**“Biomolecule Thermophoresis”**

**Dieter Braun, Ph.D.**
Professor, Systems Biophysics, LMU Munich

**[Abstract]**
The movement of biomolecules in a temperature gradient is a sensitive and versatile way to probe protein interactions, including the important class of membrane receptors binding to its target molecule. The binding is detected all-optically in various biological fluids (www.nanotemper.de). We screened for drug-protein interactions without labeling the protein and were able to successfully commercialize the method. The physical basis of the movement was studied with DNA, RNA and polystyrene beads and could be understood by the energy in the shielding capacity in combination with the Seebeck effect. Recently, we demonstrated the thermophoresis of biomolecules in living cells.
Temperature gradients also move fluids by thermal convection. Combined with the thermal control of molecules, various molecule traps can be implemented. In hydrothermal pores of rock, thermal molecule traps occur naturally. They offer a compelling disequilibrium system to drive molecular evolution. We showed that a thermal gradient can drive DNA replication by thermal cycling and trap only the long nucleic acids. The combination bodes well to implement an autonomous Darwinian evolution of molecules. The first selection pressure is the physical molecule size.
Despite accumulating molecules in bulk water, thermophoretic traps enhance the polymerization of biomolecules. Thermal traps form metastable conglomerates from short oligonucleotides if they have matching end sequences. This implements a macroscale amplifier of nanoscale sequence information. Together with a hairpin replication scheme using tRNA, thermal traps can provide a roadmap from replication to translation without explicit backbone ligation chemistry.
Our aim is to create autonomous non-equilibrium systems in the lab to understand the transition from dead to living matter.