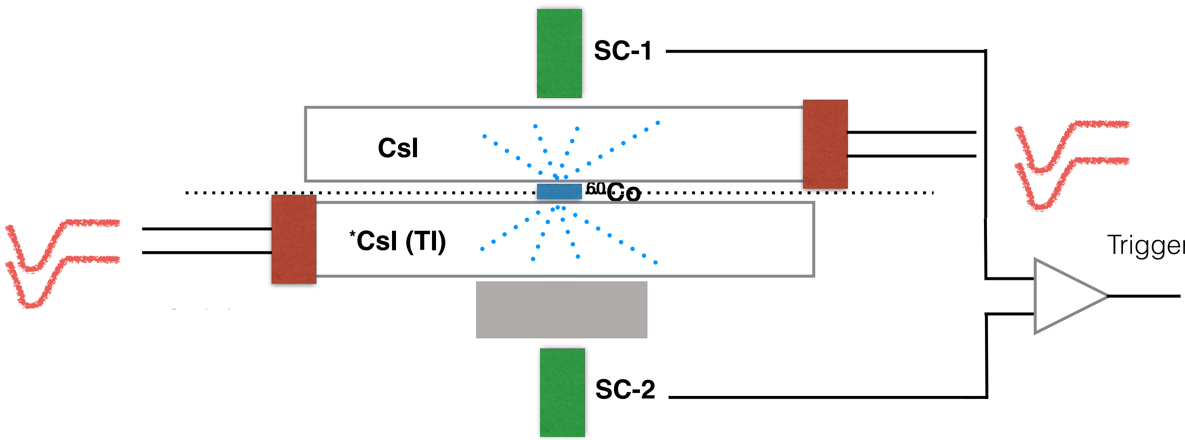
Update analisi dati in cosmici @ LNF: verso la conclusione

G. Finocchiaro

ECL meeting, 10 novembre 2017

Introduction

- We studied several detector configurations with our cosmic ray telescope, and a high-intensity (~3MBq) ^{60}Co source



- Two crystals, up to 8 channels recorded, scintillators and lead to trigger straight tracks
- The ^{60}Co source corresponds to ~2-2.5 times the average background in the FWD endcap predicted by MC 12

Database of CRT (+ ^{60}Co source) data on single crystals:

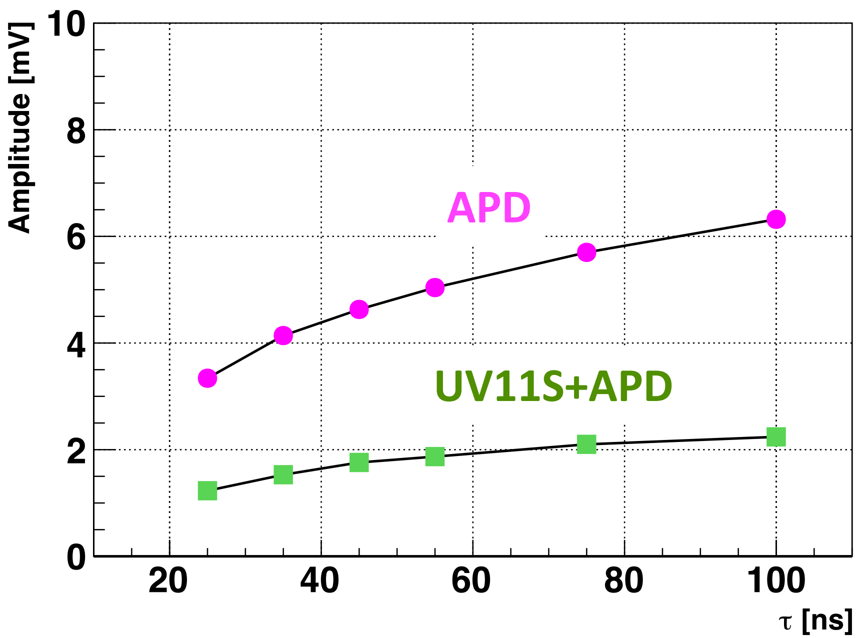
- Pure CsI with LAAPD readout
  I. bare crystal
  II. + UV11S filter
  III. + UV11S filter + NOL9 WLS
  IV. + UV5S filter + NOL9 WLS

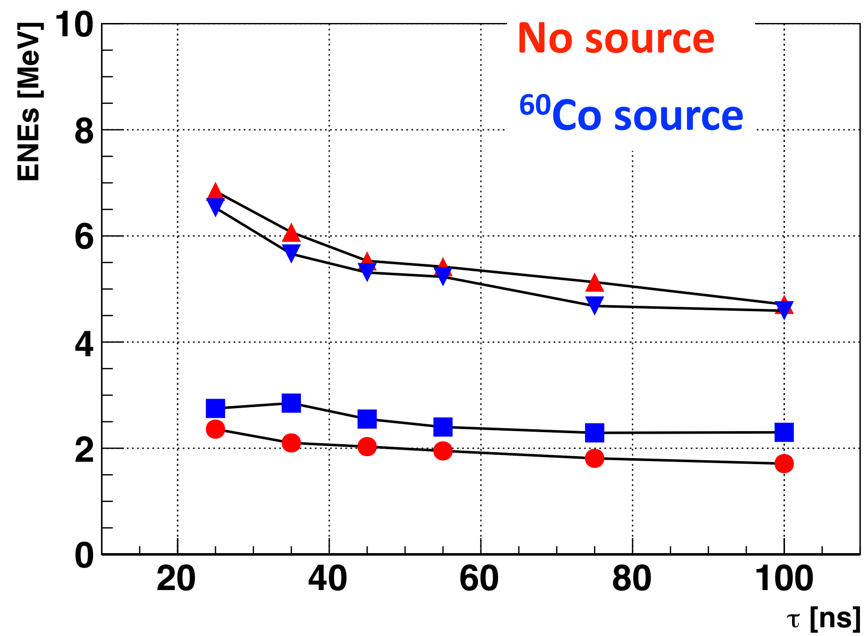
- Pure CsI with photopentode readout

- CsI(Tl)
  I. pin-diode readout
  II. pin-diode + APD readout (transimpedance amplifier)
  III. pin-diode + APD readout (charge integrating amplifier)

CsI + UV11S

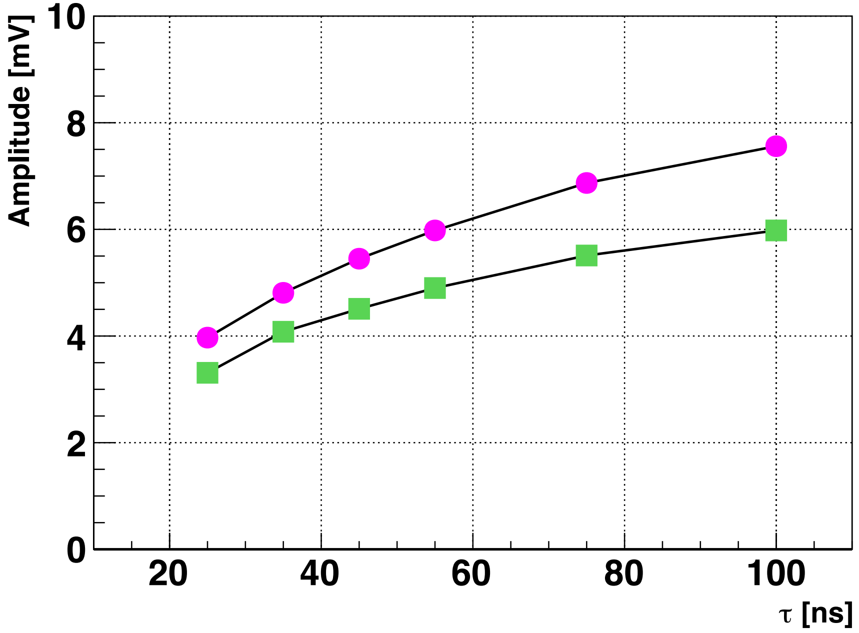
1 APD

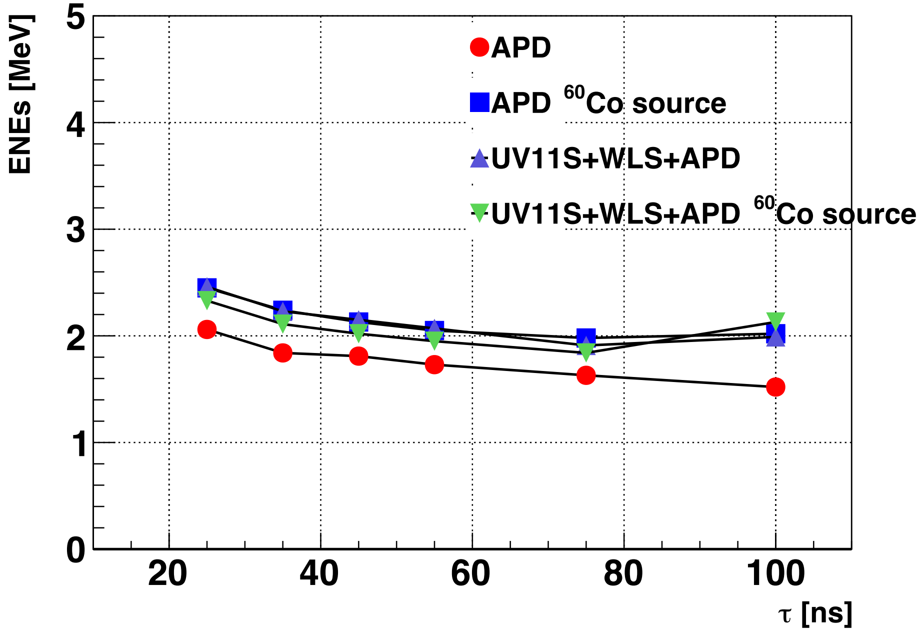




CsI + UV11S +WLS

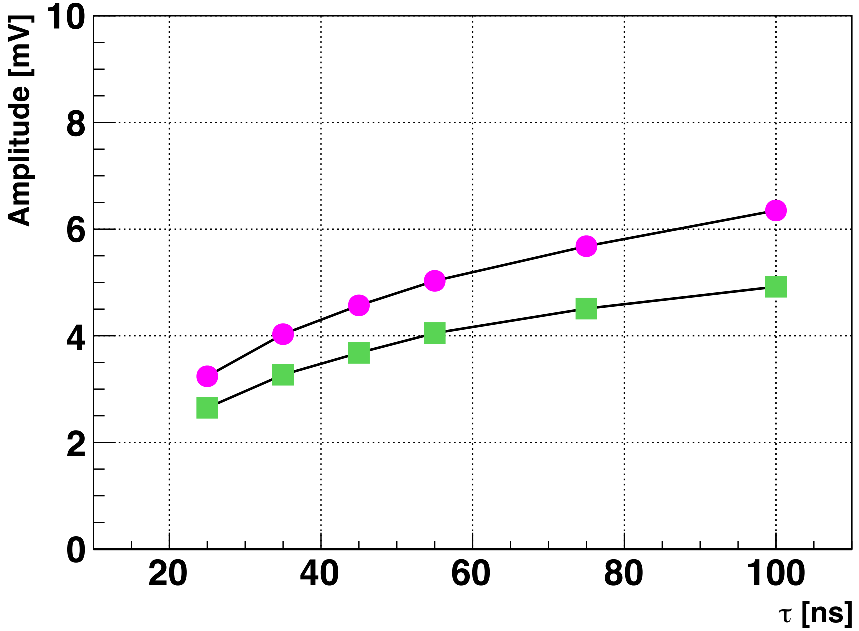
1 APD





CsI + UV5S +WLS

1 APD



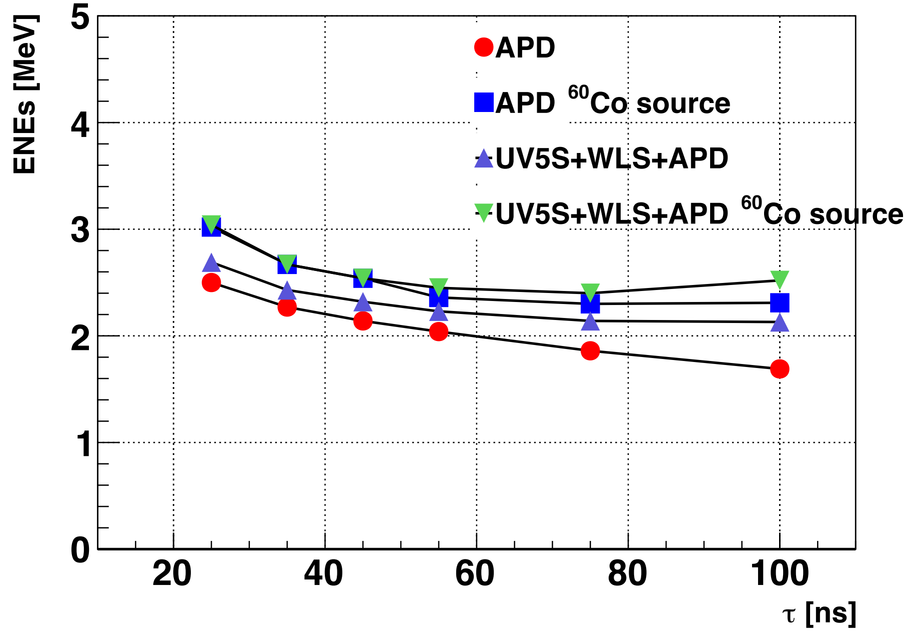


Photo-pentode

Photo-pentode energy resolution

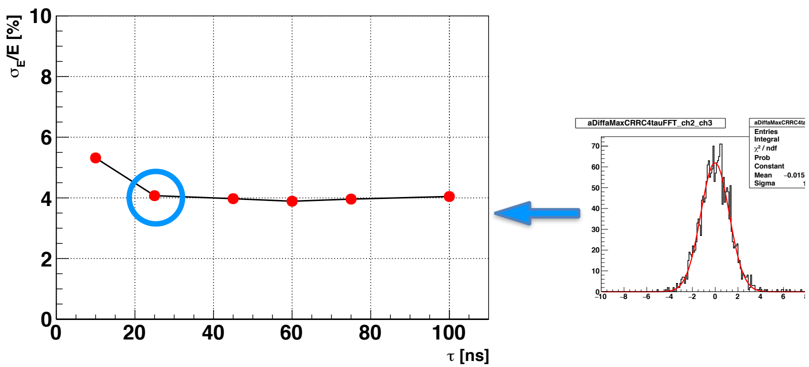
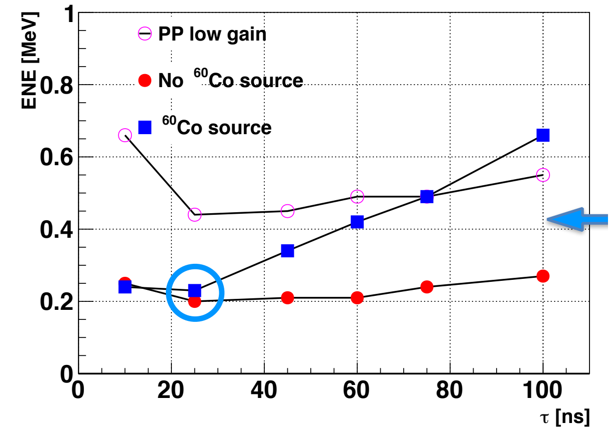
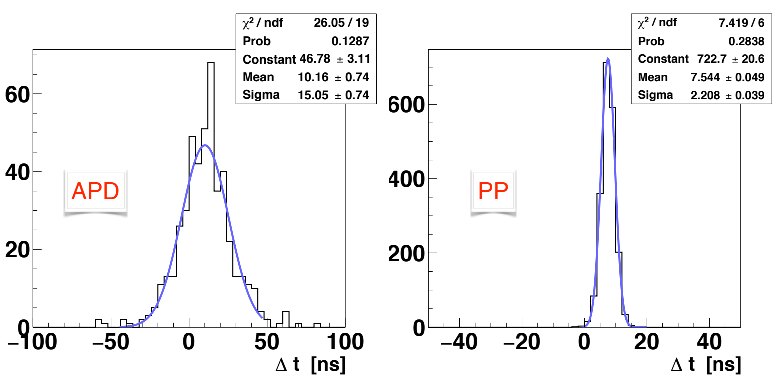


Photo-pentode EN



- High S/N ratio ==> small ENE
- τ=25ns optimal both for ENE and resolution

Photo-pentode time resolution (pure CsI)



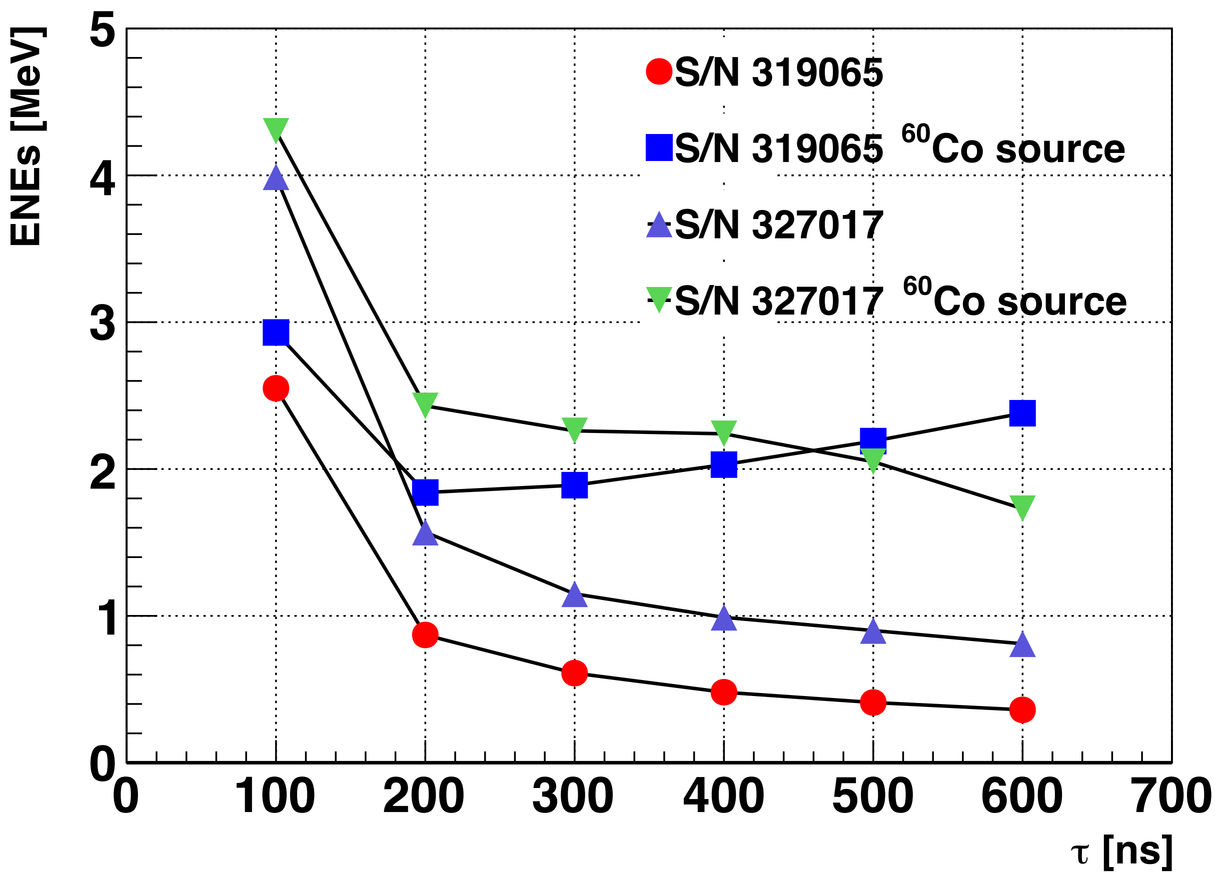
- σ_t (APD @ τ=45ns) ~ 7.5ns
- σ_t (PP @ τ=25ns) ~ 1.6ns

CsI(Tl) - reference crystal

319065 reference
327017 700 Gy

2 pin diodes

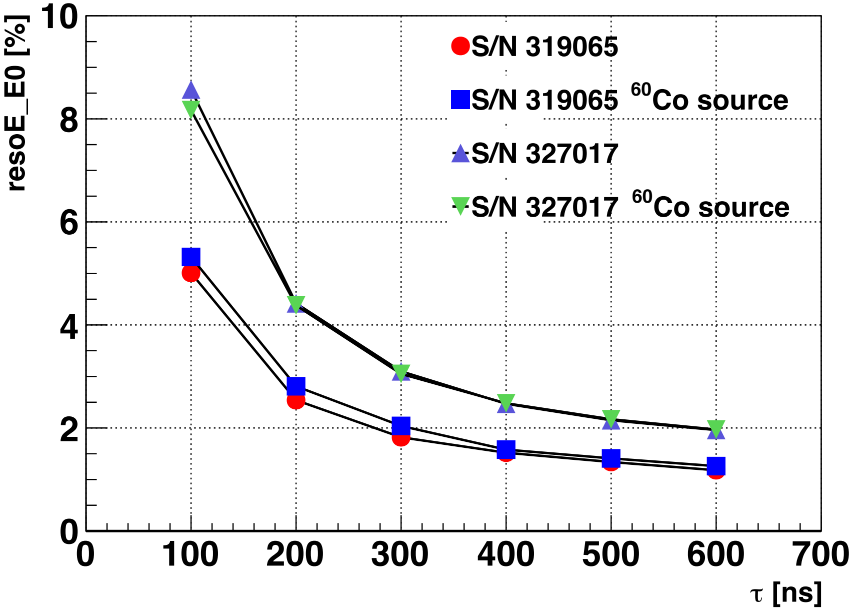
Pile-up noise



CsI(Tl) - reference crystal

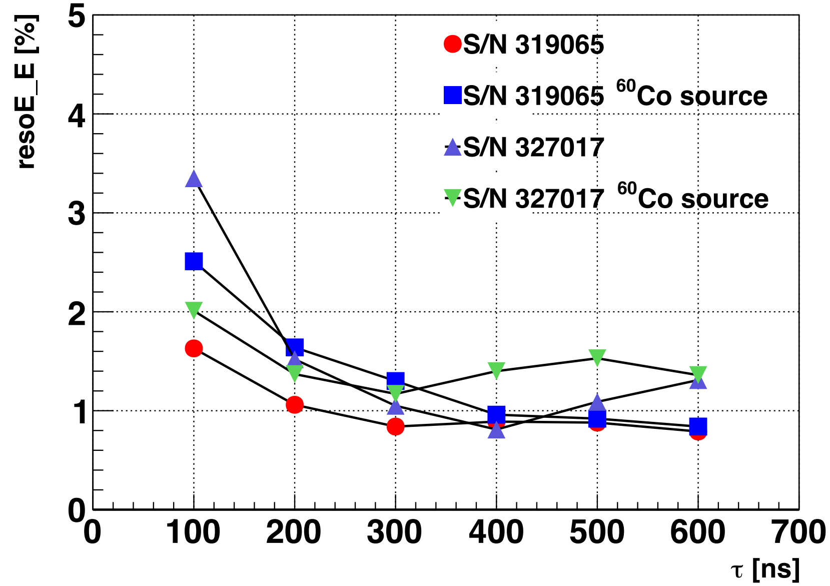
319065 reference
327017 700 Gy

2 pin diodes



Energy resolution

Stochastic only



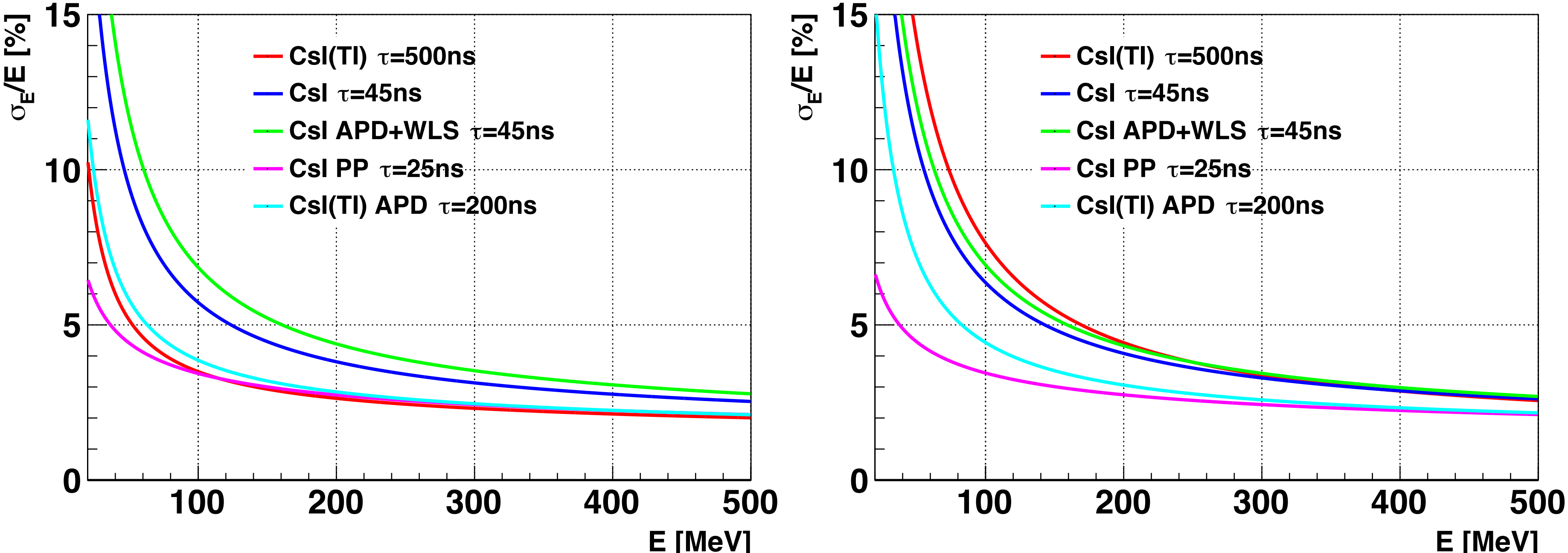
Relative energy resolution

- Parameterised as

$$\frac{\sigma_E}{E} = \frac{a}{E} \oplus \frac{b}{\sqrt{E}} \oplus \frac{c}{\sqrt[4]{E}} \oplus d$$

- We use the values of the Belle II TDR for the constant term **d=1.43%**, and for the one related to shower containment **c=0.81%**.
- For the other terms, we use measurements on single crystals from the cosmic muon setup

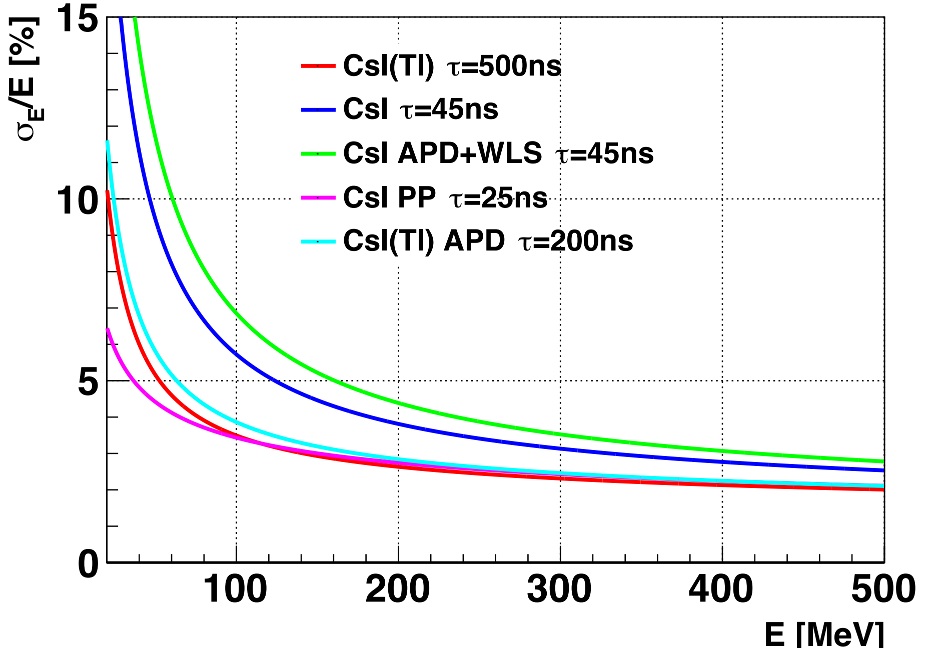
ECL energy resolution



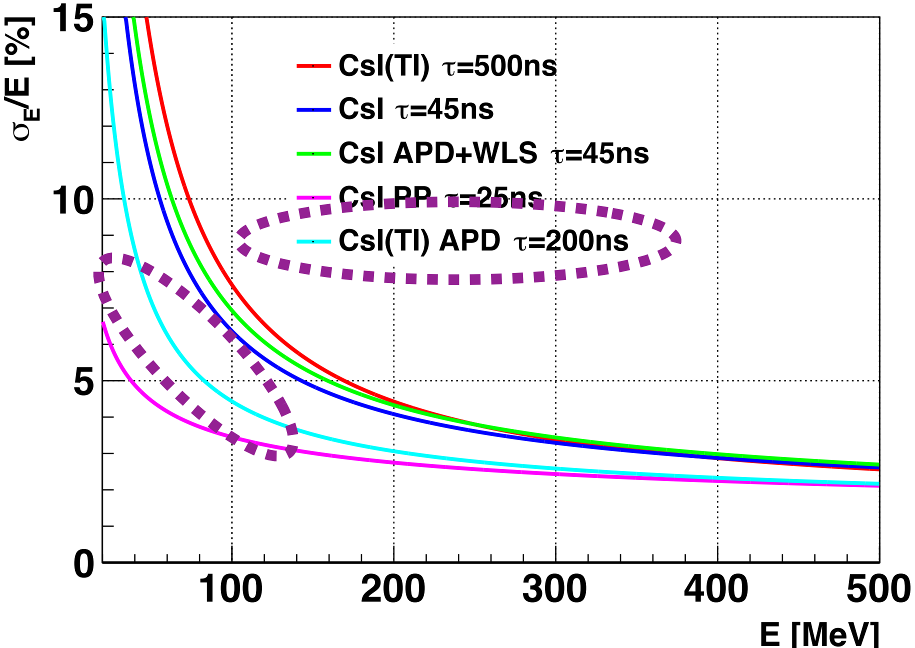
No ^{60}Co source

With ^{60}Co source

ECL energy resolution

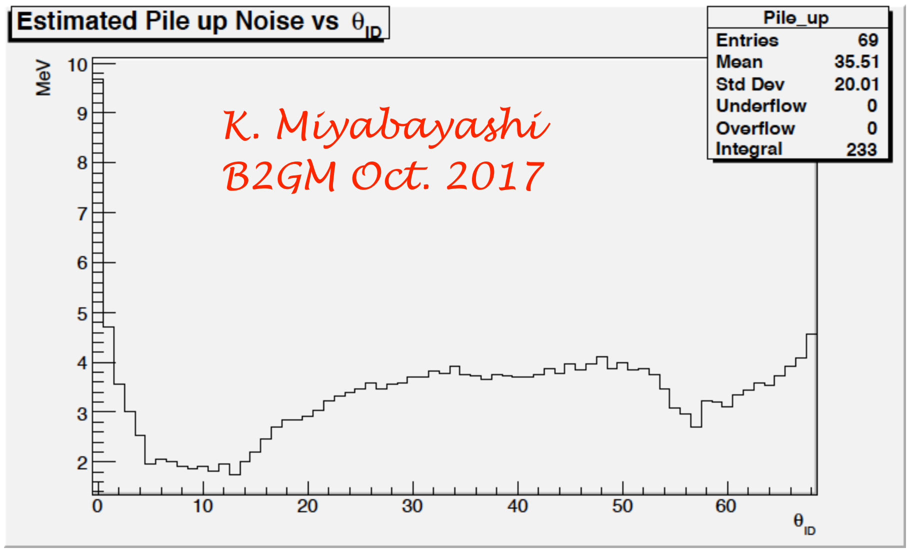


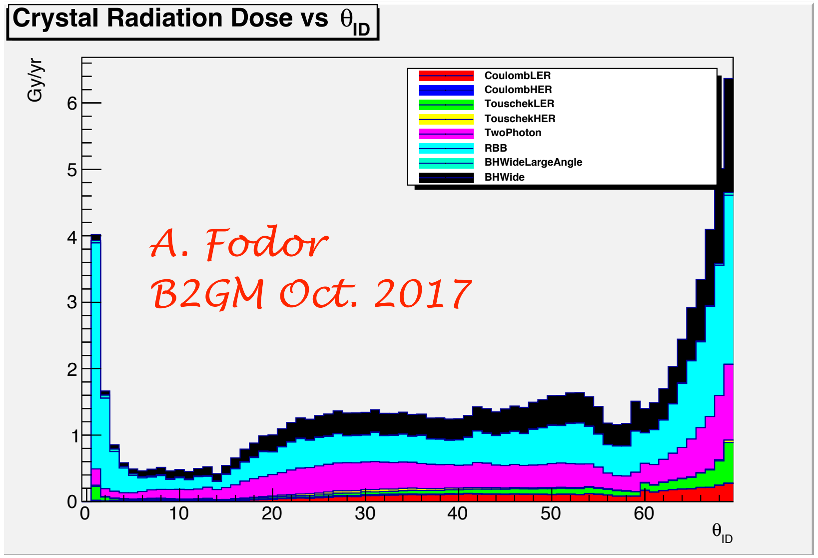
No ^{60}Co source



With ^{60}Co source

Belle II background predictions in ECL





i.e., with the exception of the first three rings, the pile-up noise is *smaller* in the FWD endcap than elsewhere (the full MC says).

- Adding photosensors to the Belle CsI(Tl) crystals should be considered as a way to improve robustness against background (at a relatively low cost), both in the endcaps and in the barrel.

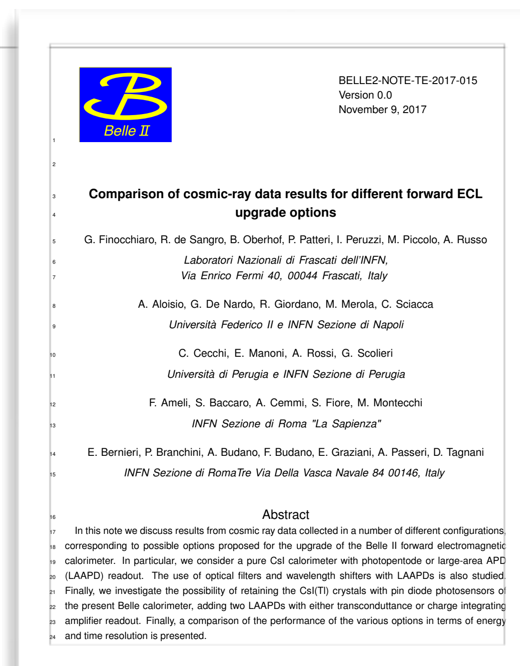
Conclusions and outlook

Adding photosensors to the Belle CsI(Tl) crystals should be considered as a way to improve robustness against background (at a relatively low cost), both in the endcaps and in the barrel.

Conclusions and outlook

Adding photosensors to the Belle CsI(Tl) crystals should be considered as a way to improve robustness against background (at a relatively low cost), both in the endcaps and in the barrel.

Belle2 note in preparation


Belle II

BELLE2-NOTE-TE-2017-015
Version 0.0
November 9, 2017

Comparison of cosmic-ray data results for different forward ECL upgrade options

G. Finocchiaro, R. de Sangro, B. Oberhof, P. Patteri, I. Peruzzi, M. Piccolo, A. Russo

Laboratori Nazionali di Frascati dell'INFN, Via Enrico Fermi 40, 00044 Frascati, Italy

A. Aloisio, G. De Nardo, R. Giordano, M. Merola, C. Sciacca

Università Federico II e INFN Sezione di Napoli

C. Cecchi, E. Manoni, A. Rossi, G. Scolieri

Università di Perugia e INFN Sezione di Perugia

F. Ameli, S. Baccaro, A. Cemmi, S. Fiore, M. Montecchi

INFN Sezione di Roma "La Sapienza"

E. Bernieri, P. Branchini, A. Budano, F. Budano, E. Graziani, A. Passeri, D. Tagnani

INFN Sezione di RomaTre Via Della Vasca Navale 84 00146, Italy

Abstract

In this note we discuss results from cosmic ray data collected in a number of different configurations, corresponding to possible options proposed for the upgrade of the Belle II forward electromagnetic calorimeter. In particular, we consider a pure CsI calorimeter with photopentode or large-area APD (LAAPD) readout. The use of optical filters and wavelength shifters with LAAPDs is also studied. Finally, we investigate the possibility of retaining the CsI(Tl) crystals with pin diode photosensors of the present Belle calorimeter, adding two LAAPDs with either transconduttance or charge integrating amplifier readout. Finally, a comparison of the performance of the various options in terms of energy and time resolution is presented.