Optimal high voltages for the Neolith-s gas counter

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Abstract

From a consideration of the stopping power of protons in an Ar gas environment, optimal high voltage settings of Neolith-s are examined.

1 Proton stopping power in Ar

Figure 1 shows the proton stopping power in Ar. Numerical values at specific proton energies are shown in Table 1.

It has been observed for Neolith-s that to double the pulse height one needs to add around 100 V more high voltages [1]. Multiplication factor F of the cathode/potential pulse height can thus be related to the high voltage variation ΔV as

$$F = 2^{-\frac{\Delta V}{100}}. \tag{1}$$

Here ΔV is practically taken as the deviation from the plateau voltage for minimum ionizing cosmic rays.

If the pulse height of the signal from the cathode pads and potential wires is proportional to the deposited charge, one can calculate the optimal voltage deviation ΔV from the reference value, by substituting the left side of Eq.(1) by the ratio of the deposited charge for the proton at an interested energy, $Q(E)$, to that of the reference energy (i.e., at the MIP energy), $Q(\mathrm{MIP})$,

$$\frac{Q(E)}{Q(\mathrm{MIP})} = 2^{-\frac{\Delta V}{100}}. \tag{2}$$

By solving this equation one obtains

$$-\Delta V = 100 \cdot \frac{\ln\{Q(E)/Q(\mathrm{MIP})\}}{\ln 2}. \tag{3}$$

On the other hand, if the pulse height is proportional to the square root of the deposited charge, then we obtain the following.

$$-\Delta V = \frac{1}{2} \cdot 100 \cdot \frac{\ln\{Q(E)/Q(\mathrm{MIP})\}}{\ln 2}. \tag{4}$$

The $-\Delta V$ values estimated using the above two assumptions for the 200 and 20 MeV protons are summarized in Table 2.

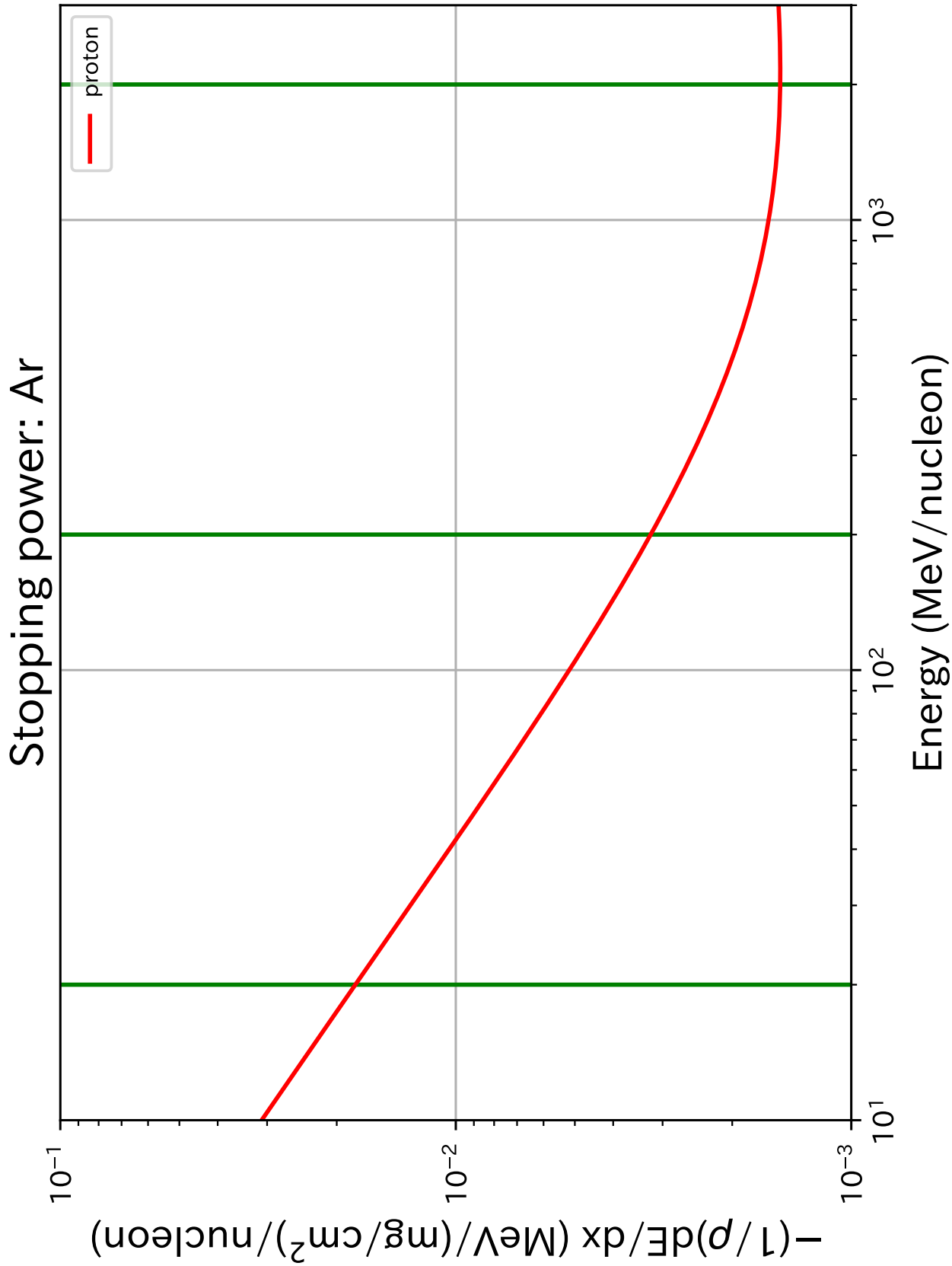

Figure 1: Stopping power of protons in an Ar environment.

Table 1: Proton stopping powers at specific proton energies.

Energy (MeV/u)	Q (MeV/(mg/cm^2)/nucleon)
2000.0	0.001512
200.0	0.003215
20.0	0.017940

Table 2: Variation of the optimal high voltage from the reference value associated with the MIP particles.

Energy (MeV/u)	$-\Delta V$ (P.H.$\propto$Q) (V)	$-\Delta V$ (P.H.$\propto\sqrt{\text{Q}}$) (V)
200.0	108	54
20.0	357	178

References

[1] Neolith first prototype efficiency curves (Neolith-ss@ISCT).