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# PhD or Post-Doc Position

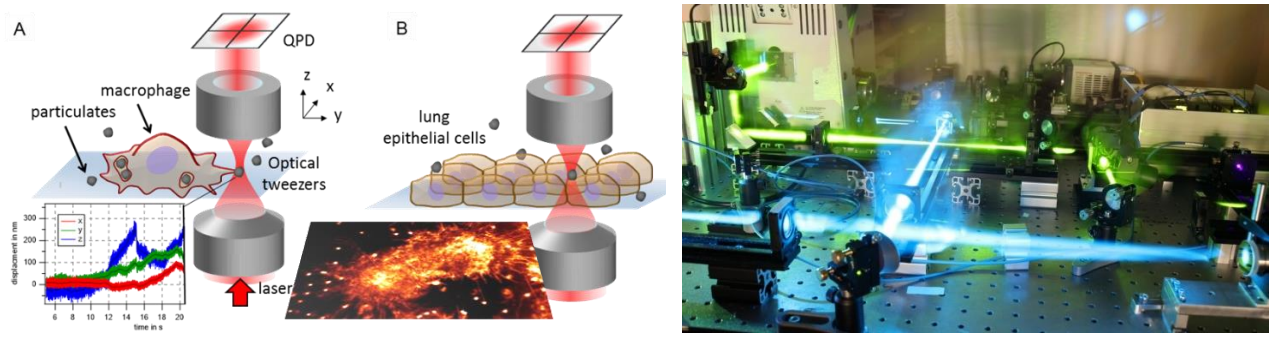
## The interaction of particulate matter with lung cells investigated by fast super-resolution microscopy and optical tweezers

**Background**: Particulate matter (PM) are microscopic particles (0.1 – 10µm) suspended in the ambient air. Whereas some atmospheric particulate matter is natural (from wildfires and sandstorms), most of today's airborne particulates originates from human made industrial processes, from power plants, burning of fuel and from vehicles. Based on several WHO studies, it is accepted that PM represents a serious health risk. The fine and ultrafine PM fraction penetrate deeper into the lungs, enter the alveoli and may pass into the blood circulatory system, hence depositing PM in all organs of the organism. However, the first stages of contact and uptake of ultrafine particles into lung cells could hardly be monitored and understood.

**Project goals:** The goal of this DFG-project is to analyze the biophysical mechanisms of the entry of ultrafine particulate matter into alveolar (macrophage and epithelial) lung cells at the level of single cellular reactions. This requires new investigative approaches, where novel advanced optical technologies (100Hz ROCS-microscopy and Photonic Force Microscopy) and biophysical concepts (thermal noise changes) will be employed. We want to characterize the response behavior of lung cells experiencing dynamic chemo-mechanical stimuli from different particles on so far unexplored spatial and temporal scales. The project will be in scientific exchange with researchers from environmental toxicology / pulmonology. The objectives are

a) What biophysical principles govern the entry process of particulate matter into cells?
b) How do particle properties influence the fate of the particle when it gets into contact with the cell?
c) How do different cell types handle particulate matter?

**Work packages:** Extension of Microscopes and stage (fluid gas flow chamber), Development of different cell models, Thermal noise tracking of particle engulfment, Characterization of uptake process by monitoring binding strength and friction, Imaging of PM-cell interactions by ROCS microscopy




Left: Optically trapped and non-trapped particles fluctuate nearby living cells. Trapped particles are moved toward the cell membrane and its positions fluctuations (3D trace) are recorded in 3D at 2 MHz temporal resolution via quadrant photo-diodes (QPDs). Bottom insets: microsecond nanometer position traces of the particles defined by thermal and cellular forces. Label-free ROCS-superresolution image of a macrophage with many 200 nm particles. Right: Photo of ROCS setup.

### Qualifications and Requirements

We seek a motivated physicist/engineer with a strong background/interest in biophysics and microscopy / optical tweezers. The candidates (salary: PhD 3.5 yrs 66% E13, Post-Doc 2.5 yrs 100% E13) will prepare cells, construct a microflow-chamber, design biophysical experiments, improve super-resolution microscopy (ROCS), 3D thermal noise tracking, optical tweezing, advanced data analysis and computer modeling. The candidate will give tutorials and will participate at several scientific conferences. The candidate should have an excellent MSc in physics or engineering, English language proficiency at level B2 or higher.