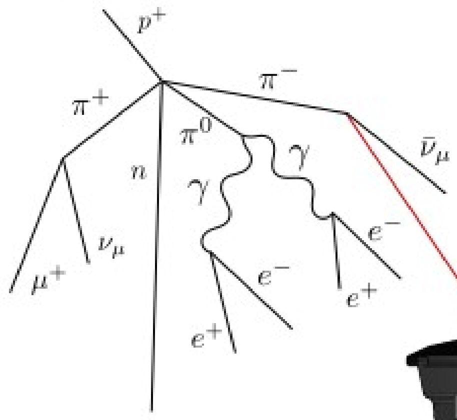
A photomultiplier tube model for the water Cherenkov detectors of LAGO

J. Peña-Rodríguez*, S. Hernández-Barajas, Y. León-Carreño, L. A. Núñez, and L. Otiniano for the LAGO collaboration

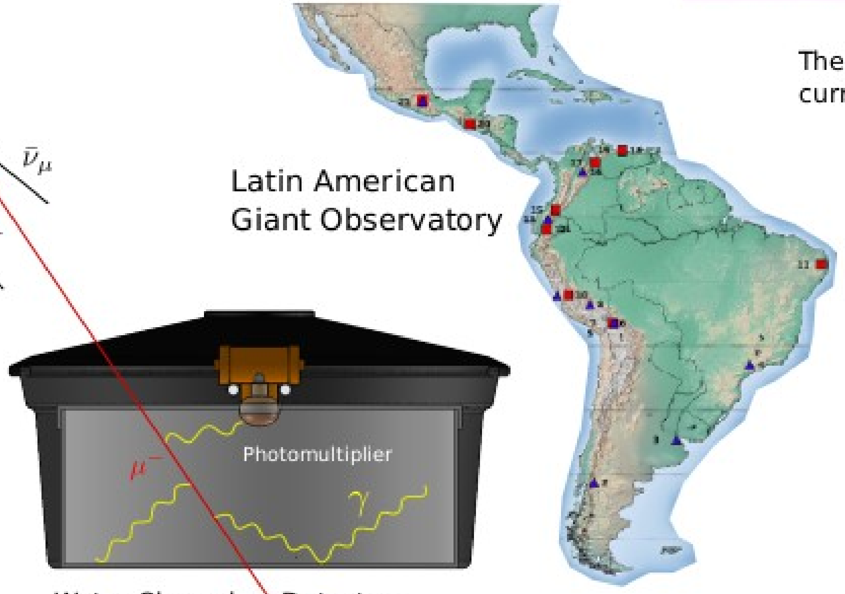
Universidad Industrial de Santander

*jesus.pena@correo.uis.edu.co

Intro



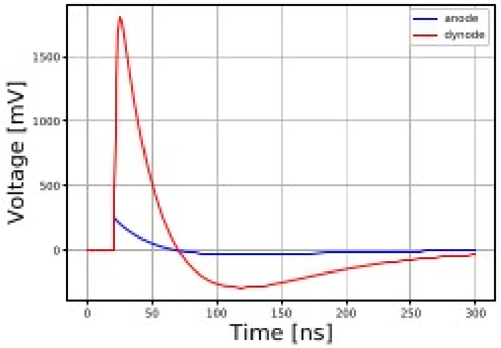
Extensive Air Shower

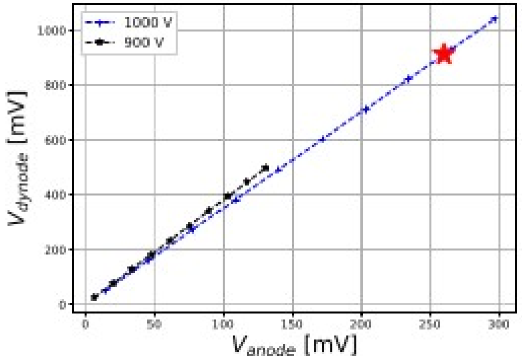


Water Cherenkov Detector

Results

The estimated and measured VEM charge differ by **4%**





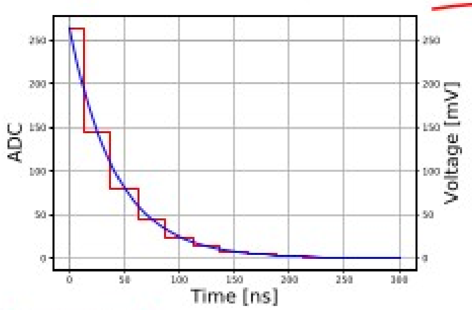
VEM, Vertical Muon Equivalent

Model

Mathematical Model

PSpice Model

The PMT model takes the number of dynodes (N), the bias voltage (V_B), the photocathode current (I_k), the inter-dynode bias fraction (ϵ_i), and intrinsic parameters (k, α)

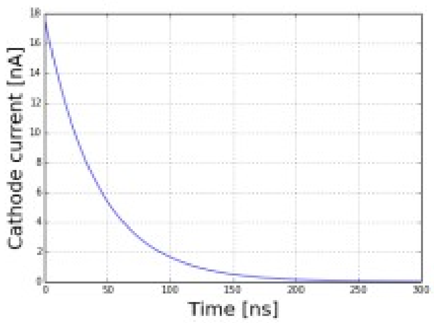


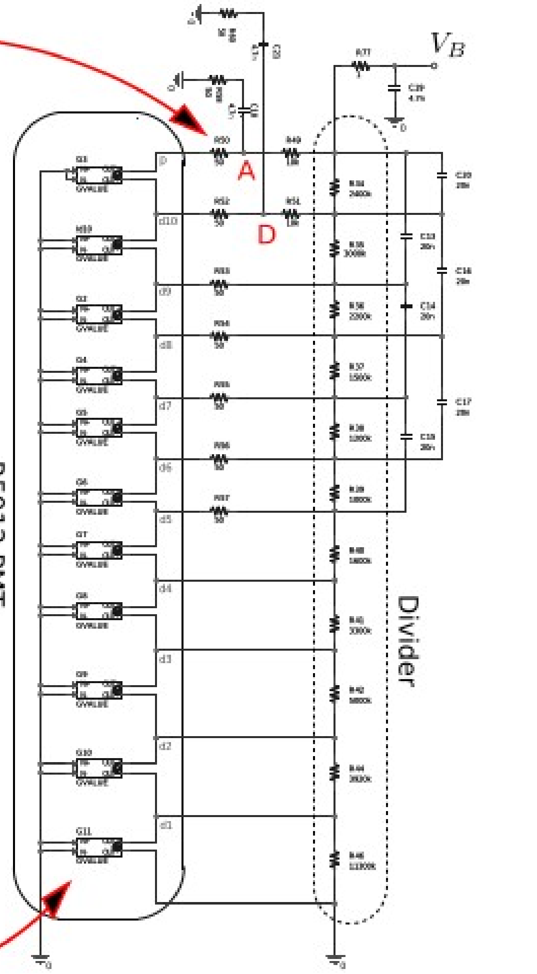
Anode current

$$I_a = I_k k^N (V_B \epsilon)^{N\alpha}$$

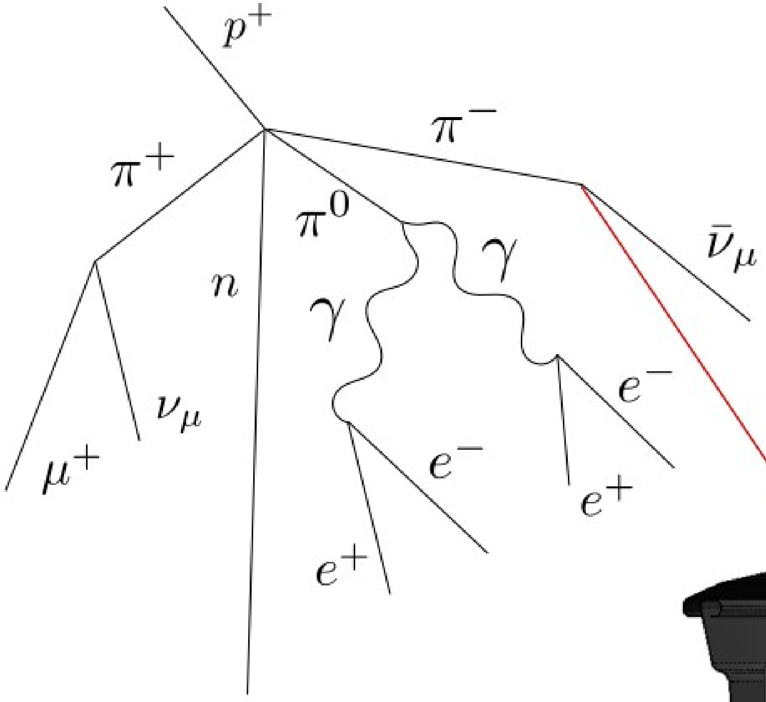
ith-Dynode current

$$I_{d,i} = I_k \frac{(kV_B^\alpha)^N \left(\prod_{i=1}^{N} \epsilon_i\right)^\alpha}{(kv_i^\alpha)^{N+1-i}\left(\prod_{i=1}^{N+1-i} \epsilon_i\right)^\alpha}, \quad i = 1, 2, \cdots N$$

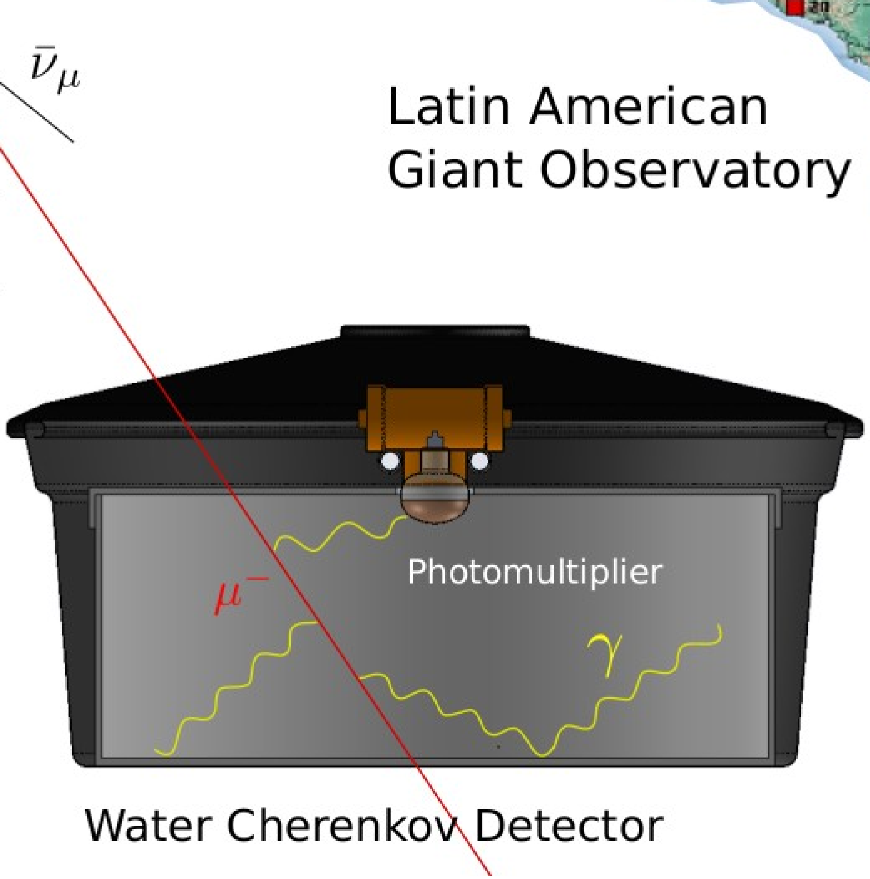




Intro

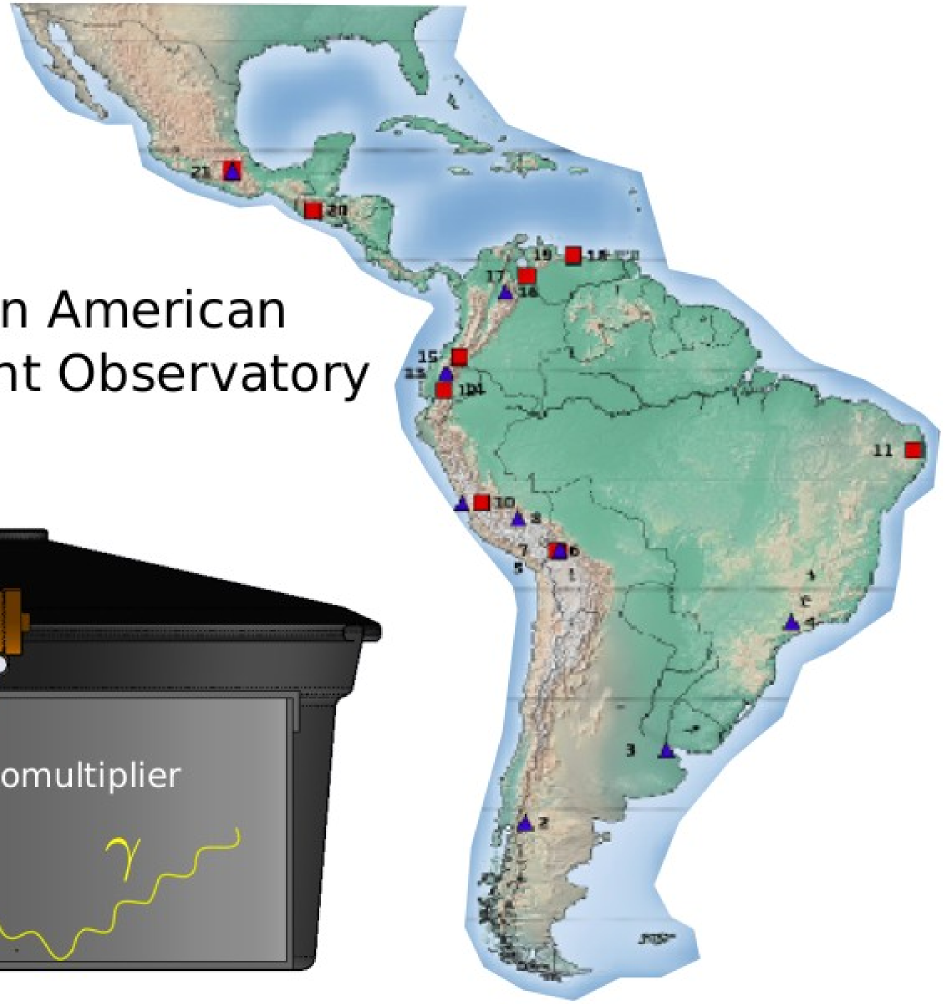


Extensive Air Shower



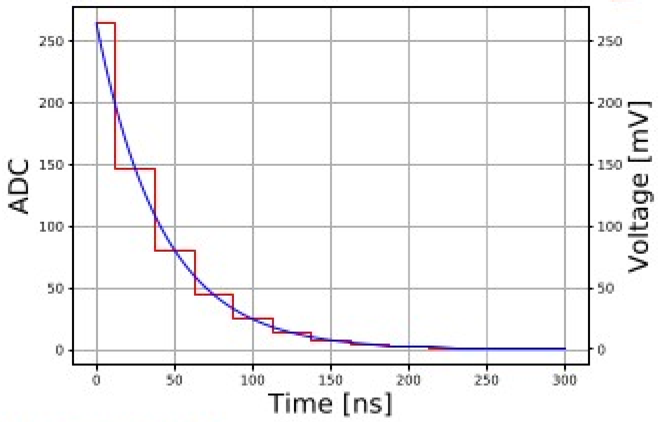
Water Cherenkov Detector

Latin American Giant Observatory



Model

VEM anode signal



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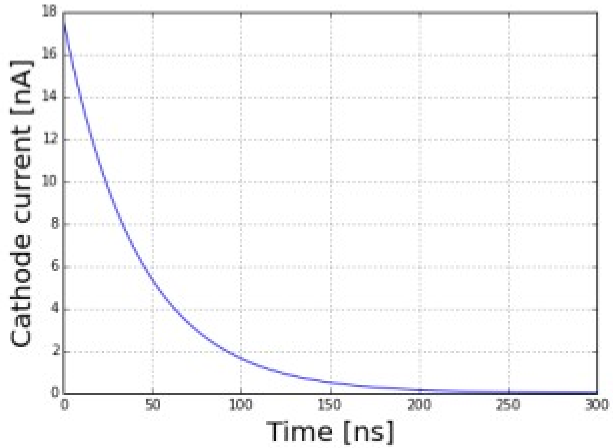
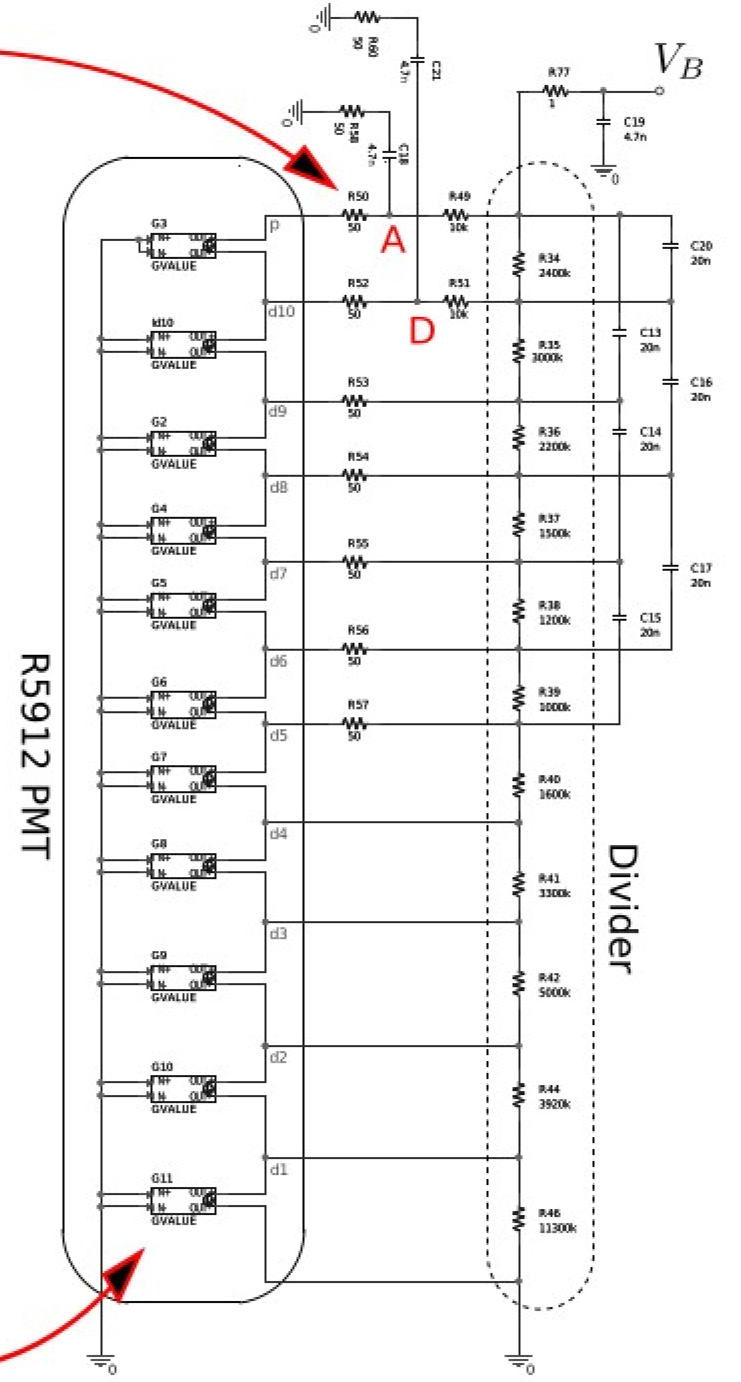
VEM photocathode current





Results

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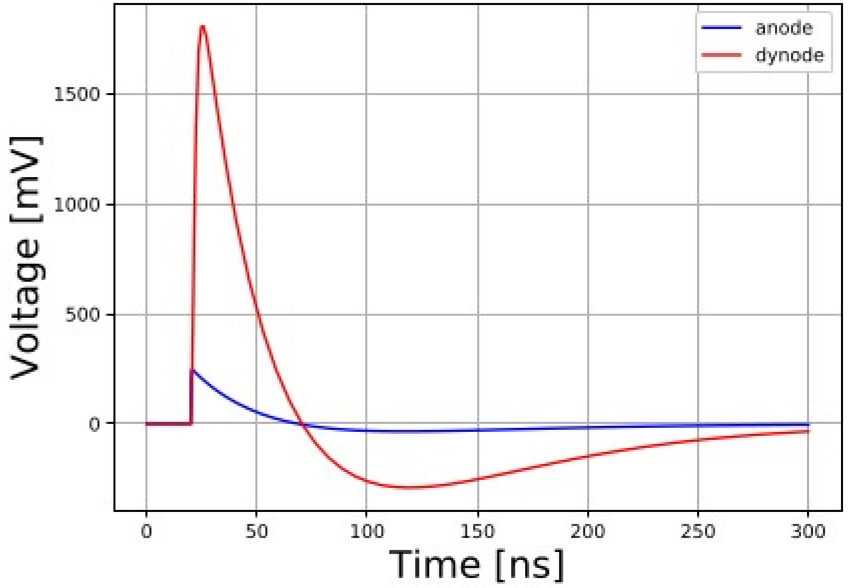
Pulse shape



Linearity