SFB 1027 - Seminar

SFB 1027 Physikalische Modellierung von Nicht-Gleichgewichtsprozessen in biologischen Systemen

Prof. Dr. Ulrich Gerland

Physics Department, Technical University of Munich

Non-equilibrium effects that facilitate the emergence of self-replication and evolution

Based on the work of many researchers in the field, G. Joyce and L. Orgel have described a plausible path, referred to by them as the “molecular biologists’ dream”, which starts from nucleoside bases and sugars, and culminates in a minimal evolving system, from which more complex systems can then arise via the powerful principle of Darwinian evolution. The intermediate steps along this path include the formation of random polynucleotides, and the fortuitous creation of a ribozyme that is capable of catalyzing the template-directed polymerization of itself and its complement. The path is referred to as a “dream”, because it is a chain of extremely unlikely steps, each involving “uphill” reactions, a multitude of unwanted side reactions, a gigantic sequence “search space”, various ways of losing or destroying the desired product, or a combination of such “obstacles”. Alternative paths to a minimal evolving system face similar issues and are currently no less a dream than the above “RNA first” scenario. From the perspective of statistical physics, the “obstacles” constitute different forms of energetic and entropic barriers, which block the path to a minimal evolving system. A plausible driving force is needed to overcome each of these barriers. A general “energy currency” (like ATP in extant organisms) is an implausible driving force, since it would require a complex molecular machinery to produce (ATP synthase) and use (ATPase) that currency. Plausible driving forces require that the individual steps of the path be directly coupled to other processes that run sufficiently strongly downhill. However, these other processes need not be chemical reactions – they can be non-equilibrium physical processes. I will discuss recent work that explores some scenarios of how Physics could have helped Chemistry to create Biology.

Montag, 28.4.2014, 14 Uhr c.t.

Campus Saarbrücken, Geb. E2 6, SR E11

Der Gast wird betreut von Albrecht Ott

Alle Interessenten sind herzlich eingeladen,

Der Sprecher des SFB
Heiko Rieger