Joint LLC Seminar

Thursday October 26th, 15:15
The Rydberg Lecture Hall, Dep. of Physics

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What X-rays can tell us about the climate effects of clouds

Atmospheric aerosols are tiny nano- and microscopic pieces of particulate matter suspended in the air. Aerosols from both natural and anthropogenic sources play crucial roles in regulating global climate, in particular via their critical influence on the formation and properties of clouds. Every single cloud droplet in the atmosphere has formed by water condensing onto the surface of an aerosol particles and together, aerosols and cloud droplets interfere with Earth's radiation balance by scattering and reflecting both incoming sunlight and re-emitted heat.

Surface active (surfactant) organic compounds have been identified in atmospheric aerosol particles from a wide range of environments. Many of these surfactants can significantly reduce aqueous surface tension, but their effects on submicron aerosol properties and cloud microphysics are still not well constrained. Droplet surface tension is a key parameter in Köhler theory governing cloud formation, but size-dependent variations in microscopic droplet surface tension can introduce large variations in predictions of cloud-climate effects, which are currently not included in most atmospheric models. Many organic aerosol components also have Brønsted acid or base character. Dissociation equilibria of acids and bases determines the pH of aqueous aerosols and droplets, which is considered a key property governing aerosol chemistry, but is similarly poorly constrained in atmospheric models.

Our research team and collaborators have used and further developed experimental approaches relying on synchrotron radiation based spectroscopy and imaging to investigate models systems of atmospheric aerosols and cloud droplets. We have mainly focused on applications of highly surface sensitive X-ray photoelectron spectroscopy (XPS) on liquid microjet samples, but also investigated bulk-phase phenomena in micro-solutions with X-ray absorption spectroscopy and deposited aerosol particles with scanning transmission X-ray microscopy. Recently, we successfully applied ambient pressure (AP) XPS to study the earliest stages of water uptake onto deposited aerosol particle samples. Together with researchers from Lund University and MAX IV, we have participated in the commissioning of a new aerosol sample delivery system for introducing an aerodynamically focused beam of unsupported aerosol particles, sampled in situ from a range of sources, directly to the experimental chamber at the beamline endstation.

Results from these experiments have revealed new - and in some cases highly surprising - properties of atmospheric aqueous aerosol and droplet models, with profound implications for the chemistry, cloud formation, and climate effects of aerosols in the atmosphere.

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The Rydberg Lecture Hall is located at the Department of Physics, Professorsgatan 1

Coffee and refreshments will be served before the seminar from 15:00