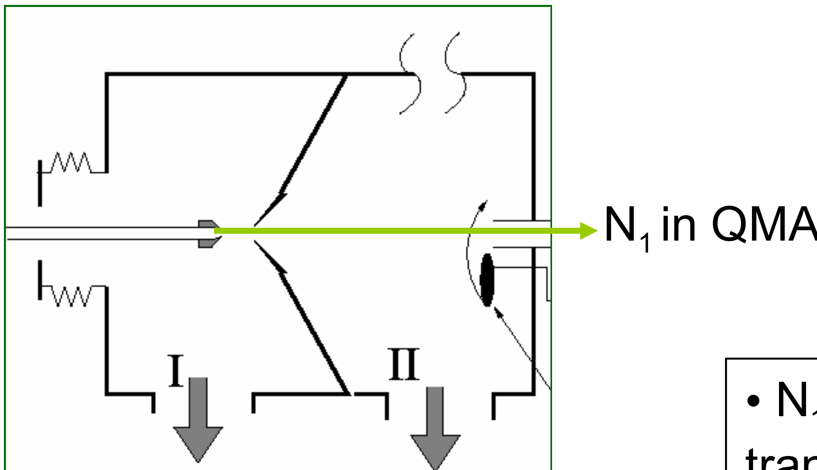
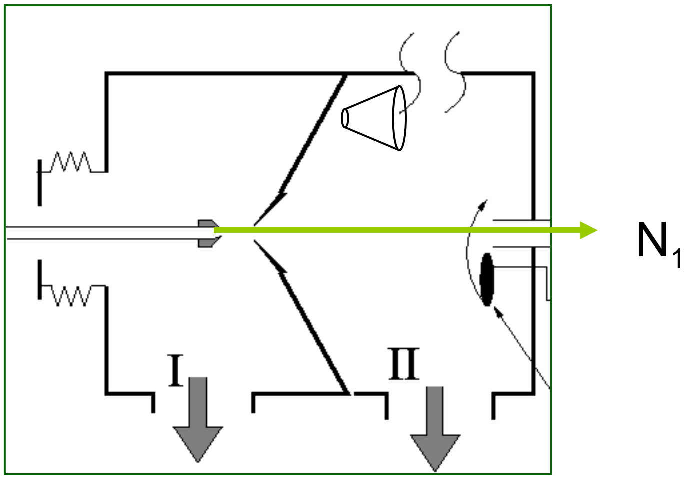
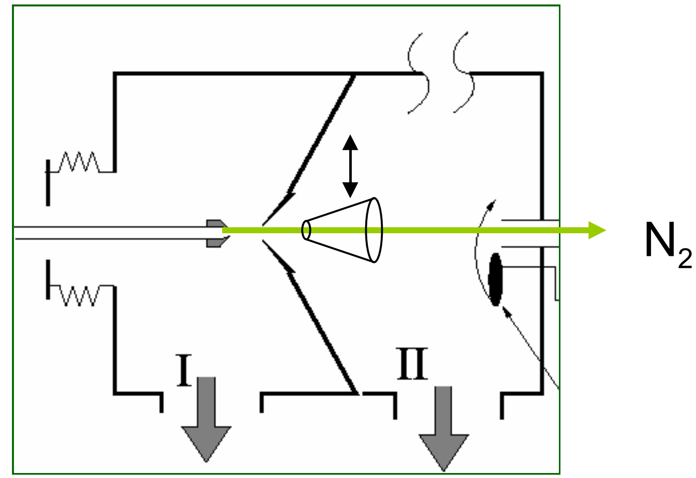


$$N_1 = N_0 \exp\left[-\frac{\sigma}{kT}\int \mathrm{pdl}\right]$$

- N_1 is the beam density integrated in the transverse plane (units particles/m)
- QMA signal is proportional to N1
- p is pressure in chamber 2
- T is temperature of rest gas
- integral is from skimmer to chamber exit
- N_0 is the beam density at the skimmer

Use a cell to create a pressure bump from particles lost to IBS





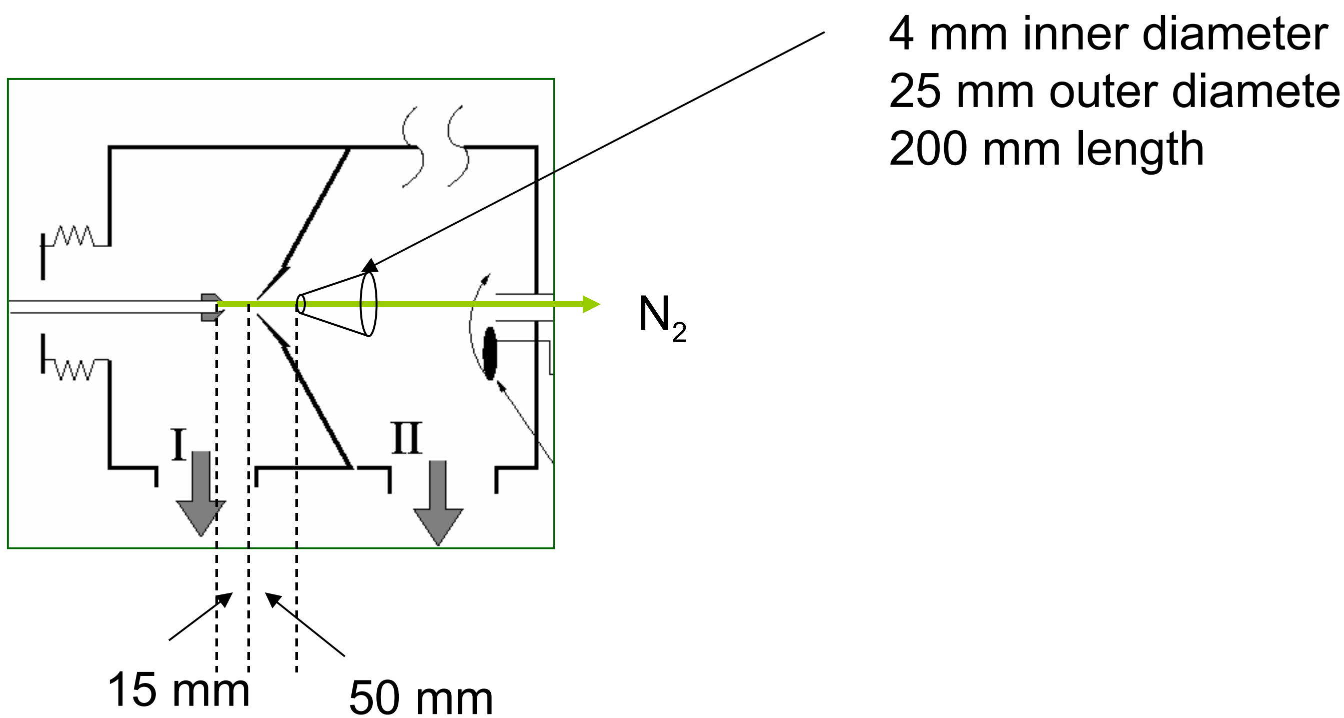
$$\int \mathrm{pdl} = p_0 L$$

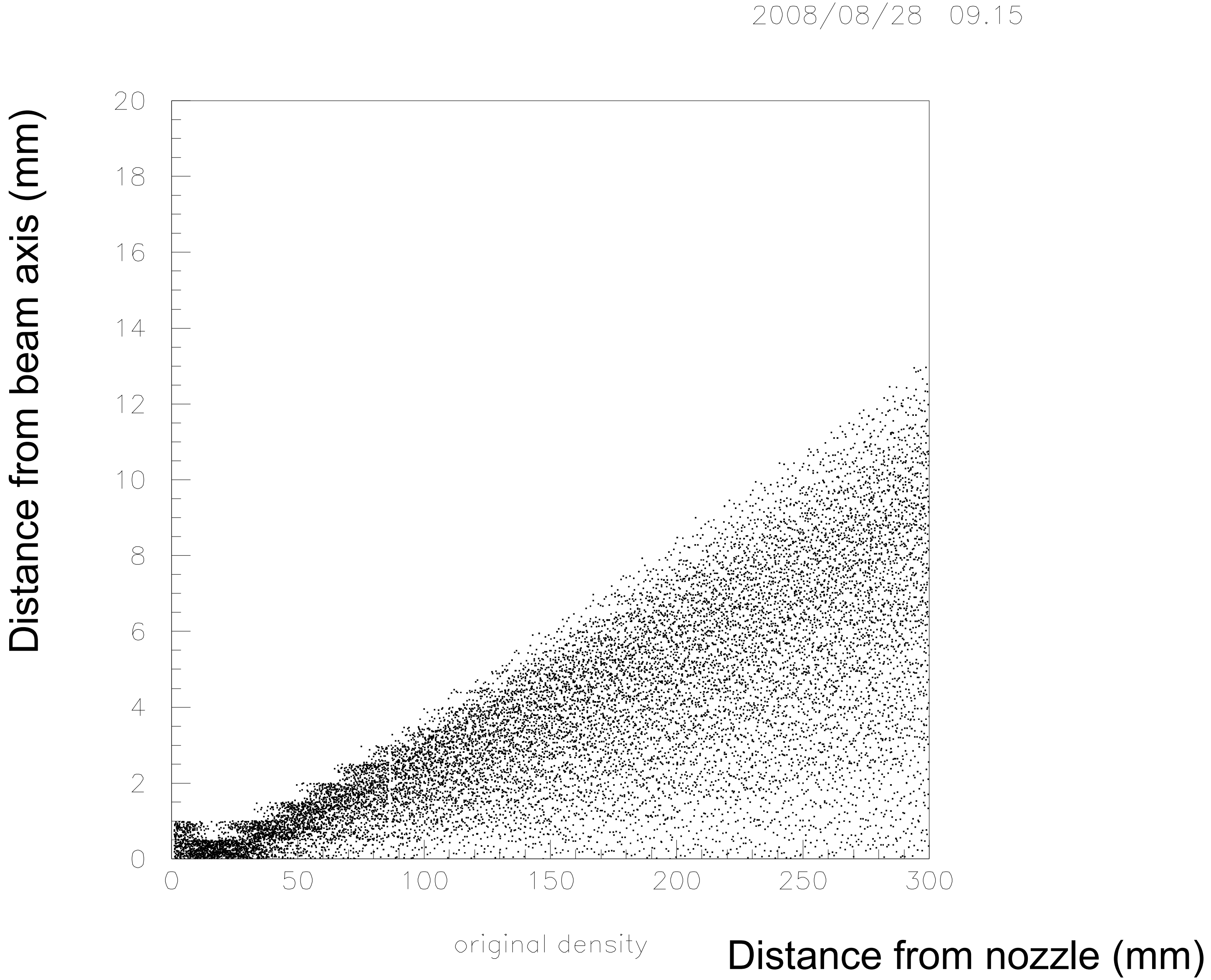
$$\int \mathrm{pdl} = p_0 L + \frac{Q_{IBS}}{2C_{cell}} L_{cell}$$

$$\frac{N_2}{N_1} = \exp\left[-\frac{\sigma}{kT} \frac{Q_{IBS}}{2C_{cell}} L_{cell} \right]$$

- Q_{IBS} is the flow, in atoms per second, of IBS scattered atoms, assumed to originate at the cell center
- C is the conductance of the cell from the center outward. (sum of two halves)
- The pressure bump is triangular, thus the factor of 1/2

Design specs





2008/08/28 09.15
Distance from beam axis (mm)
0
2
4
6
8
10
12
14
16
18
20
0
50
100
150
200
250
300
original density
Distance from nozzle (mm)

$$\frac{N_2}{N_1} = \exp\left[-\frac{\sigma}{kT} \frac{Q_{\mathrm{IBS}}}{2C_{\mathrm{cell}}} L_{\mathrm{cell}} \right]$$

$$\sigma = \ln\left(\frac{N_1}{N_2}\right)\left(\frac{2kTC_{\mathrm{cell}}}{Q_{\mathrm{IBS}} L_{\mathrm{cell}}}\right)$$

Peaking factor 1.5 (inside Q_{IBS})
C_{cell}=32.75 l/s
$\Delta v/v$=0.30 (beam temperature)
σ=100 A^2
T=300 K
L_{cell}=0.20 m
Q_{IBS}=1.30x10^{-4} mbar l/s
Input flow = 2.5 mbar l/s
$\Rightarrow$ N2/N1=0.990 (for molecular beam)

C_{cell}=16.07 l/s
L_{cell}=0.10 m
Q_{IBS}=1.22x10^{-4} mbar l/s
$\Rightarrow$ N2/N1=0.991

- Cell is outside the beam envelope – no wall collisions in the absence of IBS
- Q_{IBS} calculated with estimates in talk from SPIN2004.
- Must use 1 mm skimmer
- Cell is 4-25 mm diameter and 200 mm long