Characterizing cold (bio)particle beam beyond optical scattering limit using strong-field ionization

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We have demonstrated that buffer-gas cell (BGC) cooling combined with the aerodynamic-lens focusing (ALS) enables the generation of controlled, intact, isolated, and collimated beams of large nanoparticles and macromolecules that are desired for x-ray-single-particle-diffractive-imaging (SPI) [1–2]. Optical scattering was commonly applied to pre-characterize such beams for particles larger than 80 nm. However, it is not efficient for smaller molecules due to low signal-to-noise ratios.

Here, we extend this methodology to characterize BGC-ALS generated beams of small molecules in the protein-size range by using strong-field ionization, specifically through photofragmentation induced by a femtosecond laser, detected via time-of-flight mass spectrometry (TOF-MS) and velocity-map imaging (VMI). This approach provides access to beam profiles and hit rates of small molecules below the optical detection limit, paving the way for ultrafast studies of isolated gas-phase proteins.

References:

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