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Slow beams of high-mass organic molecules

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Abstract:

Matter-wave interferometry is well suited for testing the border between quantum and classical physics. Besides this fundamental motivation, quantum assisted metrology experiments also allow to investigate internal properties of biologically relevant peptides or even small proteins. However, the challenge is in building sources yielding intact, stable, intense and focused molecular beams, as well as in detecting them with high efficiency.
In this work I describe the implementation and characterization of different techniques for the generation of biomolecular as well as nanoparticle beams. Among these methods, laser-induced acoustic desorption (LIAD) of biodyes produces intact and slowest (<10 m/s) molecules. We demonstrate successful evaporation of functionalised peptides up to 1265 amu and quasi-continuous volatilization of massive perfluoroalkylated silver nanoparticles exceeding 10^5 amu. We show that functionalised polypeptides with 30 amino acids and a mass of more than 12 kamu can be desorbed into a supersonic expansion jet and detected via subsequent photoionization. Finally, I discuss the advantages and disadvantages of these beam generation techniques with respect to a possible implementation in matter-wave interferometers.