

Physics Colloquium

Many physical processes, including the intensity fluctuations of a chaotic laser, the detection of single photons, and the Brownian motion of a microscopic particle in a fluid are unpredictable, at least on long timescales. This unpredictability can be due to a variety of physical mechanisms, but it is quantified by an entropy rate. This rate, which describes how quickly a system produces new and random information, is fundamentally important in statistical mechanics and practically important for random number generation. We experimentally study entropy generation and the emergence of deterministic chaotic dynamics from discrete noise in a system that applies feedback to a weak optical signal at the single-photon level. We show that in this system the dynamics transition from shot noise to chaos as the photon rate increases and that the entropy rate can reflect either the deterministic or noisy aspects of the system depending on the sampling rate and resolution of the measurements.

Rajarshi Roy was a student of Leonard Mandel at the University of Rochester, who taught him to design small scale table-top experiments and explore the nature of light and its interaction with atoms and molecules. Understanding order and randomness in light and matter has been a passion ever since. After receiving his Ph.D in 1981, he went to Boulder, Colorado, as a postdoctoral research associate to work at the Joint Institute for Laboratory Astrophysics (JILA) and then moved to the School of Physics, Georgia Institute of Technology, in 1982. He worked there for seventeen years and was chair of the School when he moved to the University of Maryland (UMD) to set up a laboratory for research on the nonlinear dynamics of optical devices and systems. Since 1999 he has worked there in the Department of Physics, the Institute of Physical Science and Technology (he has served as the director of IPST from 2003 to 2014), and the Institute for Research in Electronics and Applied Physics (IREAP), where his labs are located. He has guided, individually or jointly with other faculty, the research of thirty six Ph.D students. He has worked with many postdoctoral fellows and visiting faculty over a period of almost forty years. and is a fellow of the Optical Society of America and the American Physical Society. Currently, he organizes a research experience for undergraduates (NSF REU) program at UMD.

Rajarshi Roy

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Thursday
August 30, 2018

4:10PM

Lewis Lab 316

Refreshments at 3:45PM

**“Random Numbers from Light: Photons,
Chaos and Entropy”**