**STERILE NEUTRINOS** 



# Detector response in the STEREO experiment

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#### Neutrino signal in liquid scintillator

Reactor  $\bar{\nu}_e$  interact in the detector via Inverse Beta Decay IBD  $\bar{\nu}_e + p \rightarrow e^+ + n$ 

 Admixture of LAB+PXE+DIN • WLS: PPO and bis-MSB • H-fraction of 11.45% • Gd-concentration of 0.2 wt. % • Attenuation length of ~ 7m

Prompt Event, positron annihilation  $E_{vis,e+} \simeq E_{\bar{\nu}_e} - 0.8 \text{ MeV}$ 

> **Delayed Event,** neutron capture

Gd nuclei

**4** - - - - -

## **STEREO detector**

• What? <u>Reactor</u> neutrino experiment. • Why? Testing the hypothesis of <u>sterile neutrinos</u>. • How? Measuring the Ve flux via inverse beta decay. • Where? At the ILL research reactor (Grenoble, France). • When? Started data taking in <u>Nov 2016</u>, until end 2019. Detector response

## **Calibration Techniques Internal Calibration**

• Calibration tubes placed along the TG cells, where radioactive sources can be deployed at different heights. • Frequent calibration runs (on a weekly basis) to monitor response during the experiment's operation time.



0	0 0
Energy [MeV]	
0.511 x 2	1 1 5)
1.30 + 2.70	$ u_e $
1.12	
0.667	
0.835	• (
0.6 + 1.69	
1.17 + 1.33	
(0-10) + 3.757n	
4.44 + n	20

 $\mathcal{V}_{2}$ 





## **Light Collection and MC tuning**

Ue

#### **Light cross-talks**

• Despite the **reflective plates** between cells, light cross-talk from cell i to cell can happen:

• Characterization and monitoring of light leaks is crucial to understand the detector's response.

 $L_{ij} = Q_i / Q_j$ 

#### ▼ Sketch representing Leaked light Cell 5 the light cross-talks. **Collected light** DATA



### **Liquid parameters**





are

0.





• Light cross-talk between cells in MC are **tuned** to match inhomogeneous cross-talk observed in data at percent level.

#### **Energy non-linearities**

• *Birk's law* describes a LS's quenching curve, parametrized by the Birk's constant kB



- **kB** describes energy nonlinearities.
- A broad selection of calibration sources allowed the determination of **kB**.

100 200 300 400 500 600 700 800 Height of the source [mm]

• Absolute light yield

▲ Deviation of the large peak position at different deployment heights relative to the charge peak at z=45cm, for TG cell 5.

#### **Energy Reconstruction**

The collected charge in each cell i is translated into



positions. Gamma Catcher response - Phase II harge of GC segments GC IN20, 27 February 2018 GC D 19, 27 February 2018 240 230 (0)(0)



0

0







O<sub>0.99</sub>

• A x<sup>2</sup> best fit estimation provided an optimal value of:

 $kB = 0.096 \pm 0.007 \text{ mm/MeV}$