Here we introduce the commonly referenced variables which will be discussed in further detail.

1 Variables in IMS

The variables which will be introduced can be grouped into three distinct categories: instrument-state, mass, and measured quantities.

1.1 Instrument-State Variables: (L, V, E) and (N, T, P)

L is the length of the drift space and V is the voltage drop across the drift space. The electric field for a traditional linear drift tube is constant and equivalent to $E = \frac{V}{L}$. N is the number density of the drift gas. If the drift gas is considered ideal then $N = N_0 \cdot \dfrac{P \cdot T_0}{P_0 \cdot T}$, where $T_0 = 273.15$ K, $P_0 = 760$ torr, and $N_0 = 2.687 \cdot 10^{19}\text{cm}^3$ (the number density of an ideal gas at STP).

1.2 Mass Parameters: $(m, M, q = Ze)$

m and M correspond to the ion and drift gas masses respectively and q corresponds to the charge of the ion.

1.3 Measured Quantities: (t_d, v_d)

t_d is the drift time required for an ion swarm to traverse the length of the drift space L. This terminal velocity is called the drift velocity (v_d). The drift velocity of a given ion population is equivalent to $v_d = \dfrac{L}{t_d}$ where the length is often predetermined and the drift time is measured.

2 Ion Mobility (K)

The mobility (K) of an ion swarm is important and related to the drift velocity of an ion where $K = \frac{v_d}{E}$. The central observation is that if an electric field (E) is applied to ions dispersed in gas, the ions move with a characteristic average terminal velocity (v_d) in the direction of the field. The mobility K is defined as the ratio of the velocity to the field strength and is traditionally reported in units of $\text{cm}^2\text{V}^{-1}\text{sec}^{-1}$.

3 Five Underlying Assumptions of IMS

1. $n << N$: Ions have a much lower number density then neutrals (additionally, mutual coulombic repulsion of ions is unimportant, ion-ion collisions unimpportant, and each neutral encounters 0 or 1 ion during a mobility experiment).

2. Collisions are instantaneous.

3. Three-body collisions are rare.

4. Ions reach a terminal velocity defined by $v_d = KE$ (vacuum and "low" pressures excluded from consideration).

5. Ion-neutral reactions and clustering may be ignored (in real experiments clustering is common).