



Update

May 2008



RESEARCH NEWS

Selecting the best song, and candidate

To understand the primary elections, study music. Duncan Watts, an SFI External Professor and Columbia University sociology professor, has done just that. And what he's found is disturbing – if the purpose of the primaries is to pick the best candidate.

Duncan wondered to what extent people's opinions are influenced by the opinions of others and how much they reflect their own tastes. So he chose a

simple case to study: musical preferences.

He and his colleagues asked 14,000 people to rate their preferences among 48 songs they hadn't heard before. He divided the listeners into nine groups. In eight of them, listeners were allowed to see the ratings of previous listeners in their group. In one group, the control group, listeners made their choices strictly on their own.

People, of course, tended to repeat the selections of their predecessors.

Duncan believes this helps explain why the winner of the Iowa and New Hampshire primaries usually goes on to win the party's nomination. Early success acts as a kind of contagion, breeding later success. But the ultimate winner may not be the candidate most people prefer based strictly on their own opinions. ■



People's musical choices are influenced by the preferences of others. Election choices might be too.

(Image: ©iStockphoto.com)

IN THIS ISSUE

- > Lit Bits 2
- > Teaching in China 2
- > Pagel co-edits book 2
- > SFI In the News 3
- > Cancer workshop 3
- > Animal behavior 3
- > Irene Lee award 3
- > Lessons of example 4
- > Fabrizio Lillo award 4
- > ABMS course 4

INSIDE SFI

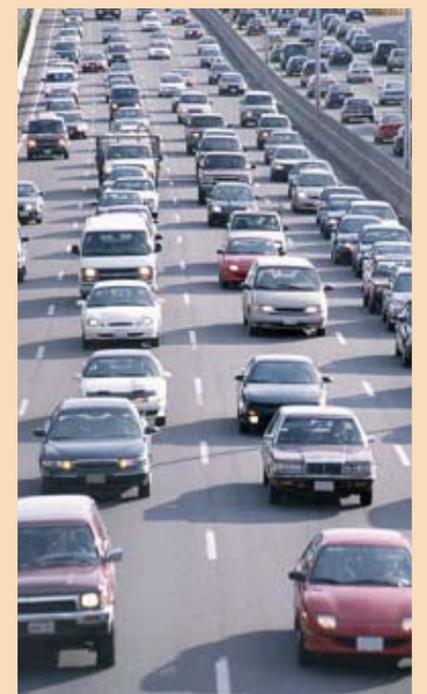
Symposium: Cities and sustainability

As the world urbanizes, will the resource demands humanity places on earth increase or decrease, and why? As urbanization in the developing world catches up with that of the developed world, what lessons might be distilled from a better understanding of cities as complex systems?

SFI's April 11 Science Board Symposium in Santa Fe prompted an examination of cities from many angles. Invited speakers represented physics, economics, ecology, sociology, and anthropology.

The daylong discussion was part of a whirlwind weekend for SFI that included an April 10 Science Steering Committee meeting, an April 12 Science Board meeting, an April 13 Board of Trustees meeting, and

> more on page 2



RESEARCH NEWS

April workshop at SFI draws HIV gene hunters

For a tiny speck of RNA that can't properly even be called alive, HIV is a wily bugger. An individual virus may not display any brainpower, but over a few generations the virus can use the power of evolution to evade almost any drug thrown at it.

This cunning makes life hard for drug and vaccine developers. If a drug attacks the virus through a feature that is inessential for the virus's survival, the virus will evolve resistance within about a day. So HIV researchers hunt for ways to attack features of the virus it relies

on to survive and reproduce. That way, the virus will have a much harder time slipping out of the drug's grasp with its Protean tricks.

Researchers' best shot at finding those essential features is by becoming HIV

> more on page 2

LIT BITS

Mesa Verde migrations; **Kohler, Timothy [SFI External Professor]**; Varien, M.; Wright, A.; Kuckelman, K.; *American Scientist*, 2008 (Vol. 96), pp. 146-153

Comparing maintenance strategies for overlays; **Krishnamurthy, Supriya [SFI External Professor]**; El-Ansary, S.; Aurell, E.; Haridi, S.; *Proceedings of the 16th Euromicro Conference on Parallel, Distributed, and Network-Based Processing*, 2008, pp. 473-482

Maps of random walks on complex networks reveal community structure; Rosvall, M.; **Bergstrom, Carl [SFI External Professor]**; *Proceedings of the National Academy of Sciences of the United States of America* 105 (4), Jan. 29, 2008, pp. 1118-1123

Mathematical estimates of recovery after loss of activity: Long-range connectivity facilitates rapid functional recovery; Hubler, M.J.; **Buchman, Timothy [SFI External Professor]**; *Critical Care Medicine* 36 (2), February 2008, pp. 489-494

Quantum-classical correspondence principles for locally nonequilibrium driven systems; **Smith, Eric [SFI Professor]**; *Physical Review E* 77 (2 part 1), February 2008, pp. 132-155

Robustness of the European power grids under intentional attack; **Solé, Ricard [SFI External Professor]**; Rosas-Casals, M.; Corominas-Murtra, B.; Valverde, S.; *Physical Review E* 77 (2 part 2), February 2008, pp. 50-56

Information flows in causal networks; **Ay, Nihat [SFI External Professor]**; Polani, D.; *Advances in Complex Systems* 11 (1), Feb. 2008, pp. 17-41

Simple quasispecies models for the survival-of-the-fittest effect: The role of space; Sardanyes, J.; Elena, S.F.; **Solé, Ricard [SFI External Professor]**; *Journal of Theoretical Biology* 250 (3), Feb. 7, 2008, pp. 560-568

Computing the non-linear anomalous diffusion equation from first principles; **Fuentes, Miguel [SFI**

Postdoctoral Fellow]; Caceres, M.O.; *Physics Letters A* 372 (8), Feb. 18, 2008, pp. 1236-1239

Do animal personalities emerge? (reply); Wolf, M.; **van Doorn, Sander [SFI Postdoctoral Fellow]**; Leimar, O.; Weissing, F.J.; *Nature* 451 (7182), Feb. 28, 2008, pp. E9-E10

Evolution of learning in fluctuating environments: When selection favors both social and exploratory individual learning; **Borenstein, Elhanan [SFI Postdoctoral Fellow]**; **Feldman, Marcus [SFI Science Steering Committee Member and External Professor]**; Aoki, K.; *Evolution* 62 (3), March 2008, pp. 586-602

The 1918-1919 influenza pandemic in England and Wales: Spatial patterns in transmissibility and mortality impact; Chowell, G.; **Bettencourt, Luis [SFI External Professor]**; Johnson, N.; Alonso, W.J.; Viboud, C.; *Proceedings of the Royal Society B-Biological Sciences* 275 (1634), March 7, 2008, pp. 501-509

SFI IN THE NEWS

Thomson Scientific's *Science Watch* for March 2008 names SFI as a "rising star" institution for environment/ecology. The moniker goes to the institution achieving the highest percentage increase in total citations in that field from August to October 2007. Thomson notes this is a repeat honor for SFI. The company tracks trends in basic research. <http://scientific.thomson.com/>

The March 25 ColumbiaTribune.com announced an April 25 lecture by SFI President and Distinguished Professor Geoffrey West at the University of Missouri. "West, president of the Santa Fe Institute and one of *Time* magazine's 100 most influential people in the world for 2006, studies how the relationships between animals and other biological phenomena are related to social phenomena such as human relationships, investment, and terrorism," the article said. www.columbiatribune.com/2008/Mar/20080325News005.asp

An April 6 *New York Times* article, "How to turn

IMPACT

Two SFI profs teach in China

Graduate students, faculty, and advanced undergrads at Fudan University in Shanghai, China, were introduced to frontier techniques for studying institutional and social change in two courses taught by SFI External Professor Peyton Young (Oxford University and Brookings Institution) and SFI Professor Sam Bowles.

The overlapping courses, taught in early April, drew on Peyton's research in individual strategy and social structure research and Sam's work in microeconomics, as well as his recent and forthcoming essays in *Science* on modeling early human evolution.

Sam says he found the students well prepared and engaged.

"Institutional change is proceeding at a dizzying pace around our Fudan students and colleagues," he says. "They responded avidly to our typically SFI combination of dynamical systems analysis and agent-based modeling, addressed to capturing the essentials of modern China's real issues such as the design of optimal economic incentives for the provision of public goods, the diffusion of innovations, and the dynamics of new property rights systems." ■

CREDITS

Editorial staff
John German
Ginger Richardson
Della Ulibarri

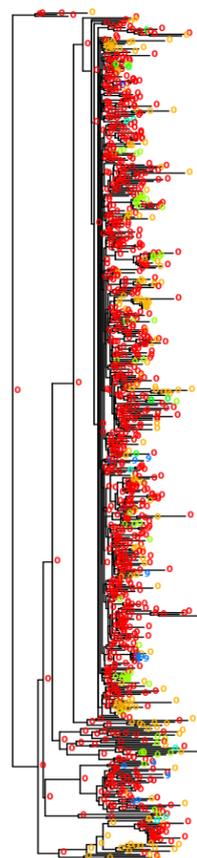
Contributors
Julie Rehmeyer
Pat Lowe
Sam Bowles

Design and production
Michael Vittitow

The *SFI Update* is published monthly by the Institute to keep our community informed about current work and activities. Please send comments to Ginger Richardson at grr@santafe.edu.

> HIV gene hunters continued from page 1

genealogists. If some feature of the HIV genome has evolved independently, over and over, researchers believe it's probably important.



Current best estimate of the phylogenetic tree for various strands of HIV. (Image: Bette Korber)

SFI Professor Tamoy Bhattacharya and SFI External Professor and Science Steering Committee Member Bette Korber (Los Alamos National Laboratory), during a workshop held at SFI April 27, brought together vaccine developers and the mathematicians who develop tools for reconstructing genealogical relationships.

"As a vaccine researcher, if you don't understand the genealogy of these viruses, it's very difficult to do anything," says Tamoy. "What is the best

mathematics we can apply to these questions, and how can we solve the problems that need solving? We have to bring these communi-

ties together to figure that out."

For more information: www.santafe.edu/events ■

INSIDE SFI

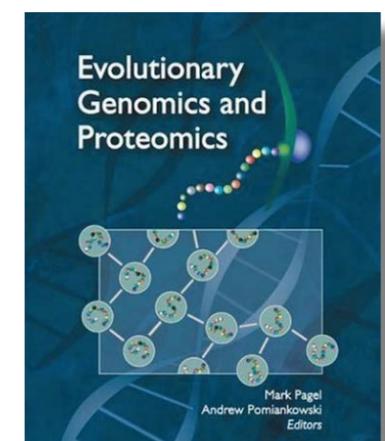
Book: Genomics, proteomics in evolutionary context

Evolutionary Genomics and Proteomics, a book edited by SFI External Professor Mark Pagel (University of Reading) and Andrew Pomiankowski (University College London), has been released.

Its publisher, Sinauer Associates Inc., calls it "the first major review of developments in the rapidly advancing areas of genomics and proteomics, with particular emphasis on placing these fields in an evolutionary context."

The book's 13 chapters, written by leading scientists, include studies of systems biology, the origins of genes, gene regulation, proteome complexity, and more.

Reviewer Andrew Clark (Cornell University) says the book "superbly highlights the new research problems that have arisen from a genome-wide



perspective on evolution, and sets out the looming challenges faced by evolutionary biologists wishing to understand how phenotypic diversity, complexity, robustness, and evolvability emerge."

For more information: <http://www.sinauer.com/detail.php?id=6557> ■

> Symposium continued from page 1

an April 14 public lecture by Nobel Peace Prize winner and former Soviet President Mikhail Gorbachev.

Cities are hubs of innovation, politics, and commerce. They also are the genesis of disease, poverty, and pollution. The question of whether urban living, on balance, is more or less sustainable than rural living is still unresolved to some extent, says SFI External Professor Luis Bettencourt (Los Alamos National Laboratory), who helped organize the event.

Many factors influence a city's sustainability: how dense or how sprawling it is, the use of heating and air conditioning, patterns of consumption, and the availability of public transportation, for example.

The important questions, says Luis, are how can people create efficient

cities of scale that would reduce the negative effects of urbanization, and what solutions might improve the overall sustainability of cities? It's not clear yet what actionable insights the study of urbanization might offer urban planning, he says.

"Cities have the characteristics of a complex system," he says. "They are not purely social, ecological, economic, or physical, yet we have new indications that much about cities is universal and predictable. This is a natural direction

for an institution like SFI, and there is a lot more yet to do."

For more information, www.santafe.edu/events/workshops ■



IKONOS detail of central Vienna, Austria.

(Image: NASA)

a herd on Wall St.," reviews recent research on wild swings of panic or exuberance in financial markets and what psychological indicators lead to reversals of such swings. The article discusses SFI External Professor Brian Arthur's (Palo Alto Research Center) classic problem, the "El Farol game," as an approach to understanding group decisions, and SFI Postdoctoral Fellow Willemien Kets is quoted: "Dr. Kets contends that a switching strategy can be successful precisely because others decide to stick to [a previously made choice, such as] a congested road. 'You see this grass is always greener kind of behavior emerging,' Dr. Kets said in an interview, 'which suggests that a variety of contrarian strategies will evolve naturally in the course of any such game because there are people who are more conservative in their strategies.'" www.nytimes.com/2008/04/06/weekinreview/06carey.html#

An April 8 *New York Times* article, "Vanished: A Pueblo Mystery," describes renewed debate among archeologists about why the Anasazi people abandoned the Colorado Plateau and

migrated into Arizona and New Mexico in the late 13th century, and what role climate change played. "In an effort to draw together the skein of causes and effects, [SFI External Professor Tim Kohler, Washington State University] and members of the Village Ecodynamics Project are collaborating with archeologists at Crow Canyon on a computer simulation of population changes in southwest Colorado from 600 to around 1300. Combining data on rainfall, temperature, soil productivity, human metabolic needs, and diet gleaned from an analysis of trash heaps and human waste, the model suggests a sobering conclusion: As Anasazi society became more complex, it also became more fragile. 'You can't easily peel off a lineage here and a lineage there and have them go their own way,' Dr. Kohler said. 'These parts are no longer redundant. They're part of an integrated whole.' Pull one thread and the whole culture unwinds." www.nytimes.com/2008/04/08/science/08anasazi.html?pagewanted=1

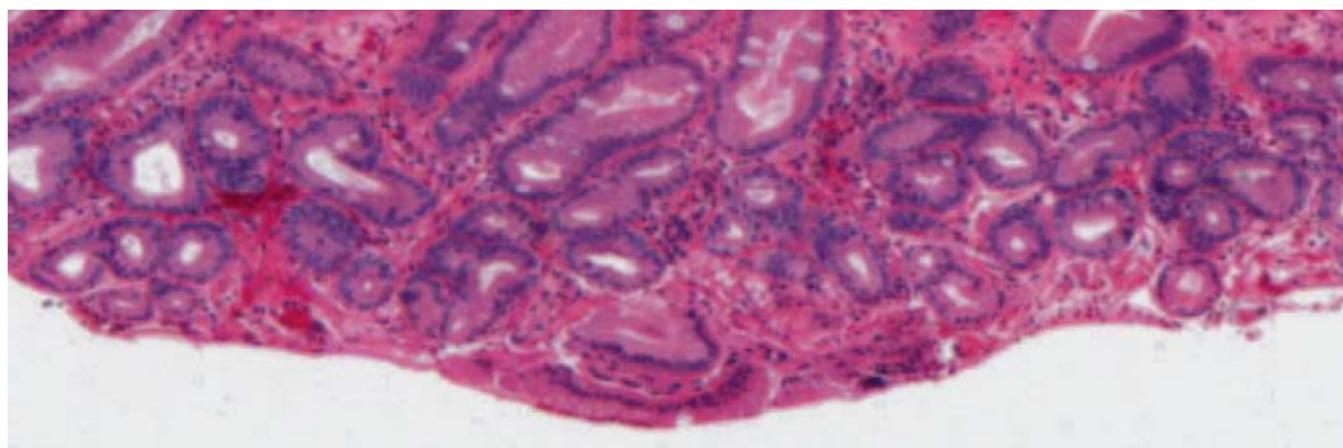
The April 14 *Business Day* (South Africa) features SFI Board of Trustees Chairman Bill Miller, Chief

Executive Officer and Chief Investment Officer of Legg Mason Capital Management, Inc.: "On the outside Miller and his operation might look like a standard-issue money management firm. It's a buttoned-down, conservative-looking crew. But spend some time with the man and his brain trust, and you realize that this is more like some sort of academic enclave or work house. Miller's group is just as likely to be discussing the functionality of ant colonies or river systems as P/E ratios... Miller is also chairman of the Santa Fe Institute, a think tank founded to study complexity. He has spent decades studying freethinking overachievers, and along the way he's become one himself." www.businessday.co.za/articles/markets.aspx?ID=BD4A730915

An April 13 *Santa Fe New Mexican* article discusses SFI External Professor Alan Perelson's (Los Alamos National Laboratory) recent work suggesting that HIV replicates more quickly than previously thought: "Previous estimates, which just looked at a cell at a single point in time, suggested that 100 to 200 viruses might be made

in each infected cell," Alan said. "That estimate was later raised to 1,000 to 2,000. But when we looked at a cell over its life span, we found each cell was making approximately 50,000 viruses – and it looks like that's the minimum." The article also quotes SFI External Professor and Science Steering Committee Member Bette Korber. www.santafenewmexican.com/Local%20News/Los-Alamos-National-Laboratory-Scientists--Estimates-of-HIV-pro

An April 14 Associated Press article reported on the public lecture in Santa Fe by Nobel Peace Prize winner and former Soviet President Mikhail Gorbachev: "Gorbachev decries America's military buildup since the Cold War and he is calling for more international cooperation in addressing political and environmental problems...He says the size of the U.S. defense budget makes it appear that America is at war with the world. Gorbachev also criticizes the U.S. for taking a unilateral approach to foreign policy rather than working with its allies." The lecture benefited SFI. www.kvia.com/Global/story.asp?S=8165889&nav=AbC0



Barrett's esophagus tissue (a pre-malignant condition)

RESEARCH NEWS

May workshop: Is evolution an enemy within?

The same rules of natural selection that have led to the enormous diversity of life are at work deep within our bodies – with sometimes less desirable outcomes.

If an animal has a mutation that makes it survive longer and reproduce faster, its descendants will spread throughout a population, changing the nature of the entire species. Similarly, a mutated cell that survives longer and reproduces more quickly will tend to spread throughout our bodies. We have a term for cells like that: cancer.

Evolution, SFI External Professor John Pepper believes, has the potential to explain not just how cancer comes to

be, but why. He is organizing a workshop to bring evolutionary biologists and cancer researchers together at SFI May 18-23. John is an assistant professor of ecology and evolutionary biology at the University of Arizona.

"We have a whole toolbox in evolutionary biology, and we really should be putting those tools to work understanding cancer," he says.

He found that natural selection seems to explain why cancer evolves too well. "This seems like such an inexorable process that I started being puzzled as to why all of us don't have cancer," he says. Somehow, he says, the body has to turn off evolution, forcing cells

to cooperate rather than compete.

Cells replicate through a roundabout method that had never been satisfactorily explained. John and his colleagues suggest that this method is precisely what was needed to short-circuit evolution, preventing cancers from popping up throughout the body.

He thinks this insight is just one of many that may come from an evolutionary perspective on cancer. The workshop, he hopes, will get more researchers exploring the approach.

For more information: www.santafe.edu/events ■

PEOPLE

Irene Lee wins Women in Technology Award

Irene Lee is one of seven women honored with 2008 Women in Technology Awards by the New Mexico Information Technology and Software Association (NMITSA).

The awards are part of a new NMITSA program to promote the careers of women in technology and recognize those who already work in the industry.

Irene is principal investigator of SFI's summer and after-school Project GUTS (Growing Up Thinking Scientifically). She also is on the Board of Directors for the New Mexico Supercomputing Challenge and serves on the New Mexico Public Education Department's Math and Science Advisory Council, which is responsible for developing a plan for advancing math and science education in the state.

The Supercomputing Challenge management team nominated Irene for the award "for her leadership and creativity



Irene Lee

on behalf of several statewide science, technology, engineering, and mathematics education programs," according to her nomination. "She motivates students and teachers, and understands the importance of engaging hands-on activities for all students, it said.

She was honored during a NMITSA awards brunch April 3 in Albuquerque.

"Irene is a superb model for young women," says Celia Einhorn, program manager for the Supercomputing Challenge. ■

RESEARCH NEWS

Group examines dominance, inequality in animals

An interdisciplinary working group at SFI March 28-30, "Dominance, Leveling, and Egalitarianism in Primates and Other Animals," drew a top-notch group of researchers to explore social dominance and inequality in group-living primates and other animals.

SFI Professor Samuel Bowles says the meeting's goal was to examine comparable cross-species measures of critical dimensions of these processes. Along with Sam, the group's conveners included primatologists Carel Van Schaik (University of Zurich), Tim Clutton-Brock (University of Cambridge), and Joan Silk (UCLA), as well as UCLA anthropologist Robert Boyd, an SFI External Professor.

Members shared their latest studies of species that feature a range of behav-

iors reflecting dominance and inequality – from fiercely egalitarian African lionesses and "democratic" coalitions of subordinate baboons that challenge alpha males, to hierarchical animals such as female spotted hyenas.

"Knowledge of the dynamics contributing to inequality and hierarchy among other animals may eventually allow us to better understand why humans at various points in our history and pre-history have been deliberately egalitarian, autocratically despotic, and just about everything in between," Sam says.

The group is supported by the Behavioral Sciences Program at SFI, the European Science Foundation, and the U.S. National Science Foundation. ■



Spotted hyena (Image: ©iStockphoto.com/Elvis Santana)

ON & OFFS

For SFI's schedule of workshops, lectures, and colloquia: www.santafe.edu/events

COMINGS & GOINGS

For a schedule of SFI visitors: www.santafe.edu/events/calendar-visitors-week.php

IMPACT

Public lecture: Google research director touts the lessons of example

Today's internet represents a treasure trove of data, with billions of pages of information. A person could never look at them all, but computers today can consider massive amounts of data very well, says Peter Norvig, Director of Research at Google, Inc.

Some online language translators, for example, already sift through a sea of

Google's Peter Norvig
"Practice Makes Perfect"
May 14, 7:30 p.m.

language usage to arrive at, and use, the single best or most used translation of a word or phrase – in essence learning by example.

If you couldn't reduce the problem to something you could understand with a pencil and paper or a calculator, you couldn't use it."

Norvig is scheduled to give an SFI Public Lecture May 14, 7:30 p.m., at

the Armory for the Arts in Santa Fe (1050 Old Santa Fe Trail).

His lecture, "Practice Makes Perfect: How Millions of Examples Lead to Better Models of Language, Pictures, and Other Things," will explore the modeling possibilities presented by today's vast internet and the computational requirements for such modeling.

"Historically, the way to do modeling is for people to think deeply about the data to get to theory," says Norvig. "If you couldn't reduce the problem to something you could understand with

a pencil and paper or a calculator, you couldn't use it."

Today, "the data is its own model," he says.

For more information, www.santafe.edu/events/abstract/1225 ■

PEOPLE

Fabrizio Lillo wins DPG's young scientist award

During its annual conference in Berlin Feb. 25-29, the Deutsche Physikalische Gesellschaft (German Physics Society) awarded SFI External Professor Fabrizio Lillo (University of Palermo) the Young Scientist Award for Socio- and Econophysics.

The award, sponsored by McKinsey & Company, a global management consulting firm, recognizes outstanding original contributions that use methods of physics to develop a better understanding of socioeconomic problems.

Juried by an international panel of scientists, the award is given to a leading researcher in the field under 40 years of age. Fabrizio's award recognizes his

research in econophysics of financial markets – a field at the boundaries between physics, economics, and biology.

"Econophysics is a relatively young discipline in which concepts and techniques of statistical mechanics are applied to socioeconomic systems," he says.

In a series of papers since 2000, Fabrizio has investigated the dynamics of financial markets on different scales, ranging from stock portfolios down to the actions of individual traders.

He says his goal is twofold: He hopes to contribute to the understanding of

how financial markets work and help improve trading strategies and minimize trading costs. ■



Fabrizio Lillo

BUSINESS NETWORK NEWS

SFI co-sponsors ABMS course

SFI is co-sponsoring the 7th Annual Agent-Based Modeling and Simulation (ABMS) Course May 12-16 at Argonne National Laboratory in Argonne, Ill.

The course introduces managers, analysts, and software developers to methods of exploring complexity in business and organizational dynamics using ABMS, says Michael North of Argonne's Decision and Information Sciences Division.

Lectures and hands-on laboratories are used to introduce the foundational ideas and tools of ABMS and their application to business questions. The course is hosted by Argonne, a longtime SFI Business Network member, and is one of SFI's Business Network Topical Meetings. Network members receive a tuition discount. ■



SANTA FE INSTITUTE

1399 Hyde Park Road
Santa Fe, New Mexico 87501
T 505.984.8800
F 505.982.0565
www.santafe.edu