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Particle identification using SSNTD

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Some time ago, we derived an equation on which particle identification by SSNTD may be based (Ganguly and Syam 1987). This equation is

$$\frac{2(x_2-x_1)}{\left[\frac{1}{\left(\frac{dE}{dx}\right)_1^2}-\frac{1}{\left(\frac{dE}{dx}\right)_2^2}\right]}=kMZ^2 \qquad (1)$$

In this equation x_1 and x_2 ($> x_1$) are depths below the point of entry of the particle into the detector ; $\left(\frac{dE}{dx}\right)_1$, $\left(\frac{dE}{dx}\right)_2$ being the corresponding rates of loss of energy. The success of the method depends on the accuracy of the measurement of V_t, the tract etch rate, at different depths ; for V_t and $\left(\frac{dE}{dx}\right)$ are related through, e.g., an equation (Yadav *et al* 1986) of the form (which is valid for CR-39) :

$$V_t/V_0=1+(5.672\times10^{-4})\left(\frac{dE}{dx}\right)+(1.22\times10^{-10})\left(\frac{dE}{dx}\right)^{2.7}$$
$$+(7.56\times10^{-18})\left(\frac{dE}{dx}\right)^{3.7} \qquad (2)$$

wherein $\frac{dE}{dx}$ is expressed in MeV/cm.

Unfortunately for tracks ending in the detector it is quite difficult (if not impossible) to measure V_t with sufficient accuracy, at least from the shape of the etch pit (Ganguly and Syam 1987). An alternative procedure would be to measure V_t directly from the rate at which the depth of the pit increases. But this method can hardly be successful (because of the problem of track recognition) without an arrangement for "in situ" etching.

These difficulties are not present if the particle passes straight through the SSNTD. If the track lies perpendicular to the detector surface (and the track density is relatively low), the necessary information about V_t at two different depths may be obtained from the "front" and the "back" side track-etch-rates of the same track.

Thus if we take a CR-39 detector 100 μ thick, and allow it to be etched for one hour, and if the resulting depths of the pit for a particular track on the "front" side and the "back" side be 10 μ and 15 μ respectively, then we can put $x_1 = 5\ \mu$, $x_2 = 92.5\ \mu$, $(V_t)_1 = 10\ \mu$/hr. and $(V_t)_2 = 15\ \mu$/hr. Using eqs. (1) and (2) we can then find MZ^2, whence the nature of the particle. Incidentally, for an α-particle the energy (E_α) required to punch through 100 μ of CR-39 is approximately 15 MeV (using range $R_\alpha \cong$ const. E_α^2). Thus a test of this idea can be made at the VECC, Calcutta.

References

Ganguly A K and Syam D 1987 *Proc. 5th Nat. Conf. on SSNTDs* (Calcutta) p 49
Yadav J S, Biswas S and Durgaprasad N 1986 *Nuclear Tracks* **12** 415