

Resistive Glass Drift Tube Used to Inject Externally Formed Ions into a Submillimeter Ion Trap

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The Oak Ridge National Laboratory mass spectrometry program¹ has pioneered the use of ion trap mass spectrometry for analysis of a wide variety of species, ranging from atmospheric gases to large biomolecules.² The ion storage capability permits ion reactions to be employed, yielding additional information about the nature of the sample and reducing false positives. The principal difference in the way various samples are analyzed is in the method of sample introduction and ionization. Our aim is to further develop a flexible hand-held mass spectrometer coupled to ion mobility spectrometry to be capable of detection and analysis of multiple threats, from gases, liquid samples, and airborne particles. The diverse nature of the samples can be accommodated by an instrument with different plug-and-play inlet systems operating with an ion trap array mass analyzer/detector. Examples of potential inlet systems used with laboratory ion trap mass spectrometers include electrospray inlets for proteins and other biomolecules, membrane inlets for volatile organic compounds, direct sampling of atmospheric samples, particle inlet systems for mass analysis of airborne particles, and atmospheric pressure chemical ionization of molecules that readily form negative ions.

Because of the difficulty to trap translationally hot ions in small ion traps, a need for a method to kinetically cool the ions is employed to inject ions externally into a 1mm cylindrical ion trap. Collisions with the neutral buffer gas is a well employed method for cooling ions; however it is not often used in controlling kinetic energy profiles. Because we will need a

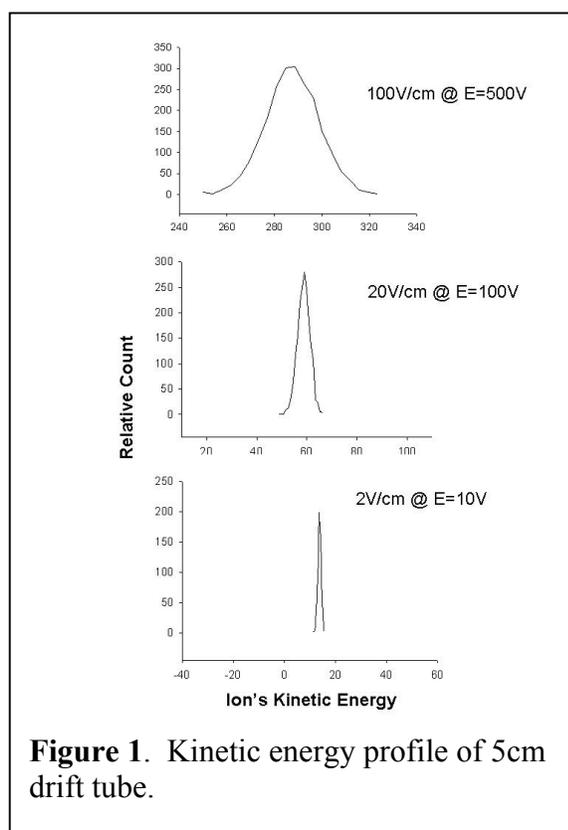


Figure 1. Kinetic energy profile of 5cm drift tube.

¹ McLuckey, S.A. et al. "Mass Spectrometry at Oak Ridge National Laboratory", *Rapid Commun. Mass Spectrom.*, **10**, 253-398, (1998).

² Moxom, J.; Verbeck, G.F.; Whitten, W.B.; Ramsey, J.M., "Field Portable Cylindrical Ion Trap Mass Spectrometer", 2004, *Rev. Sci. Instr.*, in progress; J. Moxom, P. T. A. Reilly, W. B. Whitten, and J. M. Ramsey, "Sample pressure effects in a micro ion trap mass spectrometer", *Rapid Commun. Mass Spectrom.* **18**, 721-723 (2004); J. Moxom, P. T. A. Reilly, W. B. Whitten and J. M. Ramsey, "Analysis of volatile organic compounds in air with a micro ion trap mass analyzer", *Anal. Chem.* **75**, 3739-3743 (2003).

vacuum of 0.1 milliTorr or higher for operation of the ion trap, the drift tube will be used at pressures about 1 Torr. This leads to a large mean free path, increasing the diffusion of the ions, and producing poor separation resolution, but allows for discrete translational energy profiles (Figure 1).

We describe here how a drift tube can be used to control the translational kinetic energy of ions and control the energy distribution, so as to couple with a submillimeter ion trap mass spectrometer. We can control the translational energy by varying the pressure and the applied field to the drift tube. We have shown that discrete translational energy profiles can be achieved using a resistive-glass drift tube.

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