

# Towards Future Upgrades of JUNO: Cherenkov-Scintillation Separation Enhancing Background Suppression for Rare Events Search

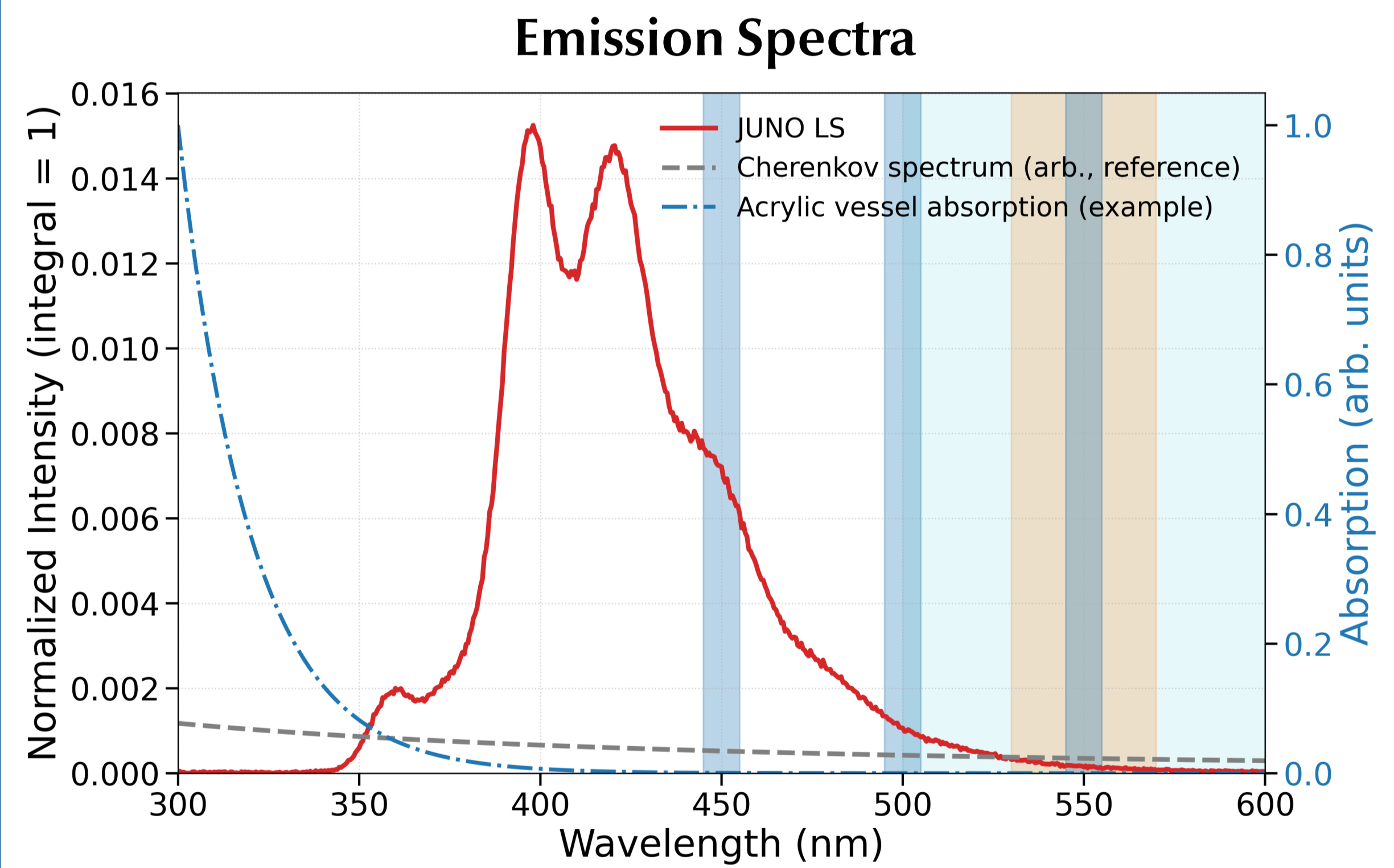
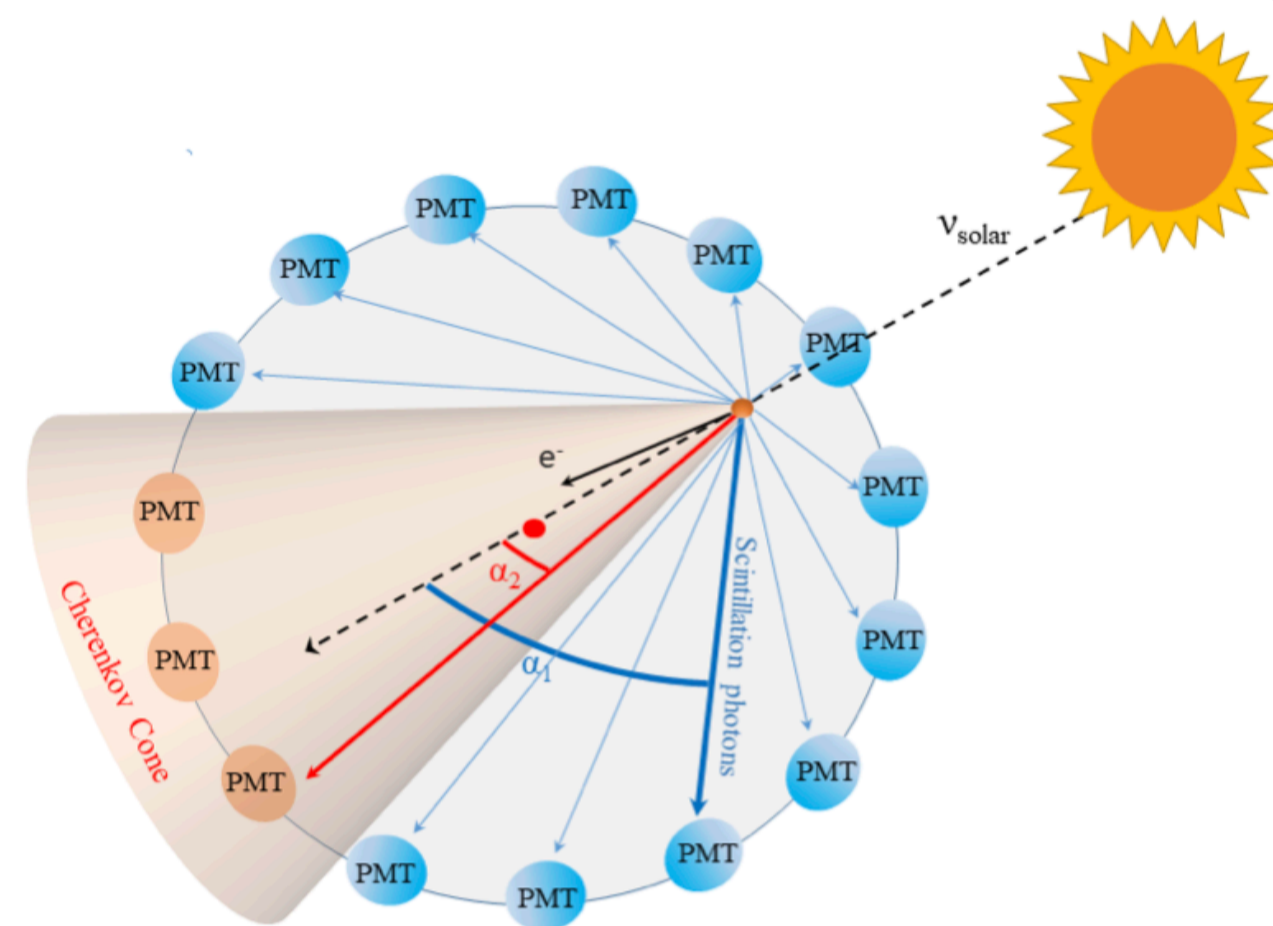
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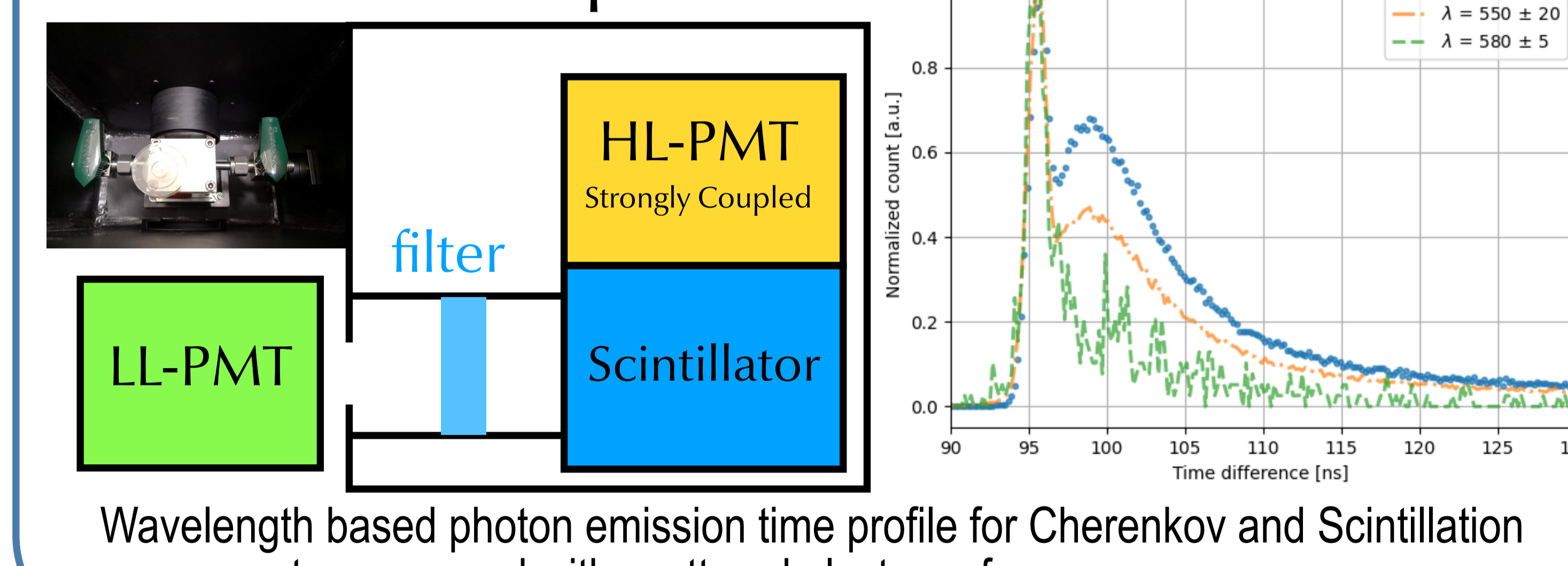
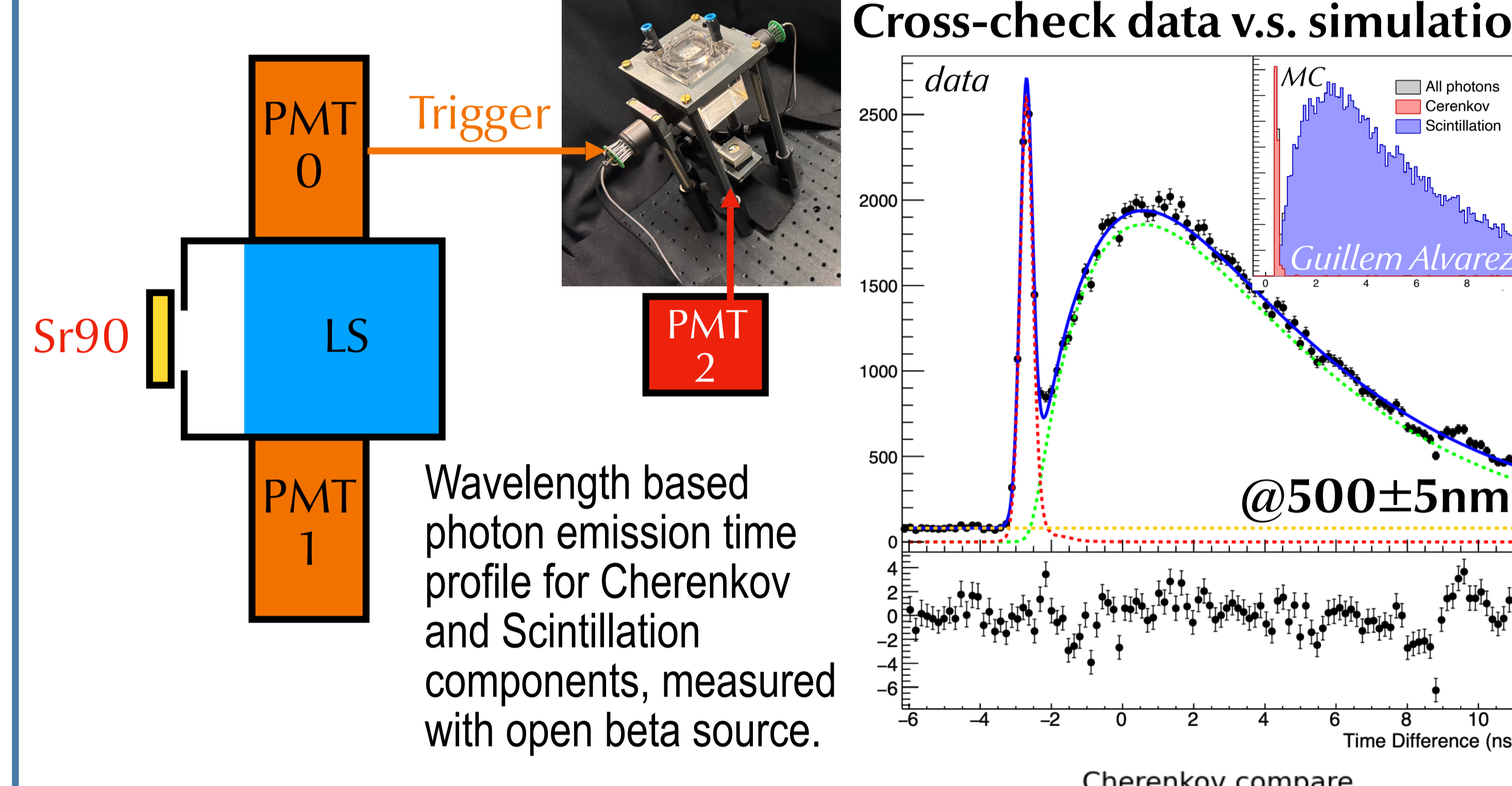
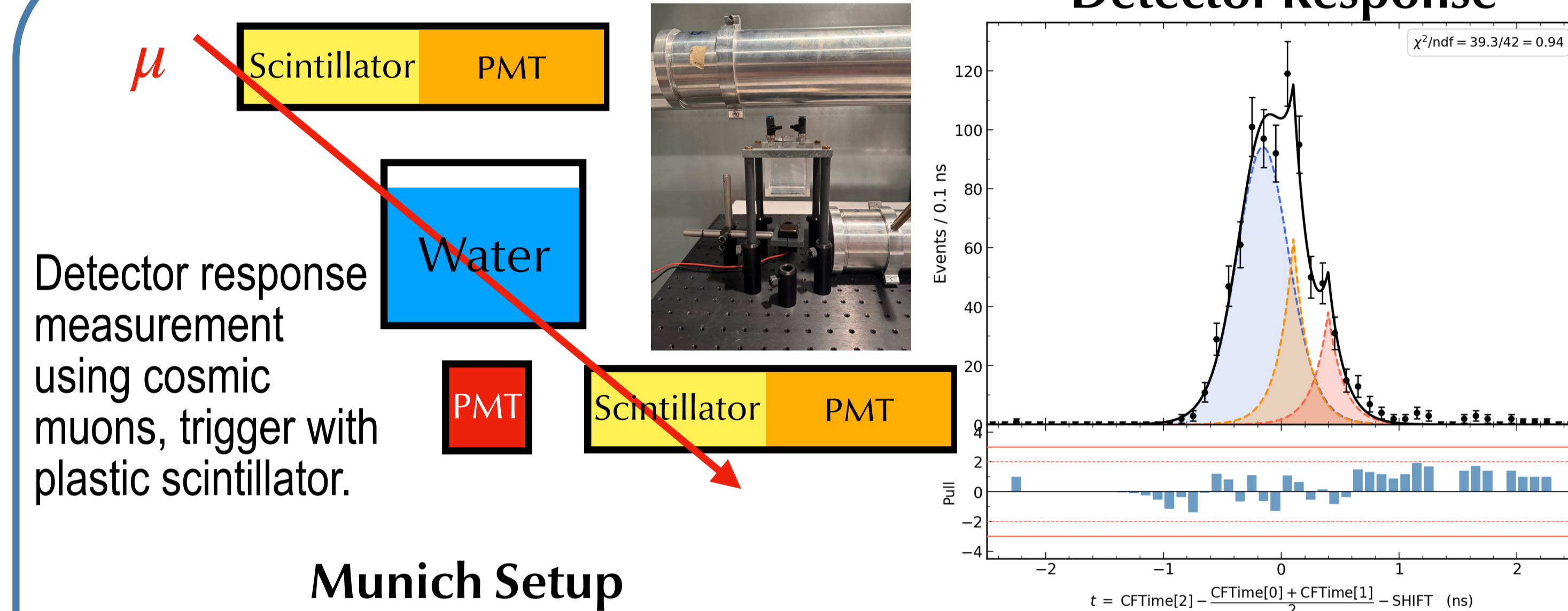
## Introduction & Motivation

To enhance the sensitivity to rare event searches in possible future upgrades of the JUNO detector, including the diffuse supernova neutrino background (DSNB) and neutrinoless double beta decay ( $0\nu\beta\beta$ ). A promising approach is the separation of Cherenkov and scintillation light.

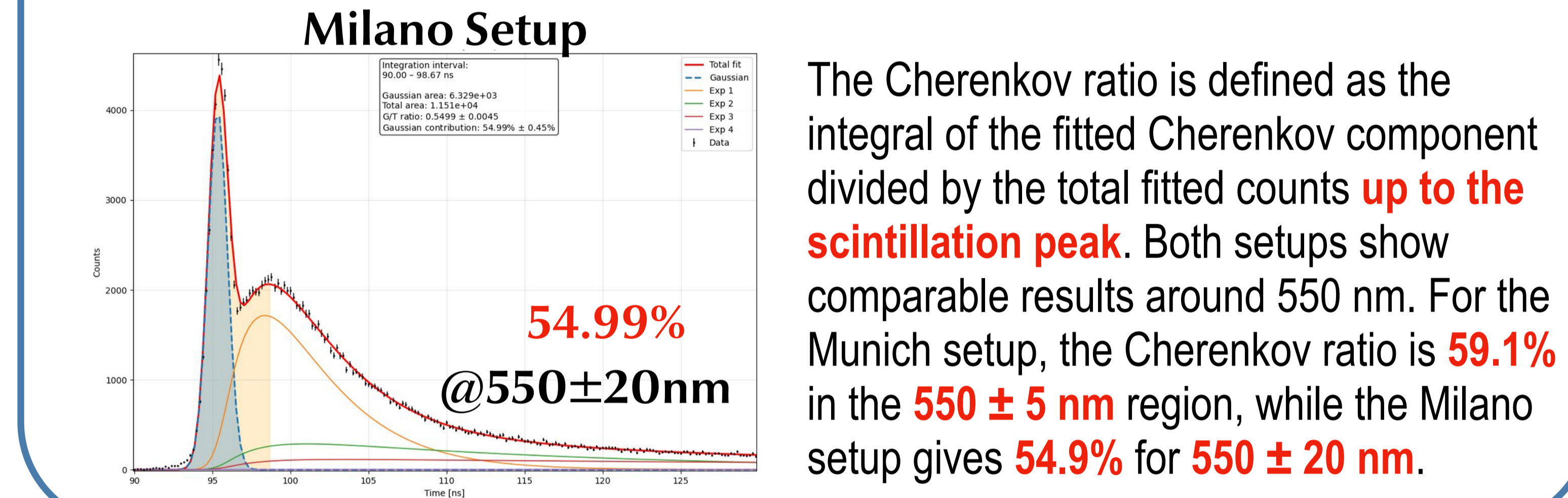
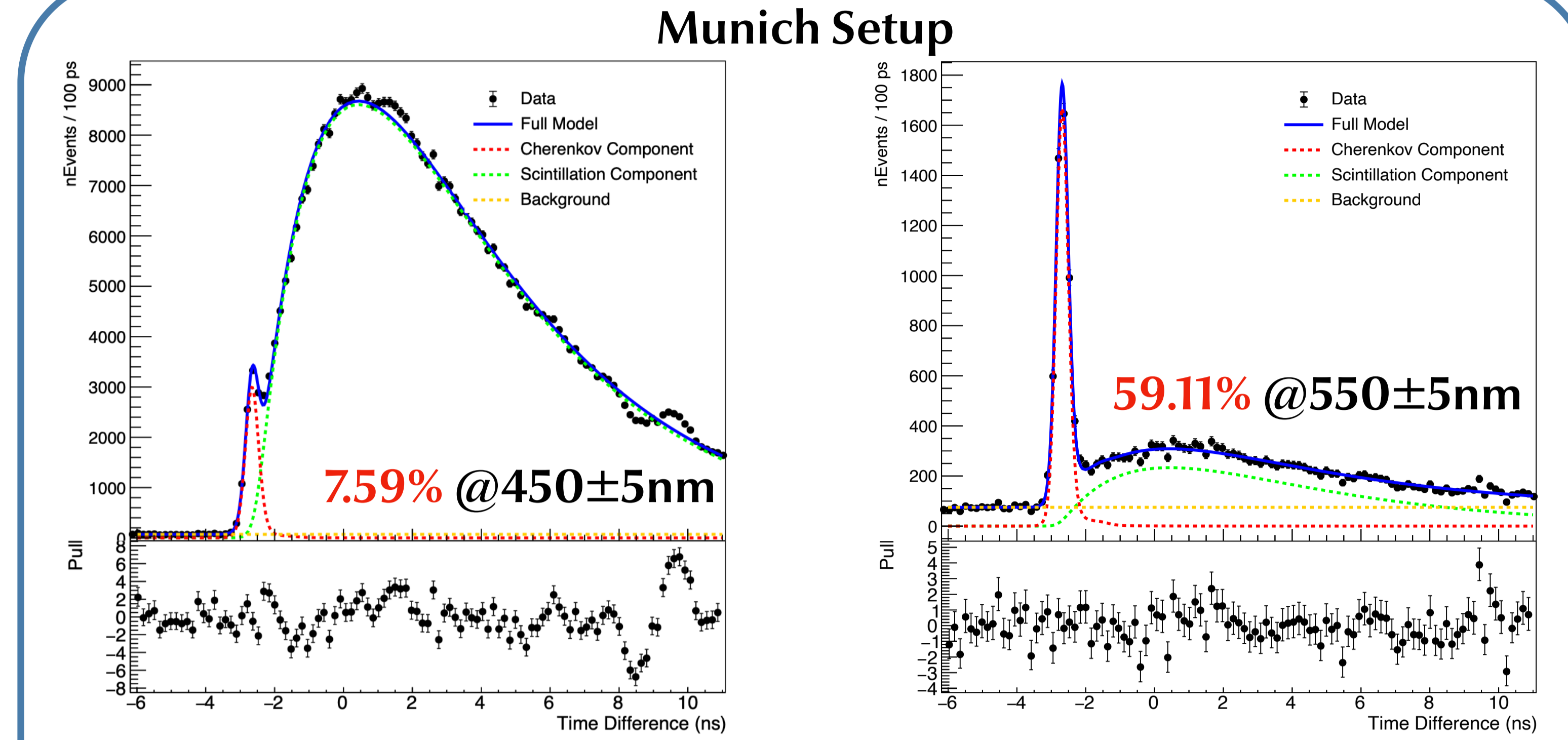


- High light yield** → excellent energy resolution;
- Large target volume** → substantial isotope mass for  $0\nu\beta\beta$  searches with loading
- Ch-Sc Separation & Hybrid Detection for Background Suppression:**
  - For  $0\nu\beta\beta$  searches: addressing **inevitable Solar- $\nu$**  backgrounds;
  - Additional Cherenkov ring counting bkg rejection;
  - For DSNB searches: combing algorithms from Cherenkov and scintillation detectors, further suppressing NC background from atmospheric  $\nu$  in JUNO-like scenario.

## Experimental Setups



## Wavelength based Ch-Sc Separation Study



The Cherenkov ratio is defined as the integral of the fitted Cherenkov component divided by the total fitted counts **up to the scintillation peak**. Both setups show comparable results around 550 nm. For the Munich setup, the Cherenkov ratio is **59.1%** in the **550 ± 5 nm** region, while the Milano setup gives **54.9%** for **550 ± 20 nm**.

## Conclusions & Outlook

Table-top experiments and wavelength-based studies have validated Cherenkov-scintillation separation in organic LS. Ongoing work explores sensitivity improvements in large JUNO-like hybrid detectors using bandpass-coated PMTs.

**Ideal simulation of possible upgraded OSIRIS detector (ton scale) with  $0\nu\beta\beta$  candidates**

Coating certain fraction of PMTs in a JUNO-like scenario

## References

- [1] M. Beretta et al, "Fluorescence emission of the JUNO liquid scintillator", 2025 JINST 20 P05009, 10.1088/1748-0221/20/05/P05009
- [2] M. Lu et al, Quantitative study of Cherenkov and scintillation separation in novel scintillators using a table-top setup, in preparation.