RGH: CLAS12 WITH A TRANSVERSELY POLARIZED TARGET

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1. Luminosity of CLAS12

The luminosity of the CLAS12 detector can be calculated by:

$$L = N_e \times N_p = \left(\frac{1}{q_e}\right) INl\rho$$

N_e and N_p is the the number of electrons and protons, respectively. I is the current of the CLAS12 detector. The density and length of the target is represented by ρ and l, respectively. The fraction $1/q_e$ is the inverse of the charge of an electron. $N = \frac{n_p N_A}{M}$ where n_p is the number of protons, N_A is Avogadro's constant, and M is the molar mass of the target. This equation can be rearranged to find the desired current for running the CLAS12 at the correct luminosity:

$$I = \frac{L \times q_e}{Nl\rho}$$

The current is set by inside the gcard used to set the geometry of the CLAS12 detector::
<option name="LUMI_EVENT" value="n_e, time window, bunch time" />
n_e is the number of electrons per event. The time window to observe occupancies inside the Drift Chamber subsystem of the CLAS12 detector is 250 ns. Once the desired current is known we can find the number of electrons per event:

$$I = \frac{n_e \times q_e}{timewindow}$$
$$n_e = \frac{I \times \text{time window}}{q_e}$$

However, the atomic packing factor, APF, needs to accounted for:

$$APF = \frac{N_{\text{particles}} \times V_{\text{particle}}}{V_{\text{unit cell}}} = 0.68$$

Therefore, the actual number of electrons in LUMI_EVENT needed to run the CLAS12 detector at the correct luminosity is:

$$n_e = n_e + 0.68 n_e.$$

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