

# Calibration of a Photomultiplier Response

Presented by:

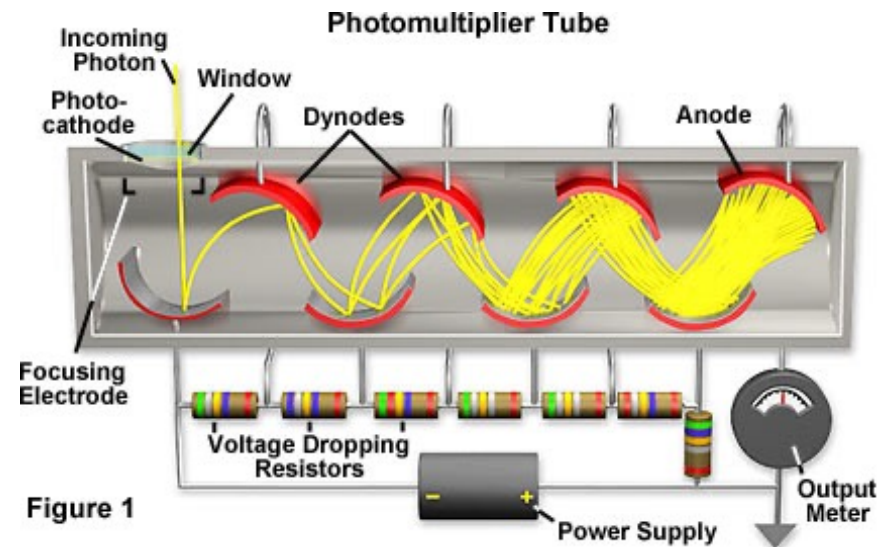
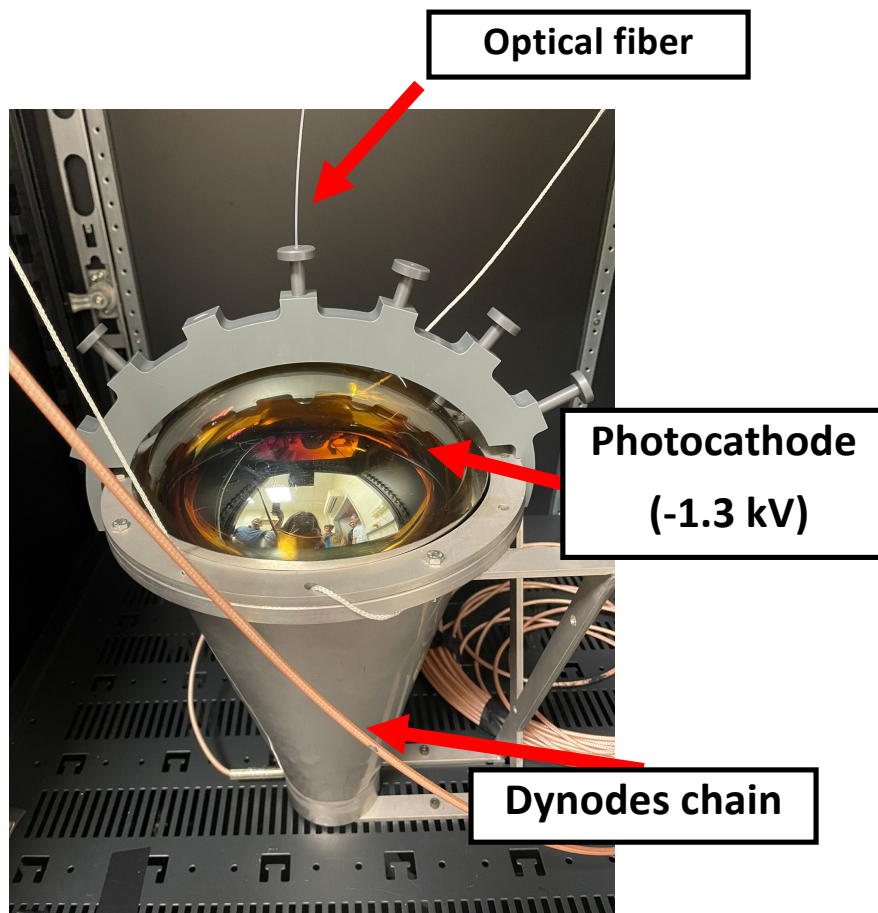
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Supervised by Dr. Eric Baussan

# Outline

- Photomultiplier tube
- Experimental Setup
- Calibration workflow
- Results and conclusions

# Photomultiplier tube

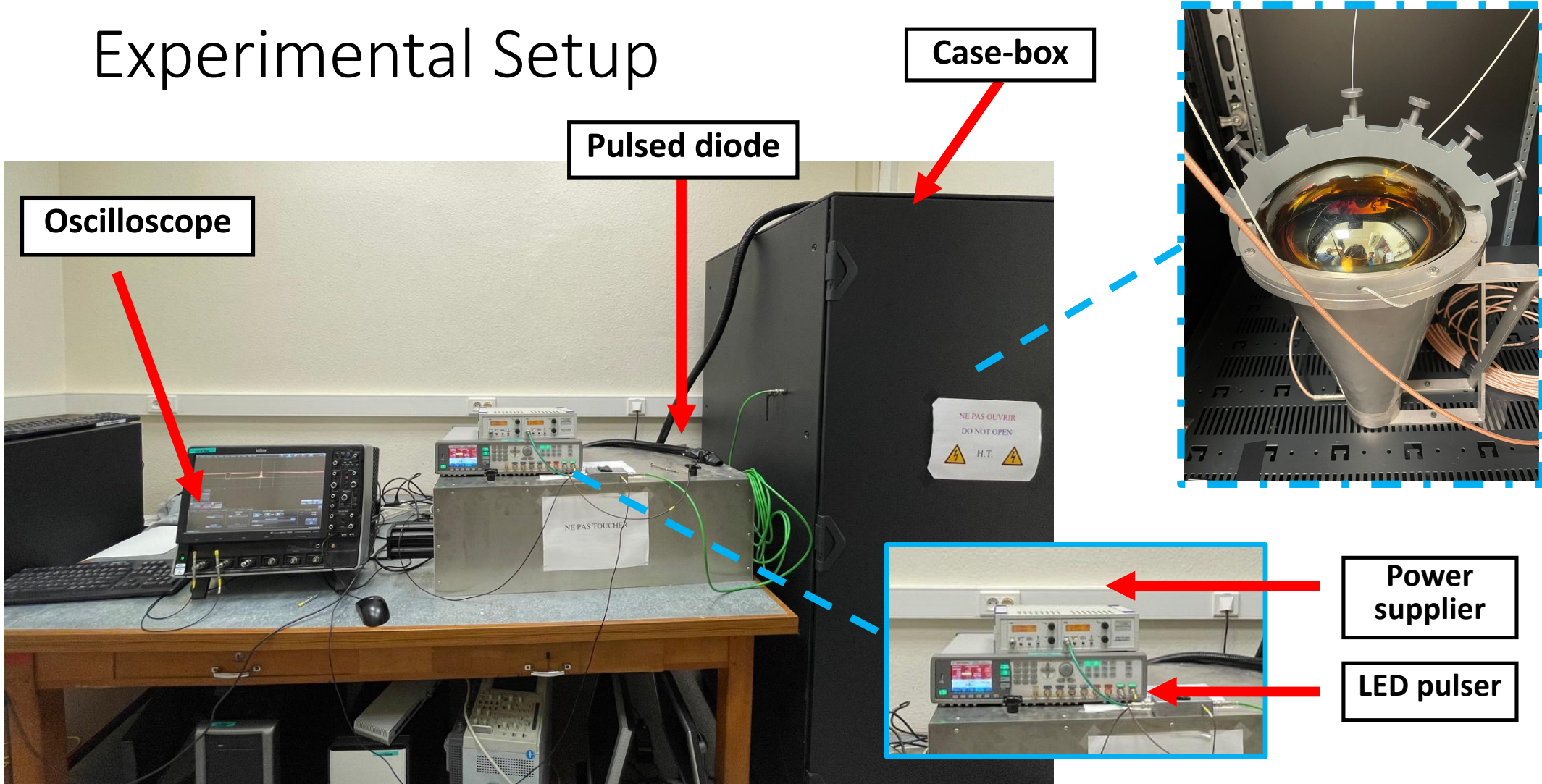


$$\Sigma_q = n_{el} / n_{ph}$$

$$Q = G * n_{el}$$

$$Q = G * \Sigma_q * n_{ph}$$

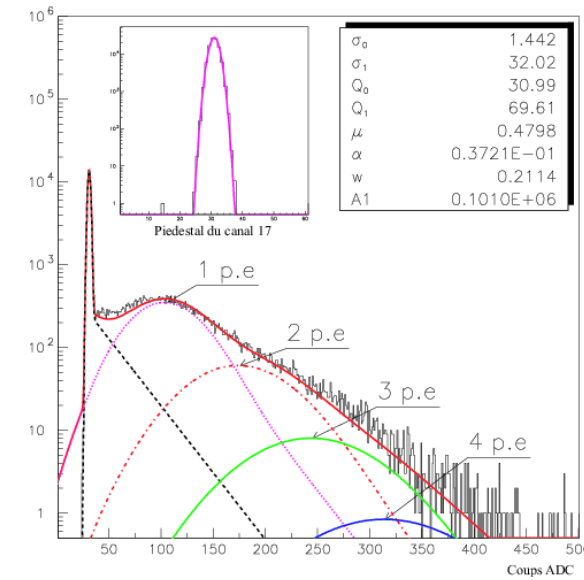
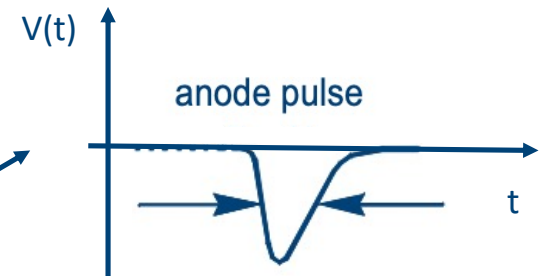
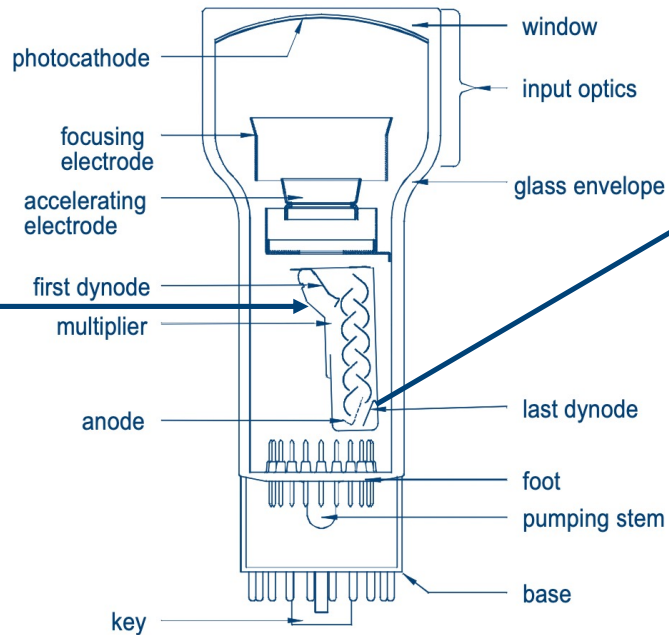
# Experimental Setup



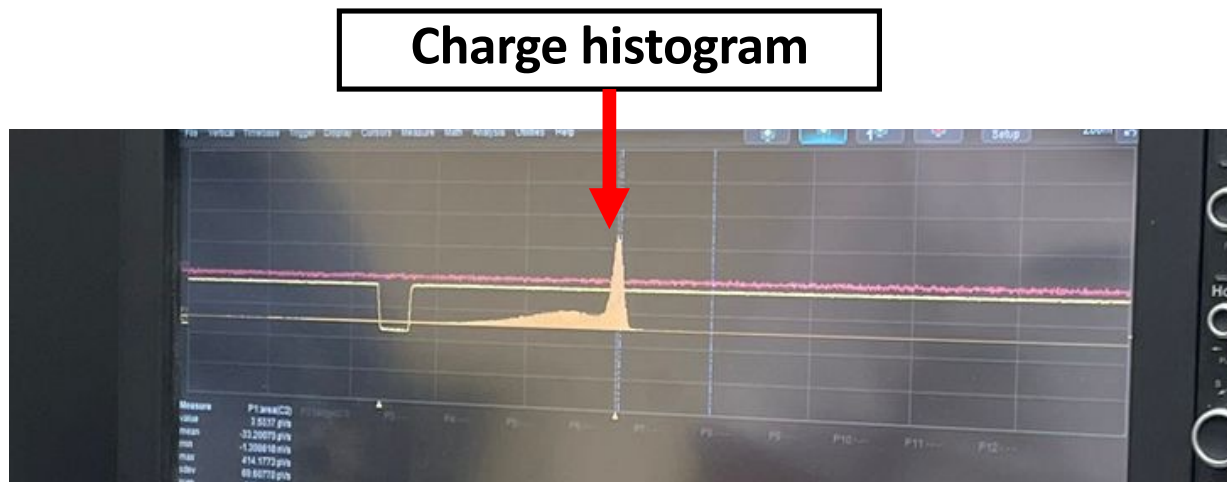
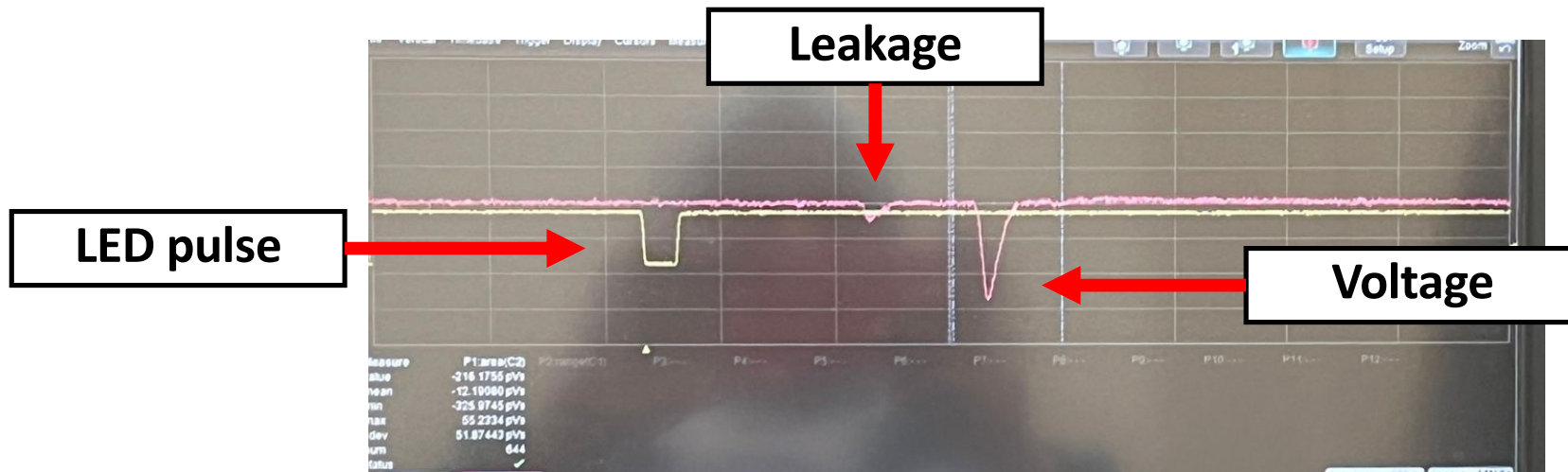
Light Injector System

light pulse at photocathode

Power supplier

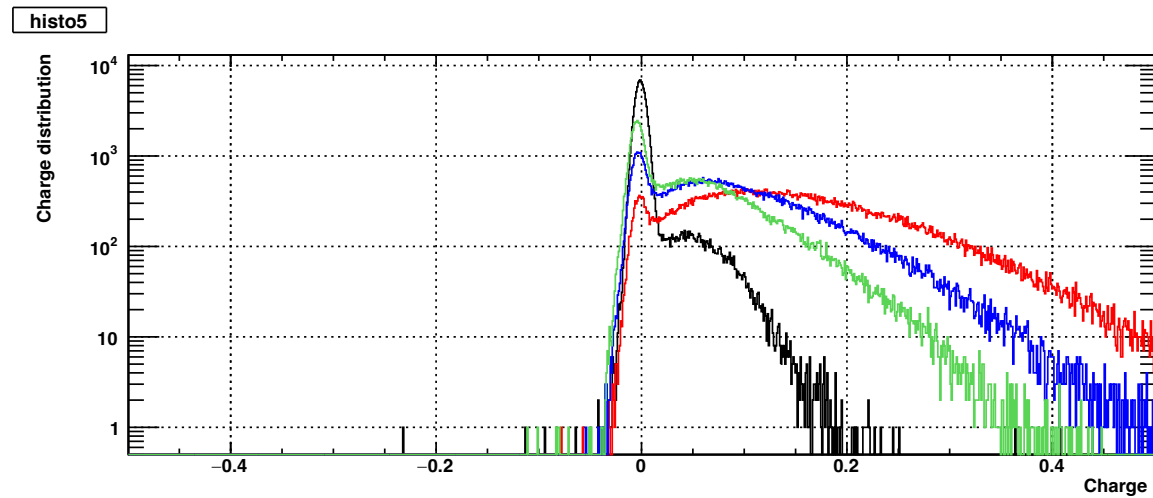
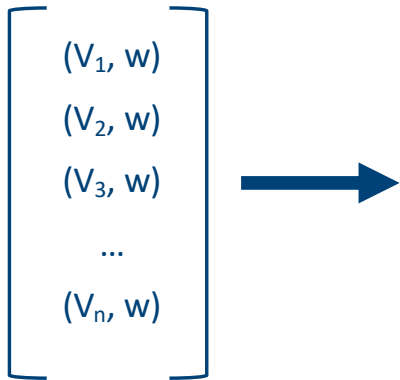






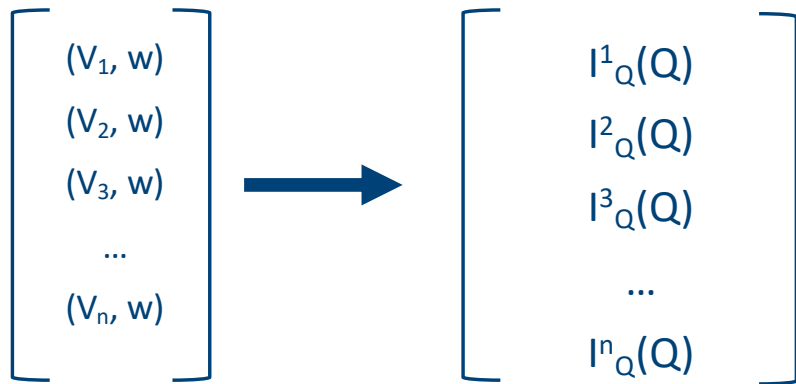
# Calibration procedure

## 1) Data collection



# Calibration procedure

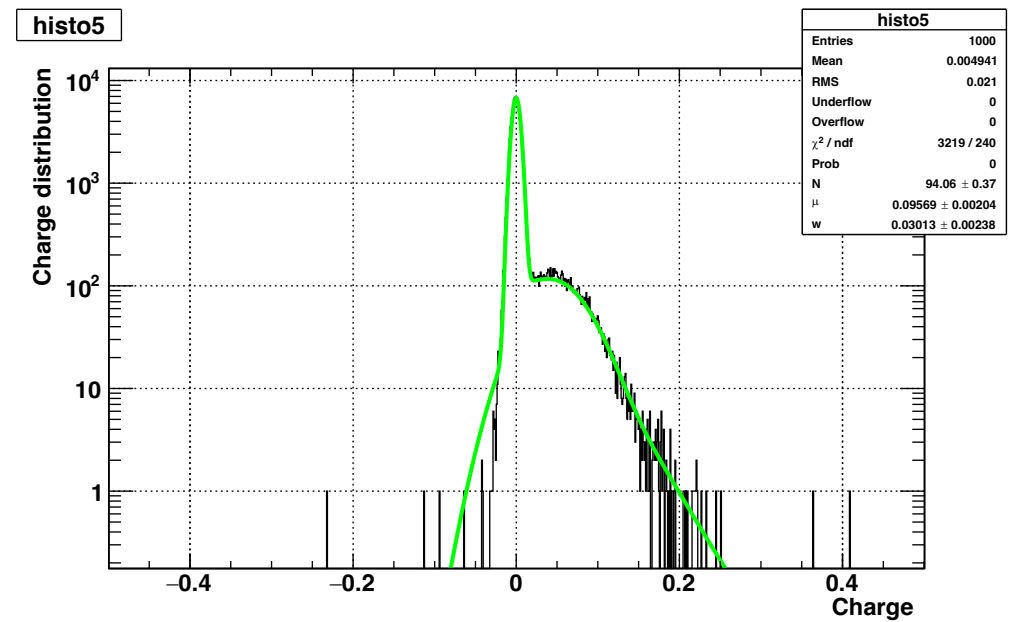
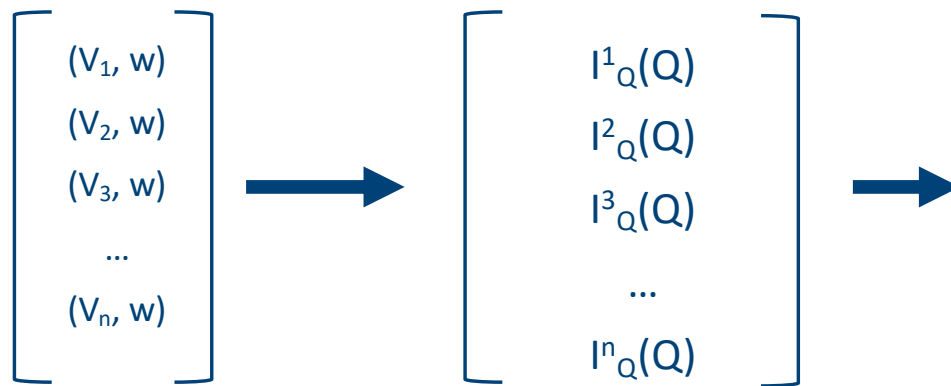
## 1) Data collection





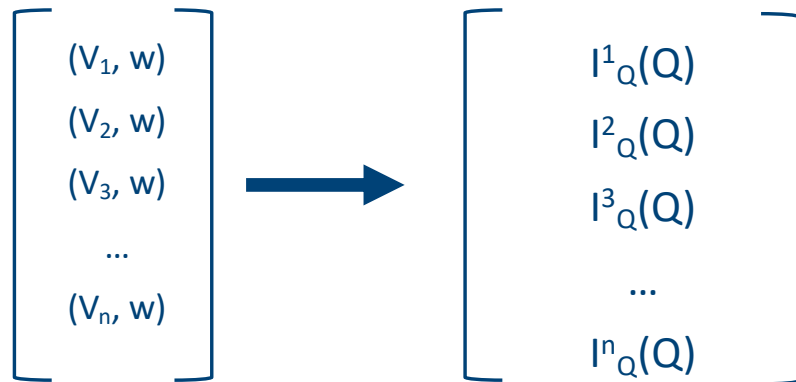
# Calibration procedure

## 2) Fitting



# Calibration procedure

## 2) Fitting



Poisson process :

$$P_\mu(n) = \frac{\mu^n}{n!} \cdot e^{-\mu} \quad \text{avec} \quad \mu = \langle N_{pe} \rangle = \langle N_\gamma \rangle \cdot \varepsilon_q \cdot \varepsilon_c,$$

$$G_{\bar{Q}, \sigma}(q) = \frac{1}{\sqrt{2\pi}\sigma} \cdot \exp\left(-\frac{1}{2} \frac{(q - \bar{Q})^2}{\sigma^2}\right) \quad \text{avec} \quad \bar{Q} = \mu \cdot e$$

Ideal Signal

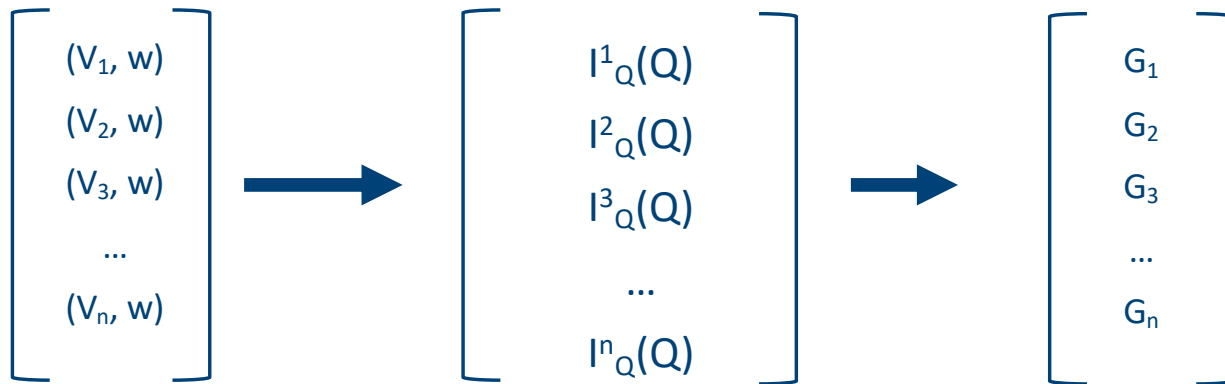
$$S_d(q) = [P_\mu \otimes G_{\bar{Q}, \sigma}](q)$$

Fitting Signal

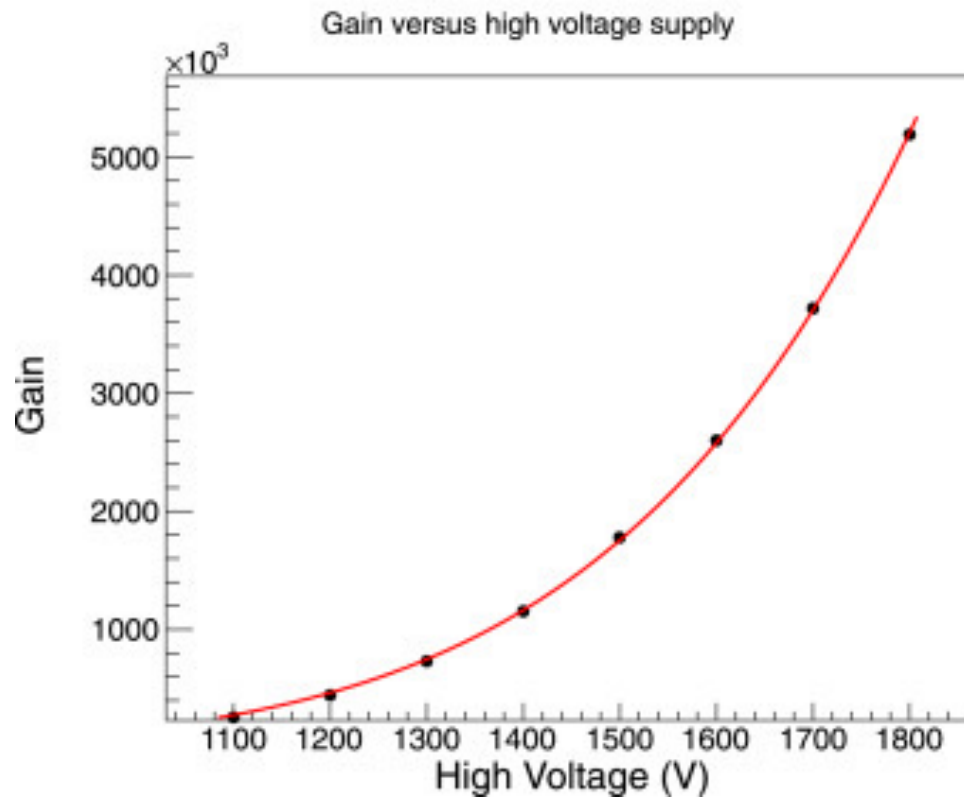
$$S_{analyse}(q) = \sum_{n=0}^{\infty} \frac{\mu^n e^{-\mu}}{n!} \cdot \left\{ (1-w) \cdot \frac{1}{\sqrt{2\pi}\sigma_n} \cdot e^{-\frac{(q-Q_n)^2}{2\sigma_n^2}} + w \cdot \frac{\alpha}{2} \cdot e^{-\alpha(q-Q_n-\alpha\sigma_n^2)} \right. \\ \left. \cdot \left[ \operatorname{erf}\left(\frac{|Q_0 - Q_n - \alpha\sigma_n^2|}{\sigma_n\sqrt{2}}\right) + \operatorname{sign}(q - Q_n - \alpha\sigma_n^2) \cdot \operatorname{erf}\left(\frac{|q - Q_n - \alpha\sigma_n^2|}{\sigma_n\sqrt{2}}\right) \right] \right\}$$

# Calibration procedure

## 2) Fitting



# Results and conclusions



$$Q = G * n_{el}$$

$$\Sigma_q = n_{el} / n_{ph}$$

$$Q = G * \Sigma_q * n_{ph}$$



Thank you for your  
attention !

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