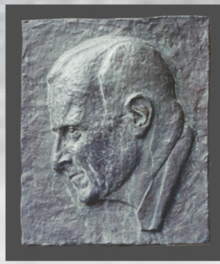


Karl Friedrich Bonhoeffer Lecture

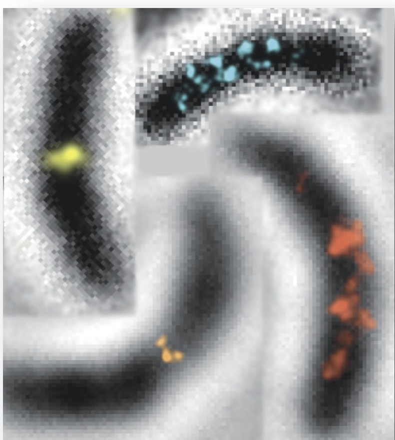
Mittwoch, den 27.5.2009 -17:00 Uhr

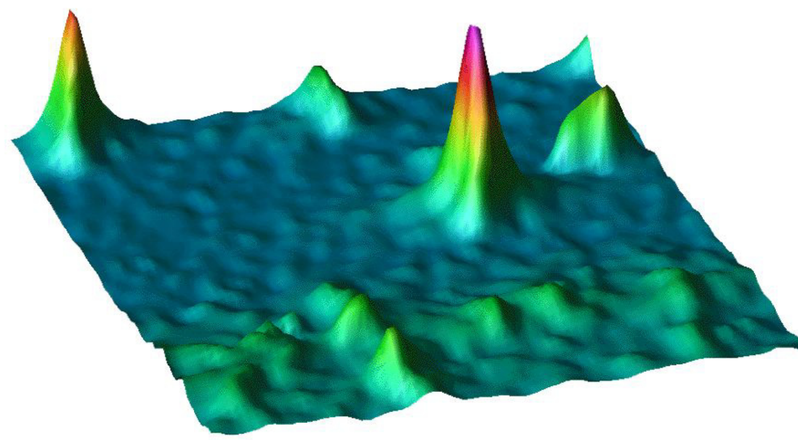
Fakultät für Physik

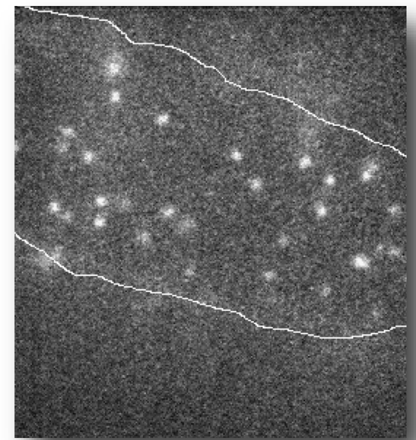
Friedrich-Hund-Platz 1, Lichtenberg-Hörsaal HS1

Prof. W. E. Moerner
Stanford University,
Stanford, CA, USA

Single-Molecule Biophysical Imaging, Superresolution, and Trapping







In the two decades since the first optical detection and spectroscopy of a single molecule in a solid, much has been learned about the ability of single molecules to probe local nanoenvironments and individual behavior in biological and nonbiological materials, all in the absence of ensemble averaging that can obscure heterogeneity. Several novel effects from the low-temperature studies (e.g., single-molecule imaging, blinking induced by spectral diffusion, and photoswitching) now have important analogs and applications at room temperature. Because each single fluorophore acts as a light source roughly 1 nm in size, microscopic imaging of individual fluorophores leads naturally to superlocalization, or determination of the position of the molecule with precision beyond the optical diffraction limit, simply by digitization of the point-spread function from the single emitter.

Single biomolecules with fluorescent labels have been detected in living cells for some time; in the case of bacteria, subwavelength resolution was recently provided by the treadmilling motion of single bacterial actin (MreB) molecules along filaments. Superresolution imaging in confocal microscopy was shown to be possible more than a decade ago by Stefan Hell et al., using spatial patterning of a quenching beam which is overlapped with a confocal pumping spot, and this approach has shown great progress recently. In complementary work using wide-field imaging of single molecules, adding photoswitching to superlocalization has also provided true superresolution imaging, and a new array of acronyms (PALM, STORM, etc.) and advances have appeared. In our work using photoswitchable EYFP, a novel protein superstructure can now be directly imaged in a living bacterial cell at sub-40nm resolution. To extend to 3-dimensional superresolution, we have developed a new optical microscope with a double-helix point-spread function which has yielded precision on the order of 10 nm in x, y, and z. These important advances as well as progress in the development of new photoswitchable single-molecule emitters for superresolution imaging in polymers and in biological systems will be reviewed.

To observe a single biomolecule in solution for more than a millisecond or so, typically it must be tied down to a surface or encapsulated in some fashion. To address this, we have built a new kind of trap for nanoscale objects in solution which overcomes the deleterious effects of Brownian motion, the ABEL trap (for Anti-Brownian ELectrokinetic trap). Because this trap does not rely on optical forces like laser tweezers, far smaller objects can be trapped, even individual biomolecules, and observed in solution for extended periods.

Gastgeber: Prof. Dr. Stefan W. Hell

Bitte beachten Sie, dass wegen Umbauarbeiten im Manfred-Eigen-Hörsaal die Lecture
dieses Mal NICHT im Max-Planck-Institut für biophysikalische Chemie stattfindet.