1 Gas Flow in The CDC

We start by estimating the voloume of the CDC. The chamber is roughly 1.5 m long plus another 0.15 m in the gas plenums. The radial shape is annular with an inner radius of 10 cm and and outer radius of 58 cm. Putting this all together, we arrive at a total volume as follows:

$$\begin{aligned} V_{cdc} &= (1.5\,m)\cdot\pi\left((0.58\,m)^2-(0.10\,m)^2\right) \\ V_{cdc} &\approx 1.7\,\mathrm{m}^3\,. \end{aligned}$$

We will then assume that the maximum gas flow is three gas changes per day. This leads to a total volume of about 5.1 m^3 per day. This then leads to a flow rate of

$$\begin{aligned} \frac{dV}{dt} &= 3.2\,\mathrm{liter/min} \\ \frac{dV}{dt} &= 53\,\mathrm{cm}^3/\mathrm{s} \end{aligned}$$

If this gas needs to flow through a $\frac{1}{4}$" ID gas tube, then we estimate that the cross sectional area of the tube is $0.3\,\mathrm{cm}^2$, which yields a gas flow speed of about 150 cm/s. Assuming that the gas is coming in through four such tubes, we get a flow rate of 37.5 cm/s.

2 The CLAS Region I Chamber

Each of the six sector of the CLAS region 1 chamber is fed with two 0.25 inch OD stainless steel tubes. Taken together, they have about the same cross sectional area as the tubes above. The volume of one of the region one chamber is

$$\begin{aligned} V_{RI} &\approx (2\,m)\times(1\,m)\times(0.3\,m) \\ V_{RI} &\approx 0.67\,m^3 \end{aligned}$$

or about 40% of the volume of the CDC. Nominally, we would then want four times the gas flow through the CDC that we have through region I. This would lead one to assume that four tubes should be ok for filling the chamber. However, we would also note that there is likely more resistance to the gas flow in the CDC than in region I.

Tube ID	Area	Gas Speed
$\frac{1}{4}$"	0.3 cm^2	150 cm/s
$\frac{1}{2}$"	1.3 cm^2	42 cm/s
1"	5.1 cm^2	10 cm/s

Table 1: A table showing the cross sectional area and flow speed at three gas changes per day for various sized tubes.