Extraction of the neutrino rates in the STEREO experiment

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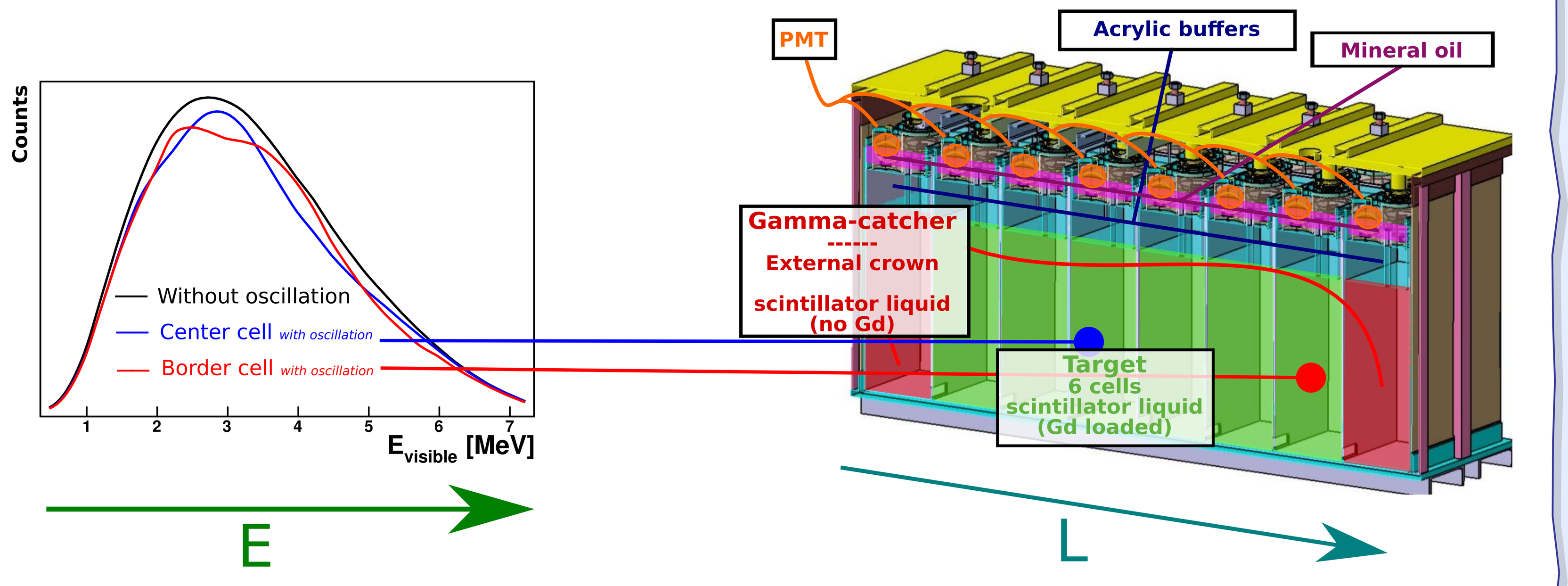
The STEREO experiment

Designed to probe the **Reactor Antineutrino Anomaly** (RAA) region, which can be explained by introducing a **light sterile neutrino** at the eV^2 scale.

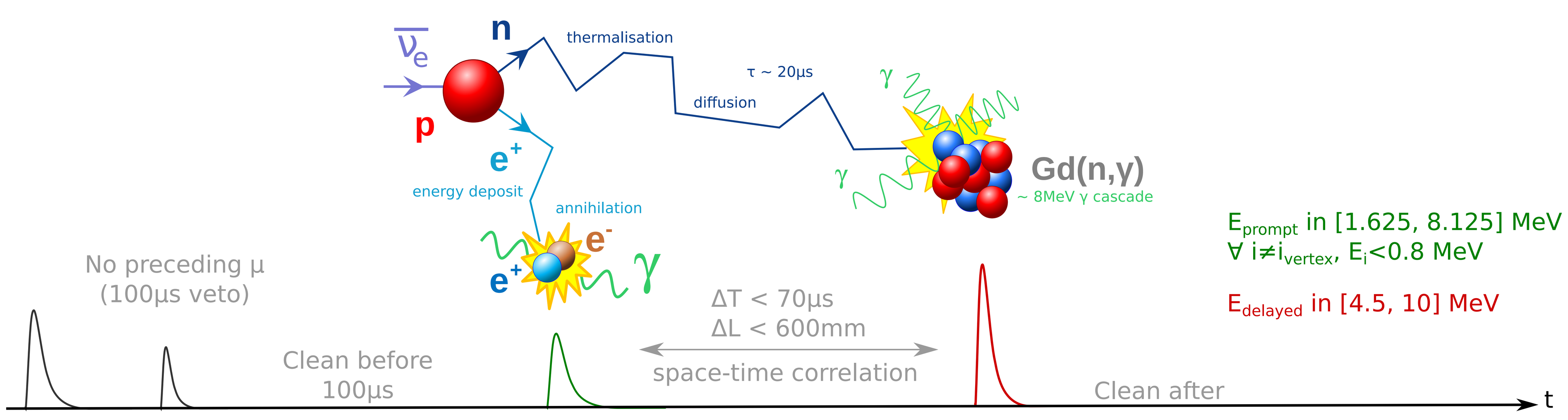
✓ 10 m from the **compact** and **highly ^{235}U enriched** reactor core at ILL (Grenoble, France)

✓ **Segmented** target filled with **Gd-doped liquid scintillator**

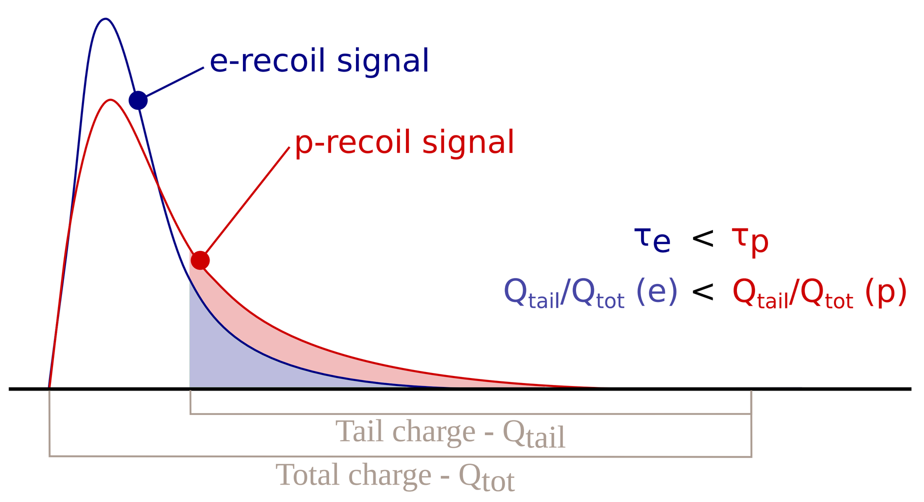
✓ Test the oscillation hypothesis with a **relative comparison** of the $\bar{\nu}_e$ energy distributions
→ reduced detection systematics and no reference to an external prediction



Neutrino detection principle

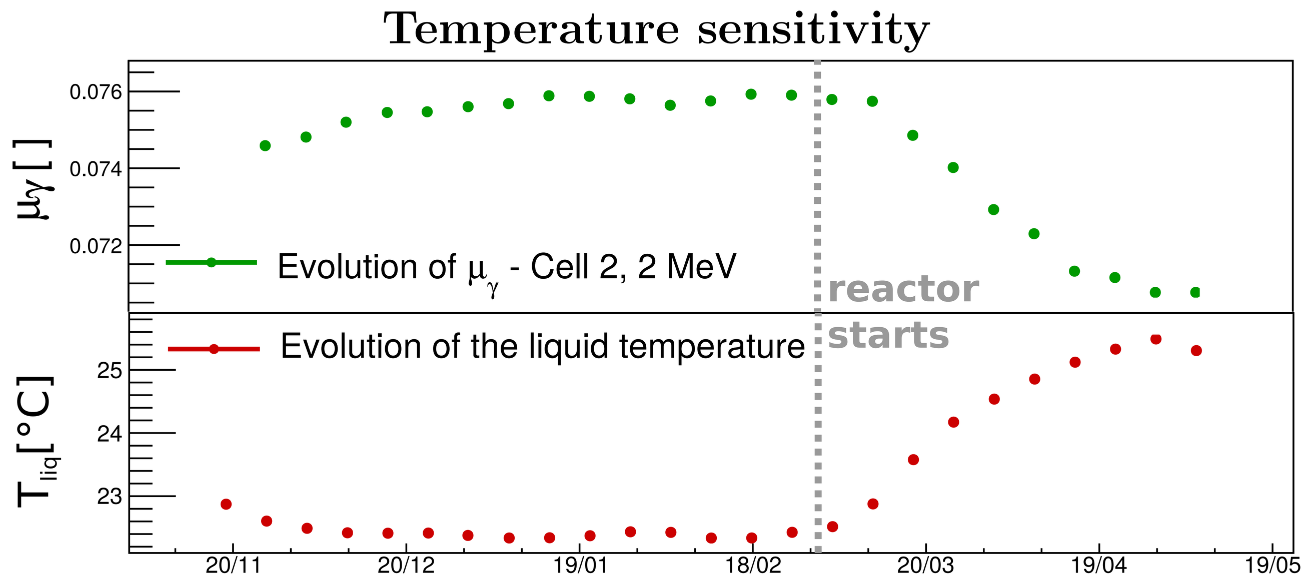


Pulse Shape Discrimination

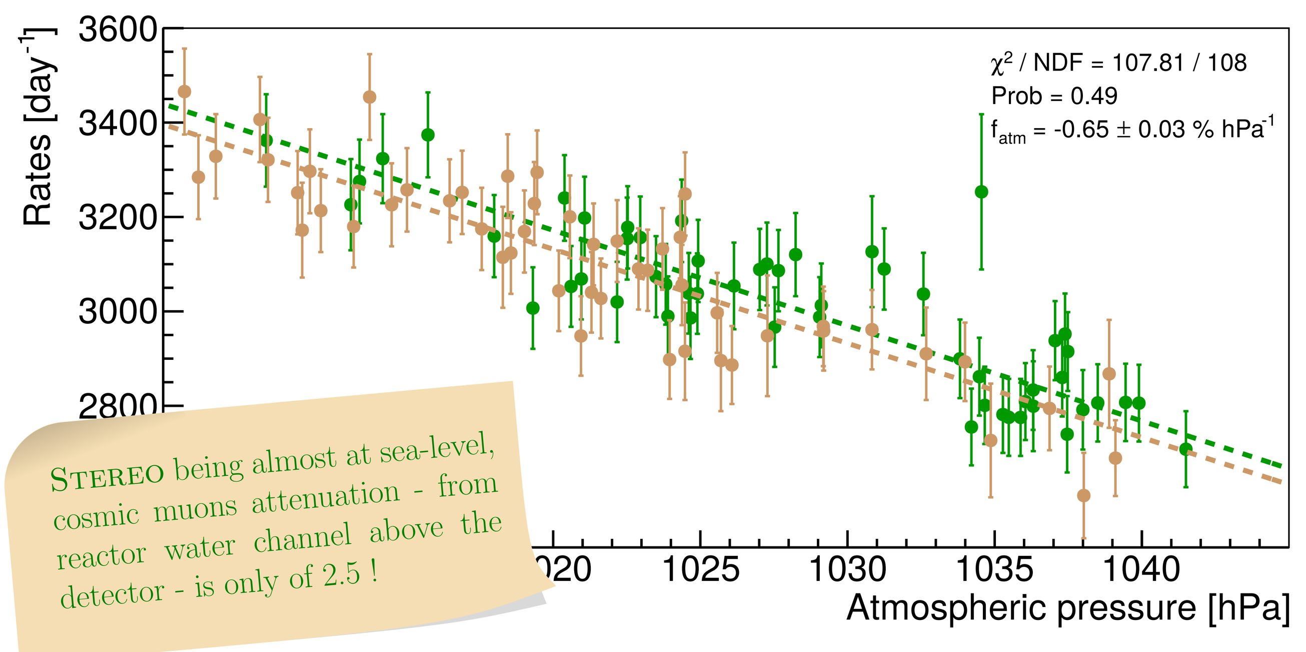


Environnemental conditions sensitivity

Temperature sensitivity

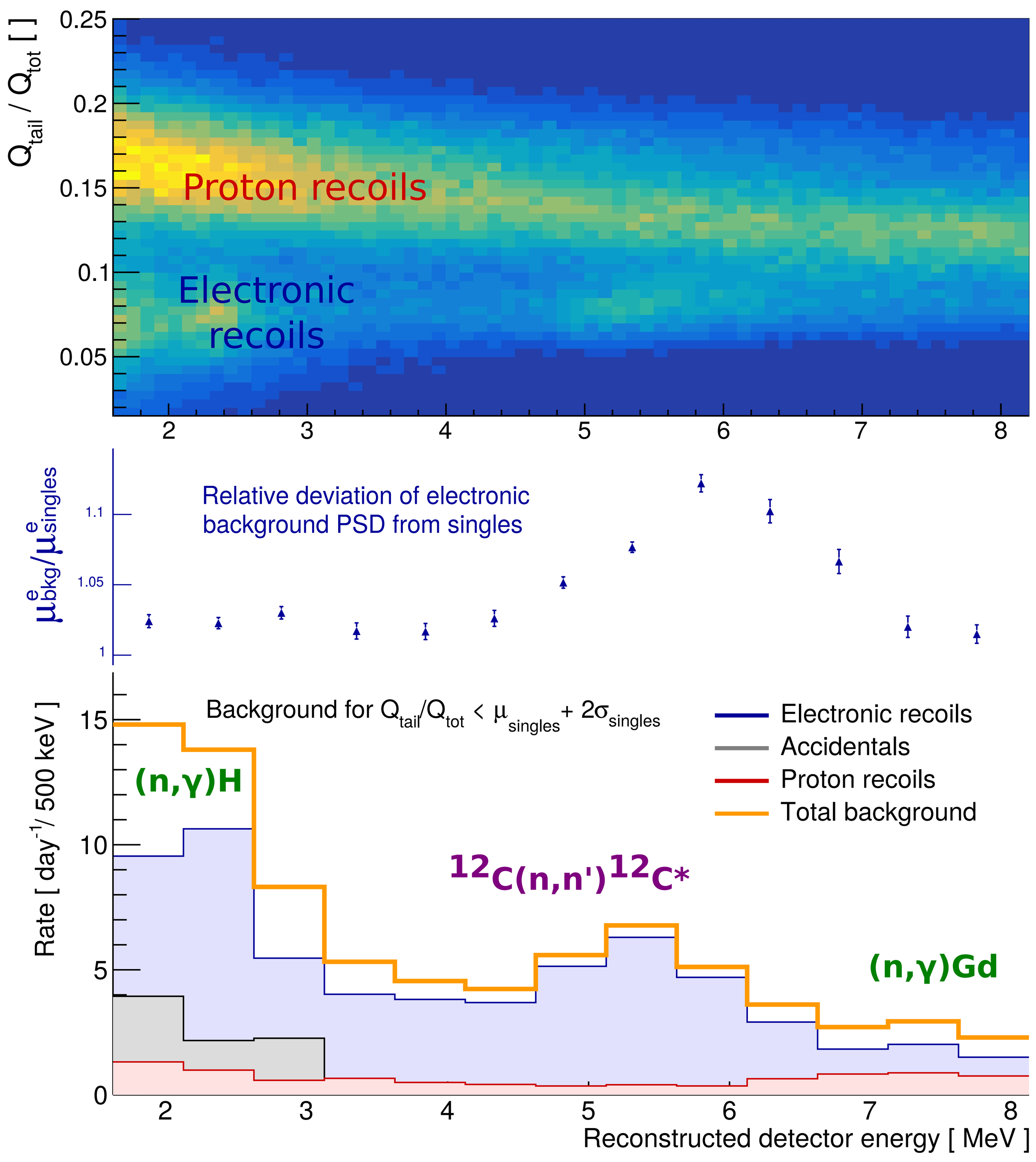


Atmospheric pressure correlation



Stereo being almost at sea-level, cosmic muons attenuation - from reactor water channel above the detector - is only of 2.5 !

Correlated background in STEREO



Identified components:

- **Muons stopping and decaying** in the top of the detector, rejection based on charge collection asymetry
- **^{12}C(n,n')^{12}C*** reactions, where the prompt event is a **mixing** between electronic and proton recoils.
- **Multiple neutron captures**, the prompt being either a 2.2 MeV γ or a 8 MeV γ cascade.
- **Fast neutrons** interacting in the liquid before being captured

From background parametrization to ν-rates extraction

The background PSD distribution can be parametrized by a multi-gaussian probability density function (p.d.f.)

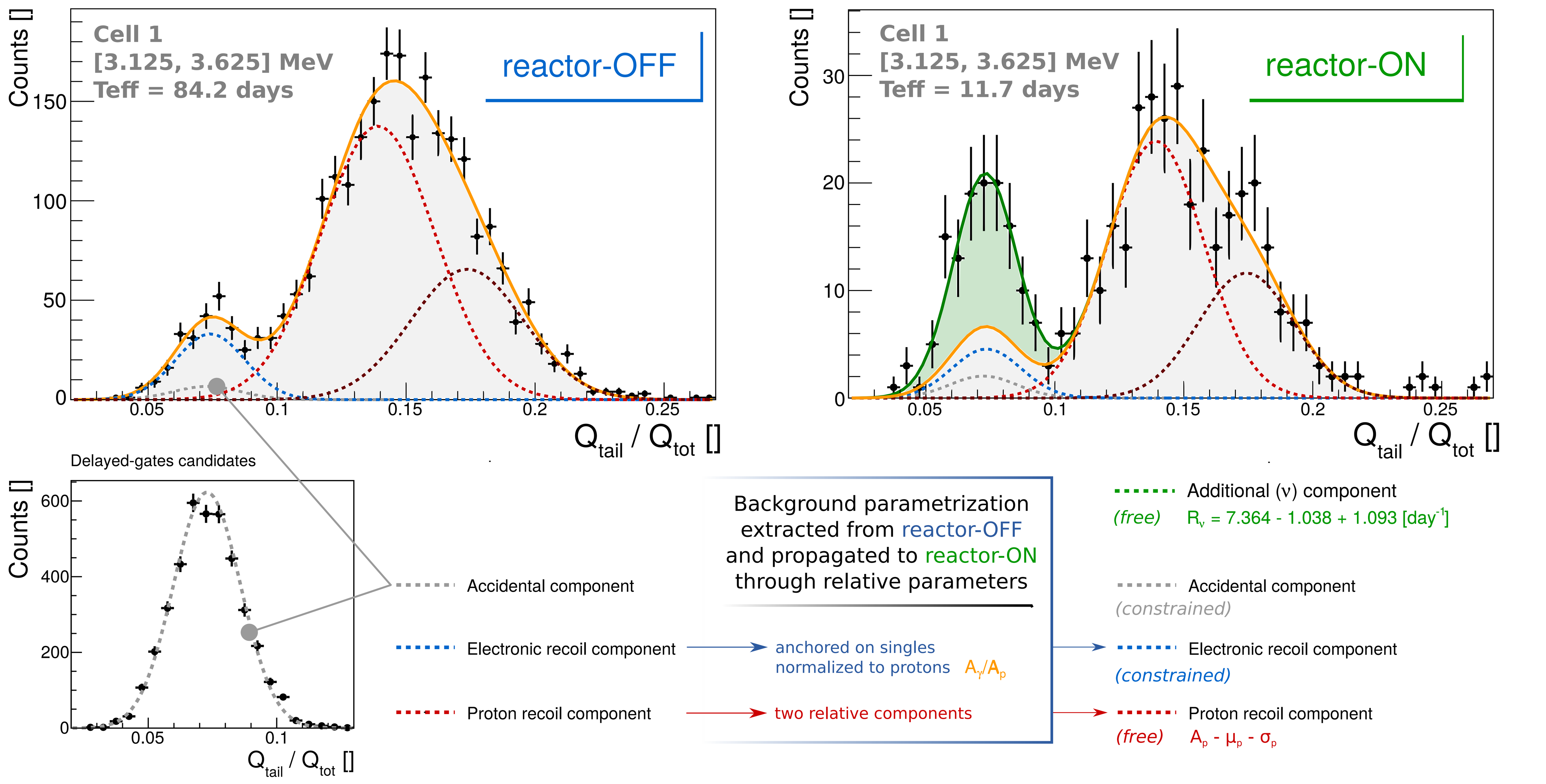
$$\mathcal{M}^{corr}_{bkg}(t, \mathrm{E}, \mathrm{cell}) = \mathcal{A}_p \times \left[\frac{\mathcal{A}_e}{\mathcal{A}_p} \cdot \mathcal{M}_\gamma + \mathcal{M}_p \right]$$

$\mathcal{M}_\gamma$ and $\mathcal{M}_p$ are the normalized **electron-recoil** and **proton-recoil** background p.d.f., $\mathcal{A}_p$ controls the size of the latter while $\frac{\mathcal{A}_e}{\mathcal{A}_p}$ drives the balance between both.

✓ Atmospheric pressure correction is no longer needed: **auto-coherent treatment** using local rescaling to p-recoil background

✓ PSD parameters variations are monitored and fitted along time

✓ Extended Maximum Likelihood (EML) fit **adapted to low statistics**, procedure validated with Monte-Carlo pseudo-experiments.



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