Michael Swift <i>Separation and pattern formation in fluid-immersed granular mixtures</i>
	18:30	Dinner

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<sup>1</sup>Abstracts available at <http://www.mpipks-dresden.mpg.de/~multi04/>

# Program<sup>1</sup>

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Tue, 27 July	09:10 - 09:50	Javier J. Brey <i>Hydrodynamic description of an open fluidized granular gas</i>
	09:50 - 10:30	Marc Barthelemy <i>Topology-traffic coupling: An ingredient for modelling weighted networks</i>
	10:30 - 11:00	Coffee Break
	11:00 - 11:40	Imre Janosi <i>Nonhydrostatic behavior in packing of frictionless discs</i>
	11:40 - 12:00	Serge Hoogendoorn <i>Self-organized games of walking</i>
	12:00 - 12:20	Hans Herrmann <i>Apollonian networks</i>
	12:30 - 14:00	Lunch
	14:30 - 18:00	Guided city tour and/or visit of a museum
	18:30 - ...	Dinner at Restaurant Waldschlösschen
Wed, 28 July	09:10 - 09:50	Michael Schreckenberg <i>Do we understand real traffic? - Data, models and simulations</i>
	09:50 - 10:30	Lucilla de Arcangelis <i>Slow dynamics and structural arrest in chemical and colloidal gels</i>
	10:30 - 11:00	Coffee Break
	11:00 - 11:40	Stefan Sokolowski <i>Application of a density functional theory in the studies of interfacial properties of chain particles and their mixtures</i>
	11:40 - 12:00	Frank Schweitzer <i>Driven-particle models for active biological motion</i>
	12:00 - 12:20	Uwe Börner <i>Modeling myxobacterial rippling</i>
	12:20 - 12:30	<b>Group photo</b>
	12:30 - 14:00	Lunch

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# Program<sup>1</sup>

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	15:00 - 15:40	Thorsten Pöschel <i>Force-free granular gases: Kinetic theory meets computer simulations</i>
	15:40 - 16:00	Andrew Angel <i>Overshooting currents and condensation transitions in the zero-range process</i>
	16:00 - 16:30	Coffee Break
	16:30 - 17:10	Andrea Puglisi <i>Thermal convection in simulations of mono-disperse and bi-disperse granular gases</i>
	17:10 - 17:30	Duncan Sanders <i>Are Brazil nuts attractive?</i>
	18:30	Dinner
Thu, 29 July	09:10 - 09:50	Marta Gonzalez <i>Scaling of the propagation of epidemics in a system of mobile agents</i>
	09:50 - 10:30	Marcus W. Beims <i>Environment dependent transport in multiple-asymmetric-well-potentials</i>
	10:30 - 11:00	Coffee Break
	11:00 - 11:40	Fernando Peruani <i>Collective behavior of active Brownian particles with rod-shape</i>
	11:45 - 13:30	Lunch

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<sup>1</sup>Abstracts available at <http://www.mpipks-dresden.mpg.de/~multi04/>

## Participants

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# Participants

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## Frequently asked questions

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- **SEMINAR AND WORKSHOP SECRETARIAT:** Office 2 A 7 (second floor) from Monday to Thursday 08:00 - 12:00 and 13:00 - 16:45. On Friday 08:00 - 12:00 and 13:00 - 15:30.
- **SCIENTIFIC COORDINATOR'S OFFICE:** Eshel Ben-Jacob, Dirk Helbing, Hans Herrmann, Jason Gallas, Iain Couzin office 2 A 9 (tel.: 2109). Frank Schweitzer office 1 B 8 (tel.: 1208).
- **WORKSHOP I WELCOME:** On the evening of July 25, 2004 at 07:30 p.m. a welcome reception will take place in the hall of the institute as an occasion to get to know each other while enjoying a buffet. Everybody is invited to join! Non-participants pay 6 € to Mr. Schneider from the cafeteria.
- **COMPUTERS:** The computers in the offices 2 A 13, 2 A 14, 2 A 15, 2 A 16 and 2 A 18 are reserved for the participants. Every participant gets an own computer account. Your login is the one you specified in your registration/application form or in case you specified none the first 8 letters of your last name. If your name has less than 8 letters then just leave the rest unfilled. Please log on to the machine "milou". The password is . Please change your password as soon as you have logged in. The command is **passwd**. After changing your password it is also possible to work on the machines "janus" and "titania".  
**The computer account will be deleted two months after September 17, 2004. Please get in contact with Hubert Scherrer-Paulus (2 A 6) for keeping your account longer than November 17, 2004.**  
Information on the institute's computer system is available through:  
[http://www.mpipks-dresden.mpg.de/closed/getting\\_started/getting\\_started.html](http://www.mpipks-dresden.mpg.de/closed/getting_started/getting_started.html)  
If you have any questions please contact Thomas Müller (2 A 4) or Torsten Goerke (2 A 12) in computer-related questions. Help with hardware (terminals, printers) can be obtained from Helmut Deggelmann (2 A 10).
- **PRINTERS:** A list of all available printers in the institute can be found under:  
[http://www.mpipks-dresden.mpg.de/closed/getting\\_started/Available\\_printers.html](http://www.mpipks-dresden.mpg.de/closed/getting_started/Available_printers.html)
- **LIBRARY:** Our library is a reference library, which means that books must remain in the institute. You are allowed to check out books and use them in your office. Please ask Mrs. Näther, our librarian, for details. Journals should not be taken out of the library. Articles, which are not available in our library may be requested from other libraries in Germany. Information concerning the library is available at  
<http://www.mpipks-dresden.mpg.de/library/library.html>, including an on-line catalogue.
- **COPY MACHINES:** You can use the copy machines in 1 C 11 and 2 C 11.
- **OFFICE SUPPLIES:** Paper and everyday office materials are available in room 1 C 11. To request further material please contact Mrs. Dohrmann at the institute's reception desk.
- **HEALTH INSURANCE:** If you do not have a health insurance which is valid for Germany please come to the workshop secretariat in order to arrange one.
- **SOCIAL PROGRAM:** Please check the conference board in the hall and the webpage for details.

## Frequently asked questions

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- **TELEPHONE CALLS:** For private calls you can buy a telephone card at the institute's reception desk. It costs 10 €. You can also use the coin phone in the entrance hall of the institute. For business calls please come to office 2 A 7.
- **FAX:** A fax machine is available on the ground floor at the institute's reception desk.
- **MAIL:** Internal and external outgoing mail can be left at the reception desk at the entrance. Stamps are also available there upon request.
- **PRIVATE CAR:** You need a special permit to park your car at the institute's parking lots, please contact Mrs. Dohrmann at the institutes reception desk in order to get the permit.
- **SHOPPING:** Throughout Germany shops are open Monday to Friday from 09:00 to 18:00 (in the city centre until 20:00 or even 22:00) and Saturday from 09:00 to 20:00
  - The main shopping centre "Prager Strasse" is close to the Main Railway Station. Take tram no. 3 to the stop "Walpurgisstrasse" and keep to the left. You will find a large department store (Karstadt) as well as many other shops on "Prager Strasse". If you walk in direction of the "Altmarkt" you will find another shopping mall called "Altmarktgalerie" with more than 100 shops.
  - Food and beverages: within 5 minutes walk along the tram tracks towards the city centre you will find a bakery and a butcher on the right hand side of the street (on Landsberger Strasse). A few more minutes in the same direction, but on the left hand side, you will find a small supermarket (Konsum) and a shop selling fresh fruits and vegetables, as well as beverages. Every Wednesday and Saturday there is a small market at Münchner Platz from the morning until early afternoon.
- **FOR THOSE ACCOMMODATED IN THE MPI GUEST HOUSES:**
  - Breakfast: is served weekdays from 08:00 a.m. onward at the cafeteria. On weekends there is the possibility to have breakfast in the nearby bakery on Münchner Platz - Bäckerei Möbius. They serve breakfast on Saturdays from 6 a.m. onward, on Sundays only from 1:30 p.m. onward.  
The student's pub "B'Liebig" on Liebigstr. 24 is offering a breakfast buffet (cost: 7,00 Euro) on Sundays from 9 a.m.
  - Guest house keys: you can open each entrance of the institute as well as the library with your guest house key. Within the blue part of the key is a chip: move it along the little box at each entrance, after a beep you can open the door.  
**On your departure day please drop the guest house keys into the box in the entrance hall of your guest house. Please vacate the guest house before 9 a.m.**
- **LAUNDRY:** There is the possibility to wash your clothes in the basement of guest house no. 2. Please dry your clothes there and not in your room!
- **SECURITY:** After 6:30 p.m. the entrances of the institute should be locked. Please check after entering or leaving the institute that the door is correctly shut. Please leave your window shut or tilted, but not open.

YOUR SUGGESTIONS AND QUESTIONS ARE ALWAYS WELCOME!

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