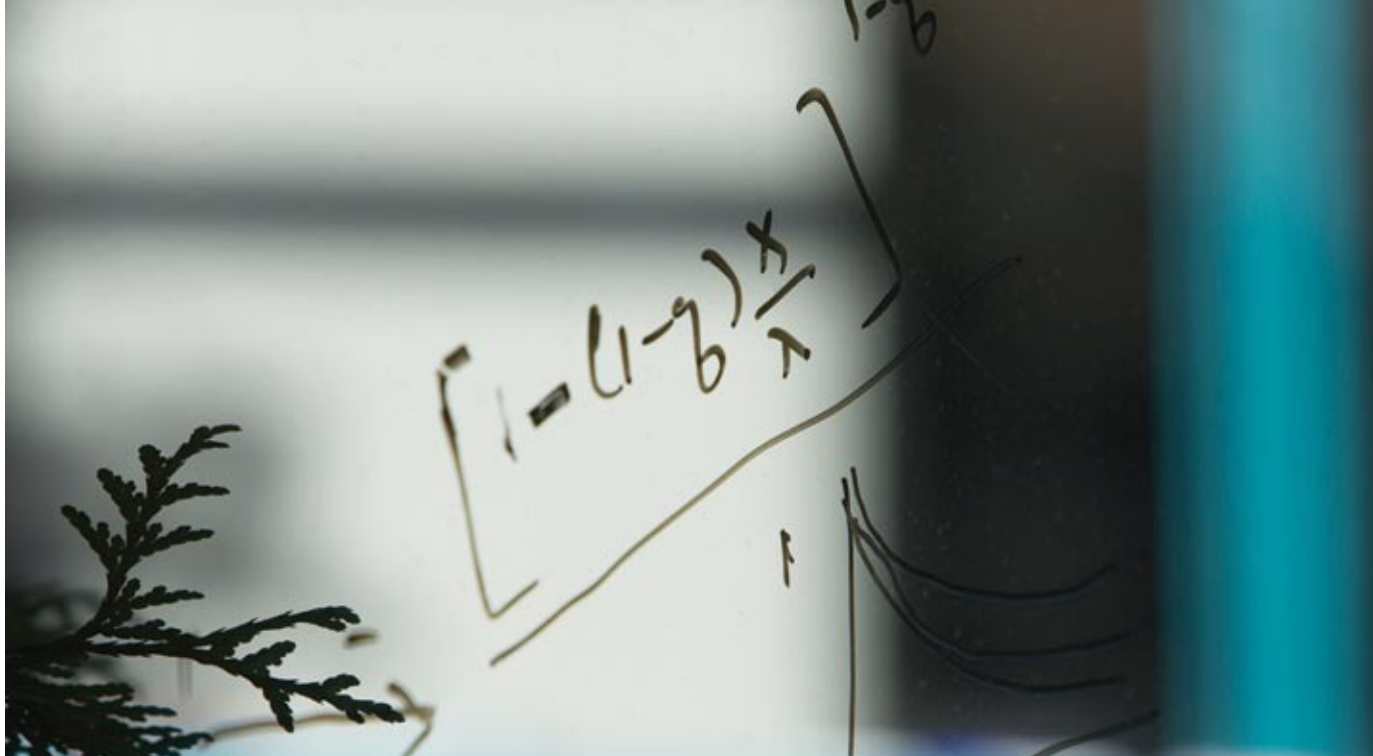




TRANSITIONS

External Faculty

The driving force of SFI's scientific life is its network of external researchers, affiliated with universities and research institutions throughout the world. Here are the most recent additions:

David Ackley received a Ph.D. from Carnegie Mellon University, and then went on to be a member of the Cognitive Science Research Group at Bellcore. Currently, he is professor of computer science at the University of New Mexico. His ongoing research interests center on artificial life models and real artificial life; current research emphases include genetic algorithms and programming, distributed and social computing, robust self-aware systems, and computer security.

Sander Bais From quantum field theory to string theory, Sander Bais's research focuses primarily on problems in theoretical high-energy physics. He has, however, "made interesting excursions to adjacent fields like condensed matter theory and physics

of the early universe" and explored novel applications of information entropy with the Santa Fe Institute's J. Doyne Farmer.

A science writer by hobby, Bais frequently contributes to Dutch newspapers and magazines. He has authored two books for a general audience, one that walks the reader through a handful of physics equations that "marked turning points in our thinking about nature" and a pictorial guide to relativity that was published this year.

Bais lives with his family in the Netherlands, where he works as a professor at the University of Amsterdam's Institute for Theoretical Physics.

Carl Bergstrom An expert on information and evolution, Carl Bergstrom has modeled the spread of antibiotic resistance in hospitals, mapped the flow of information through scientific communities, and co-authored a paper with his father on parent-offspring conflict. He is an associate professor of biology at the University of Washington.

Bergstrom enjoys learning about

other fields and collaborating with other researchers to tackle parallel problems across different disciplines. He is "thrilled to be affiliated with the Santa Fe Institute," as he considers it to be "the leading place in the world for interdisciplinary interaction in the sciences."

In his free time, Bergstrom studies the art of bonsai.

Luis Bettencourt works for the theoretical division of Los Alamos National Laboratory. He says it's "a great thrill to be involved with SFI, which has pioneered the scientific environment essential for progress in interdisciplinary research areas."

Bettencourt's professional interest lies in discovering themes in complex systems where new data and mathematical theory can test classic ideas and develop predictive insights. His current projects include analyzing data from living neural networks, working with epidemiological data streams to predict the evolution of emerging infectious diseases, and understanding human social dynam-

ics through the study of urban organization. He is also conducting an empirical investigation of Santa Fe coffee shops.

Raissa D'Souza Trained as a statistical physicist, applied mathematician, and theoretical computer scientist, Raissa D'Souza is currently a professor of engineering at UC Davis, where she is helping launch their Complex Systems Center. Her current interest is building mathematical models of feedback and interaction in layered networked systems.

D'Souza has been a regular visitor to SFI since 1996, when she attended the Complex Systems Summer School as a Ph.D. student studying cellular automata. She recently came full circle when she attended the China Complex Systems Summer School in 2006 and 2007 as a lecturer and helped organize the SFI-sponsored residency month at the Institute for Complex Systems in Valparaíso,

Chile. As a member of the External Faculty, she welcomes the opportunity to further contribute to the vitality and intellectual energy of SFI.

An avid rock climber and aspiring blue water sailor, D'Souza intends someday to count scaling El Cap and sailing to French Polynesia among her accomplishments.

Brian Enquist is a broadly trained plant ecologist and associate professor at the University of Arizona. His lab investigates how functional and physical constraints at the level of the individual (anatomical and physiological) influence larger scale ecological and evolutionary patterns. In particular, the lab focuses on two core areas: (1) Highlighting and deducing general principles, scaling rules, and the physical constraints influencing the evolution of organismal form, function, and diversity; and (2) Understanding the larger scale ramifications (ecological, evolutionary, and

ecosystem) of these rules/constraints. In order to address these critical issues, the lab uses both theoretical, computational, biophysical, and physiological and ecophysiological approaches. Research in the lab can be summarized into four distinct yet interrelated areas: (1) The evolution of form and functional diversity; (2) The origin of allometric relationships (how characteristics of organisms change with their size) and the scaling of biological processes from cells to ecosystems; (3) The evolution of life-history and allocation strategies; and (4) Community ecology and macroecology.

Enquist first came to the Santa Fe Institute in 1997 as a student in the Complex Systems Summer School.

Duncan Foley is a non-mainstream economist who came to SFI in 2001 for a workshop on the management of common-property resources. He has since been thinking about the range of ways physics concepts and methods can be applied to economic problems, the general area sometimes called "econophysics." He believes that the Santa Fe Institute "can provide a forum where physicists interested in economic systems can learn more about economic history, the history of economic thought, and what is known about the actual functioning of economic institutions."

Foley, Leo Model Professor of Economics at the New School for Social Research, also has a strong interest in the relation of evolutionary thinking to economic behavior, in statistical theory and information, and in the complex neurological system that gives rise to circadian rhythms. He hopes his work in these areas will intersect with the thinking at SFI.

Matthew Jackson, a professor of economics at Stanford University,

is currently putting the finishing touches on a book about social and economic networks. He also co-edits a monograph series and a journal of games and economic behavior. Highlights from his past studies include examining the incentives for countries to go to war and exploring a system by which Andorran farmers mutually insure each other against fires.

Jackson "looks forward to working with other researchers at SFI and studying how social network structure impacts beliefs, decision making, and behavior."

Jon Machta, a statistical physicist, works with phase transitions, non-equilibrium systems, pattern formation and the computational power of physical processes. He is interested in the interface between computer science and statistical physics both from the practical angle of algorithm development and for the insights that computational complexity theory provide in understanding and characterizing the emergence of complexity in physical systems.

Machta is a professor at the University of Massachusetts, where he has been head of the Physics Department for the past five years. He has greatly enjoyed his visits to SFI and "looks forward to the closer connections as an External Faculty member and new arenas in which to work."

Stephan Mertens Trained as a theoretical physicist, Stephan Mertens claims an identity as a "migrant who wanders back and forth between physics, mathematics, and computer science." He has worked on phase transitions in computational problems, algorithmic complexity, pseudorandomness, and on parallel computing.

Mertens is currently working with SFI professor Cris Moore on a book

entitled *The Nature of Computation*, and hopes that SFI will become his intellectual home for the next couple of years.

Maya Paczuski founded the Complexity Science group at the University of Calgary in 2006. Through collaboration, the group seeks to combine theory, technological advances, and the best available data to models of distributed information networks (such as global computing), structure of complex networks (such as protein interaction), complex dynamical systems, and social and economic phenomena.

In September 2007, Paczuski presented some of her transdisciplinary research on signaling-metabolic networks in a lecture for the ENRAGEing Ideas workshop. The lecture addressed the challenges of developing cancer treatments, and how network theory and nanoscience could combine to address them.

Paczuski has committed to "increase communication between different scientific disciplines and between science and the general public."

Mark Pagel, editor-in-chief of the journal *Evolutionary Bioinformatics* and a professor of biological sciences at the University of Reading, hopes to collaborate with SFI faculty in studies of "assembly rules" for protein networks, on ideas of redundancy and evolvability, and on studies of language and cultural evolution.

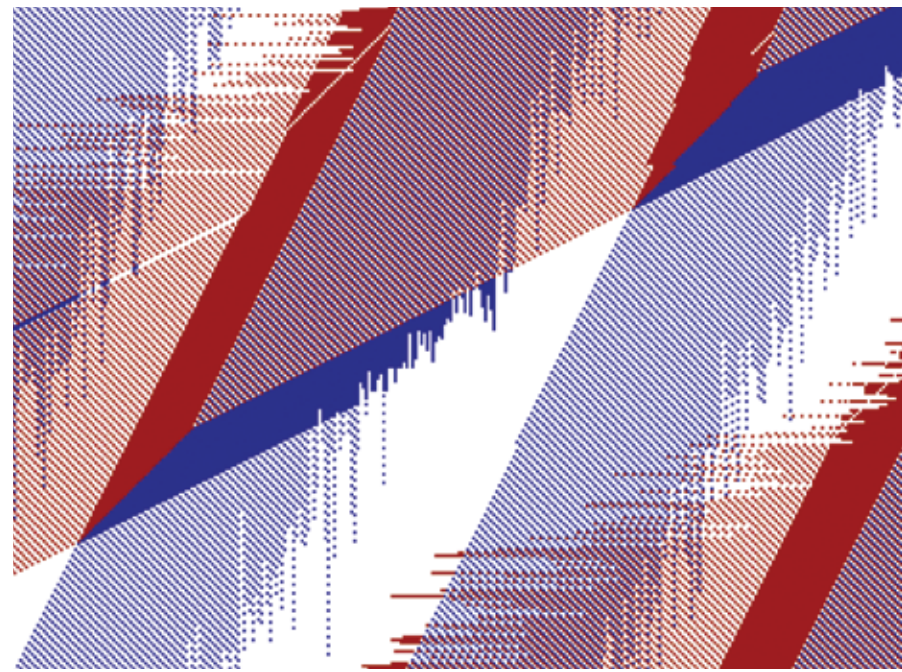
His past work includes statistically inferring the structure of dinosaur genomes, studying the evolution of the prion proteins that cause mad cow

disease, and contriving a theory to explain why human infants don't look like their parents. The reason, he says, is "they have evolved to avoid detection in the event that the domestic father is not the biological father." Interestingly, he is married with two children.

Sidney Redner, a Boston University physics professor, cut class for the entire 2004–2005 academic year. He spent his truancy at the Los Alamos Center for Nonlinear Studies as the distinguished Ulam Scholar. This jaunt in the Southwest brought him to the Santa Fe Institute, where he was introduced to like-minded researchers.

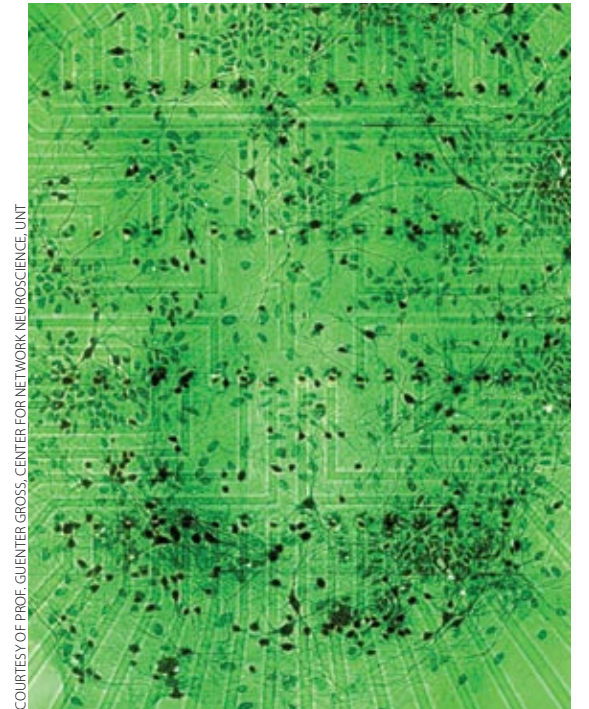
As a practitioner of statistical mechanics and network theory, he appreciates that SFI is "a place where his brand of research is in the focus rather than in the margins."

Redner has modeled aging and immortality in cell proliferation, the



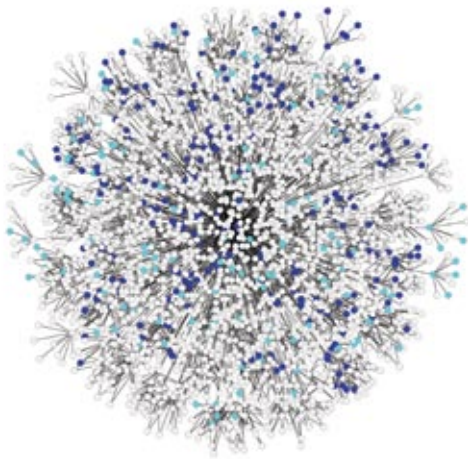
COURTESY OF RAISSA D'SOUSA / UC DAVIS

Raissa D'Souza's research on emergent patterns in a model of flow and jamming: Bands of red particles moving eastward and blue particles moving northward self-organize and delay the onset of the jamming phase transition.



COURTESY OF PROF. GUYEN GROSS, CENTER FOR NETWORK NEUROSCIENCE, UNT

Luis Bettencourt's work on neural networks: Analysis of patterns of electrophysiological activity in cortical tissue grown *in vitro* provides a window into collective information processing mechanisms in the brain.



COURTESY OF S. CLIBERTI

Andreas Wagner's work with the evolution of molecular networks: Each circle corresponds to a transcriptional regulation network, a network of genes that can turn each other on and off.

effect of zealotry on elections, and can tell you exactly why soccer and baseball are more competitive than football.

Cosma Shalizi came to the Santa Fe Institute in 1998 to work in the Evolving Cellular Automata Project; the Computation, Dynamics and Inference group; and the Dynamics of Learning group. With a background in statistical physics of complex systems, most of his current work draws on information theory, which he considers to be "an invaluable tool for proving probabilistic results."

He says his name really is Cosma, and swears that it is "one of a small number of Italian masculine names ending in A." When not writing books or teaching at Carnegie Mellon University, Shalizi likes to contemplate Talking Heads lyrics and optimize the information on his website for retention in the pineal gland.

Stefan Thurner, a "wannabe concert clarinetist" and the head of the Medical University of Vienna's Complex Systems Research Group,

hopes to use his physics background to broaden the concept of statistical mechanics in order to make it more suitable for predicting complex systems. Since his first invitation to the Santa Fe Institute in 2000, Thurner has analyzed magnetic fields of human brain activity, developed a statistical method for calculating gene expression, and studied banking networks and financial asset price dynamics.

He believes that "any progress in handling complex systems resides in finding ways of treating their intrinsically large number of variables simultaneously," and that "shamelessly generalizing and advancing statistical mechanics is a promising starting point for a better understanding of social and economic systems that are way too complicated for the classic, reductionist approach to science."

In his free time he raises funds for a school-building project in South America.

Constantino Tsallis Born in Athens but currently living in Brazil, physicist Constantino Tsallis specializes in complexity and nonextensive statistical mechanics. He is credited with introducing the notion of what is known as "Tsallis entropy" and "Tsallis statistics" in his influential 1988 paper "Possible generalization of Boltzmann-Gibbs statistics" published in the *Journal of Statistical Physics*. Tsallis recently spent two full years at SFI as a visiting researcher, which he describes as "a wonderful period in my personal and scientific life when I had the opportunity of interacting with great scientists."

As a member of the External Faculty, he would like to "participate in all possible manners of the SFI scientific life." He hopes to visit SFI again, collaborate with various resident members, and possibly organize workshops.

Andreas Wagner heads a laboratory at the University of Zurich's Department of Biochemistry. The Wagner Lab pursues the study of evolution at all levels, from individual genes to communities of organisms. Wagner himself is examining the evolution of molecular networks.

As a member of the SFI External Faculty, he hopes "to advance the frontier of our understanding of evolution by interacting with the best minds that study complex systems." ◀

Robert O. Anderson 1917-2007

Robert O. Anderson, Chairman of the SFI Board of Trustees in the early 1990s, died in November 2007.

In addition to his leadership role at SFI, Anderson served on the Board of Regents of New Mexico Tech and was Distinguished Professor of Petroleum Engineering there. The Robert O. Anderson School of Management at the University of New Mexico was named as a tribute to him in 1974. He was a Life Trustee of the California Institute of Technology, the University of Chicago, and the International Institute for Environmental Development in London.

Besides being active in the oil business, Anderson's other business interests included cattle raising and feeding operations, mining and milling, and general manufacturing.

Anderson received numerous awards for his tireless efforts in support of public, charitable, and political affairs.