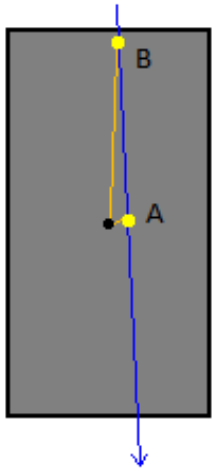
Ar-CO2 Drift Time and Lepton Pair Production

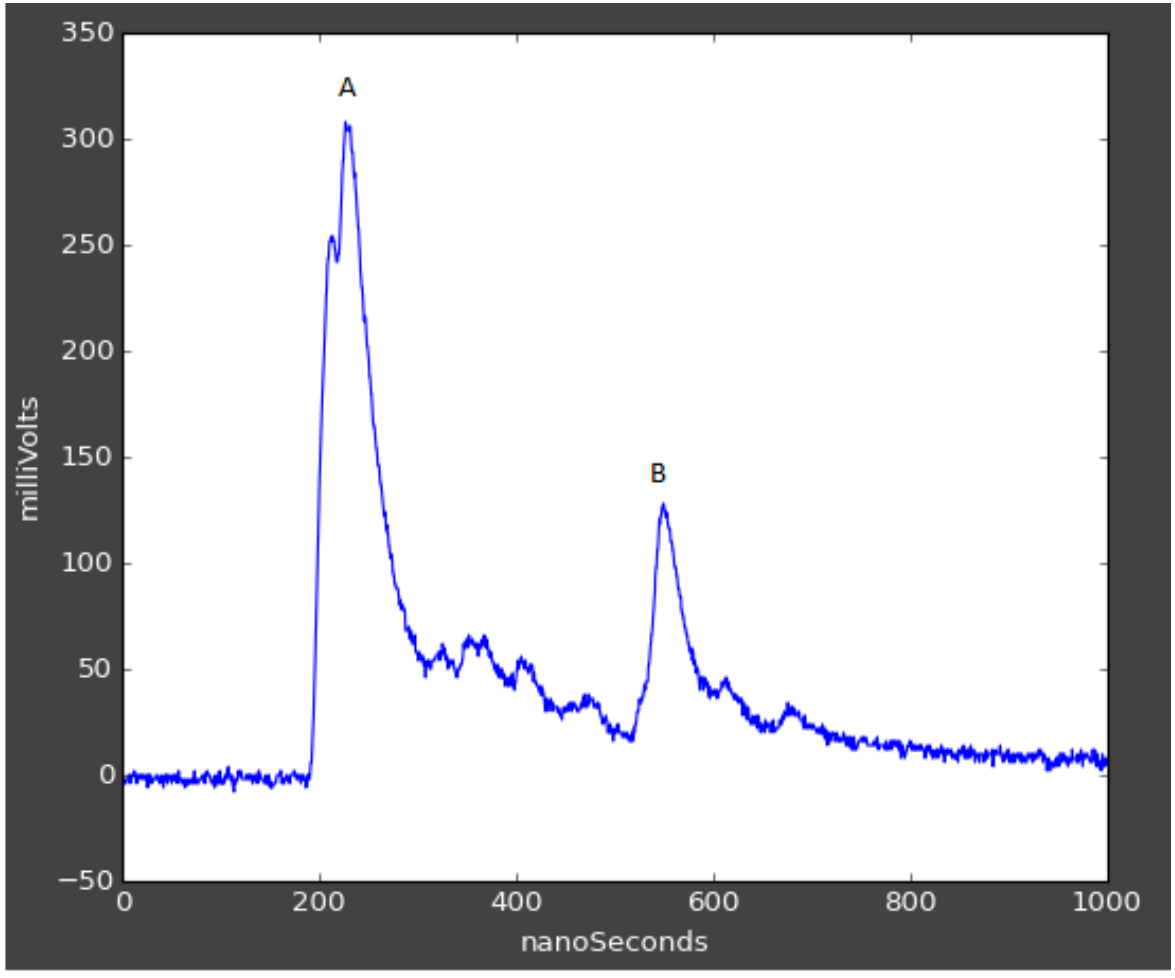
Michael Roberts

July 16, 2015

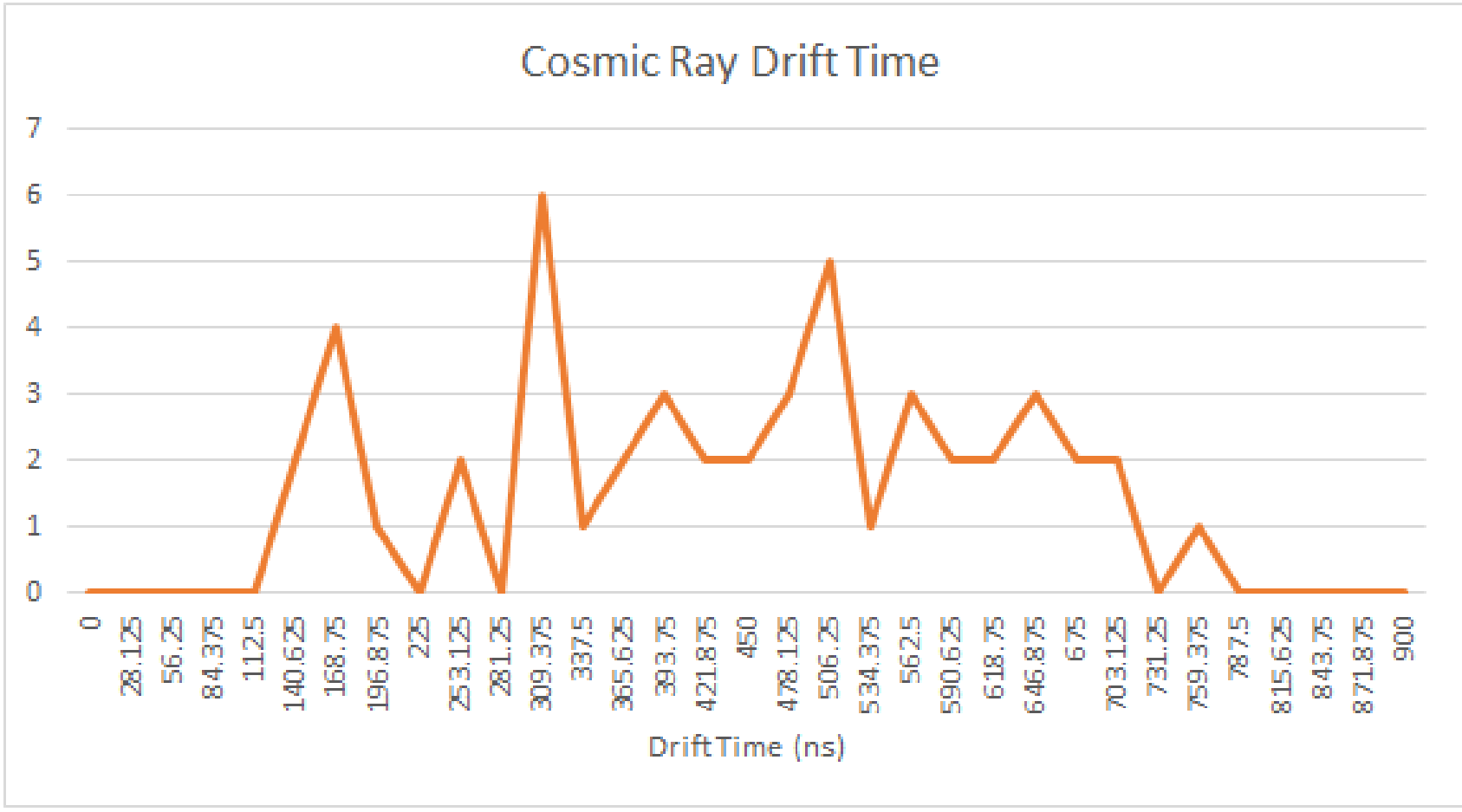
Drift Time

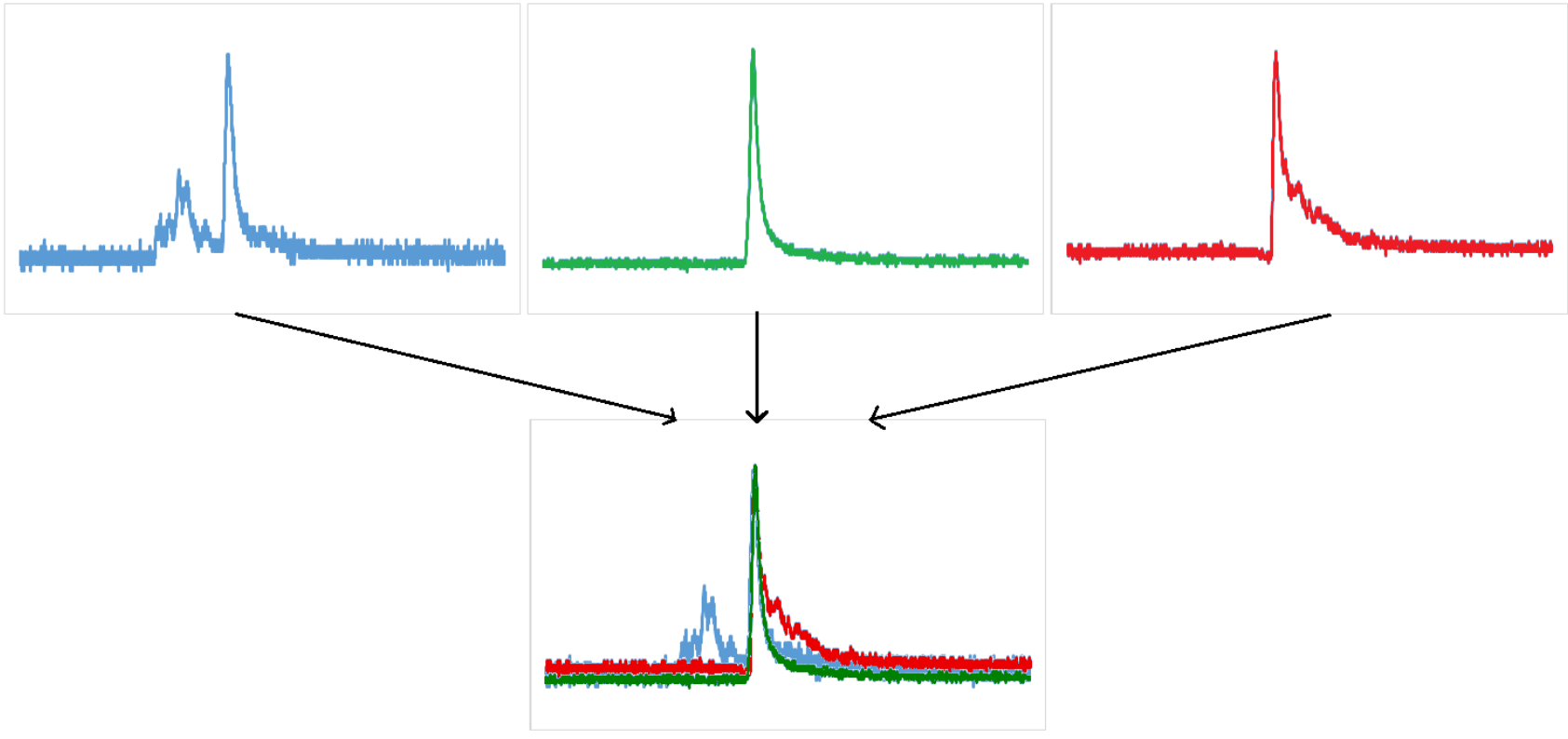


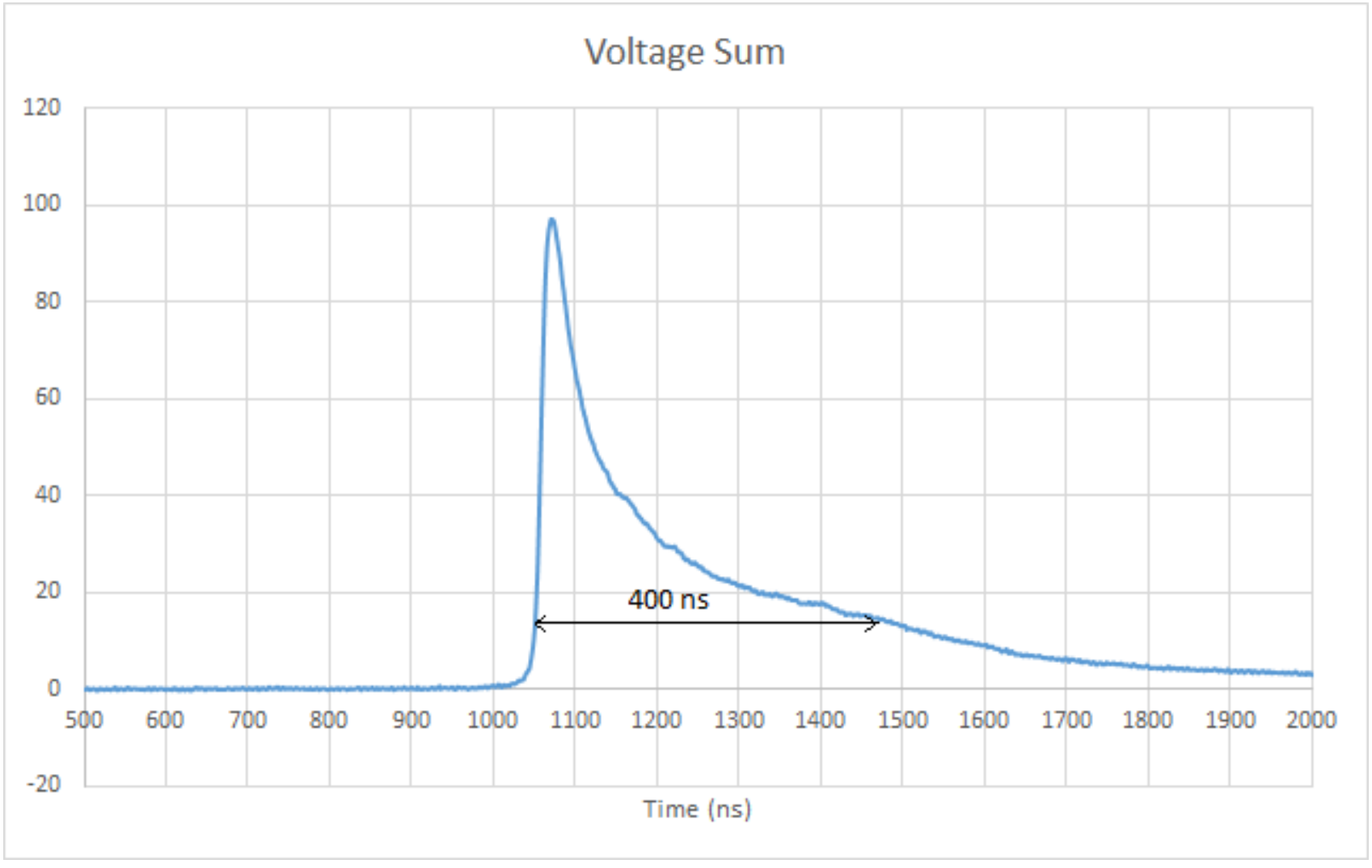
Cross section of one cell of detector



Typical cosmic ray signal


Cosmic Ray Drift Time
7
6
5
4
3
2
1
0
0
28.125
56.25
84.375
112.5
140.625
168.75
196.875
225
253.125
281.25
309.375
337.5
365.625
393.75
421.875
450
478.125
506.25
534.375
562.5
590.625
618.75
646.875
675
703.125
731.25
759.375
787.5
815.625
843.75
871.875
900
Drift Time (ns)




Voltage Sum
120
100
80
60
40
20
0
-20
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
400 ns
Time (ns)

Lepton Pair Production

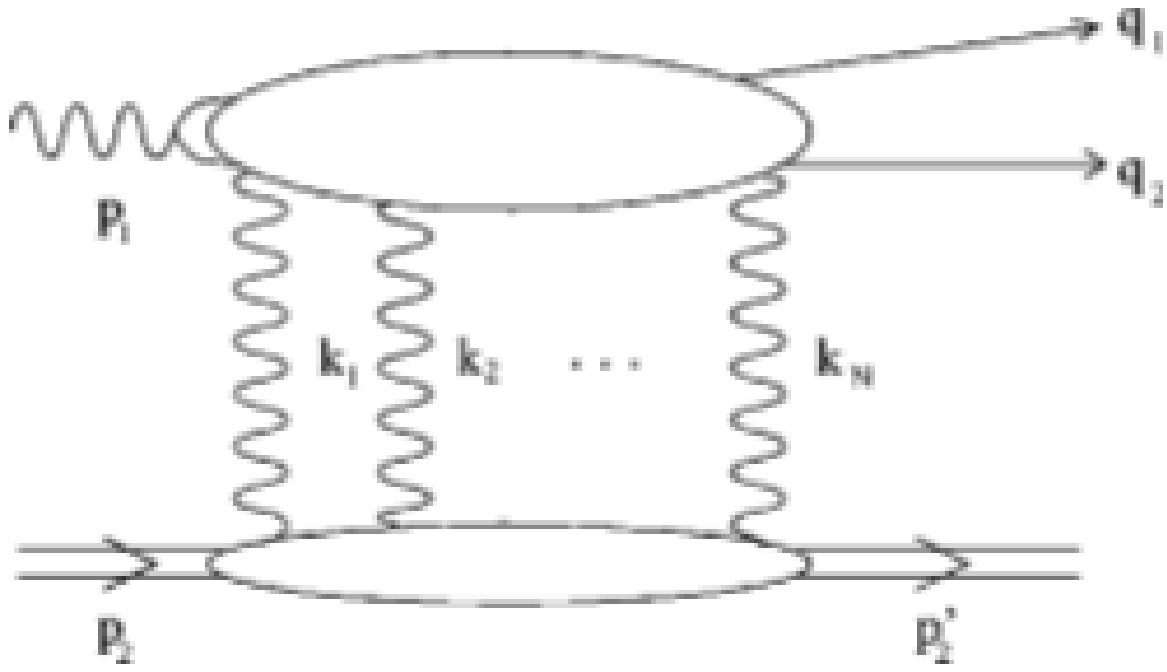


FIG. 1. A diagram with N photons, exchanged in the t channel. Diagrams of this type contribute to the leading asymptotic of lepton pair production by a high energy photon.

In the Moliere approximation of atomic form factor in the Tomas–Fermi model (we use it below) the expression for form factor is [11]

$$\frac{F(q^2)}{\vec{q}^2} = \frac{1 - F_A}{\vec{q}^2} = \sum_1^3 \frac{\alpha_i}{\mu_i^2 + \vec{q}^2}, \tag{12}$$

with $\alpha_1 = 0.1$; $\alpha_2 = 0.55$; $\alpha_3 = 0.35$ and $\mu_i = (mZ^{1/3})b_i$ with $b_1 = 6.0$; $b_2 = 1.2$; $b_3 = 0.3$. In this case, the analytic expressions can be obtained

$$\Phi(\vec{r}_1, \vec{r}_2) = 2\sum_1^3 \alpha_i \big[K_0\big(\mu_i|r_2|\big) - K_0\big(\mu_i|r_1|\big)\big]. \tag{13}$$

$$J_S(\vec{p}_1, \vec{p}_2) = \frac{i}{2v}\int \frac{d^2r_1\, d^2r_2}{(2\pi)^2} e^{-i\vec{p}_1\vec{r}_1 - i\vec{p}_2\vec{r}_2} K_0\big(m|\vec{r}_1 - \vec{r}_2|\big) v\big[e^{-iv\Phi(\vec{r}_1,\vec{r}_2)} - 1\big];$$

$$\vec{J}_T(\vec{p}_1, \vec{p}_2) = \frac{-1}{2v}\int \frac{d^2r_1\, d^2r_2}{(2\pi)^2} e^{-i\vec{p}_1\vec{r}_1 - i\vec{p}_2\vec{r}_2} \frac{m(\vec{r}_1 - \vec{r}_2)}{2|\vec{r}_1 - \vec{r}_2|} K_1\big(m|\vec{r}_1 - \vec{r}_2|\big)\big[e^{-iv\Phi(\vec{r}_1,\vec{r}_2)} - 1\big].$$