

Visualizing electrostatics of a single biomolecule in the fluid phase

Prof. Madhavi Krishnan

*Physical and Theoretical Chemistry
University of Oxford,
UK*



The desire to “freely suspend the constituents of matter” in order to study their behavior can be traced back over 200 years to the diaries of Lichtenberg. From radio-frequency ion traps to optical tweezing of colloidal particles, existing methods to trap matter in free space or solution rely on the use of external fields that often strongly perturb the integrity of a macromolecule in solution. We recently introduced the ‘electrostatic fluidic trap’, an approach that exploits equilibrium thermodynamics to realise stable, non-destructive confinement of single macromolecules in room temperature fluids, and represents a paradigm shift in a nearly century-old field. The spatio-temporal dynamics of a single electrostatically trapped object reveals fundamental information on its properties, e.g., size and electrical charge. We have demonstrated the ability to measure the electrical charge of a single macromolecule in solution with a precision much better than a single elementary charge. Since the electrical charge of a macromolecule in solution is in turn a strong function of its 3D conformation, our approach enables for the first time precise, general measurements of the relationship between 3D structure and electrical charge of a single macromolecule, in real time. I will present our most recent advances in this emerging area of molecular measurement and show how such high-precision interaction energy measurements at the nanoscale may be able to unveil contributions from previously unanticipated phenomena in intermolecular interactions in solution.

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**MPIDS, Prandtl lecture hall, AI building,
Am Faßberg 11, Göttingen**

**Max Planck Institute for Dynamics and Self-Organization
Dynamics of Complex Fluids
Prof. Stephan Herminghaus**

Email: stephan.herminghaus@ds.mpg.de, Phone: +49-(0)551/5176-200
Am Faßberg 17, 37077 Göttingen, Germany