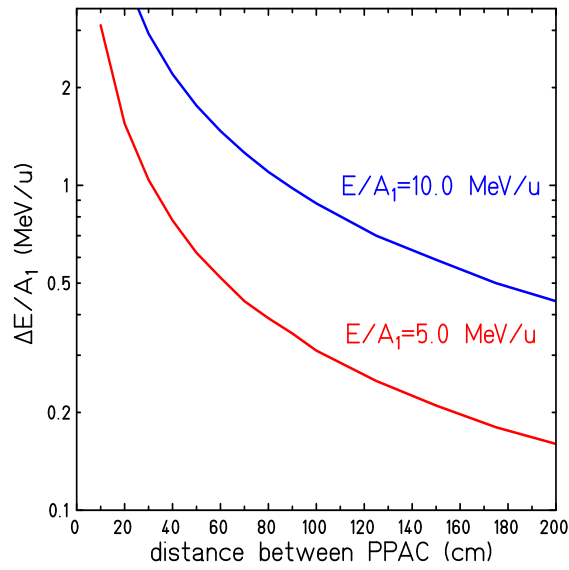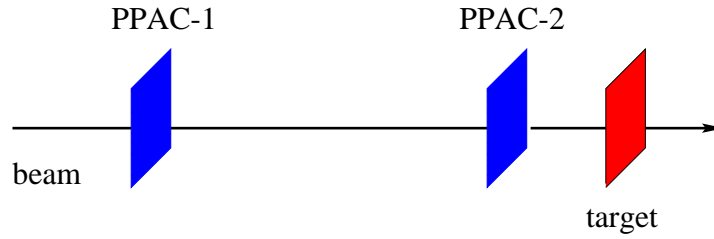# Beam Energy Measurement

Figure 1: For each projectile the beam energy is measured by two position-sensitive parallel plate counters (PPAC). The displayed results are calculated for a time resolution of $\triangle t = 1.ns$.

projectile velocity:

$$v = 1.39 * 10^9 * \sqrt{E/A_1} \quad (cm/s) \qquad with \qquad E/A_1 \quad (MeV/u)$$

time of flight measurement:

$$t_2 - t_1 = \frac{s_2 - s_1}{v} = 0.72 * \frac{s_2 - s_1}{\sqrt{E/A_1}} \quad (ns) \qquad with \qquad s_2 - s_1 \quad (cm)$$

beam energy:

$$E/A_1 = 0.52 * (\frac{s_2 - s_1}{t_2 - t_1})^2 \qquad with \qquad t_2 - t_1 \quad (ns)$$

accuracy of beam energy measurement:

$$\frac{\triangle E/A_1}{\triangle t} = -2 * 0.52 * \frac{(s_2 - s_1)^2}{(t_2 - t_1)^3} = -2 * E/A_1 * \frac{1}{t_2 - t_1} = -2.78 * \frac{(E/A_1)^{3/2}}{s_2 - s_1}$$