



A TABLETOP APPARATUS TO MEASURE THE MAGNETIC MOMENT OF THE MUON

D. Ely, D. Kroening, and M. Yuly
Department of Physics
Houghton College
One Willard Avenue
Houghton, NY 14744





Talk Outline

- Muon Characteristics and Formation
 - Experimental Apparatus
 - Theory
 - Electronics
 - Timing Calibration
 - Determined Values
- 



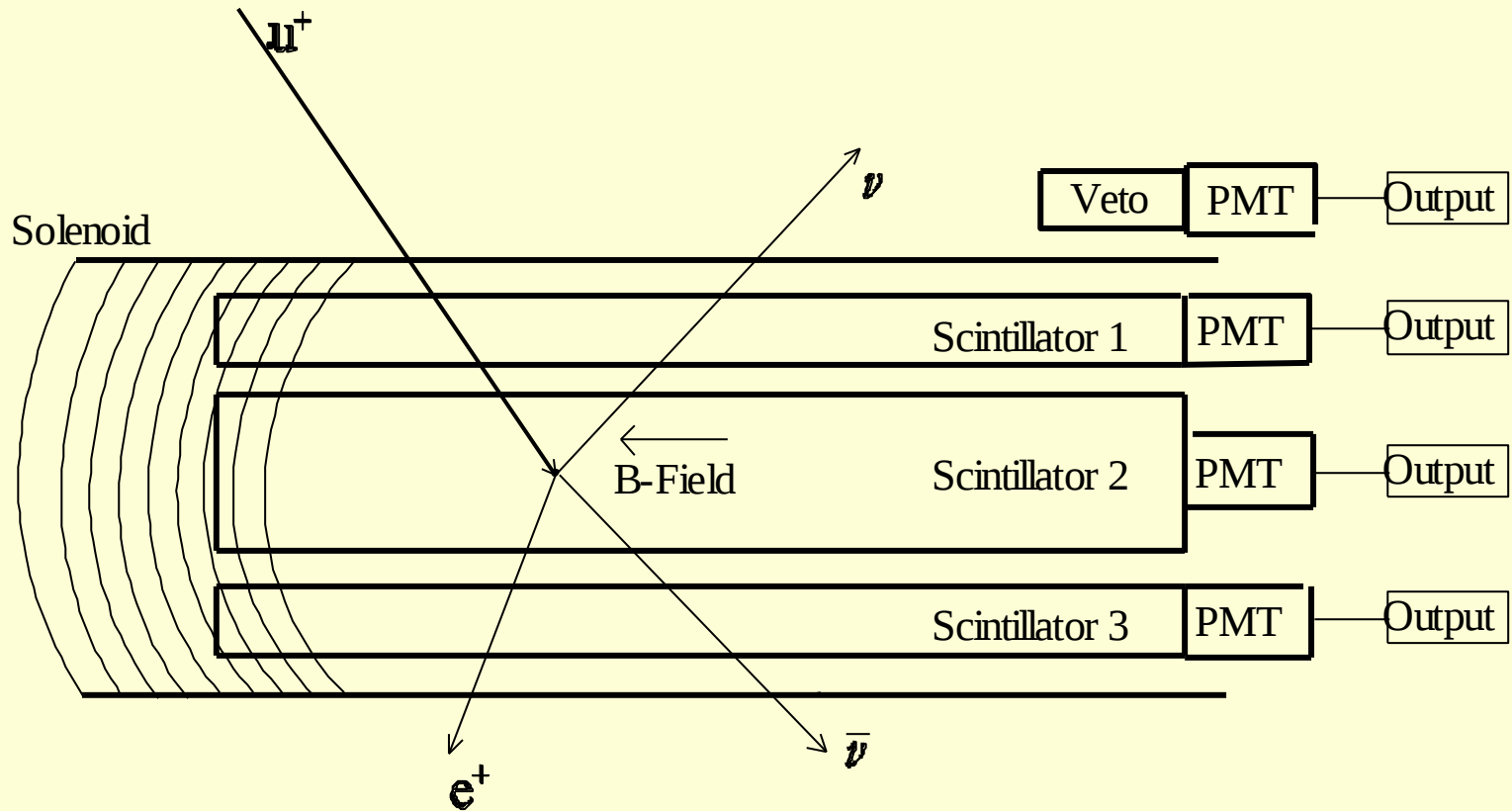
Characteristics of Cosmic Ray Muons

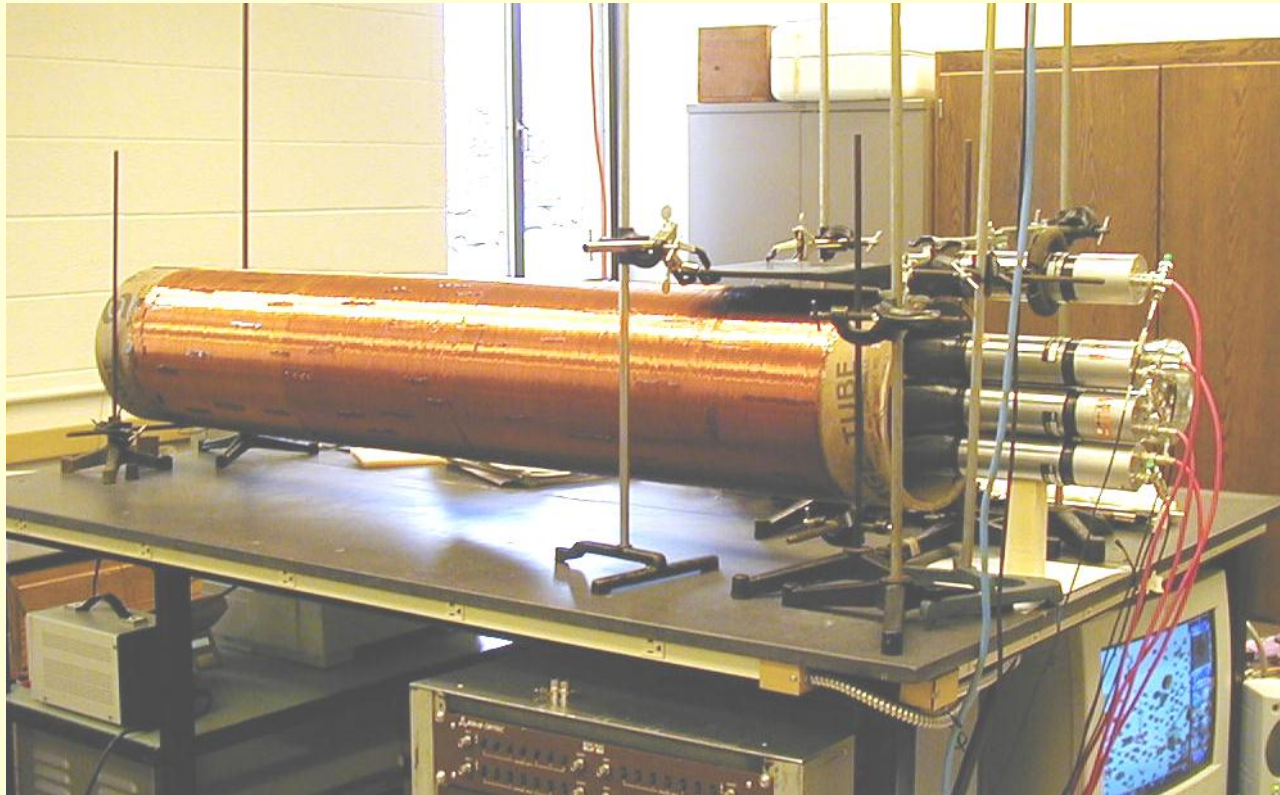
- Formed primarily from pion decay

$$\pi^{\pm} \rightarrow \mu^{\pm} + \nu$$

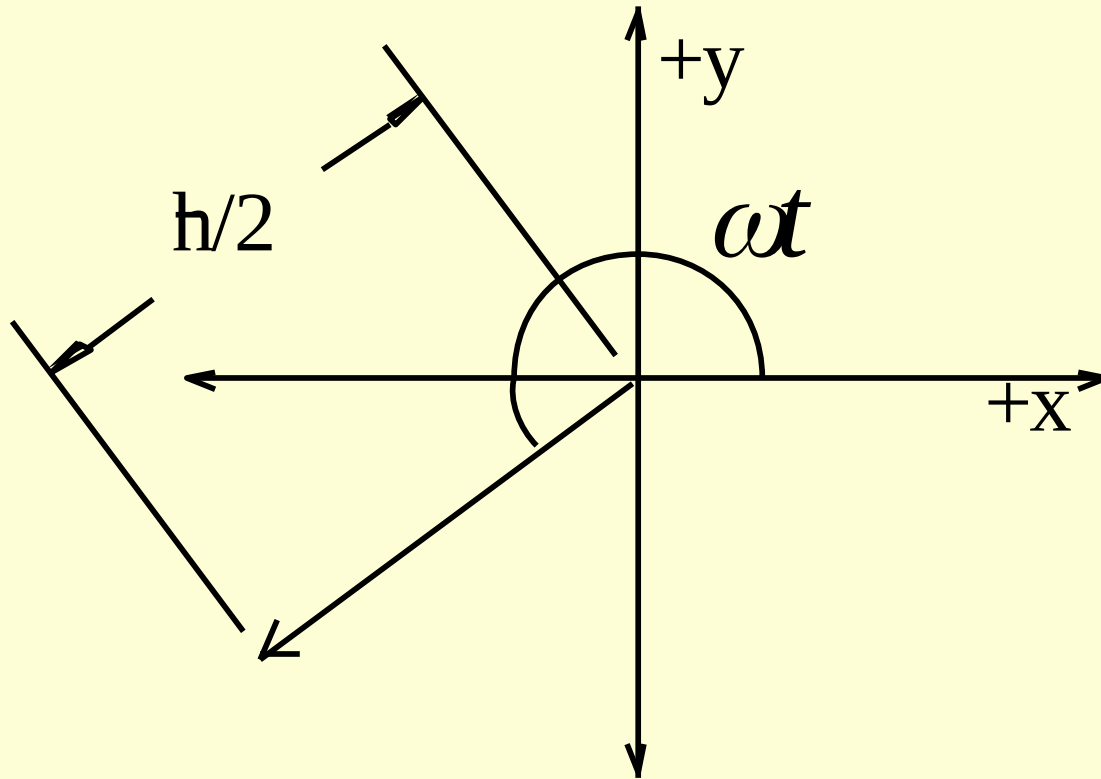
- Lepton $\rightarrow$ Spin- $1/2$ particle
 - $m_{\mu} = 105 \text{ MeV}/c^2$ (muon mass)
 - $\tau = 2.2 \text{ } \mu\text{s}$ (muon mean lifetime)
 - Muons decay via $\mu^{\pm} \rightarrow e^{\pm} + \nu + \bar{\nu}$
- 

Schematic Diagram of Scintillators





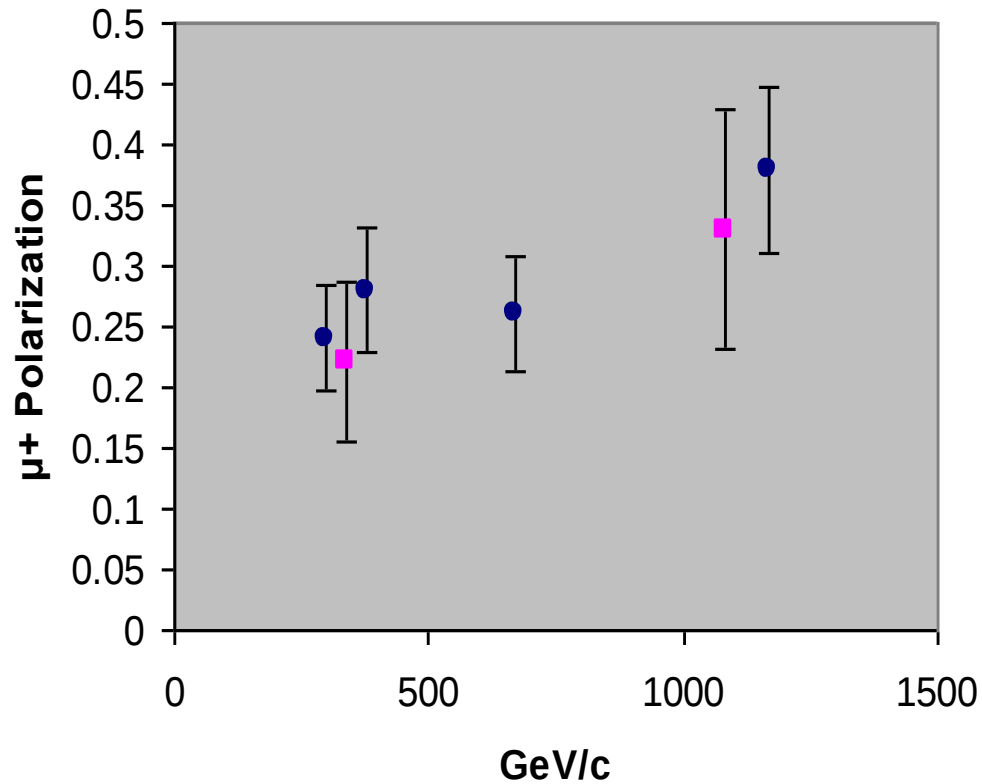
Muon Precession



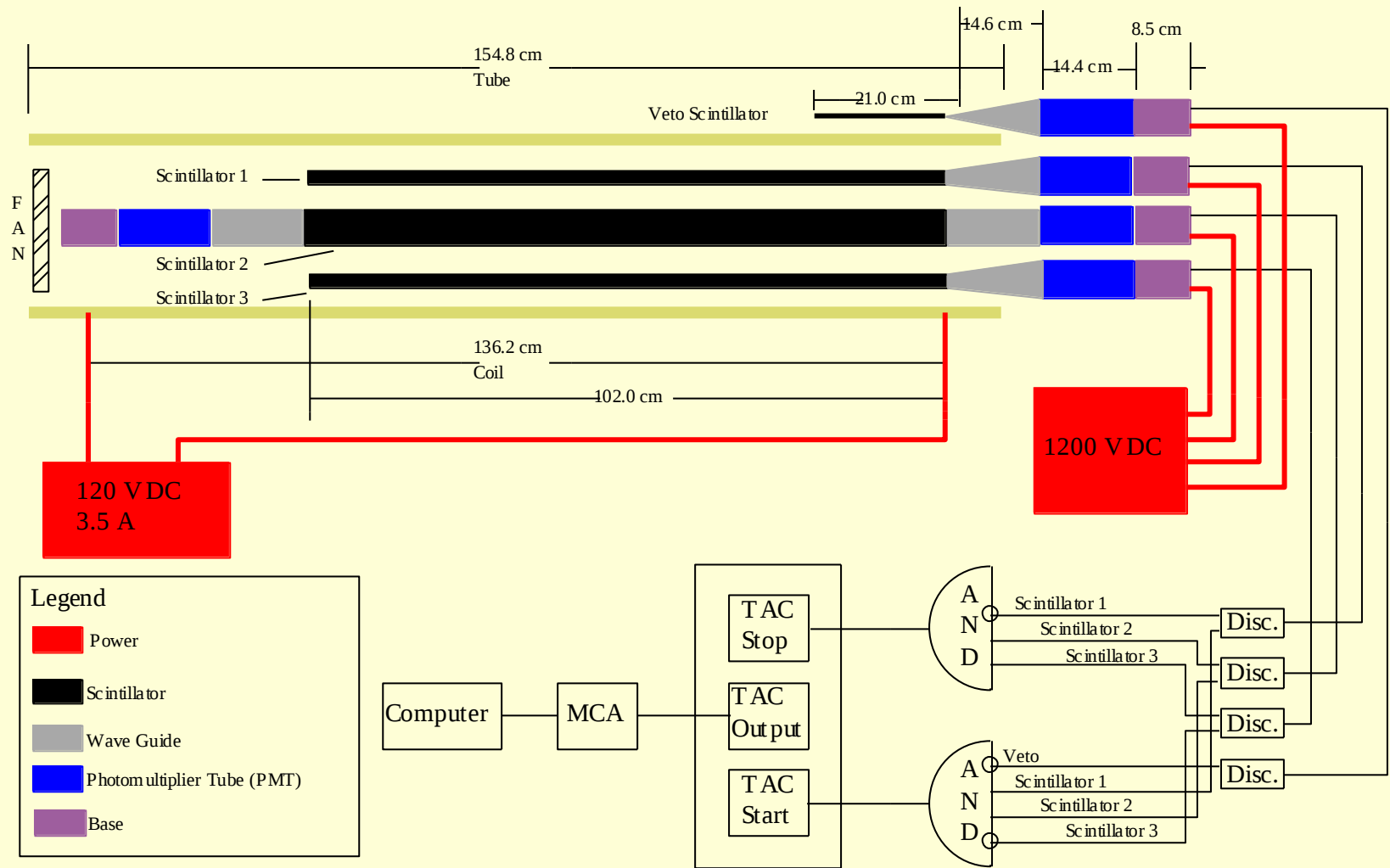
• Precessional Frequency:

$$\omega = \frac{geB}{2m_{\mu}c}$$

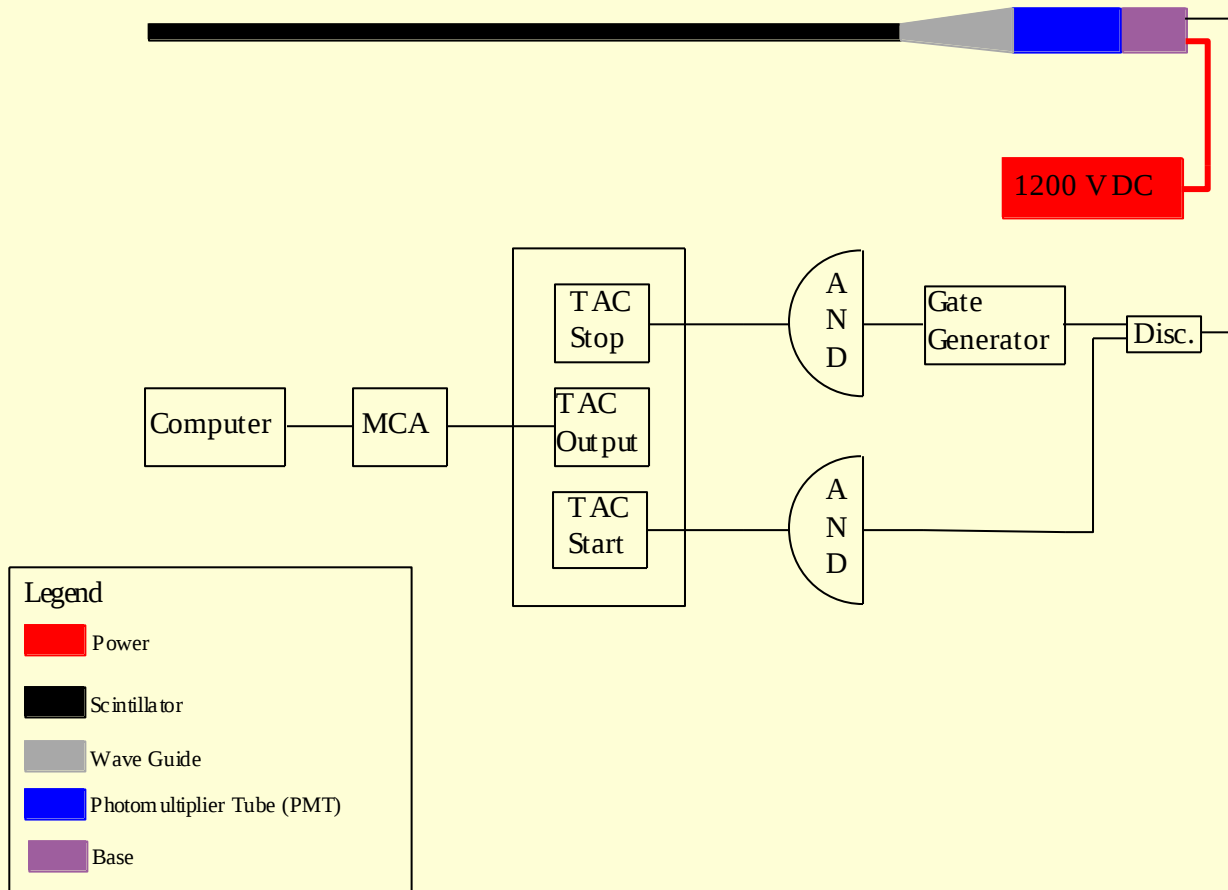
Plot of μ^+ Polarization as a function of Momentum



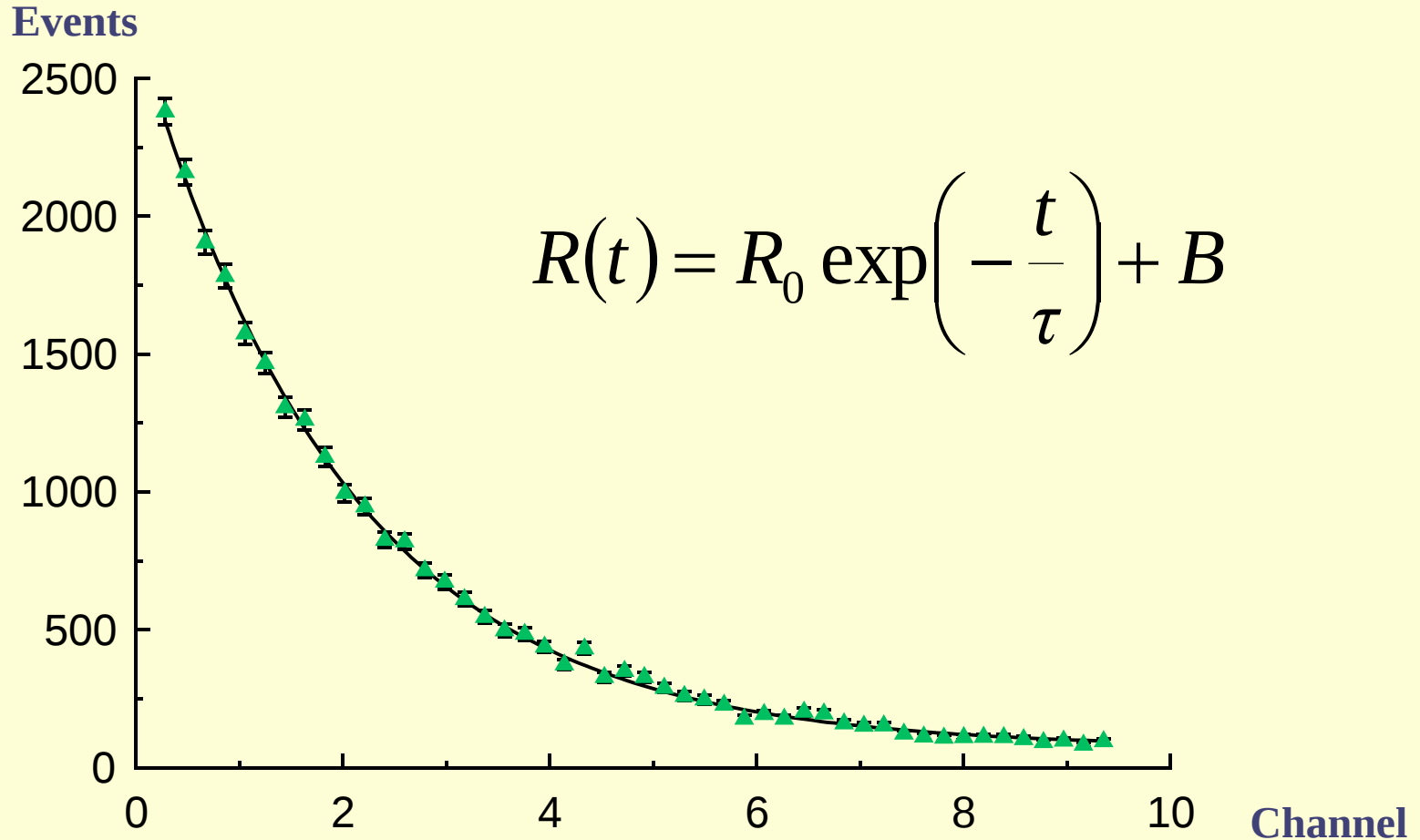
Obtained from B.A. Dolgoshein, B. Luchkov and V. Ushakov, Sov. Phys. JETP 15, 654 (1962)
and A.I., Proc. Moscow Conf. 1, 317 (1959)



Timing Calibration Circuit

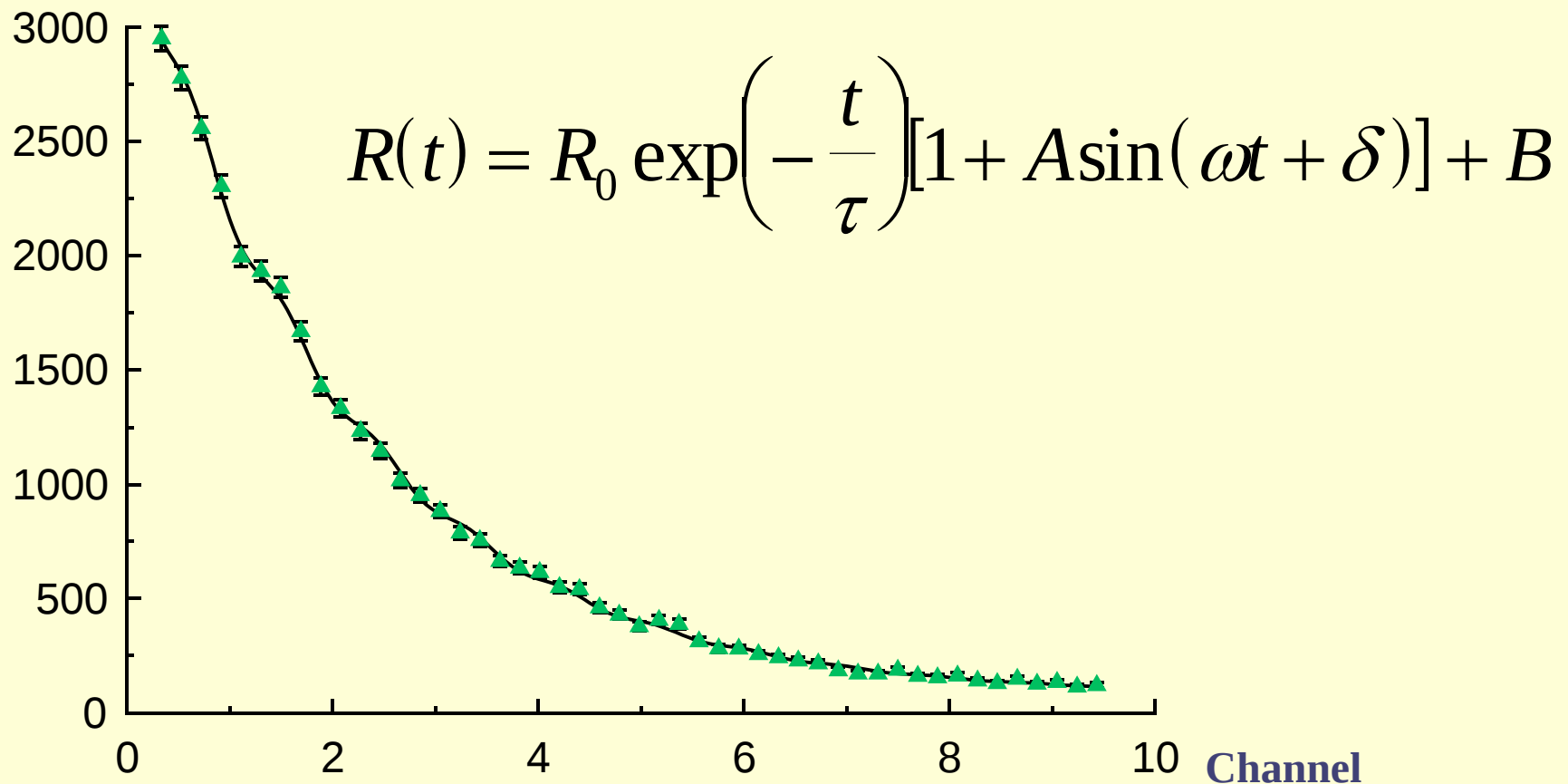


Muon Decay Curve (Zero B-Field)



Muon Decay Curve (42 Gauss $\pm$ 5% B-Field)

Events





Determined Values

● $\tau = 2.19 \pm 0.04 \mu\text{s}$

- (Accepted value is $2.19703 \pm 0.00004 \mu\text{s}$)

● $g = 2.89 \pm 0.16$

- (Accepted value is 2)

