

## Introduction

- Anti-neutrinos from reactors are excellent probes for monitoring reactor power and its core composition as well as for sterile neutrino searches, as also being planned with “Indian Scintillator Matrix for Reactor Anti-Neutrino” - (ISMРАН) [1][2].
- Apart from reactor related background, cosmogenic neutrons and muons related background will also be encountered inside the reactor hall.
- A good understanding of cosmogenic background in Plastic Scintillator Bars (PSBs) in a matrix, is an essential prerequisite for understanding the non-reactor background to estimate their uncertainties.

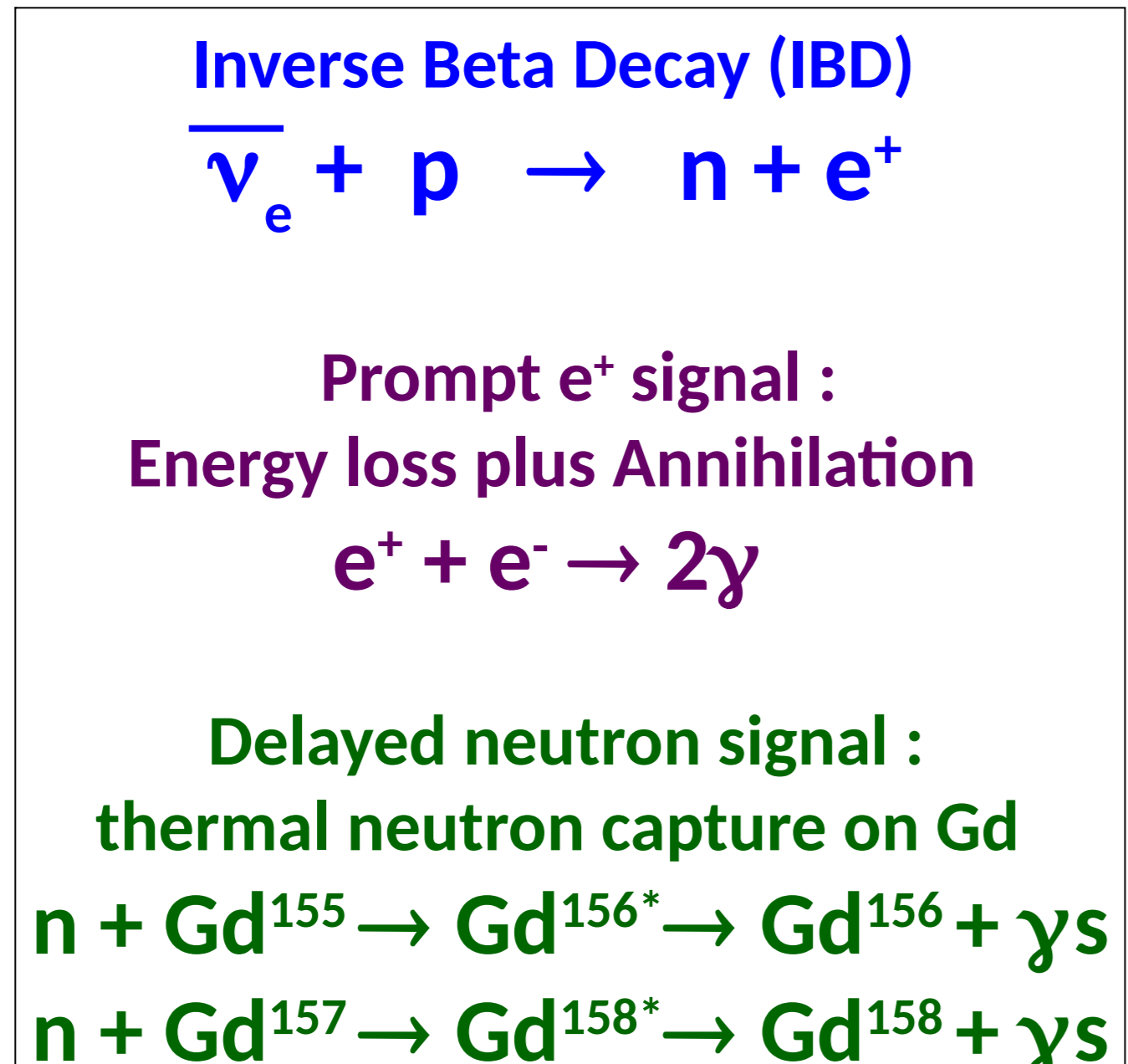
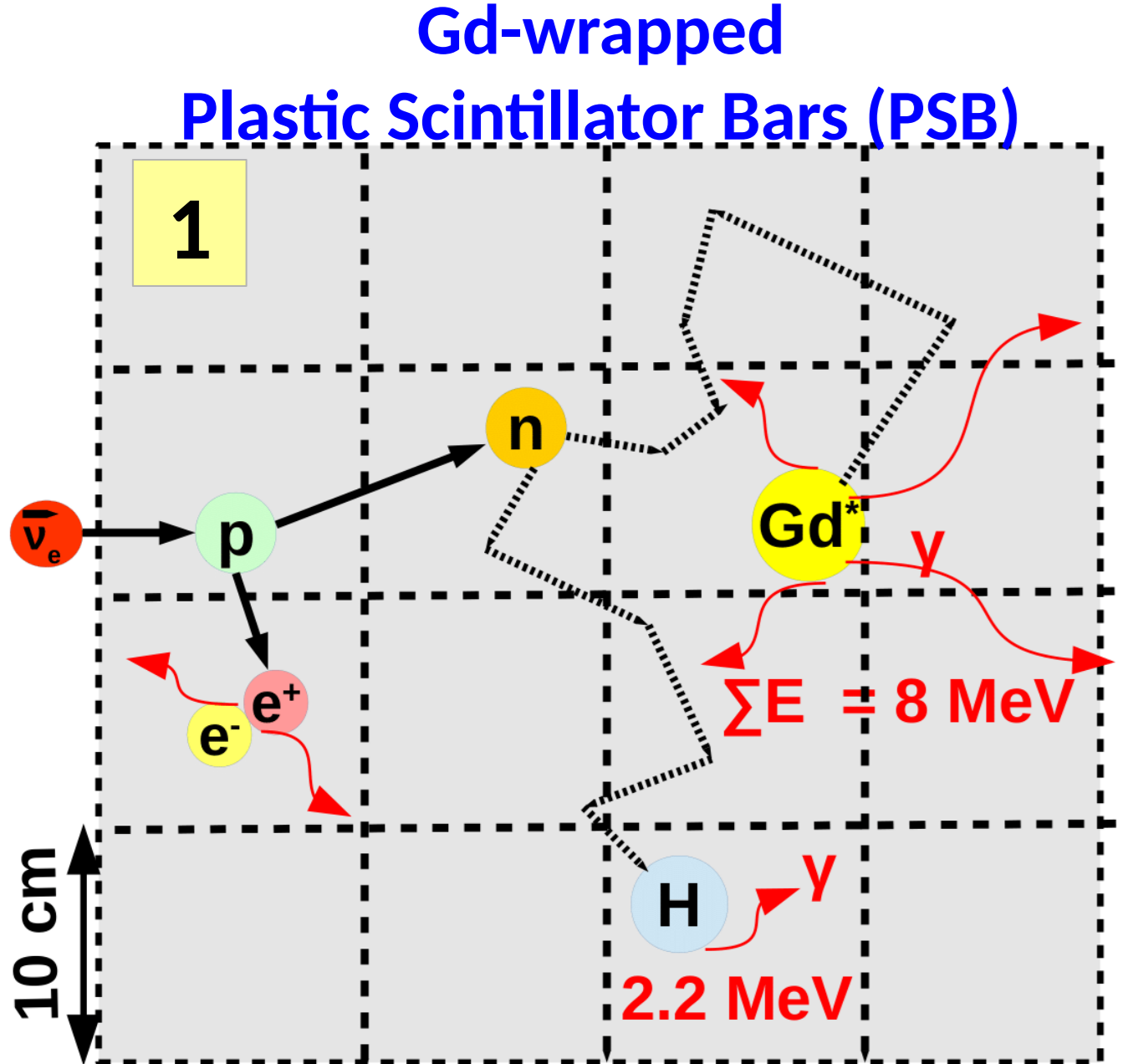


Fig 1 : IBD event inside a PSB matrix

## Experimental Setup

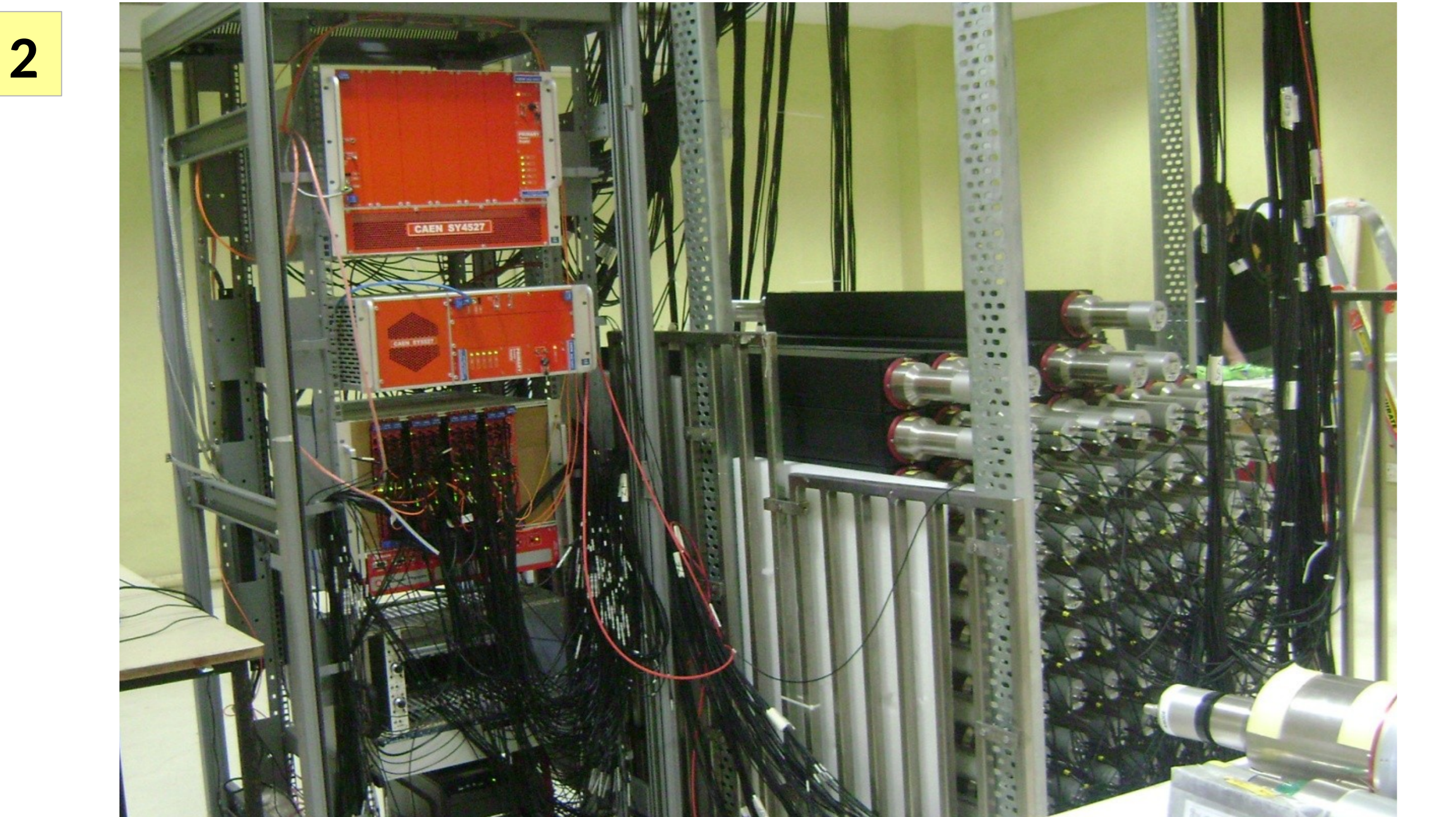


Fig 2 : ISMRAN matrix (9 x 9) in a non-reactor environment with High Voltage Power Supply and Digitizers.

- Each PSB is 100 cm long with a cross-section of (10 × 10) cm<sup>2</sup>, wrapped with Gadolinium Oxide coated on aluminized mylar foils.
- Three inch diameter, PMTs are coupled at the both ends of each PSB.

Cell8	Cell5	Cell2
Cell7	Cell4	Cell1
Cell6	Cell3	Cell0

## Data Analysis

The characterization of the different non-reactor, cosmogenic background is done on the basis of cell arrangement consisting of 9 PSBs in each cell.

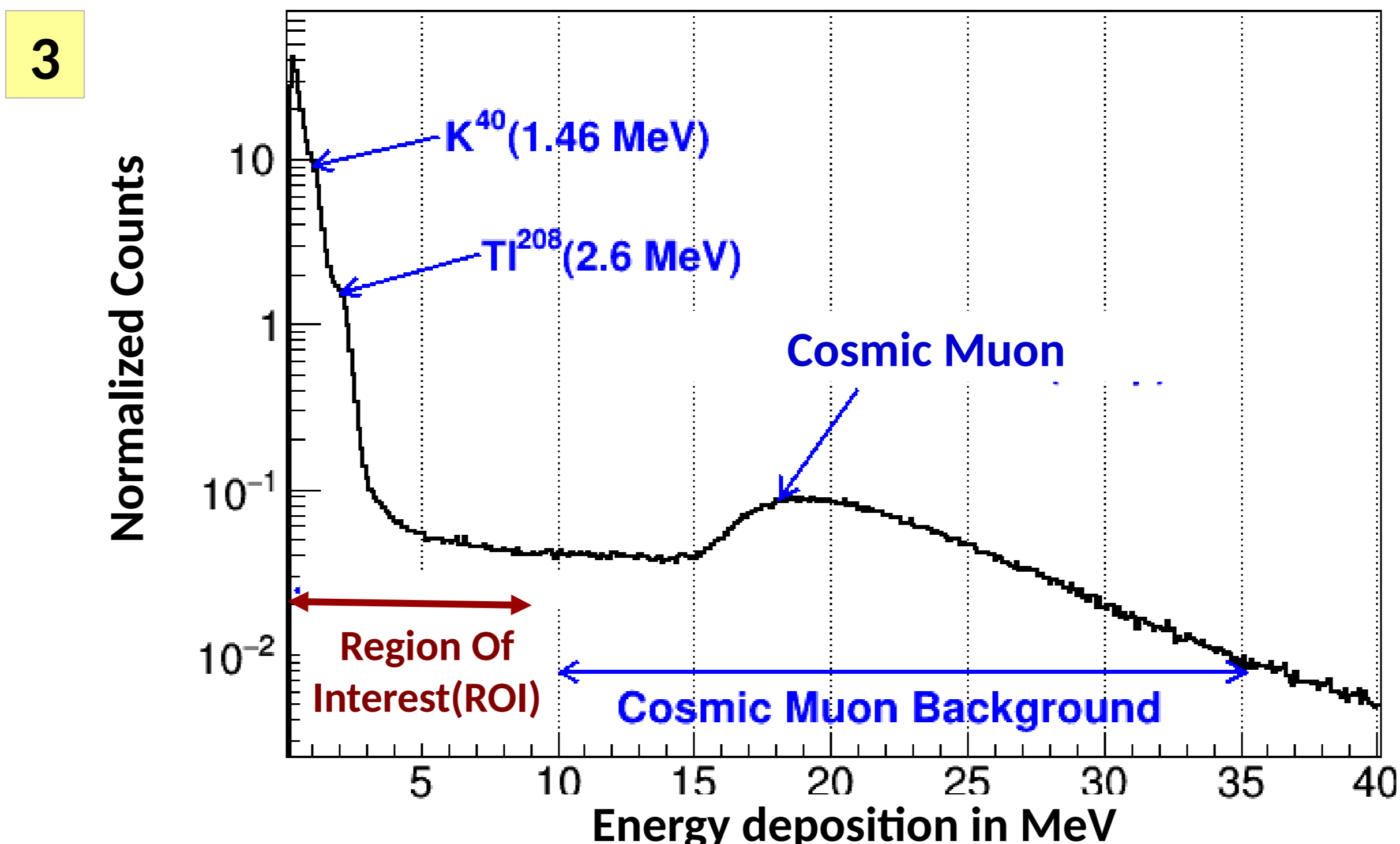


Fig 3 : Energy deposition spectrum in a single PSB in a non-reactor environment. The spectrum has two regions : (a) Region Of Interest (ROI) for IBD ; (b) Cosmic Muon background region

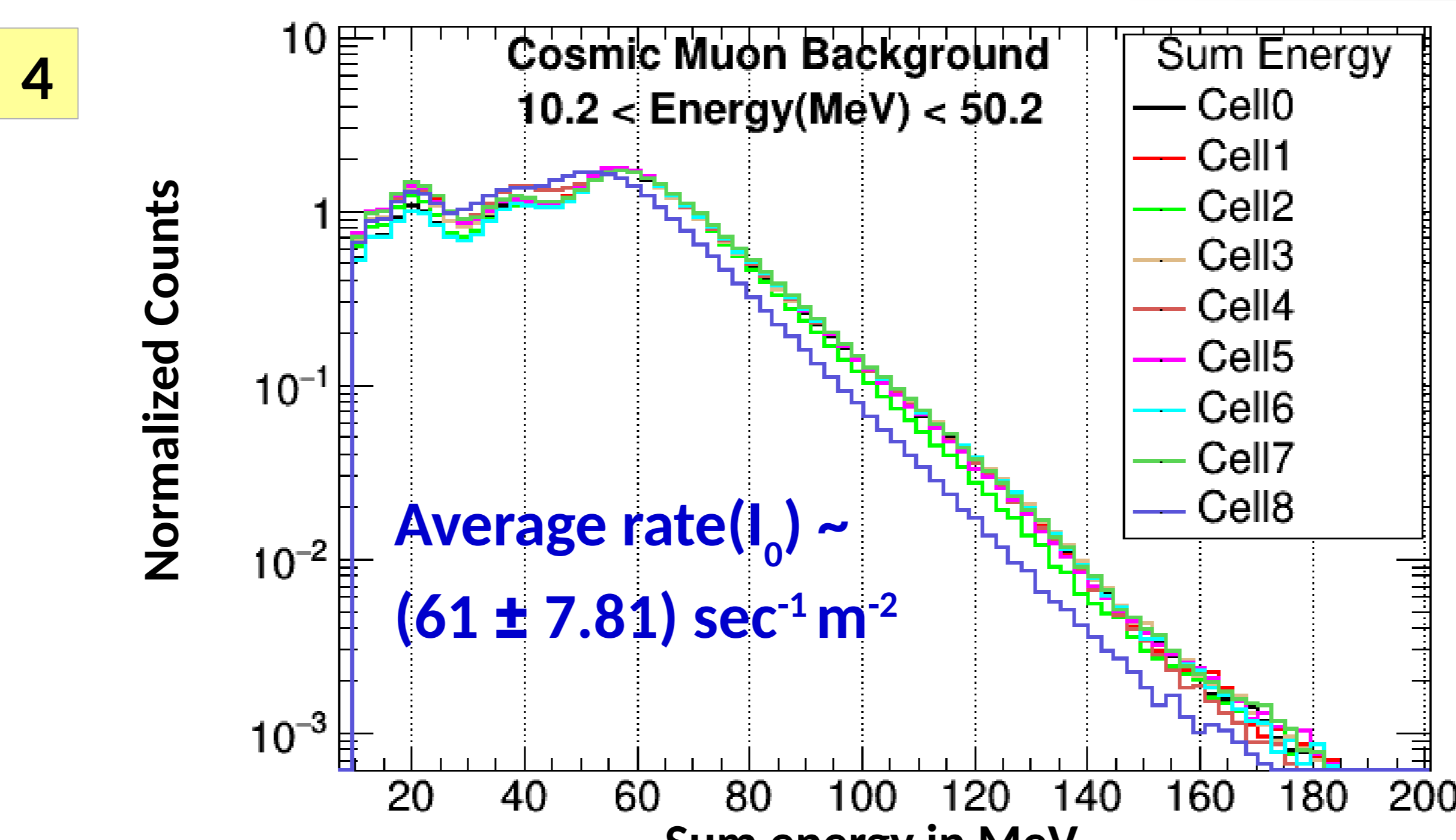


Fig 4 : Cellwise, Sum energy deposition spectrum of cosmic muon with energy cut [10.2 MeV-50.2 MeV]. The event by event sum energy distribution peaks at ~ 20 MeV (Single multiplicity), ~40 (Double multiplicity) MeV, ~ 60 MeV (Triple multiplicity).

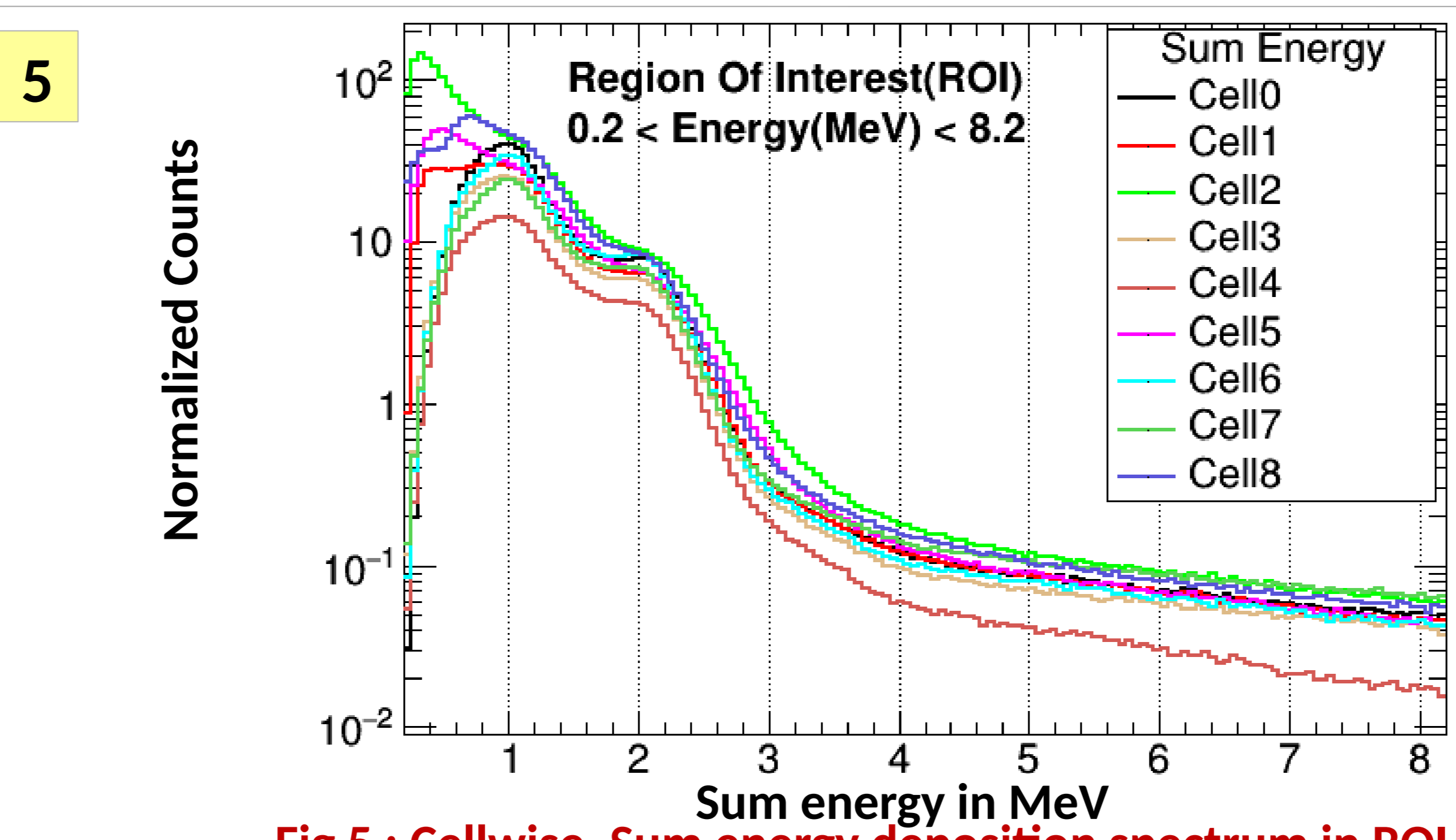


Fig 5 : Cellwise, Sum energy deposition spectrum in ROI with energy cut [0.2 MeV- 8.2 MeV]. K<sup>40</sup> and TI<sup>208</sup> are natural radioactive backgrounds, giving γ of energy 1.46 MeV and 2.6 MeV respectively in our ROI in the PSBs.

## Measurements

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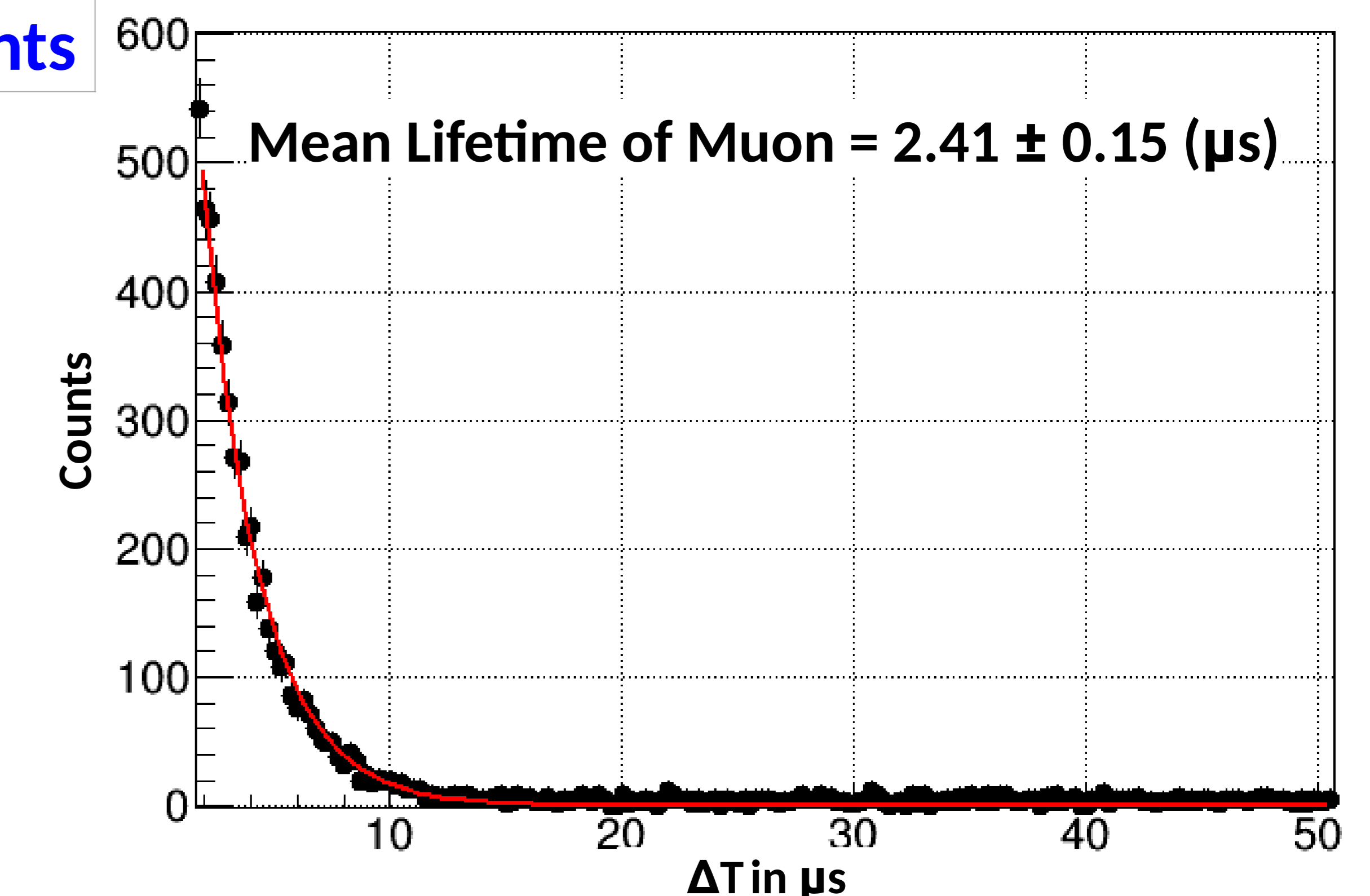


Fig 6: ΔT distribution between Stopped Muon (SM) and muon correlated Michel electron events.

- Timing difference (ΔT) distribution between SM tagged events (Prompt) and SM correlated events (Delayed : Decay (Michel electrons)) within the time window (0.1 < ΔT (μs) < 50.1).

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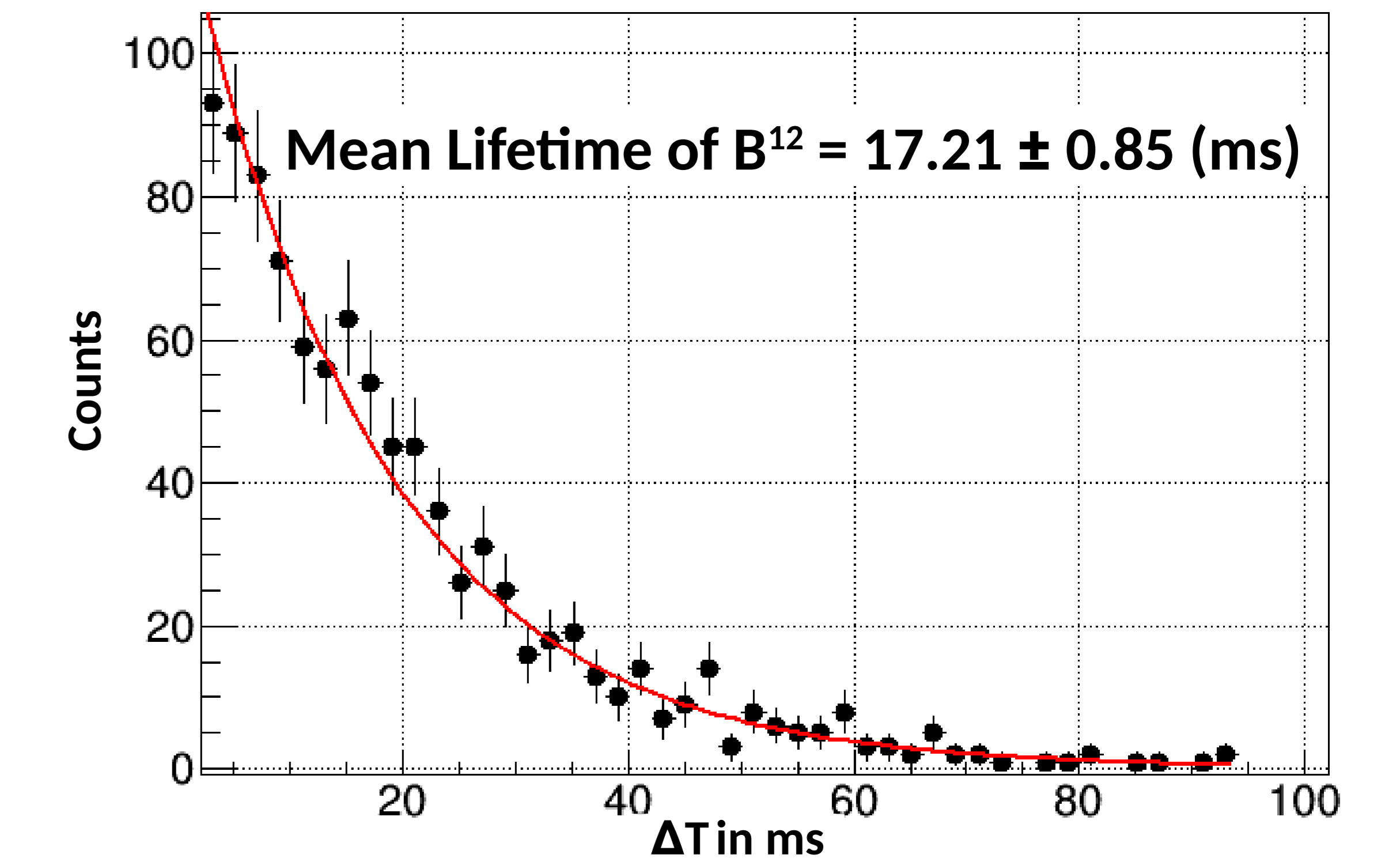


Fig 7: ΔT distribution between SM and muon correlated B<sup>12</sup> events. Timing difference (ΔT) distribution between SM tagged events (Prompt) and SM correlated events (Delayed : Capture : C<sup>12</sup>(μ, ν)B<sup>12</sup> (β decay)) within the time window (0.2 < ΔT(ms) < 96.2).

## Conclusion & Outlook

- Sum energy distribution of natural radioactive background, cosmic muon and the timing characteristics of SM correlated events has been measured and studied.
- Sum energy distribution of SM correlated events, cosmogenic neutrons, muon spallated neutrons will be studied.
- These experimentally measured results will be useful for discriminating correlated and uncorrelated background events from true IBD events in reactor ON and OFF condition inside the Dhruva reactor hall, with the ISMRAN set up.

## References

[1] D. Mulmule et. al., NIM A 911(2018) 104-114.  
 [2] S.P. Behera, D.K. Mishra & L.M. Pant; Phys. Rev. D 102, 013002(2020).  
 W<sup>+</sup>IV 2021, The 28<sup>th</sup> International Workshop on Weak Interactions and Neutrinos-Online, University of Minnesota, USA, June 7-12, 2021