Towards trapping and cooling for quantum optics with massive clusters and molecules

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The generation of cold samples of neutral, large molecules and very massive metal clusters in the gas phase has recently become an important challenge for experiments on the foundations of physics such as matter wave interferometry and quantum assisted metrology. We propose the use of a cryogenic, buffer-gas loaded ion trap in combination with a cluster source and the subsequent neutralization by photodetachment to produce a neutral, cold cloud of massive clusters.

Experimental proposal

For future experiments in the field of quantum optics with large molecules slow and internally cold particles are necessary. As standard effusive sources do not provide the high beam qualities needed, we propose the following experimental steps for the creation of neutral molecular beams:

Simulation results

To establish the important ion trap parameters as well as to observe the effect of trapping and cooling the ion beam, simulations were performed using SIMION 8.

The decrease of the ion cloud's phase-space inside the currently used trap geometry appears feasible.



ion trap set-up: cools particles



M. Karas and F. Hillenkamp, Anal. Chem. 60, 2299 (1988). E. Reiger, L. Hackermüller, M. Berninger and M. Arndt, Opt. Comm. 264, 326 (2006).