International affairs are ripe for its most profound change in several centuries, a revolution in thinking similar to the revolution that has remade physics, economics, biology, and other sciences over the past 50 years.

That’s the premise of a working group, “International Affairs and Complexity,” scheduled for Aug. 28-31 at SFI that will involve 12-15 invited experts in science, foreign policy, and business.

“Our system of diplomacy was developed hundreds of years ago and was effective when very traditional states with well defined needs interacted with each other,” says SFI President and Distinguished Professor Geoffrey West.

Today, nation states are much more complex entities representing many interests, and non-traditional players — alliances, political groups, even terrorist organizations — often get involved in, or influence, international relationships.

Modern nations are, in many ways, complex adaptive systems, says SFI Science Board Co-chair Simon Levin, who is co-organizing the event with SFI Professor Doug Erwin and Joshua Cooper Ramo, Managing Director of Kissinger Associates and former TIME magazine senior editor, foreign editor, and assistant managing editor.

“This drives a new level of complexity and interconnectedness that requires a rethinking of the way we do things,” he says. “Is there an approach to the international system that can take uncertainty as a given, that acknowledges complexity as a first concern, and that looks for stability not in strong central authority but in the sorts of self-organization that makes complex systems stable and resilient?”

The gathering is the first in a series of planned activities intended to apply complexity thought to problems in foreign affairs and to engage influential foreign policy thinkers in complexity science. Its goal, says Levin, is “to air ideas on both sides and begin a dialogue that we hope will grow and persist for years.”

During the event, participants will begin by reviewing the classic approaches to foreign affairs. They’ll then explore what changes have taken place in recent years and discuss whether complexity science can help.

The seeds for the interaction were set when Ramo, writing a book on revolutionary groups and terrorism, read Fragile Dominion, Levin’s book based on his Ulam Lectures at SFI a decade ago. Ramo contacted Levin to explore common interests, which turned out to be substantial.

RESEARCH NEWS

‘Six degrees’ revisited: Thinking globally, navigating locally

An SFI working group Aug. 4-6, “Networks and Navigation,” draws its theme from a novel take on Stanley Milgram’s famous “six degrees of separation” experiment in 1967, according to co-organizer Aaron Clauset, an SFI Postdoctoral Fellow.

Milgram sent envelopes to randomly selected people in Nebraska and Kansas with a bit of information about a target person — call her Sarah — who lived in Boston. He asked them to forward a letter to Sarah, if they happened to know her. If not, they should instead send the letter to someone they did know who was more likely to know her. The letters that reached Sarah did so in just six steps, on average.

But that’s not the only remarkable outcome of the experiment, says Aaron. That any of the letters made it at all is incredible, because its recipients knew just their own friends and acquaintances while having little information about the shape of the social network as a whole. Somehow, that local information was all they needed to get the letter to Sarah.

If researchers understood how social networks work, they could target their activities more effectively.

‘Six degrees’ revisited: Thinking globally, navigating locally

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RESEARCH NEWS

Behavior series prompts ideas

SFI’s behavior series seminar began this summer with a July 7 presentation by SFI Professor Doyne Farmer on “Viruses and Votes of Equilibrium.”

The seminars, organized by Postdoctoral Fellow Dan Hruschka and Willemien Kets, bring together researchers from different backgrounds to discuss current research in the behavioral sciences both within and outside the Institute, thus stimulating discussion across fields and institutions.

Presentations cover work ranging from finished papers to ideas for new research.

Doyne’s presentation — which reviewed the traditional use and limitations of equilibrium models in economic theory, and then suggested alternative
A paper in the June 27 issue of Science co-authored by SFI External Professor Pablo Marquet (Pontificia Universidad Católica de Chile) sheds light on the effect climate warming is having on the elevations at which native plant species thrive.

Pablo’s collaborators include Jonathan Lenor and Jean-Claude Guegot of AgroParisTech, France, and Patrice de Ruffray and H. Brisse, CNRS (National Center for Scientific Research), France.

Spatial fingerprints of climate change on biotic communities are usually associated with changes in the distribution of species at their latitudinal or altitudinal extremes.

By comparing the altitudinal distribution of 171 forest plant species between 1905 and 1985 and 1986 and 2005 along the elevation range (0 to 2600 meters above sea level) in Western Europe, the researchers show that climate warming has resulted in a significant upward shift in species optimum elevation. This upward shift, according to the research, has averaged 29 meters per decade, and the shift is larger for species restricted to mountain habitats and for grassy species, which are characterized by faster population turnover.

The study suggests that climate change affects the distributional range as well as the distributional margins of plant species.

Science paper describes plants’ climate climb

INSIDE SFI
Colloquium: To three R’s add thinking computationally

To reading, writing and arithmetic, let’s add computing.

Jeanette Wing, President’s Professor of Computer Science at Carnegie Mellon Uni-
versity and Associate Director for Computer and Information Science and Engineering at the NSF, spoke at SFI July 11 about the need for computational thinking to become a fundamental skill used by everyone.

“When your daughter goes to school in the morning, she puts in her backpack the things she needs for the day. That’s prefiguring and caching. Which line do you stand in at the supermarket? That’s performance modeling for multi-server systems,” she said.

“We are often too easily swept up with the rapid progress in technology and the surpris-
ing uses by society of our technology that we forget about the science that underlies our field,” she added. Accessing the field’s scientific drivers to solve problems at all levels will open up new research avenues and educational opportunities.

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Woodie Powell (Stanford/SFI External Professor)

As a focal point, workshop participants will explore ways technological advancement can facilitate the transition to a low-carbon-emis-
sion energy infrastructure.

In a larger sense, the organizers anticipate the forum will provide a way for people thinking about technological innovation from different perspectives to build a more integrated body of knowledge and begin to address important remaining questions.

> Behavior series continued from page 1

approaches needed for the field of econom-
is to progress – drew a diverse audience and stimulated a lively discussion, in line with the aim of the series.

“The seminars are a good way of encourag-
ing interaction among the natural sciences and behavioral sciences,” says Willemen, who started her postdoctoral fellowship at the Institute in January.

The schedule is at SFI’s Events page (www.
santafe.edu/events/). The series is funded by the behavioral sciences endowment of George Cowan, Distinguished Fellow and Founding President of the Institute.
SFI in the News

SFI President and Distinguished Professor Geoffrey West, SFI Distinguished Fellow and Founding President George Cowan, and SFI External Professor (University of Victoria, Canada) were among notable signatories in an announcement of the release of “14 questions to the future” that call on the work of SFI External Professors (a total of 288) to provide a “clear roadmap on how to get science and America’s future.” The questions, culled from more than 3,300 submitted questions from signatories, are available at www.sciencedebate2008.com.

The April 8 issue of Harper’s magazine includes an article, “Contagious cancer: The evolution of a life,” that cites the work of SFI External Professor John Peper (University of Arizona) and collaborators about how the tools of evolutionary biology and ecology can provide new insights into the clinical control of cancer. www.harpers.org

Faculty News

SFIs Science Steering Committee and Appointments & Review Committee recently recommended appointments of nine new SFI Professors, and these appointments were accepted by President Geoffrey West:

Doug Erwin, Senior Scientist and Curator of the Smithsonian National Museum of Natural History’s Department of Paleobiology, and SFI Science Steering Committee Chair. Doug’s research focuses on the history of life and evolution, including ecological and developmental aspects of the origin of animals, the causes and consequences of the great and Perman mass extinction, and the evolutionary history of really old snails.

David Krakauer, SFI Science Steering Committee member: David’s work is concerned with the evolutionary history of information processing mechanisms in biology, with an emphasis on robust information transmission, signaling dynamics, and resilience to catastrophic novel, higher level features. The research spans several levels of organization, finding analogous processes across the breadth of biology, microbiology, and organism behavior.

Doyne Farmer, SFI Science Steering Committee member: Doyne has broad interests in complex systems and has done research in dynamical systems theory, time series analysis, and econometrics. His current, main interest is in developing quantitative theories for social evolution, in particular for financial markets.

New External Professors

SFIs Science Steering Committee has recommended appointments of nine new SFI External Professors since January, and those recommendations were accepted by President Geoffrey West:

Morton Christensen, Co-Director of Center for Social Sciences and Advanced Studies, Department of Psychology, Cornell University: Morton’s interests include language acquisition and processing, statistical learning, and how first principles, general models of language and statistical learning, neuropsychological (event-related potential) brain functions, and the relationship between language, language evolution, and genomics of language.

Vincent Danos, Professor, Computational Systems Biology, University of Edinburgh, U.K., and Director of Research, CNRS (National Center for Scientific Research), France: Vincent’s research interests range from mathematical logic and the semantics of programming languages to probabilistic and agent-based models. At Edinburgh he is leading development of an efficient high-performance simulation platform for formal signaling that will enable the rapid generation of cellular insight — including causal information — without requiring significant modeling in quantitative capability from the user.

Andrew Dobson, Professor, Ecology & Evolutionary Biology, Princeton University: Andrew’s research is focused on the population ecology of infectious diseases and the conservation and management of threatened species. Over the last eight years he has studied infectious diseases in a variety of endangered and for threatened ecosystems, enabling him to develop sections of a larger body of theory that deals with the role of infectious diseases in driving wild populations to extinction — a key unsolved problem of conservation biology.

Santiago Elena, Research Professor, Evolutionary Virology, Instituto de Biologia y Celular de Plantas, Valencia, Spain: Santiago’s interests are related to the evolutionary biology of microbes, focusing on the study (within the framework of populations genetics) of the mechanisms that generate and maintain the genetic variability of RNA viruses, the potential of digital genome assembly as model systems for evolutionary studies, and in silico and mathematical hierarchical models of the viral infectious cycle.

Jessica Green, Assistant Professor, Center for Evolutionary Ecology, Evolutionary Biology, University of Oregon: Jessica is an applied and theoretical ecologist interested in biodiversity and patterns in the distribution and abundance of species. Using interdisciplinary approaches at the interface of microbiology, ecology, mathematics, informatics, and computer science, her work aims to understand the forces that organize heterogeneous ecological systems and to apply this understanding to help inform conservation policy and management decisions.

Pablo Marquet, Associate Professor, Department of Ecology, and member of the Center for Advanced Studies in Ecology and Evolution, Faculty of Forest Sciences, Pontificia Universidad Católica de Chile, Chile: Pablo is interested in the application of theoretical physics to the study of biodiversity and evolution. His work focuses on understanding the role of dispersal in shaping biodiversity and community structure, and on the fundamental limits to the diversity of ecological systems. Pablo is a former SFI International Fellow.

Juan Perez Mercader, Distinguished Research Professor, Higher National Research Council, and Director and Founder, Centro de Astrobiologia, Madrid, Spain: Juan’s fundamental interest is in the application of the theoretical physics to the knowledge of the universe, especially of life. He has hundreds of technical publications and has won numerous awards for his work in theoretical physics and astrophysics. He has served as an advisor consultant to NASA and Los Alamos National Laboratory. He is a member of the publishing council of Astrobiology and The International Journal of Astrobiology.

Kazuo Nishimura, Director, Institute of Economic Research, Kyoto University, Japan: Kazuo focuses on information processing and computer systems, and economics and quantitative studies of human behavior as they relate to economic theory.

Rajiv Sethi, Professor, Barnard College, Columbia University, Department of Economics: Rajiv’s work in Dynamic & Quantitative Studies of Human Behavior focuses on economics and inequity. This summer he co-authored a book, International Trade and Labor Standards: A Proposal for Linkage, which proposes international trading systems reforms that help in the fight against exports to countries in promoting the well-being of peoples in ways that are acceptable to both rich and poor nations.

New International Fellows

The Institute in July appointed two new International Fellows:

Eric Goles, Science Director, Institute for Complex Systems, Valpaireo, Chile: Eric, a mathematician and computer scientist, is best known for his work on cellular automata. In 1993 he was awarded the Premio Nacional de Ciencias Exactas (Chilean National Science Prize). He also was President of CONICYT (the Chilean equivalent of the U.S. National Science Foundation), as well as an advisor on science and technology to the Chilean government.

Virgilio Almeida, Professor of Computer Science, Federal University of Minas Gerais, Belo Horizonte, Brazil: Virgilio’s research interests include performance evaluation and modeling of large scale distributed systems. He has held visiting professor positions at Boston University and Polytechnic University of Catalonia, as well as visiting appointments at Xerox PARC and Hewlett-Packard Research Laboratory. He is a recipient of a Fulbright Research Scholar Award and is a full member of the Brazilian Academy of Sciences.

SFI’s International Fellowship Program aims to foster interdisciplinary research in targeted countries by identifying outstanding researchers affiliated with an academic institution in India, China, former Soviet countries, or countries in Africa, Eastern Europe, or Latin America.

Selected International Fellows have demonstrated experience in the study of complex adaptive systems in an interdisciplinary environment. They continue to do research in their home institutions while participating in collaborative research with SFI researchers. Fellowships are awarded for a two-year term.

Thinking globally continued from page 1

SFI Departures

Statistical physicist and former SFI Postdoctoral Fellow Michael Gastner’s last day at the Institute was Friday, May 16, and he will return to his position at the Institute for the Chemistry and Biology of the Marine Environment, Carls-von-Ossietzky University, Oldenburg, Germany. This is the last of several former SFI Postdoctoral Fellows — including Chao Yang and Thimo Rohlf’s last day at the Institute was May 27; Thimo is now at the Max Planck Institute for Mathematics in Leipzig.

Can understanding social networks improve the Internet’s performance? (Image: Aaron Clauset)

The meeting is co-organized by Aaron, Dmitri Krioukov and KC Claffy (UC San Diego), and SFI Professor Cris Moore (University of New Mexico). For more information, www.santafe.edu/events/
It’s the case of the missing flu virus. When the flu isn’t making people sick, it seems to vanish. Yet, every year it reappears and starts its attack anew.

So where does it go when it disappears? Does it hibernate, lying dormant in a few people and preparing for its next onslaught? Does it bounce around from the Northern hemisphere to the Southern hemisphere and back, following the seasons?

Neither, it turns out. Former SFI Graduate Fellow Derek Smith, now at Cambridge, led a crew of virus hunters that traced the virus’s breeding grounds to Asia. New flu varieties almost always evolve in Asia and then hitch a ride each year with travelers, spreading to Europe, Australia, North America, and finally to South America, where they die away.

The team’s work may help make the flu vaccine better. Because the flu virus is constantly evolving, scientists meet at the World Health Organization twice a year to decide on a vaccine formulation, but they must make a choice a year in advance of the targeted flu season to allow time for the vaccine to be manufactured and administered.

Asia, the study suggests, is the best place to look for up-and-coming strains.

The team published its findings recently in Science.

The roots of the project extend back to when Smith was a graduate fellow at SFI from 1992 through 1997. During that time he collaborated with Stephanie Forrest and Alan Perelson, and later with Alan Lapedes, Robert Farber, and Terry Jones, all of whom were affiliated with SFI, to develop the methods and software to build antigenic maps.

“This work is highly multidisciplinary, with epidemiologists, computer scientists, computational biologists, mathematicians, virologists, immunologists, geneticists, veterinarians, and MDs,” Smith says. “It was made possible by collaborations with people from all of these disciplines. The Santa Fe Institute is one of the few places that could have gestated such work and I am immensely grateful for the five years I spent at SFI.”