A. Personal Statement

The goal of this research proposal is to study the relationship between epileptic network dysfunction and cognitive deficit related to Alzheimer's disease by the methods of computational neuroscience. The multiple and multi-level effects of elevated amyloid beta level will be studied by a computational platform constructed based on existing computational models of different hippocampal rhythm generators I elaborated with several generation of students in Budapest and Kalamazoo. I have a general interest in the emerging fields of computational neuropharmacology, computational neurology and computational psychiatry. Specifically I worked with Mihaly Hajos (Pfizer, now Yale), Colin Lever (Durham U, UK), Vaibhav Diwadkar (Wayne State U) on problems related to anxiety and schizophrenia.

I became fascinated by the problem of the hidden relationship between neurodegeneration due to Alzheimer's disease (AD) and temporal lobe epileptic activity, and I would like to use my experience accumulated over the decades to build with my students a computational platform to study hypotheses of the underlying cellular, synaptic and network.

I am very excited that two excellent neuroscientists, Istvan Mody (UCLA), and Jorge Palop (Gladstone Institutes) agreed to help our project by both consulting on the biological basis and data sharing. This way I strongly hope that in the coming years we will be able to test with our computational tools a set of recently suggested hypotheses about the cellular, synaptic and network mechanisms of the multiple effects of amyloid-beta in the induction of epileptiform activities and cognitive deficit. I also hope that our computational methods will help to test the effects of putative drugs to reduce epileptic seizures and reverse the direction of cognitive impairment.

I strongly believe that scientific research should be started in the early years of undergraduate studies, and I have been successfully working with students for many years. It happened that for many
of the Hungarian students I was the supervisor both of their undergraduate and graduate studies. Many of them mentioned here served as teaching and research assistants at Kalamazoo College and seem to be very successful (see in parentheses their past and present affiliations). Among my former Hungarian students Tamas Kiss (Pfizer, Cambridge, Mass.), Mate Lengyel (Cambridge, UK and CEU (Budapest)), Gergo Orban (Brandeis, Cambridge (UK)), Wigner (Budapest)), Gabor Csardi (Lausanne U, Harvard), Balazs Ujfalussy (Cambridge (UK)), Zsofi Huhn (Budapest), Kinga Makogi (Columbia U), Mihaly Banyai (Wigner, Budapest), Judit Szente (U. Michigan (Ann Arbor)), Dori Cserpan (Wigner, Budapest), Laszlo Zalanyi (Wigner (Budapest)) helped to produce research atmosphere at Kalamazoo College. For nine years I used the program support from the Henry Luce Foundation to have them. Further excellent former Hungarian students of mine are Ildiko Aradi (Ohio U, UC Irvine, Northwestern, Gedeon Richter Biopharmaceutical Plant (Budapest), Zoltan Somogyvari (Wigner (Budapest), Csaba Foldy (UC Irvine, Stanford). Eric Zilli (Boston University, now Facebook), Richard Gejji (Notre Dame, Ohio State U, Dept. Defense, Novetta), Bobby Rohrkemper (Zurich U - ETH), Clara School (NIH NIDA, Georgetown Univ.), Justin Horowitz (Washington U, Saint Louis, UI Chicago), (Eric Larson (Boston Univ, U. Washington). Tibin John, now a senior is a Goldwater scholar based on the research he made under my supervision.

Based on the nature of undergraduate teaching and research, probably the students who will work with me in the coming years are now freshmen or sophomores and enrolled to the Intro to Complex Systems and Computational Neuroscience classes I am teaching in this term. I also believe that the return to Hungarian research associates and the new visits of Kalamazoo College students to the Wigner Research Centre would scientifically be very useful, and would give an international dimension to the proposal.

**B. Positions and Honors**

[1977-1981] Research Scientist, Computing Group, Semmelweis University Medical School, Budapest  
[1981-1983] Senior Research Scientist, Dept of Anatomy, Semmelweis University Medical School, Budapest  
[1993 - 2011 ] Head of the Dept of Biophysics, KFKI Research Institute for Particle and Nuclear Physics, Hungarian Academy of Science, Budapest  
[2003-] Co-Director: Budapest Semester in Cognitive Science  
[2002 -] Henry R. Luce Professor of Complex System Studies, Dept of Physics and Dept of Psychology, Director of the Center for Complex System Studies, Kalamazoo College  
[2012- ] Honorary Research Professor, Institute for Particle and Nuclear Physics, Wigner Research Centre for Physics, Hungarian Academy of Sciences

**Recent Honors**

[2005-] Member of the EPSRC College (UK)  
[2006-] Advisory Board: Springer Complexity: Cutting Across All Traditional Disciplines  
[2008-2014] Member of the FENS-IBRO European Neuroscience Schools Programme Committee  
[2009-2010] Panel reviewer of European (CORDIS) proposals  
[2009-2010] Panel reviewer of NSF proposals  
[2010] Panel reviewer of the Bernstein Award (Germany)  
[2012-2014] Counselor-at-large: Michigan Chapter of Society for Neuroscience  
[2012-] Member of the Scientific Advisory Board of the EPJ Nonlinear Biomedical Physics  
[2012-] Member of the IEEE Computational Intelligence Society University Curriculum Subcommittee  
[2012] Program Chair: ICANN 2012: Lausanne, Switzerland
[2012] Fellow of Institute of Advanced Studies, Durham, UK
[2013] Program Chair: International Joint Conference on Neural Networks 2013, Dallas
[2013] Outstanding Service Award: International Neural Network Society
[2014] Senior Member of the International Neural Network Society
[2014] Panel reviewer: European Research Council (Neuroscience, Neural Disorders)

Other Experience and Professional Memberships

Associate Editor: Biosystems
Member of Editorial Board: Cognitive Neurodynamics,
Member of the Scientific Advisory Board of the EPJ Nonlinear Biomedical Physics
Member of the Editorial Board: Natural Computing
Memberships: Society for Neuroscience, International Society of Computational Biology,
IEEE Computational Intelligence Society, International Neural Network Society

Some recent invited lectures:
[2014] Biomath 2014, Sofia, Bulgaria
[2014] Florida Atlantic University Neuroscience Seminar
[2013] From complex systems to dynamic brain theory, Hokkaido University, Sapporo, Japan
[2013] Dynamic Brain Forum, Sigtuna, Sweden
[2012] IAS Public Lecture, Durham University, Grey College
[2012] Dynamic Brain Forum, Carmona, Spain
[2012] Lecture series: Summer School 'Achievements and Applications of Contemporary Informatics, Mathematics and Physics', Kyiv Polytechnic Institute
[2012] Luigi Ricciardi Memorial Lecture: European Conference on Cybernetics and Systems Research, Vienna, Austria
[2012] Univ. Michigan, Quantitative Biology Seminar

C. Selected Peer-reviewed Publications

Most relevant to the current application


**Additional recent publications of importance to the field (in chronological order)**


**Completed Research Support**


Univ. Michigan Center for Space Environment Modeling: Research service agreement (2011-2012). To elaborate computational models for prediction extreme solar events. PI

Henry Luce Foundation: program support (2002-2012). To build a transdisciplinary program at Kalamazoo College.

Toyota Research Institute small grant (2011). Computational modeling of predicting emerging field of technologies. PI


Pharmacia Corporation: Computational Neuroscience - Application to CNS Drug Discovery. Goal: building a translational EEG biomarkers related to anxiety. PI.

Goal: elaboration of algorithms of growing networks. PI,
Hungarian National Research Council: Design of neuroinformatics algorithms and systems with
applications in robotics (2002-2006). Goal: Design of neuroinformatics algorithms. PI.