Michael Lässig, Cologne

From Fisher to Feynman: nonequilibrium statistics of molecular evolution

Evolution is a quest for innovation: organisms adapt to changing natural selection by evolving new phenotypes. At the molecular level, adaptive evolution takes place in a sea of stochasticity generated by random new mutations and fluctuations in reproduction. The irreversibility of adaptive evolution can be measured by a quantity called fitness flux. This talk addresses the statistical foundation of molecular evolution, which is provided by a *fitness flux theorem.* The theorem reconciles opposing classic views of molecular evolution expressed by R.A. Fisher's fundamental theorem of natural selection and by S. Wright's dynamics in fitness landscapes. It shows that evolutionary dynamics and modern nonequilibrium thermodynamics obey strikingly analogous statistical principles which, in turn, can be traced back to Feynman's quantum mechanics. We will discuss how fitness flux can be measured and the theorem can be tested by evolution experiments and by analysis of genome sequences.