Capillary Vs Nozzle

• Generally sonic nozzle have higher molecular intensity.
• Sonic nozzle has a significantly narrow velocity distribution.
• Both capillary and sonic nozzle can have the same angular distribution.
  – Capillary depends on its length and diameter.
  – Sonic Nozzle depends its diameter and the distance from a skimmer.

Gas dynamics exiting capillary is molecular flow, while exiting a sonic nozzle is compressible flow.
For sonic nozzle, in literature main characteristics is the Mach number \((M=u/a)\). Where \(u\) is the flow rate and \(a=\sqrt{1.4*RT}\) is the speed of sound.

Atomic Density exiting nozzle is proportional to the Mach Number.

For maximum density circular skimmer would have to be in the centerline of flow and in the Zone of silence Mach.

G. Scoles, Atomic and Molecular Beam Methods
Nozzle Experimental Data

Mach number vs ratio of distance between nozzle and skimmer to nozzle inlet diameter

Mach number for maximum beam intensities for given source pressure

Beam intensity as a function of source pressure

L. Valyi, Atom and Ion Sources
Nozzle-Skimmer Distance

Nozzle Diameter 3.88um
Skimmer Inner Diameter: 200um

M Barret al 2012 Meas. Sci. Technol. 23 105901
Discussion

- Time evolution of the system
- Different Nozzles will have different distribution
- Due to nozzle higher intensity, multiple chamber stages required
- MolFlow doesn’t account for compressible flow