



Gambling Against the Second Law of Thermodynamics



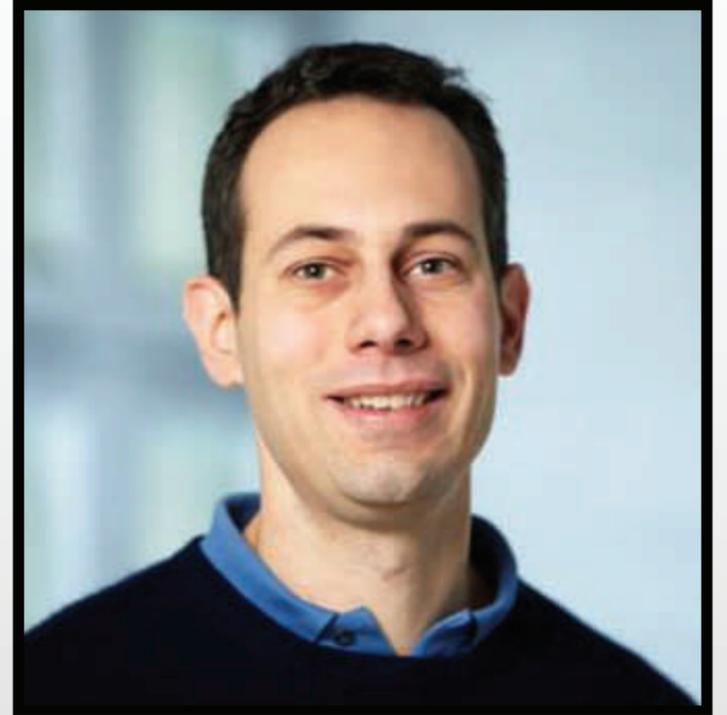
Speaker: Professor Renato Renner
ETH Zurich, Switzerland

Date: Tuesday, 10 September 2013

Time: 6:30 pm - 7:30 pm

Venue: LT31, Block S16, Level 3
Faculty of Science
National University of Singapore
10 Lower Kent Ridge Road
Singapore 117546

Free Admission



About the Speaker:

Renato Renner studied physics, first at EPF Lausanne and later at ETH Zurich. After graduation he moved to the ETH Computer Science Department for doctoral studies under the direction of Ueli Maurer. He completed his PhD degree in 2005 with a thesis on quantum cryptography, for which he received the ETH Medal and the dissertation award of the German Chapter of the ACM. For the following two years he was an HP Research Fellow in the Department of Applied Mathematics and Theoretical Physics at the University of Cambridge (UK). He has been a professor for theoretical physics at ETH Zurich since 2007. His research interests are in quantum information science as well as in the foundations of quantum theory and thermodynamics.

Abstract:

When we gamble in a casino, we are occasionally lucky and win --- but in the long run our net earnings are always zero (or negative). In his famous 1929 paper, physicist and inventor Leo Szilard argued that we are in the same situation when trying to build a perpetual motion machine of the second kind, i.e., a machine that converts heat into usable work. He considered a cylinder, filled with only few gas molecules. A piston may be inserted in the middle of the cylinder and connected to a weight. In general, the number of gas molecules on the two sides of the cylinder will not be exactly equal, resulting in a net pressure on the piston. If we are lucky, the cylinder will be pushed in the direction that lifts the weight --- we have then converted heat (from the movement of the gas molecules) into work. However, the piston will also sometimes be pushed in the opposite direction, thereby lowering the weight. In the long run the net work yield will be zero (or negative). But Szilard now went one step further and imagined an "intelligent being" knowledgeable about the position of the particles at all times. In the same way as a fraudulent gambler, able to predict the behaviour of a roulette wheel, this "intelligent being" could, by cleverly choosing the times at which the piston is inserted, always win. The result is a net conversion of heat into work, in contradiction to the second law of thermodynamics. In this talk, I will revisit Szilard's argument from a modern perspective and exhibit the important role that the concept of "information" plays in our understanding of the laws of physics.