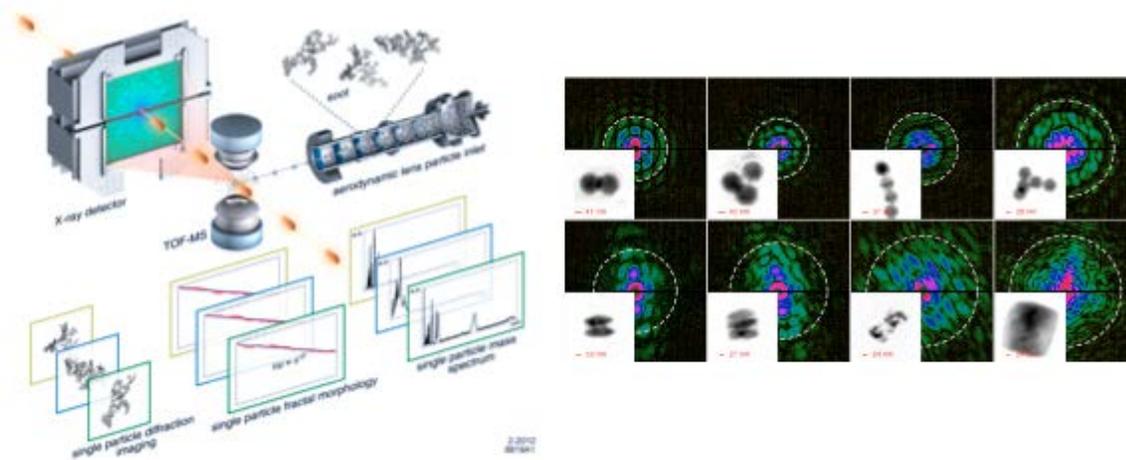


Combustion Diagnostics with an X-ray Laser? Lessons from the First Nanoscale Imaging of Airborne Particles

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What does *airborne* particulate matter look like? How do we develop quantitative descriptors for particles of complex morphology? These challenges were highlighted in the NIST workshop report "Aerosol Metrology Needs for Climate Science" (Dec, 2011). Sure, we can capture aerosol particles on surfaces - removing them from their airborne state - and probe them with high resolution optical and chemical imaging tools, but what information do we lose about the airborne particles? How can we follow dynamics? In this talk we will explore these very basic questions and their importance to combustion science. I will describe how a powerful new DOE User Facility, the Linac Coherent Light Source (LCLS), makes it possible to capture images of airborne particulate matter with 20-40 nm resolution, including particles <2.5 micron in diameter (PM2.5) like soot, NaCl particles and engineered nanoparticles (Loh et al Nature 2012). Incredibly bright, femtosecond long X-ray pulses deliver enough photons to detect scattered X-rays off individual particles injected at 150 m/s into vacuum through an aerodynamic lens stack. Computational lenses reconstruct the particle image from the scattered X-ray intensities alone. X-ray FELs can peer inside the individual airborne particles and are a sensitive probe of particle crystallinity. These capabilities also offer unparalleled insights into biological samples, such as viruses and crystallized proteins. Perspectives on the anticipated growth in single particle diffraction data due to global investment in X-ray FEL technology provide an astonishing vision of the potential impact of X-ray lasers on combustion science, technology and human health.



Video: X-ray Vision for Aerosol Scientists: LCLS Snapshots of Soot (Narrated)
<http://youtu.be/waG9G-INUYYY>