Curriculum Vitae

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EDUCATION

- **Ph.D.** 2000 August – 2004 September, Ph.D. in Physics, Department of Physics, University of Notre Dame, Notre Dame, IN. Thesis advisor: Albert-László Barabási, Emil T. Hofman Professor of Physics. Research: *Study of complex networks and applications to biological systems.* Defense: September 2004.

- **M.S.** 1999 October – 2000 June, M. S. in Physics, Department of Physics, Babeş-Bolyai University, Cluj-Napoca, Romania. Dissertation advisor: Prof. Zoltán Néda. Research topics: *Evolution of the social network of scientific collaborations; Spatial stochastic resonance in one-dimensional Ising systems.* Defense: June 2000.

- **B.S.** 1995 October – 1999 July, B. S. in Physics with Minor in Physics Education, Department of Physics, Babeş-Bolyai University, Cluj-Napoca, Romania. Thesis advisor: Prof. Zoltán Néda. Thesis topic: *Synchronization and physics of rhythmic applause.* Defense: July 1999.

EMPLOYMENT AND TEACHING EXPERIENCE

- **10/2004 – present**: Director Funded Postdoctoral Fellow, Los Alamos National Laboratory, Los Alamos, NM.

- **08/2000 – 09/2004**: Graduate Research Assistant, University of Notre Dame, Notre Dame, IN.

- **10/1999 – 12/2000**: Graduate Teaching Assistant, Babeş-Bolyai University of Cluj-Napoca, Romania. Class: Problem-solving tutorial in Quantum Mechanics I, physics majors. Teaching faculty: Prof. Zoltán Gábos.

- **10/1998 – 02/1999**: Undergraduate Teaching Assistant, Babeş-Bolyai University of Cluj-Napoca, Romania. Class: Problem-solving tutorial in Quantum Mechanics I, physics majors. Teaching faculty: Prof. Zoltán Néda.
- **02/1998 – 06/1998**: Undergraduate Teaching Assistant, Babeş-Bolyai University of Cluj-Napoca, Romania. Class: Problem-solving tutorial in Quantum Mechanics, mathematics–physics double majors. Teaching faculty: Prof. Zoltán Néda.

AWARDS AND FELLOWSHIPS

- **2005**, Alumni Association Research Award, University of Notre Dame Graduate School, Notre Dame, IN. Advisor: Prof. Albert-László Barabási.
- **2004**, Director Funded Postdoctoral Fellowship at the Los Alamos National Laboratory (two years), Los Alamos, NM.
- **2000**, Fisher Fellowship for graduate studies in Physics at the University of Notre Dame (two years), Notre Dame, IN.
- **2000**, Research scholarship from the University of Notre Dame (two months), at the Eötvös Lóránd University, Budapest, Hungary. Advisor: Prof. Albert-László Barabási.
- **1999**, SOCRATES-ERASMUS scholarship (three months) to study and engage in research at the INPG, ENSEEG-LTPCM, Grenoble, France. Advisor: Prof. Yves Brechet.
- **1998**, Research scholarship at the KFKI (two months), RMKI-ELFO, Budapest, Hungary. Advisor: Prof. Tamás Biró.
- **1999**, Performance research scholarship of the Babeş-Bolyai University (one year).
- **1998**, Scientific Conference for Transylvanian Students, Cluj Napoca, 1^{st} prize.
- **1996**, Ortvay Rudolf Problem Solving Competition, Hungary, 2^{nd} prize.
- **1995**, Selection for the Large Olympic Team (8^{th}) at the National Physics High-school Olympiad.

RESEARCH EXPERIENCE AND INTERESTS

- **Networks:** I study the characteristics of real-world complex networks, their topology, structure and dynamics. Most real-world networks such as the Internet, www, actor network, scientific collaboration networks, and cellular networks (metabolism, protein interaction network or genetic networks) are known to have a scale-free degree distribution, with diverging fluctuations in the node connectivity. This feature has been traced back to the way they grow: preferential attachment to existing highly connected nodes. These networks, however, also show high degrees of clustering. Using metabolic networks as our starting point, I have shown that most real networks have hierarchical modularity, where tight small clusters are embedded in larger and looser modules, without having a characteristic cluster scale.

- **Protein folding:** Almost all biological processes in a living cell are performed by proteins. The functionality of these amino-acid chains is strongly tied to their three dimensional structure. Fast and reliable folding to a unique three dimensional shape is crucial for protein functionality. The consensus in protein folding today is that most functional proteins evolved to have free energy landscapes with a funnel structure and that Nature simply does not make use of sequences that do not have this property. The main questions therefore are: What are the general conditions that the amino-acid sequence of a protein will have to obey in order to produce a fast and reliably folding protein? Moreover, how did Nature evolve these structures with favorable landscapes? I am working on developing a framework for investigating both of these questions, along with a new set of tools based on complex networks research.

- **Synchronization:** After a good theater performance the enthusiastic audience bursts into loud and completely unsynchronized applause. It is very common in Europe that random clapping suddenly switches to synchronized rhythmic applause, which quickens and is destroyed. Using local and global recordings of applause and models developed in synchronization theory, we explained how the audience synchronizes and why they eventually loose their developed rhythm. The key to synchronization is skipping every second beat, which reduces the frequency spread of the audience. The driving force for speed-up of the applause and it's consequent destruction is the low overall noise level of the slow rhythmic applause.

- **Spatial Stochastic Resonance:** An Ising system placed in a periodically changing magnetic field is known to show stochastic resonance. We explored the behavior of an Ising chain in a spatially periodic magnetic field using the transfer-matrix method. For low enough magnetic field intensities the correlation between the external magnetic field and the response in magnetization presents a maximum for a given temperature. This spatial stochastic resonance is realized in the equilibrium state and not as a dynamical response to external time-periodic driving.

PUBLICATIONS

Current citation index (based on ISI): 583 citations.

1. *Exact Results on Gradient Networks*, A. Clauset, C. Moore, E. Lopez, E. Ravasz, Z. Toroczkai, *J. Phys. A: Math. Gen.*, (submitted).

2. *The Architecture of Biological Networks*, S. Wuchty, E. Ravasz and A.-L. Barabási, in: T.S. Deisboeck, J. Yasha Kresh and T.B. Kepler (eds.), *Complex Systems Science in Biomedicine*, Kluwer Academic Publishing, New York (2005), ISBN: 0306477874.

3. *Hierarchical Organization of Modularity in Complex Networks*, A.-L. Barabási, E. Ravasz and Z. N. Oltvai, *Lecture Notes in Physics* **625**, 46 (2003), R. Pastor-Satorras, J.M. Rubi,and A. Diaz-Guilera (eds.), *Proc. of the XVIII Sitges Conference on Statistical Mechanics, Sitges, Barcelona, Spain, 2002*, Springer, Berlin.

4. *Scale-free and hierarchical structures in complex networks*, A.-L. Barabási, Z. Dezső, E. Ravasz, S. H. Yook, and Z. N. Oltvai, *AIP Conf. Proc.* **661**, 1 (2003), *MODELING OF COMPLEX SYSTEMS: Seventh Granada Lectures, Granada, Spain, 2002*, Melville, New York.

5. *Hierarchical organization in complex networks*, E. Ravasz and A.-L. Barabási, *Phys. Rev. E* **67**, 026112 (2003).

6. *Experimental Determination and System Level Analysis of Essential Genes in Escherichia coli MG1655*, S. Y. Gerdes, M. D. Scholle, J. W. Campbell, G. Balázsi, E. Ravasz, M. D. Daugherty, A. L. Somera, N. C. Kyrpides, I. Anderson, M. S. Gelfand, A. Bhattacharya, V. Kapatral, M. D'Souza, M. V. Baev, Y. Grechkin, F. Mseeh, M. Y. Fonstein, R. Overbeek, A.-L. Barabási, Z. N. Oltvai, and A. L. Osterman, *Journal of Bacteriology* **185**, 5673 (2003).

7. *Hierarchical organization of modularity in metabolic networks*, E. Ravasz, A. L. Somera, D. A. Mongru, Z. N. Oltvai and A.-L. Barabási, *Science* **297**, 1551 (2002).

8. *Networks in life: Scaling properties and eigenvalue spectra*, I. Farkas, I. Derényi, H. Jeong, Z. Néda, Z. N. Oltvai, E. Ravasz, A. Schubert, A.-L. Barabási and T. Vicsek, *Physica A* **314**, 25 (2002).

9. *Evolution of the social network of scientific collaborations*, A.-L. Barabási, H. Jeong, Z. Néda, E. Ravasz, A. Schubert, T. Vicsek, *Physica A* **311**, 590 (2002).

10. *Deterministic scale-free networks*, A.-L. Barabási, E. Ravasz and T. Vicsek, *Physica A* **299**, 559 (2001).

11. *The sound of many hands clapping*, Z. Néda, E. Ravasz, T. Vicsek, Y. Brechet, and A.-L. Barabási, *Nature* **403**, 850 (2000).

12. *Physics of the rhythmic applause*, Z. Néda, E. Ravasz, T. Vicsek, Y. Brechet, and A.-L. Barabási, *Phys. Rev. E* **61**, 6987 (2000).

13. *Spatial stochastic resonance in one-dimensional Ising systems*, Z. Néda, Á. Rusz, E. Ravasz, P. Lakdawala, and P. M. Gade, *Phys. Rev. E* **60**, R3463 (1999).

CONFERENCES AND PRESENTATIONS

- Los Alamos National Laboratory, Center for Nonlinear Studies Seminar, September 1, 2005, Los Alamos, NM. *Protein folding networks.*

- News, Expectations and Trends in Statistical Physics, 3rd Next Sigma-Phy International Conference, August 13 - 18, 2005, Kolymbari, Crete, Greece. Invited speaker: *Hierarchical Modularity in Complex Networks.*

- Collectives formation and specialization in biological and social systems, April 20-22, 2005, Santa Fe, NM.

- School and Workshop on Structure and Function of Complex Networks, May 16 - 28, 2005, Abdus Salam ICTP, Trieste, Italy.
- Los Alamos National Laboratory - Arizona Days 2005, January 2829, 2005, Tucson, AZ. Invited speaker: *Hierarchical Modularity in Metabolic Networks.*
- Brookhaven National Laboratory, Condensed Matter Physics Seminar (Job interview talk), February 5, 2005, Upton, NY. Invited speaker: *Hierarchical Modularity in Complex Networks.*
- Los Alamos National Laboratory, Center for Nonlinear Studies Seminar (Job interview talk), November 8, 2004, Los Alamos, NM. Invited speaker: *Hierarchical Modularity in Complex Networks.*
- 23rd Annual Conference on Networks: Structure, Dynamics and Function, May 12 - 16, 2003, Santa Fe, NM. Poster: *Hierarchical Organization of Complex Networks.*
- Indiana Biocomplexity Symposium, April 22 - 23, 2003, University of Notre Dame, Notre Dame, IN. Poster: *Hierarchical Modularity of Metabolic Networks.*
- Genomic Approaches to Transcriptional Regulation, March 6 - 9, 2003, Cold Spring Harbor, NY.
- 15th International Symposium on Mathematical Theory of Networks and Systems, August 12 - 16, 2002, University of Notre Dame, Notre Dame, IN.
- Meeting of the American Physical Society, March 18 - 22, 2002, Indianapolis, IN. Presentation: *Evolution of the social network of scientific collaborations.*
- International Workshop on Scaling and Phase Transitions in Complex Networks, February 18 - 22, 2002, Pohang, Korea.
- 2nd Workshop on Computation of Biochemical Pathways and Genetic Networks, June 21 - 22, 2001, Villa Bosch, Heidelberg, Germany.

PROFESSIONAL ACTIVITIES

- **Referee for** Physical Review E, European Physical Journal B, Bioinformatics, Journal of Biological Systems, Biophysical Journal, FEBS Letters.
- **Editor for** *Statisztikus fizika*, Zoltán Gábos, Erdélyi Múzeum Egyesület, Cluj Napoca, 1999.
- **Summer Student Mentor**, Center for Nonlinear Studies, Los Alamos National Laboratory. Student: Andrea Asztalos, Research topic: *Modeling information processing in gene regulatory networks.*

- **Echoes of my research in the media (The Rhythmic Applause)**
  - Physical Review Focus: *Applause Physics*, 2000, `http://focus.aps.org/story/v5/st27`
  - ABC News: *Great Moments in Science – Paws for Applause*, 2003, `http://www.abc.net.au/science/k2/moments/s114463.htm`
  - Discovery.com News: *Synchronized Clapping a Primal Desire?*, 2000, `http://www.discovery.com/news/briefs/20000224/misc_applause.html`
  - FoxNews: *Roar of the crowd shows social organization*, 2000, `http://www.foxnews.com/health/022400/crowd.sml`
  - South Bend Tribune: *Study: U.S. out of sync with European applause*, 2000.
  - Discover: *Joining Hands - research on sound synchronization*, 2000, `http://www.zinkle.com/p/articles/mi_m1511/is_7_21/ai_63035789`

REFERENCES

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