From rare gas to hydrogen-bonded clusters: Size distributions of supersonic beams from a pulsed valve using the titration technique

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Synopsis We present recent improvements and characterizations of a versatile pulsed valve, which can produce supersonic gas pulses down to 20 μs duration at repetition rates of several hundred Hz. Cluster size distributions are measured by the so called titration technique, which we applied to argon, water, and ammonia clusters.

Pulsed valves offer many advantages over continuous beam sources such as higher beam densities and reduced gas load. Recently, we developed a pulsed valve in collaboration with UBC, Vancouver, which produces supersonic gas pulses down to 20 μs duration at repetition rates up to several hundred Hz. The pulsed-valve driver can be adjusted for optimal voltage amplitude, duration and repetition rate.

Figure 1. Home-built control unit for adjusting the parameters (pulse length, voltage and repetition rate) of the CRUCS valve.

Moreover we established different versions of the valve to accomodate different needs, such as improved heat conductance, or chemical resistance. The overall design and geometry of the valve is retained, making it versatile to produce rare-gas and even hydrogen-bonded clusters.

Additionally, cryogenic cooling of the valve can be utilized to produce helium nanodroplets. To estimate the cluster size distribution, we use a titration technique [1], which has accurately determined cluster sizes of continuous supersonic beams. Here, we report on a systematic study of cluster size distributions by varying expansion parameters. The technique has been applied to argon, ammonia, and water clusters, and the results are compared to models of Hagena [2] and Bobbert [3], respectively.

Figure 2. Front and Side View of the CRUCS Valve with Visualisation of size

References

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[3] C. Bobbert, S. Schütte, C. Steinbach, U. Buck 2002 *Eur. Phys. J. D* **19** 183-192

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