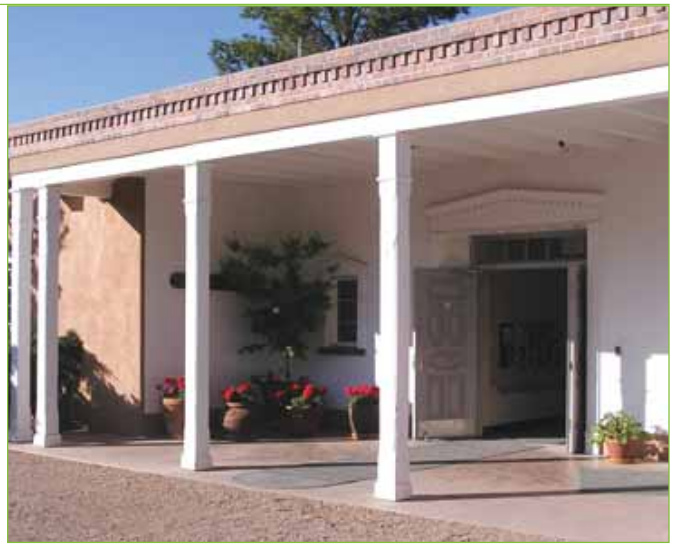
FeaturedLab

BY LOUISA DALTON

# Santa Fe Institute: Addressing Complexity



In the summer, it can be hard to find a place to sit at the Santa Fe Institute. Much of the year, only about a dozen researchers make their home at the multidisciplinary research organization. But in the summer, they double-up in work spaces with many of the roughly 70 external faculty who have primary appointments elsewhere. Add to that flocks of scientists and students moving in and out for workshops and summer school, and it's easy to see how all the chairs get filled in the one-story, pueblo-style research institute.

The visitors and faculty come with widely diverse backgrounds—from the hard physical sciences to the natural sciences, biomedical sciences and social sciences, "sort of ending up somewhere in the fringes of archaeology," says SFI president **Geoffrey West, PhD**. Since SFI's founding more than 20 years ago, the stand-alone organization, funded primarily by private money, has been an evangelist of multidisciplinary research. The institute is a safe haven for such research, West says, a place where investigators can ask fundamental, wide-ranging questions, even if they are not sure the questions will bear fruit.

The types of questions SFI researchers ask—big picture questions midway between multiple fields—tend to fall into a bucket now referred to as complexity science. Answering these questions frequently uncovers commonalities (often mathematics-based) between vastly different systems, whether they are social, natural, or artificial systems. West is now helping to organize a workshop centered on the question, "How are huge databases going to change the way we do science?" Although an astronomer posed the question, huge datasets are also a challenge in high-energy physics, biology, even the social sciences. The workshop will bring together 30 to 40 scientists from informatics, computational biology, astronomy, population dynamics, genomics, high-energy physics, and more. West hopes that some disciplinary cross-fertilization will occur, and new ideas will emerge.

Biocomputation is one of the well-fertilized fields pursued by SFI researchers. For example, **Tanmoy Bhattacharya, PhD**, one of SFI's relatively permanent researchers, was trained as a physicist but has branched out into computational biology. He studies how the rapid evolution of HIV makes it difficult to fight. So many strains now exist; he tries to take a step back and understand the virus from a global evolutionary perspective. His research will likely help others choose the best strains to use for HIV vaccine development.

Another faculty member **David Krakauer, PhD**, studies the stability and evolution of biological organizations with the help of computational principles. He believes that the science of adaptive systems could have an important impact on the design of robust, distributed computing systems.

For the most part, research done at SFI isn't driven by the promise of immediate applications. "That's what makes this place different," Bhattacharya says. "Here you can really ask important, long-term questions, ones that don't have immediate relevance ... Here you can actually understand things. And history tells us that understanding never goes to waste." □