

ANNUAL REPORT 2009

Physics of Physiological Processes Faculty of Physics, University of Vienna

STAFF

Group speaker: Ao. Univ. Prof. Dr. Karl W. Kratky
Guest scientist: Univ. Doz. Dr. Karl E. Kürten
Lecturers: Mag. Werner Gruber, Univ. Doz. Dr. Karl E. Kürten, Mag. Dr. Hans Günter Löw
Volunteers: Mag. Dr. Hans Günter Löw, Dipl. Phys. Dr. Axel Schäfer
Administration: Andrea Hnizdo
Diploma students: Matthias Fukac, Lukas Geyrhofer, Martina Hatzl, Jasmin Kölnsdorfer, Marvin Kovacs
PhD students: Mag. Werner Gruber, Dr. Said Ibrahim, Mag. Ivan Lucić, Rozhin Penjweini MSc

RESEARCH

The research group "Physics of Physiological Processes" deals with complex dynamical systems (chaos and systems research) in general and with the physics of the human body in particular. The following topics are considered: nonlinearity and feedback, self-organization and synchronization, chaos and fractals, neural networks and cellular automata. These topics are treated in various ways: from a fundamental point of view, studying computer experimental results and interpreting experimental data.

These topics are interdisciplinary, connecting physics especially with biology, psychiatry/ medicine and ecology. In this context, biophysical theses have been studying the effect of light and sound on biological systems. For instance, the fractal dimension of mushroom mycelium was analyzed, and the change of heart-rate variability of human beings was investigated. The fields of research in some detail:

Physics of physiological processes: inter- and transdisciplinary aspects

With the help of chaos and systems research, bridges to other sciences can be built, in research as well as in teaching. Attention is focused on biology and medicine. Among other things, it is investigated how chaos control is used by organisms to regulate their body functions efficiently. Furthermore, several therapies in complementary medicine are interpreted from the view-point of chaos and systems research.

Neurophysics

The mental processes of the brain are described by physical methods. At the moment the problem of cognitive learning and stammering is in the focus of investigation.

The effect of light and sound on heart-rate variability (HRV)

- a) Humans are being exposed to light of different spectral composition and of different and varying intensity. Data of biophysical parameters (e.g. ecg, emg, breath) are acquired and then analyzed by nonlinear time series and other methods. The heart-rate variability (HRV) is a major point.
- b) In a further step, three kinds of sound were presented to humans: 'pink noise', 'water' (wellspring), and 'frogs' (croaking). Their influence on HRV was again investigated.
- c) Calculating the breathing rate via HRV (utilizing the respiratory sinus arrhythmia) yields another interesting variable that makes new interpretations possible.

In addition to the research, several courses are offered, e.g., "Complex dynamical systems", "Properties of biophysical systems in theoretical models and experiments", "Physics of physiological processes", "Complementary medicine" and "Theory of complex interconnected systems I & II".

REFEREED PROJECTS

K.E. Kürten

- Theory of interconnected systems: from cellular automata to genetic, social, and neural network models (supported by the European Science Foundation ESF and by the Department of Physics, Loughborough University)

We study phase transitions from ordered to chaotic behavior applicable to various real-world networks such as gene regulation networks, social networks, multi-agent networks, majority voter networks, epidemic networks, chemical reaction networks, and neural network models. One focus of this study is the determination of critical parameters, where the network is placed "at the edge of chaos", i.e. at a subtle compromise between stability and flexibility, where biological systems have both, the necessary stability and the potential for evolutionary improvements.

Scale-free network topologies have been found almost everywhere in the real world. Many networks expand through the addition of nodes to an already existing network, and those nodes attach preferentially to nodes which are already well connected. (the rich get richer) When this is the case, a scale-free network naturally arises. In fact, a scale-free network is a very specific kind of network in which the distribution of connectivity is extremely uneven: some nodes act as "very connected" hubs using a power-law distribution, whereas most of the nodes are rather sparsely connected. Examples are computer networks and the world wide web, which react significantly different from randomly connected networks in the presence of perturbations. If nodes fail randomly, scale-free networks behave much better than random connectivity networks, because random failures are unlikely to harm an important hub. However, if the failure of nodes is not random, scale-free networks can fail catastrophically.

Conclusion: We have shown that the stability of these models depends crucially on the probability distribution of the connectivity structure as well as on the probability distribution of the Boolean interaction weights. The widely discussed scale free distributions clearly outperform the conventional choices. The mean connectivity of the systems, which was limited to $\langle K \rangle = 2$, in the original models, can be largely shifted to higher values of $\langle K \rangle$ giving rise to more realistic models of biological networks, where the nodes are usually governed by more than two incoming connections on average.

K.E. Kürten

- The Chaotic Edge of Competing Opinions (supported by COST and the École Polytechnique, Paris)

The aim of the project is to give possible explanations for social behaviour, in particular for the stability or instability of the individual and global opinion during an electoral campaign.

We intend to study a mathematical model for the emergence of collective decision making, consisting of N interacting agents, whose opinions are described by Ising spin variables. One focus of this study is the determination of critical parameters, where due to a subtle balance of opportunistic and contrarian behaviour the network can be placed "at the edge of chaos," i.e. at a subtle compromise between stability and flexibility, where the system has both, the necessary stability and the potential for "evolutionary" improvements.

The suggested study extends various Galam models to damage spreading analysis which has successfully been applied earlier to the theory of genetic and neural networks as well as spin models.

This earlier work established the existence of two dynamical phases: a stable phase, where the system is resistant to damage spreading and a disordered phase, where an initially small damage might spread all over the system. In the context of socio physics this can help to understand under which conditions special shocking events or propaganda are able to influence the results of elections. One clearly observes that in the unstable regime the agents change their opinion more or less randomly. Microscopic computer experiments also reveal that in the original models a substantial portion of the agents change their opinion from one time step to the next in a quite irregular or even random manner. There can be high degree of individual opinion change, whereas the global variable, the "average" public opinion might be quite insensitive to individual changes due to equally numerous changes of the individuals in the opposite direction. As has been demonstrated earlier, an election can result in a

random outcome due to statistical fluctuations around a “tie”. These results are reminiscent of the elections in the US (2000) and Germany (2002). Galam suggested that those were not chance driven, but possibly arised due to the coexistence of opportunists and contrarians. The corresponding network models can be shown to be placed into the disordered phase.

We propose to study this model on a scale free topology, where the individual agents are not constrained to have the same fixed number K of neighbours. Here we will explore the extent to which the stable regime can be expanded by adjusting the power-law coefficient of the scale free probability distribution. For these more realistic models a substantial increase of the ordered regime at the expense of the disordered regime is to be expected 10 such that even in the case of a “tie” the networks eventually will be stable and can be placed into the ordered phase.

H.G. Löw

- Biophysical investigation of energetic metabolic parameters of muscle tissue during electrostimulation: papillary- and skeletal muscles as examples (cooperation-project with the Institute for Toxicology, University of Vienna)

Based on the physical developments during the refereed project "Continuous fluorescence-optical detection of energetic metabolic parameters of cardiomyocytes during stress induction by electrostimulation" (University of Vienna and Facultas Verlag), further developments are performed. Primary specific aim of this project is to investigate biophysical parameters in vital muscular biomolecules under presence of short pulsed magnetic fields. Modulating the chemical and environmental conditions of the buffer solutions as well as coil-conformations and current pulse shapes studies are focused on influences of dynamic contraction-force-development as well as on autofluorescence, oxygen demand, calcium-fluorescence which represent ionic channel activities under pulsed magnetic stress induction. Force-frequency relations under presence of ionic channel blockers as well as under normoxic and hypoxic conditions are measured. Influences of spectral components of magnetic pulses on penetration depth and biomechanical transduction efficiency are studied using a novel type organ bath. This instrument allows combining fluorescence excitation, optical detection of muscle tissue as well as simultaneous measurement of muscle-tension. All data are recorded and time-stamped within a datastream using LABVIEW-Software packages and a novel developed software protocol which allows minimizing stochastic signal deviations during acquisition. This application oriented project allows specifying the electrodynamic field-parameters influencing muscle contraction and characterizes a novel kind of muscle-stimulation from biophysical and biomedical point of view.

H.G. Löw

- Fluorescence diagnosis, mini-FACS on chip research and development of miniaturized fluorescence diagnostic components using single cellular and single molecular spectroscopy methods (cooperation-project with the Ludwig Boltzmann Institute for Andrology and Urology, KH Lainz, Vienna, and with the Max F. Perutz Laboratories, Campus Vienna Biocenter)

Based on the results of the refereed project 9675 (Austrian National Bank, see above), time-correlated methods for detection of molecular binding properties between biomolecules are applied to develop and construct a miniaturized fluorescence detection device for small liquid samples in context to establish binding assays for medical diagnosis. The aim of this project is focussed to construct an "easy to use+ low-cost" fluorescence device for diagnostic physicians, which allows performing pre-screening-tests on patients blood and liquid samples. Incubation the novel developed tumor-targeting substance Photovidon (Hypericin-PVP-Complex derivative) urinary samples of potential bladder-wall cancer patients are investigated using a "mini-FACS" device as well as an ordinary standard fluorescence cell-sorter (FACS). The correlations between both methods are compared and related to the clinical data supplied by the hospital. The novel device is a contribution to early cancer diagnosis methods in biomedicine and may enhance diagnostic performance at low cost levels.

COOPERATIONS

a. INTERNATIONAL COOPERATIONS

K.W. Kratky

CANADA

- International Institute for Advanced Studies in Systems Research and Cybernetics, Tecumseh, Ontario (G.E. Lasker)

GERMANY

- Lehrstuhl für Medizintechnik und Komplementärmedizin der Universität Witten/Herdecke (D. Cysarz)
- Department of Music Education and Music Therapy, Siegen University, Siegen (C.-L. Zhang)

UK

- Faculty of Computing, Engineering and Mathematical Sciences, University of the West of England, Bristol (Q.M. Zhu)

VARIOUS COUNTRIES:

- Eurasia-Pacific Uninet (Network Office: Salzburg, B. Winklehner)

K.E. Kürten

BELGIUM

- Laboratory of Physiology, K.U. Leuven, Leuven, Belgien (L.Raeymaekers)

FRANCE

- École Polytechnique, Paris (S. Galam)

UK

- School of Mathematical and Physical Sciences, Loughborough University, Loughborough (F.V. Kusmartsev)

USA

- Department of Physics; Washington University, St. Louis (J.W. Clark)

H.G. Löw

RUSSIA

- Rostov state university, Biophysics department, Rostov-on-Don (A. Uzdensky)

NORWAY

- Institute for Cancer Research, Montebello, Oslo (J. Moan)

USA

- Wellman Laboratories for Photomedicine, Harvard medical school, Boston (M. Hamblin et al.)

W. Gruber

GERMANY

- Fachhochschule des Bundes FB Bundespolizei / Lübeck (M. Möllers)
- BV1 - Bildungsverlag EINS, Troisdorf (D. Roland)
- ZDF – Redaktion Markus Lanz (Th. Mau)

I. Lucić:

ISRAEL

- Bar Ilan University, department of physics, Ramat-Gan (A. Vishne, S. Havlin)

A. Schäfer

GERMANY

- Universität Witten/Herdecke, Herdecke (Integriertes Begleitstudium Anthroposophische Medizin, F. Edelhäuser)
- Filderklinik, Filderstadt-Bonlanden (J. Vagedes)

b. NATIONAL COOPERATIONS

K.W. Kratky

- Institute of Electrodynamics, Microwave and Circuit Engineering, Vienna University of Technology (group *Biomedical Sensors*, E. Kaniusas)
- Joanneum Research, Institut für Nichtinvasive Diagnostik, Weiz (M. Moser)
- Interuniversitäres Kolleg für Gesundheit und Entwicklung, Graz / Schloss Seggau (P.C. Endler)
- Akademie für Ganzheitsmedizin (W. Marktl)
- Universitätsklinik für Neuropsychiatrie des Kindes- und Jugendalters der Medizinischen Universität Wien (K. Toifl)

H.G. Löw

- Institut für Biomolekulare Strukturchemie der Universität Wien (G. Grabner, G. Köhler)
- Institut für Theoretische Chemie der Universität Wien (E. Gaubitzer)
- Institut für Physiologie der Medizinischen Universität Wien (D. Schmid)
- Institut für Medizinische Chemie der Medizinischen Universität Wien (P. Chiba)
- Geriatriezentrum Am Wienerwald, Lainz (H. Löw-Weiser, R. Werni)
- Department für Pharmakologie und Toxikologie der Universität Wien (C. Studenik)

W. Gruber

- Wiener Volkshochschulen, Programm 'University meets public' (M. Ludwig)
- Atominstitut der Österreichischen Universitäten, Wien (H. Oberhummer)
- Kapsch – Science to people (W. Stagl)
- KPH Krems (R. Binder)

I. Lucić

- Phonogrammarchiv der österreichischen Akademie der Wissenschaften, Wien (G. Lechleitner)

R. Penjweini

- Department of Bioelectronics, Institute of Solid State Electronics, Vienna University of Technology (S. Saghaei, K. Becker)

A. Schäfer

- ARC Seibersdorf Research, Seibersdorf (K. Schulmeister)
- Fa. ProQuant Systeme, Graz (F. Senekowitsch, F. Tschinder)

PUBLICATIONS

a. ALREADY ISSUED

- **A. Schäfer, K.W. Kratky** and K. Schulmeister, *The effect of colored illumination on breathing rate and cardiorespiratory dynamics*. Journal of Alternative Medicine Research **1**, 3 (2009) 359-366.

In 2006 we published results on the effect of colored illumination on the heart rate variability (HRV) of 12 healthy volunteers (colors of the fluorescent light tubes: red, green, and blue). Then, in 2008 we

described two new methods that estimate average breathing rates from HRV via respiratory sinus arrhythmia (RSA) sufficiently well: Count-adv and ACF-adv. The HRV recordings made during our experiments with colored light are re-analyzed. We determine average breathing rates, besides mean heart rates and the ratio of the two quantities, the heart-breath quotient. The three best methods to quantify breathing rates are used: Count-orig (old) as well as Count-adv and ACF-adv (new). Significant results show that the subjects were mostly breathing at faster rates during red and green illumination. On the other hand, blue light induced a narrower distribution of the heart-breath quotient; probably around a value of 4, which is characteristic of states of relaxation. These results are consistent with our earlier findings, suggesting that short wavelengths of visible light has a different physiological effect compared to those in the range from red to green.

- D.M. Forrester, E. Kovacs, **K.E. Kürten** and F.V. Kusmartsev, *Astroid curves of high-moment antiferromagnetic nanoparticles with tunable magnetic properties*. J. Magn. Magn. Mater. **321**, 7 (2009) 903-905.

We have determined astroids for high-moment antiferromagnetic nanoparticles (AN), which have been recently discovered and used in numerous biomedical applications. The astroid curves for such a system, which is a stack of two isolated disk-shaped ferromagnetic nanoparticles interacting antiferromagnetically, show the regions in the magnetic field plane where different numbers of minima associated with stable or metastable states may exist. We describe the properties of these ANs and estimate their other characteristic parameters such as magnetic saturation field and exchange antiferromagnetic coupling. We argue that the finding of these astroids and the properties of ANs is crucial for the use of ANs in numerous applications and for modeling stable information storage devices.

- F.V. Kusmartsev and **K.E. Kürten**, *Chaotic modes in scale free opinion networks*. Int. J. Mod. Phys. B **23**, 20/21 (2009) 4001-4020.

In this paper, we investigate processes associated with formation of public opinion in varies directed random, scale free and small-world social networks. The important factor of the opinion formation is the existence of contrarians which were discovered by Granovetter in various social psychology experiments long ago and later introduced in sociophysics by Galam. When the density of contrarians increases the system behavior drastically changes at some critical value. At high density of contrarians the system can never arrive to a consensus state and periodically oscillates with different periods depending on specific structure of the network. At small density of the contrarians the behavior is manifold. It depends primarily on the initial state of the system. If initially the majority of the population agrees with each other a state of stable majority may be easily reached. However when originally the population is divided in nearly equal parts consensus can never be reached. We model the emergence of collective decision making by considering N interacting agents, whose opinions are described by two state Ising spin variable associated with YES and NO. We show that the dynamical behaviors are very sensitive not only to the density of the contrarians but also to the network topology. We find that a phase of social chaos may arise in various dynamical processes of opinion formation in many realistic models. We compare the prediction of the theory with data describing the dynamics of the average opinion of the USA population collected on a day-by-day basis by varies media sources during the last six month before the final Obama-McCain election. The qualitative outcome is in reasonable agreement with the prediction of our theory. In fact, the analyses of these data made within the paradigm of our theory indicates that even in this campaign there were chaotic elements where the public opinion migrated in an unpredictable chaotic way. The existence of such a phase of social chaos reflects a main feature of the human being associated with some doubts and uncertainty and especially associated with contrarians which undoubtedly exist in any society.

- D.M. Forrester, E. Kovacs, **K.E. Kürten** and F.V. Kusmartsev, *Astroid curves for a synthetic antiferromagnetic stack in an applied magnetic field*. Int. J. Mod. Phys. B **23**, 20/21 (2009) 4021-4040.

The interaction of two magnetic particles separated by an interlayer is illustrated through the "astroid" curves that represent regions in the magnetic field plane where different numbers of minima associated with stable or metastable states may exist. For a single particle, we describe the astroid curves of the Stoner-Wohlfarth model. The case of two particles is then examined and found to be much more

complicated. The energy landscape of the two-particle system contains ferromagnetic, antiferromagnetic and canting states that emerge in response to the level of applied magnetic field. Because of this, up to four energy minima can exist in the system, depending upon the strength of the magnetic field and the material properties of the particles.

- J.W. Clark, A. Mandilara, M.L. Ristig and **K.E. Kürten**, *Entanglement properties of quantum many-body wave functions*. Int. J. Mod. Phys. B **23**, 20/21 (2009) 4041-4057.

The entanglement properties of correlated wave functions commonly employed in theories of strongly correlated many-body systems are studied. The variational treatment of the transverse Ising model within correlated-basis theory is reviewed, and existing calculations of the one- and two-body reduced density matrices are used to evaluate or estimate established measures of bipartite entanglement, including the Von Neumann entropy, the concurrence, and localizable entanglement, for square, cubic, and hypercubic lattice systems. The results discussed in relation to the findings of previous studies that explore the relationship of entanglement behaviors to quantum critical phenomena and quantum phase transitions. It is emphasized that Jastrow-correlated wave functions and their extensions contain multipartite entanglement to all orders.

- D. Schmid, D.L. Staudacher, C.A. Plass, **H.G. Löw**, E. Fritz, G. Steurer, P. Chiba, T. Möslinger, *Pinacidil-primed ATP-sensitive potassium channels mediate feedback control of mechanical power output in isolated myocardium of rats and guinea pigs*. Eur J Pharmacol, published online Nov 17, 2009; doi:10.1016/j.ejphar.2009.11.013

We tested the hypothesis, that ATP-sensitive potassium (K(ATP)) channels limit cardiac energy demand by a feedback control of mean power output at increased cardiac rates. We analysed the interrelationships between rising energy demand of adult rat and guinea pig left ventricular papillary muscle and down-regulatory electromechanical effects mediated by K(ATP) channels. Using the K(ATP)-opener pinacidil the stimulation frequency was increased stepwise and the mechanical parameters and action potentials were recorded. Power output was derived from force-length area or force-time integral calculations, respectively. Simultaneously oxygen availability in the preparations was estimated by flavoprotein fluorescence measurements. ADP/ATP ratios were determined by HPLC. We found highly linear relationships between isotonic power output and the effects of pinacidil on isotonic shortening in both rat ($r^2=0.993$) and guinea pig muscles ($r^2=0.997$). These effects were solely observed for the descending limb of shortening-frequency relationships. In addition, a highly linear correlation between total force-time integral-derived power and pinacidil effects on action potential duration (APD(50), $r^2=0.92$) was revealed. Power output became constant and frequency-independent in the presence of pinacidil at higher frequencies. In contrast, the K(ATP)-blocker glibenclamide produced a lengthening of APD(50) and increased force transiently at higher power levels. Pinacidil prevented core hypoxia and a change in ADP/ATP ratio during high frequency stimulation. We conclude, that pinacidil-primed cardiac K(ATP) channels homeostatically control power output during periods of high energy demand. This effect is associated with a reduced development of hypoxic areas inside the heart muscle by adapting cardiac function to a limited energy supply.

b. ACCEPTED

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c. SUBMITTED

- S. Saghafi, **R. Penjweini**, K. Becker, **K.W. Kratky** and H.-U. Dodt, *Investigating the effects of laser beams (532 and 660 nm) in annihilation of pistachio mould fungus using spectrophotometry analysis*. Journal of the European Optical Society (submitted).

d. BOOKS

- **W. Gruber**, N. Riahi und C. Rupp, *Die kleine Sonne auf großer Fahrt. Märchensammlung zur naturwissenschaftlichen Bildung*. Bildungsverlag Eins, Troisdorf - Köln 2009.

e. PATENTS

- **I. Lucić**, *Surface-Structured Device for Life-Science Applications*. App. Nr. 09010463.9-1521 (filing 13.08.2009). Designation as Inventor under Rule 19(3) EPC. Date: 7.10.09.
- **H.G. Löw** (mit G. Köhler), Konzentrations- und Speichervorrichtung für Partikel in Flüssigkeiten mit steriler optischer Analysemöglichkeit. Nr. A-1BA 258 / 2008-1, veröffentlicht am 15.9.09.
- **H.G. Löw**, Kompakte Extraktionsvorrichtung zur zerstörungsfreien Manipulation und Analyse flüssig-heterogener Partikelsuspensionen für diagnostische Sicherheitsanwendungen. Nr. A-3BA 421 / 2008-9, veröffentlicht am 15.10.09.

LECTURES, POSTERS

a. LECTURES

K.W. Kratky

- Weltbilder komplementärmedizinischer Richtungen (Ringvorlesung "Komplementärmedizinische Methoden. Grundlagen und Praxis" an der Medizinischen Universität Wien, Austria), 25.2.09.
- Comparison and Integration of Complementary Medical Methods (Modulbeginn für Gr.34 & 35, Masterlehrgang für Komplementäre, Psychosoziale und Integrative Gesundheitswissenschaften, Interuniversitäres Kolleg für Gesundheit und Entwicklung, Schloss Seggau, Austria), 18.4.09.
- Vergleich und Integration komplementärmedizinischer Verfahren (Modulbeginn für Gr.33 & 37, Masterlehrgang für Komplementäre, Psychosoziale und Integrative Gesundheitswissenschaften, Interuniversitäres Kolleg für Gesundheit und Entwicklung, Schloss Seggau, Austria), 19.4.09.
- Die Herzfrequenz-Variabilität als Indikator des autonomen Nervensystems (Workshop 15 der Med-Success 2009 der Österreichischen Medizinerunion; AKH Wien, Austria), 25.4.09.
- Vergleich und Integration komplementärmedizinischer Verfahren (Modulbilanz für Gr.33 & 37, Masterlehrgang für Komplementäre, Psychosoziale und Integrative Gesundheitswissenschaften, Interuniversitäres Kolleg für Gesundheit und Entwicklung, Schloss Seggau, Austria), 19.6.09.

K.E. Kürten

- Opinion dynamical networks: Coexistence of opportunists and contrarians on scale-free topologies (Austrian Research Center Vienna, Austria), 23.01.09.
- The chaotic edge of competing opinions (École Polytechnique, Paris), 3.4.09.
- Phase transitions and chaotic behaviour in social networks (Complex Systems Research Group, Medical University of Vienna, Austria), 24.04.09.

H.G. Löw

- Wie kann die Struktur des Wassers verändert werden? (Präsentation W-ZF 13 bei der Langen Nacht der Forschung 2009, Universität Wien, Austria), 7.11.09.

L. Geyrhofer

- Phase transitions in network dynamics ("Vienna-Theory-Lunch-Club--Seminar", University of Vienna, Austria), 13.10.09.

W. Gruber

- Science of cooking (Lehrerfortbildung Brixen, Italy), 5. & 6.2.09.
- Physik im Kindergarten (Didakta, Hannover, Germany), 13.2.09.
- Physik des Papierfliegers (PH-Graz, Austria), 9.3.09.
- Physik des Papierfliegers (KPH-Krems, Austria), 11.3.09.

- Physik des Kochens (PH-Eisenstadt, Austria), 7.5.09.
- Mit der Wissenschaft in die Küche (IST Austria - Eröffnung, Klosterneuburg, Austria), 1.6.09.
- Neuropsychik des Sterbens (Bestattung Graz, Austria), 17.6.09.
- Mit der Wissenschaft in der Küche (Bregenzerwälder Genusstage, Hittisau, Austria), 4.7.09.
- Physik und Fleisch (anlässlich der Ausstellung „Essen“ im Hygienemuseum Dresden, Germany), 12.9.09.
- Physik des Kochens (KPH-Krems, Austria), 12.10.09.

b. CONFERENCE CONTRIBUTIONS

K.W. Kratky

- Präsentation der Forschungsschwerpunkte (Workshop CAM-Forschung 2009: Status Quo und Perspektiven für Komplementärmedizin und integrative Gesundheitsförderung, Bundesministerium für Gesundheit, Wien, Austria), 25.5.09.
- Puls und Atemfrequenz als Brücke zwischen westlicher und östlicher Medizin (20. Treffen des Forums universitärer Arbeitsgruppen für Naturheilverfahren und Komplementärmedizin, Medizinische Universität Wien, Austria), 4.6.2009.
- Das Konzept der TCM und ihre Akzeptanz in Europa (3. Internationales Johannes Bischko Symposium "Komplementärmedizin quo vadis – Gestern, Heute, Morgen", 26.-28.6.2009, Kaiserin Elisabeth-Spital, Wien, Austria) 27.6.09.
- Der Einfluss optischer und akustischer Reize auf Puls- und Atemfrequenz (Workshop "Die Beziehung zwischen Atem, Puls und Blutdruck", 28.-29.9.09, Universität Wien, Austria), 28.9.09.

K.E. Kürten

- Scale free opinion networks based on local majority and minority rules: an analytical study (2nd International Symposium on Neural Networks and Econophysics: from superconducting junctions to financial markets, June 13-17, 2009 at Loughborough University, Loughborough, UK), 16.6.09.
- Chaotic modes and fractal behaviour in Josephson junction arrays (invited lecture at the Conference "TeraHertz Radiation and Metamaterials", December 15-22, 2009 in Benasque, Spain), 21.12.09.

W. Gruber

- Physics of cooking (100. MNU- Bundeskongress, Regensburg, Germany), 9.4.09.

A. Schäfer

- Ideen zur Atemfrequenz-Abhängigkeit der respiratorischen Sinusarrhythmie unter Berücksichtigung des Baroreflexes (Workshop "Die Beziehung zwischen Atem, Puls und Blutdruck", 28.-29.9.09, Universität Wien, Austria), 28.9.09.

c. POSTERS

K.E. Kürten

- Multistability, phase transitions and chaotic modes in arrays of Josephson junctions (invited poster at the XXXIII International Workshop on Condensed Matter Theories, August 05-10, 2009 in Quito, Ecuador).

R. Penjweini

- Investigating the effects of flat-top laser beams (532 and 660 nm) in annihilation of pistachio mold fungus using spectrophotometry analysis (3rd EOS Topical Meeting on Optical Microsystems, September 27-30, 2009 in Capri, Italy).

TEACHING AND WEB-BASED DIDACTICS

W. Gruber

Vorlesung "Brain Modelling I + II, Physikalische Modelle für das Gedächtnis", steht auch online zur Verfügung: <http://brain.exp.univie.ac.at>

Im Rahmen dieser Lehrveranstaltung werden aktuelle Forschungsergebnisse aus den Bereichen der Neuroscience vorgestellt und ihre Relevanz diskutiert. Der Streifzug durch die Neuroscience beginnt bei der Beschreibung von Neuronen, technischen neuronalen Netzen und dem Vergleich zu biologischen Netzwerken. Nach der Vorstellung von einigen konkreten Modellen aus der Biologie (Beispiele: Erkennen von Objekten durch das visuelle System, Synchronisation im Gehirn, Steuerungen und Regelungen im Nervensystem) endet der Streifzug bei philosophischen Fragestellungen. Da in diesem Forschungsgebiet noch viele Fragen offen sind beziehungsweise noch gar nicht gestellt wurden, wird auch auf die Grenzen des aktuellen Wissens hingewiesen.

DIPLOMA THESES – PHD THESES (Supervisor: **K.W. Kratky**, if not stated otherwise)

a. CURRENT DIPLOMA THESES

- **M. Fukac**
Simulation des menschlichen Sehsystems
- **L. Geyrhofer** (Supervisor: **K.E. Kürten**)
Critical phenomena and dynamical phase transitions in biological and social networks
- **M. Hatzl**
Die Wirkung von optischen und akustischen Reizen auf die HRV (heart-rate variability): Interpretation und Auswertung der Experimente
- **J. Kölndorfer**
Klassifizierung von Sprache und Geräuschen mittels eines Biologischen Neuronalen Netzwerks von Integrate-and-Fire Oszillatoren
- **M. Kovacs**
Die Auswirkung von Hathayoga-Atemtechniken auf die Herzfrequenzvariabilität

b. CURRENT PHD THESES

- **W. Gruber**
Synchronisationszustände des Gehirns und die Bedeutung für die Informationsverarbeitung
- **S. Ibrahim**
Naturwissenschaftliche Grundlagen der medizinischen Systeme
- **I. Lucić**
Der Einfluss unterschiedlicher Frequenzen auf biologische Systeme
- **R. Penjweini**
Biophysical investigations of photosensitization within mitotic cell cycle. Electromagnetically induced nonlinear dose-effect relations monitored by novel optical detection methods

PRIZES AND AWARDS

H.G. Löw

- Innovationscheck FFG / Fa. Thera Sensorica über 5000 € für Projektarbeiten, 13.10.09.
- Mit dem Team riscreen, Schnelltest für Blasenkrebs: 1. Platz in der Kategorie „Technologie“ beim österreichweiten Businessplanwettbewerb 2009 der Wirtschaftskammer (11 500 €, Preisverleihung am 3.12.2009)

PRESENCE IN THE MEDIA

K.W. Kratky

Movie

Beitrag zum Film "Wer hat Angst vor Wilhelm Reich?", ORF 2, 11.10.09.

W. Gruber

He features on all relevant media – as print, radio and television – in Austria, Germany and Switzerland. Some examples:

Print media and electronic journals

- "Außerirdische und Schweinsbraten", Kurier, 17.9.09.
- „Physik im Bildungssystem“, Online-Standard, 15.8.09.

Radio and television

- „Physik des Papierfliegers“, Salzburg TV, 29.4.09.
- „Science of paperplanes“, CNN, 1.5.09.
- „Aerodynamics of paperplanes“, al Jazira, 1.5.09.
- "Dorfers Donnerstalk", ORF1, 28.5.09.
- „Physik und Magie“, Markus Lanz, ZDF, 8.6.09.
- „Einstein in Salzburg – die Geburtsstunde der Relativitätstheorie“, Ö1, 20.9.09.
- "Dorfers Donnerstalk", ORF1, 15.10.09.

MISCELLANEOUS

K.W. Kratky

- Member of the Scientific Board of the journals "Research in Complementary Medicine" and "Systeme".
- Member of the Editorial Board of the "Journal of Alternative Medicine Research" and reviewer of the journals "Evidence-based Complementary and Alternative Medicine Research" and "Research in Complementary and Classical Natural Medicine".
- Member of the Scientific Board of the Viennese International Academy of Complementary Medicine as well as the Institute of Ethno-music Therapy, Gföhl, Austria.
- Fellow of the International Institute for Advanced Studies in Systems Research and Cybernetics, Tecumseh, Ontario, Canada.
- Member of the team of the Interuniversity College for Health and Development, Graz / Castle of Seggau, Austria. There, also lecturer at the European Master's Degree Program for Integrated Health Sciences.
- Member of the Board of Governors of the Scientific Society 'Dynamics – Complexity – Human Systems', Vienna, Austria.
- Member of the "Beirat für Traditionelle Asiatische Medizin im Bundesministerium für Gesundheit" (Vienna, Austria) starting with March 10, 2009.
- Chair at the 3. Internationales Johannes Bischof Symposium "Komplementärmedizin quo vadis – Gestern, Heute, Morgen", June 26-28, 2009, Kaiserin Elisabeth-Spital, Wien, Austria, 27.6.09.
- Organization of the workshop "The Relation between Breath, Pulse and Blood pressure", September 28-29, 2009, University of Vienna, Austria.

K.E. Kürten

- Guest Scientist and Lecturer.

W. Gruber

- General Editor at CISCI (Cinema and Science), an EU-Project for teaching physics.
- Lecturer at various adult evening classes ("Wiener Volkshochschulen") within the context of the project "University meets public".
- Accountant of the Austrian Biophysical Society.
- Member of the "ScienceBusters".
- Head of the jury for the "Red Bull paperwings" world championship
- Vorstandsmitglied der VHS Meidling, Wien, Austria.
- Wissenschaftlicher Beirat der KPH Krems, Austria.

COURSES IN THE ACADEMIC YEAR 2008/09

K.W. Kratky

- WS: Umwelt- und Biophysik II – Komplexe dynamische Systeme
(Schwerpunkt: Analyse von Puls und Atem) SE, 2h
- SS: Eigenschaften biophysikalischer Systeme in Modell,
Theorie und Experiment (als Mitveranstalter) VO, 2h
- SS: Gemeinsamkeiten komplementärmedizinischer Methoden –
aus naturwissenschaftlicher und interkultureller Sicht VO, 2h

K.E. Kürten

- WS: Einführung in die Theorie vernetzter Systeme I - Vom zellulären
Automaten zu genetischen und neuronalen Netzwerkmodellen VO, 2h
- WS: Neuere Entwicklungen in der Theorie vernetzter Systeme SE, 2h
- SS: Einführung in die Theorie vernetzter Systeme II - Vom zellulären
Automaten zu genetischen und neuronalen Netzwerkmodellen VO, 2h
- SS: Spezielle Anwendungen in der Theorie vernetzter Systeme II SE, 2h

H.G. Löw

- WS: Biophysikalisches Praktikum für Vorgeschrittelte (als Mitveranstalter) PR, 5h
- SS: Eigenschaften biophysikalischer Systeme in Modell,
Theorie und Experiment (als Mitveranstalter) VO, 2h

W. Gruber

- WS: Biophysikalisches Praktikum für Vorgeschrittelte (als Mitveranstalter) PR, 5h
- WS: MEi:CogSci Cognitive Science Ringvorlesung (als Mitveranstalter) VO, 2h
- WS: Komplexe dynamische Systeme VO+UE, 1h
- WS: Wie erkläre ich es meinen SchülerInnen? VO, 2h
- WS: Fachdidaktische Vertiefung - Methoden der Physikdidaktik
(als Mitveranstalter) SE, 1h
- SS: Praktikum für Schulversuche II (als Mitveranstalter) PR, 8h
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