Lab session: SiPM for CTA
Case of study:
Measurement of the speed of light with Silicon Photomultipliers

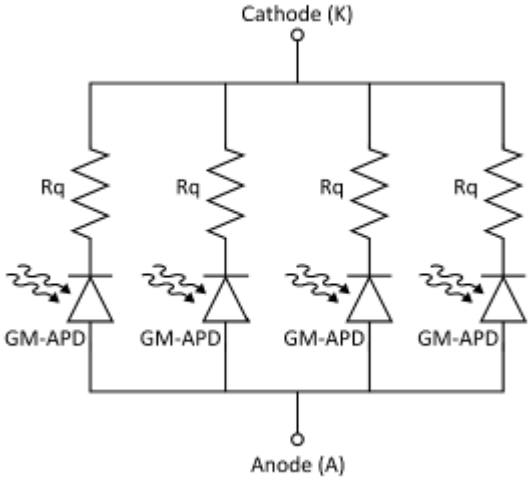
Prof. Francesco GIORDANO

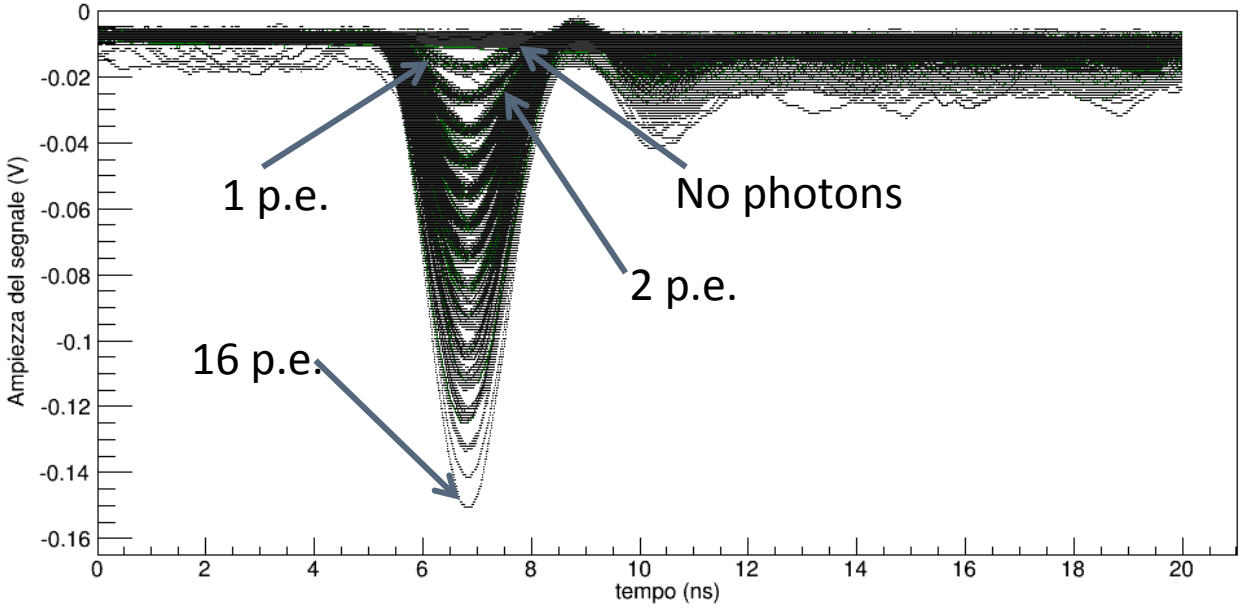
Università degli Studi di Bari «A. Moro» & INFN Sez. di Bari

The Silicon Photomultipliers (SiPM)

Silicon Photomultipliers (SiPM) are devices able to detect very low intensity of ligh(p.e.) down to single photo electron level.

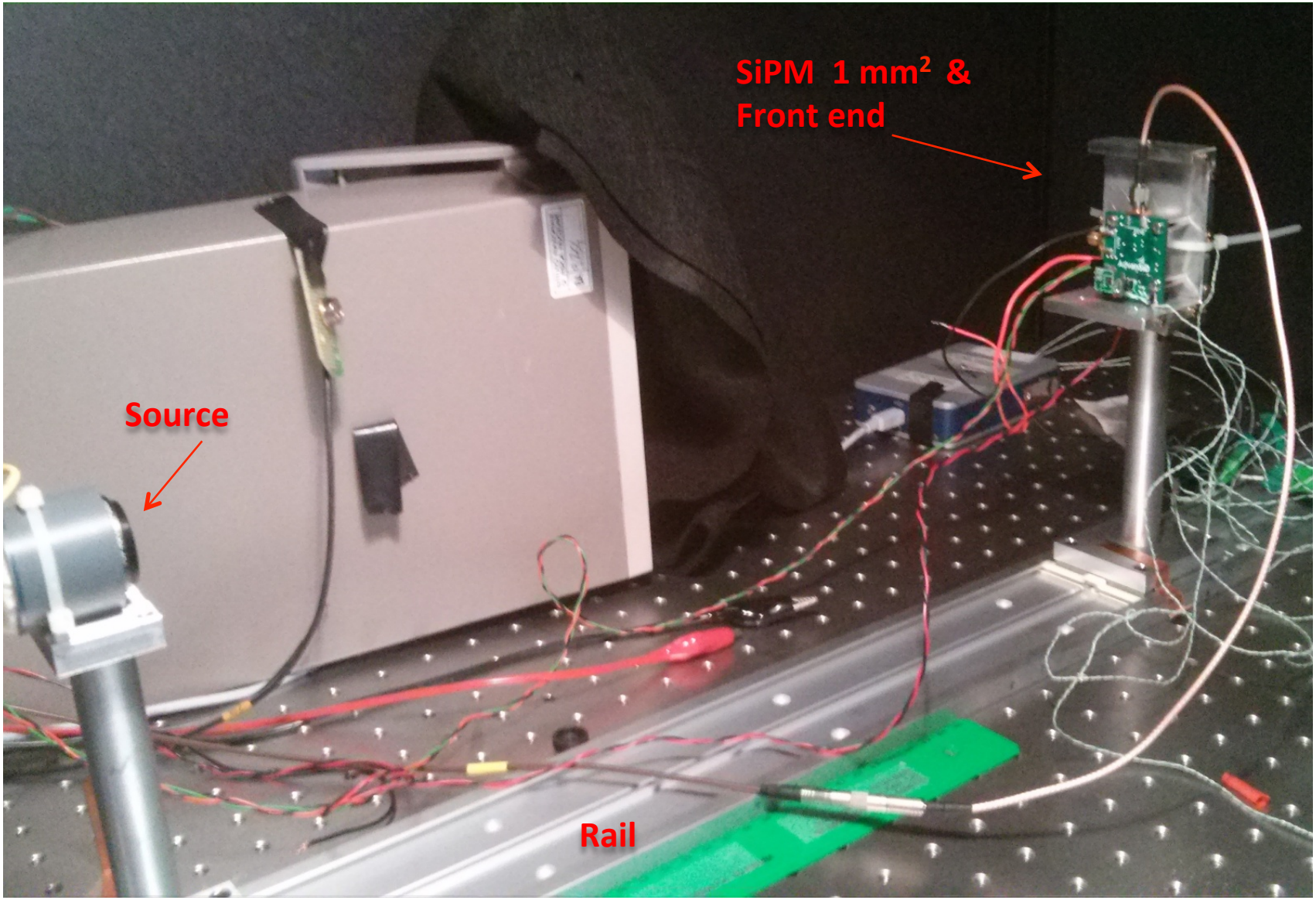
It consists of a matrix of sigle p-n junction working in geiger mode (gain > 10^6).





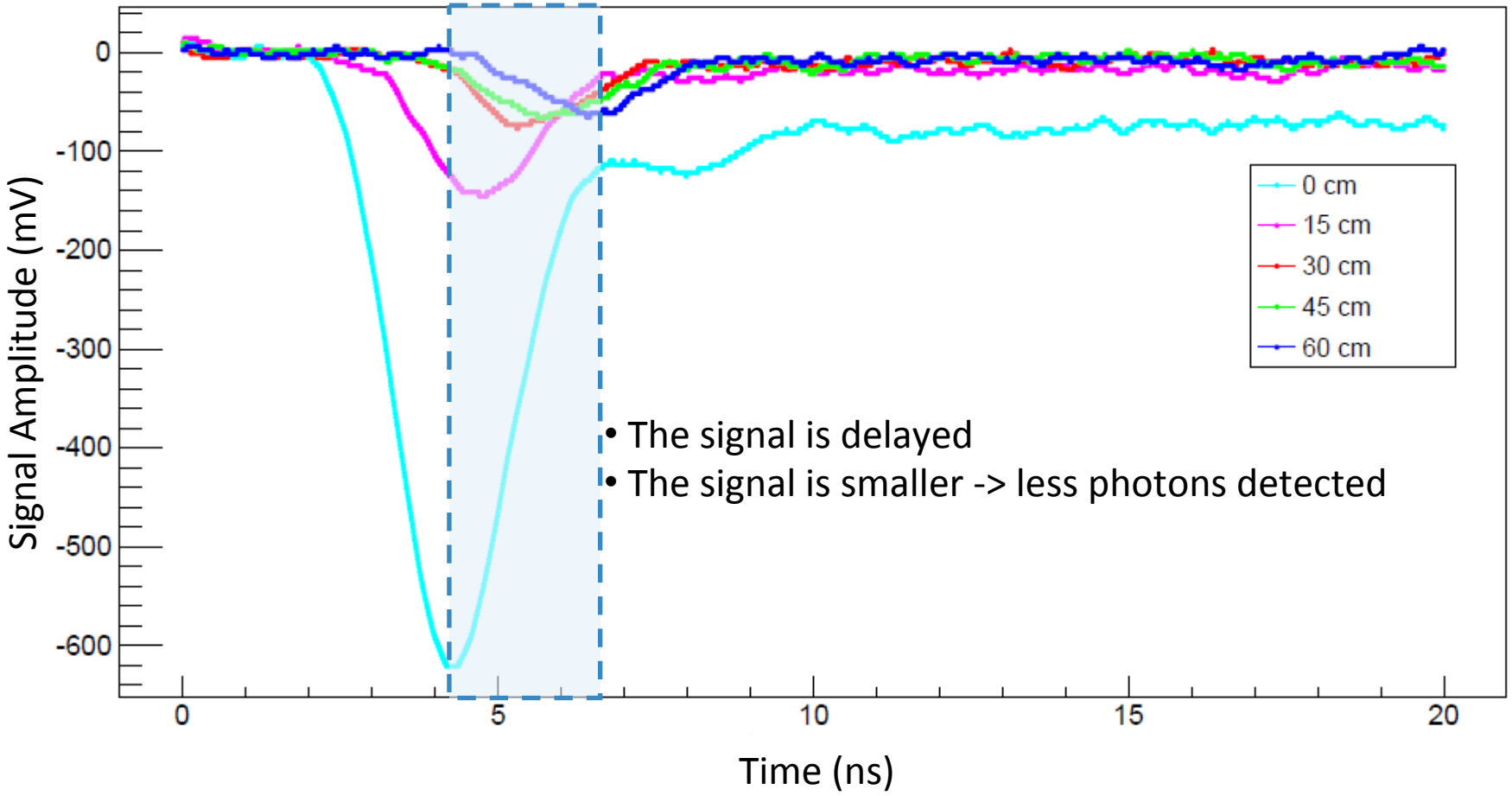
When a certain number of photons hits the SiPM, it is possible to distuinguish signals generated by one single p.e., two p.e., three p.e. etc… and observe the poissonian distribution of the number of detected photon

Measurement proof of concept



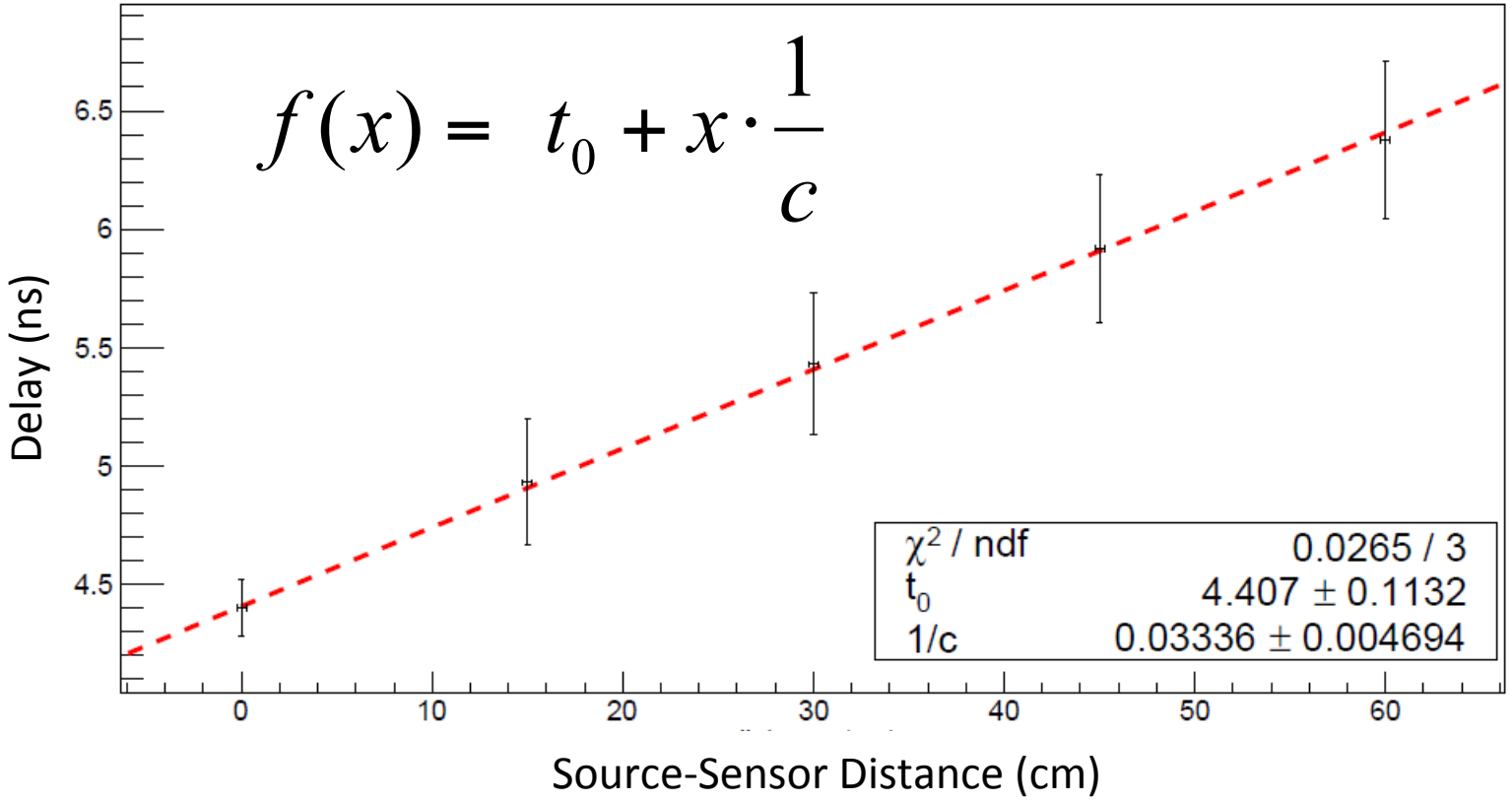
Average Waveforms for different distances

c.a. 2 ns for 60 cm source - sensor distance



The speed of light

The value of the speed of light can be estimated as the slope of the linear fit of the Delay *vs.* source to sensor distance

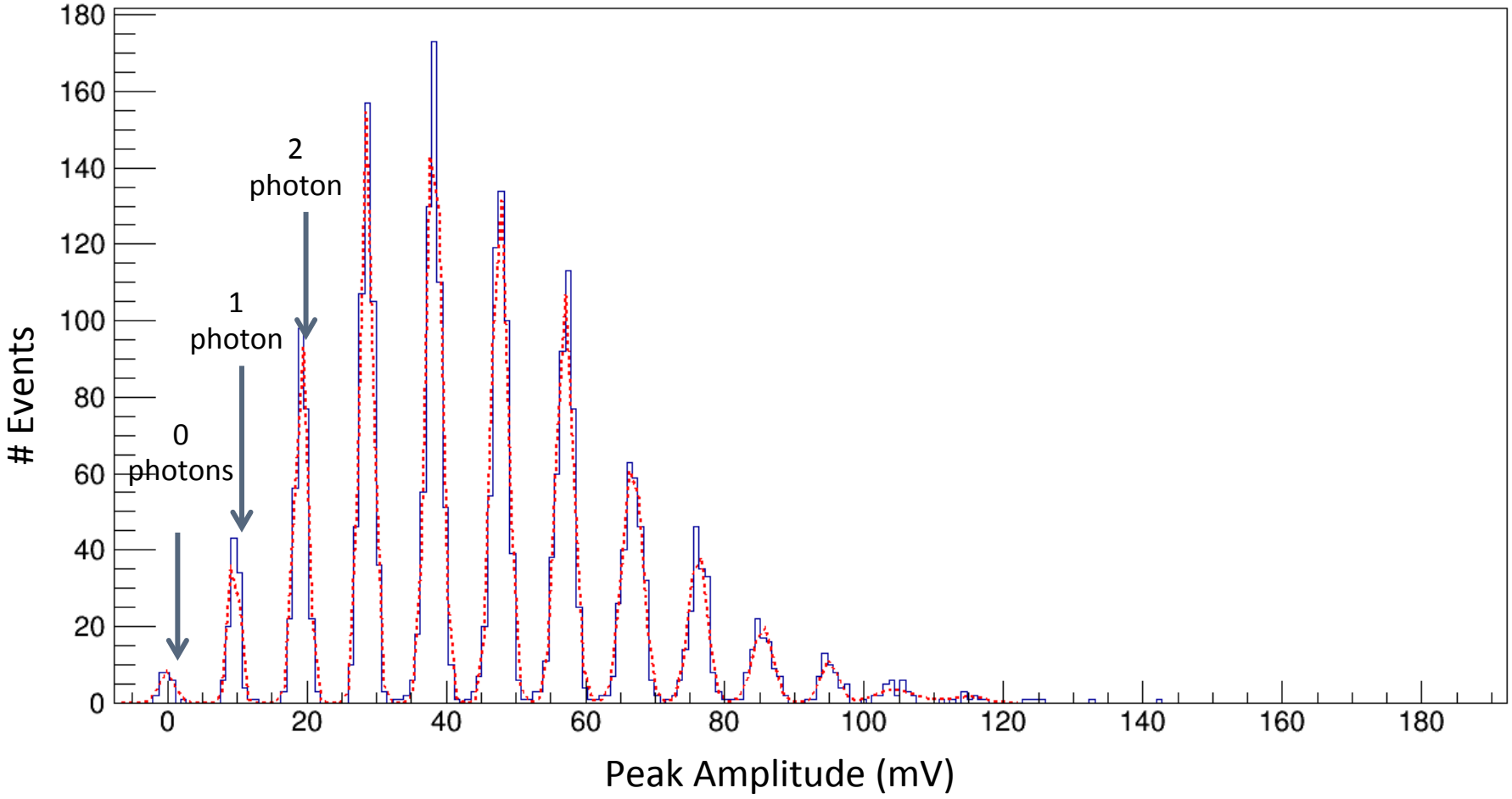


$c = 29.98 \pm 4.22$ cm/ns

$E_{r\%} \sim 10\%$

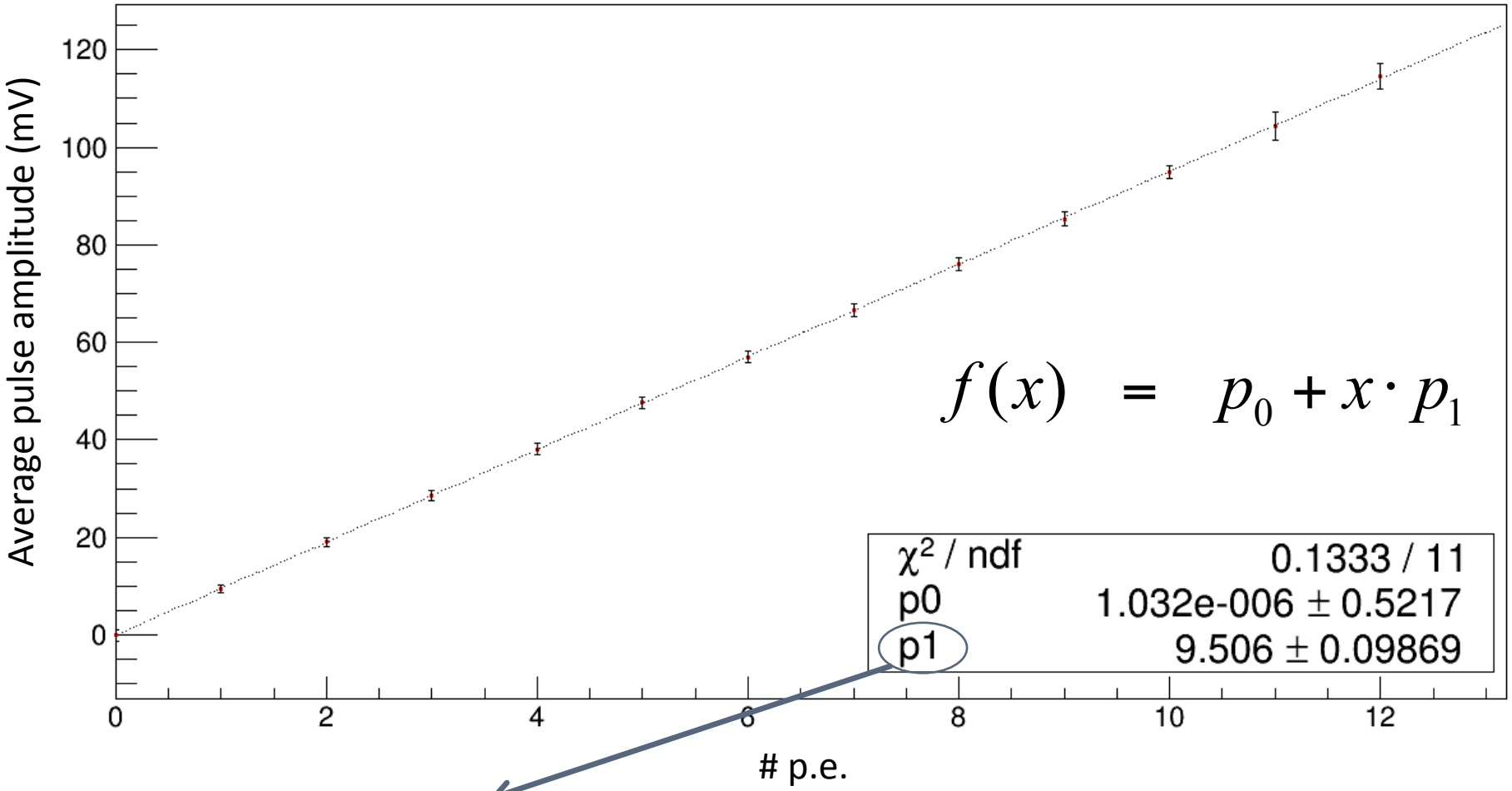
Pulse height analysis

The histogram of the detected p.e. follows a poissonian distribution. Each peak of the plot correponds to a 0 p.e., 1p.e., 2 p.e. etc etc



SiPM linearity

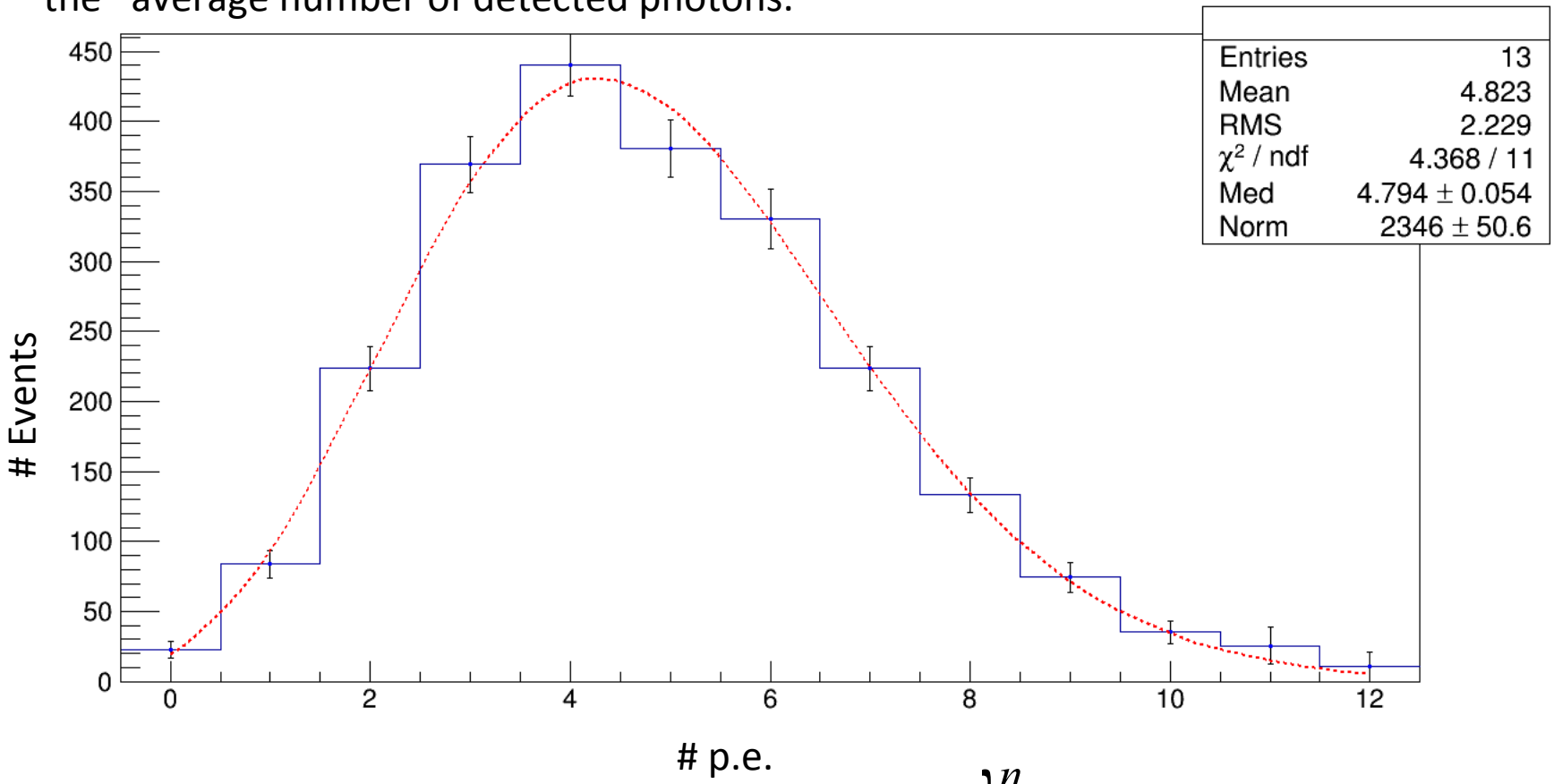
The Gaussian fit of each peak gives the average value of the signal amplitude linearly scaling with the detected # p.e.



The estimated gain is approximately 9.5 mV/p.e., taking into account the intrinsic gain of the SiPM and the gain the preamplifier.

The poissonian of # p.e.

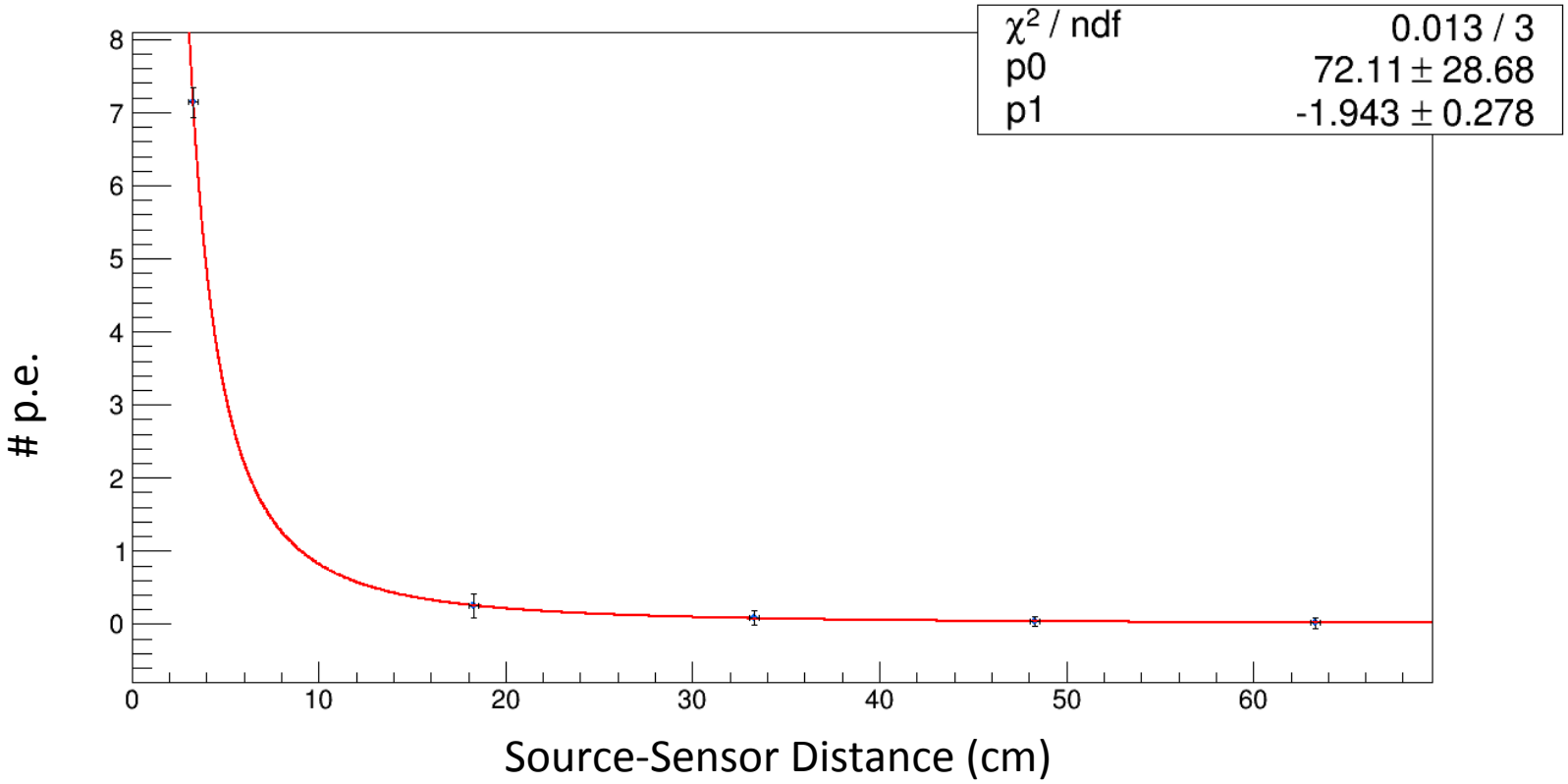
The # p.e. follows a poissonian distribution whose average is the estimated value of the average number of detected photons.



$$P(n) = e^{-\lambda} \cdot \frac{\lambda^n}{n!}$$

Inverse square law verification

The intensity of light is expressed by the number of p.e. detected by the sensor.
The inverse square law ($1/r^2$) can be verified plotting the average p.e. for different souce-sensor distances.



$$f(x) = p_0 \cdot x^{p_1}$$

$p_1 = -1.9 \pm 0.3$

Cherenkov Telescope Array

Ti piace · Pagina seguita · Condividi · Altro

Cherenkov Telescope Array

@ctaobservatory

- **Home**
- Informazioni
- Foto
- Recensioni
- Persone a cui piace
- Video
- Post

Crea una Pagina

Cherenkov Telescope Array ha aggiunto 3 nuove foto.
22 maggio 2015 ·

Potential CTA camera technology, a Silicon Photo Multiplier, is used to measure the speed of light and give a lesson in quantum mechanics and astroparticle research to students visiting the INFN and UNIBA exhibit for the Festival dell'Innovazione in Bari, Italy. #fdl2015

Visualizza traduzione