Antineutrino Flux Prediction for Nemenix

- Preliminary Considerations -

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Flux Prediction - Intro

Antineutrino flux **emitted** by the (BR2) reactor is prop. with:

- Reactor **power**
- Reactor **burnup** (fuel evolution in time)
- Other parameters provided by the theory (E/fiss., etc.)

Antineutrino flux **detected** by Nemenix detector is prop. with:

- Number of **protons** in the detector's target
- **Distance** to reactor (in a first approximation, in fact it's the solid angle on which the detector is seen)
- Detection **efficiency** (trigger threshold, analysis cuts)
- Other parameters provided by the theory (inverse beta decay X-section, etc).

Approximations/Numbers used in this study

- Reactor **power: 55 MW** (need input from reactor people, power values used in BR2 papers: 52 MW, 55 MW, 57 MW)

- Reactor **burnup: pure 235U core** (excellent approx: > 93%)

- Number of **protons in the target**: **$5.17 * 10^{22}/cm^3 * 8000\ cm^3$** (Nemenix target filled with EJ200).

- **Distance** to reactor: punctual detector and reactor → distance considered between center of mass of both (need reactor simul.)

- Detection **efficiency: 5%** (need input from detector simulations, it includes the hardware threshold influence, roughly estimated)

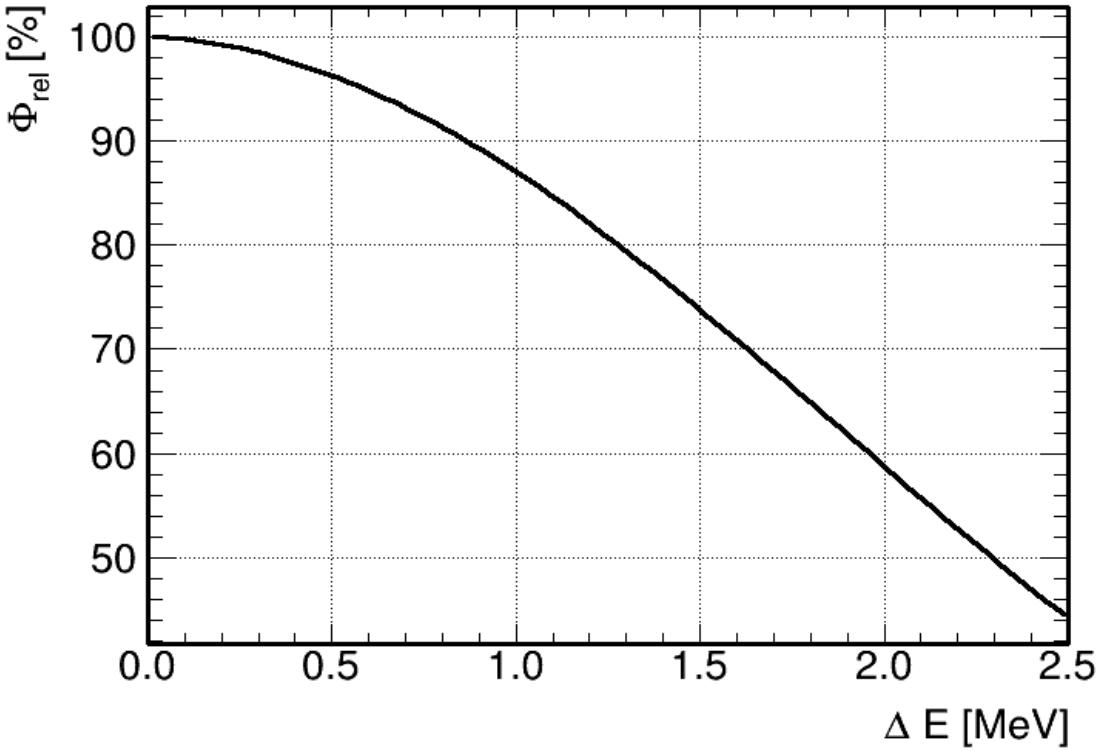
- **Deadtime:** not considered (need input from analysis, not considerd here → antineutrino rate per day livetime)

The influence of the (hardware) threshold

The **detection efficiency** value considered in this study: **5%** is just a preliminary estimation **before the DAQ upgrade** and has to be confirmed/infirmed by dedicated simulations.

ΔE = energy threshold on the IBD prompt event in the physics range

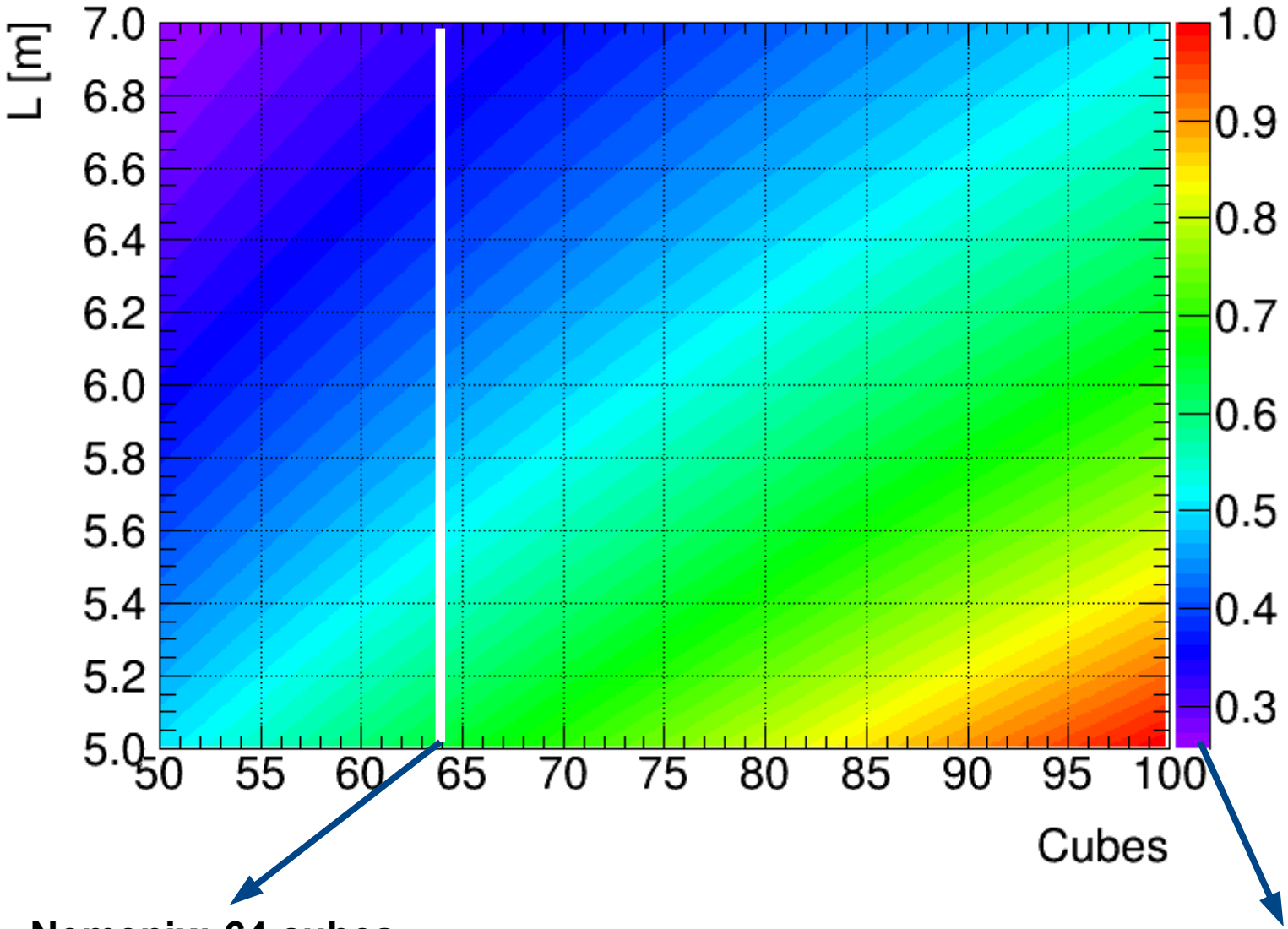
Φrel = relative event rate change w.r.t. the "no threshold" case



600 KeV threshold → 95% of the "no threshold" case

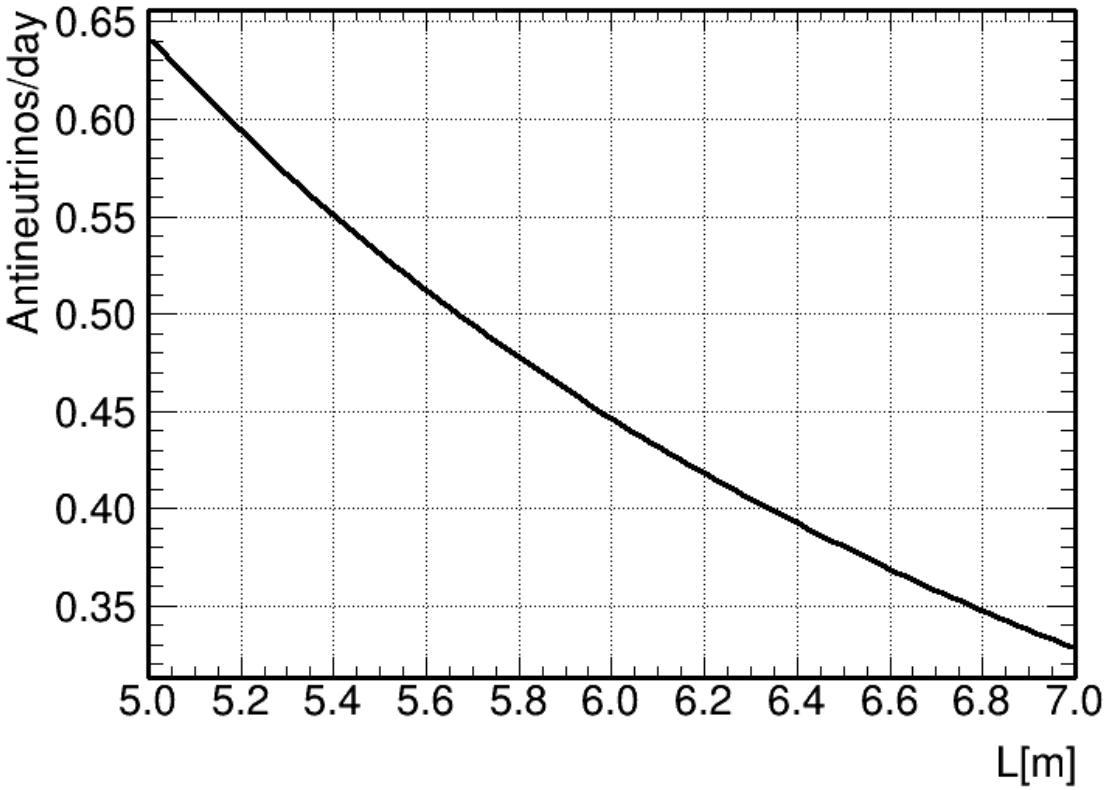
We need to know the shape of the trigger efficiency in order to evaluate better this number → need input

Reactor-Detector Distance vs. Target Mass



Reactor-Detector Distance vs. Antineutrino Rate

0.53 events/day at 5.5 m from core

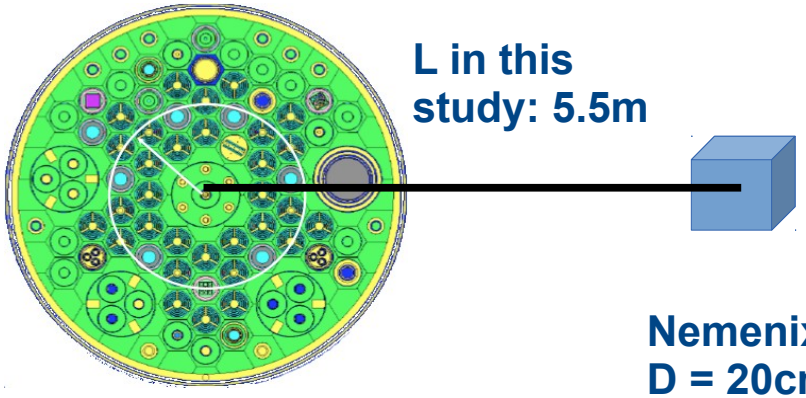


A preliminary analysis *(see for example Fred Yermia's presentation at scientific council of IN2P3: SOLiD_CS2014.pdf in your Dropbox folder)*

Shows an antineutrino flux detected by Nemenix of:

9.54 ± 3.9 / 17.7 days = 0.54 ± 0.22 antineutrino / day

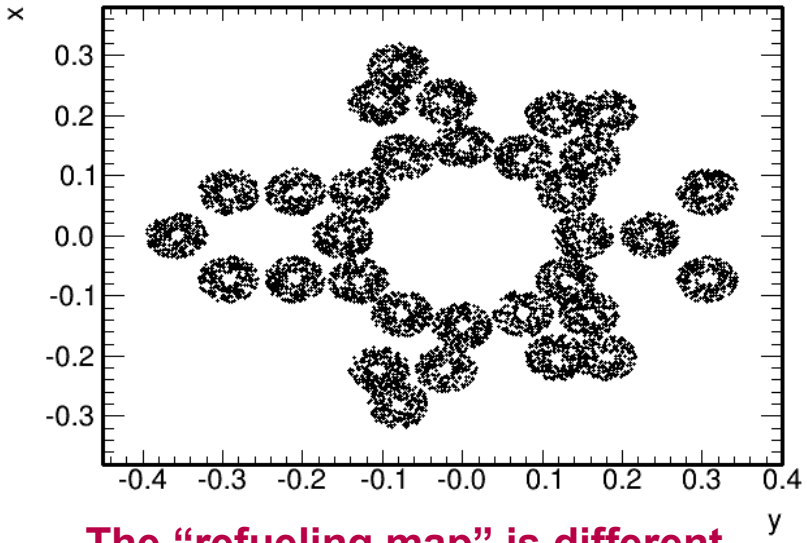
Reactor-Detector Distance Distribution



L in this study: 5.5m

Nemenix: D = 20cm

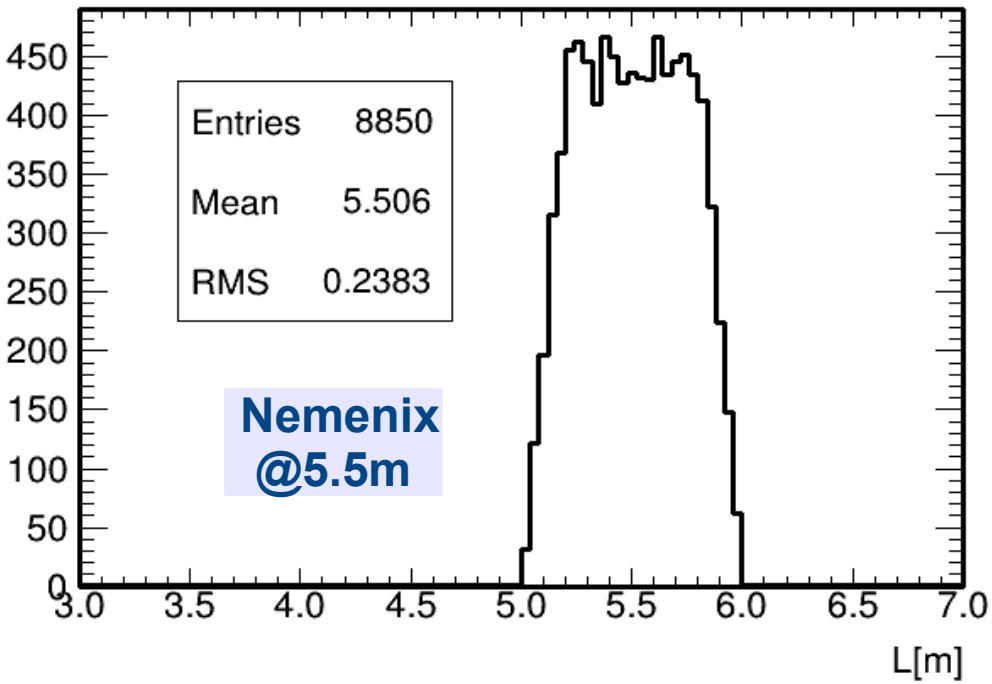
BR2 core Φ ~90 cm, effective ~50 cm



The "refueling map" is different for each reactor cycle.

The distribution of the distance traveled by antineutrinos, taking into account an example of realistic 3D geometry (need input from BR2 people) for the BR2 reactor and the geometry of the Nemenix detector.

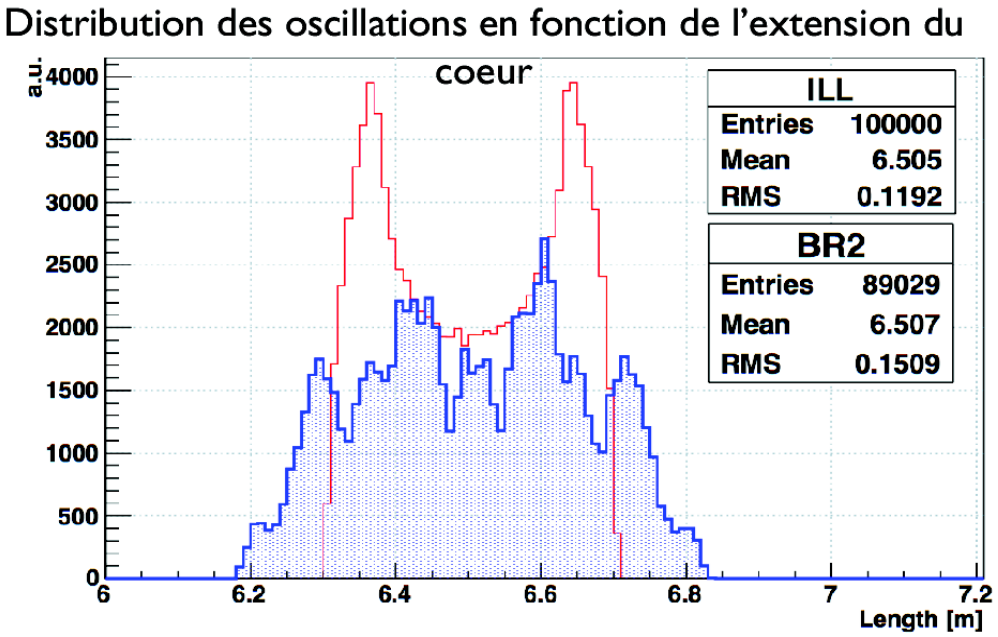
δL = 4.3% taking into account only the distance distribution



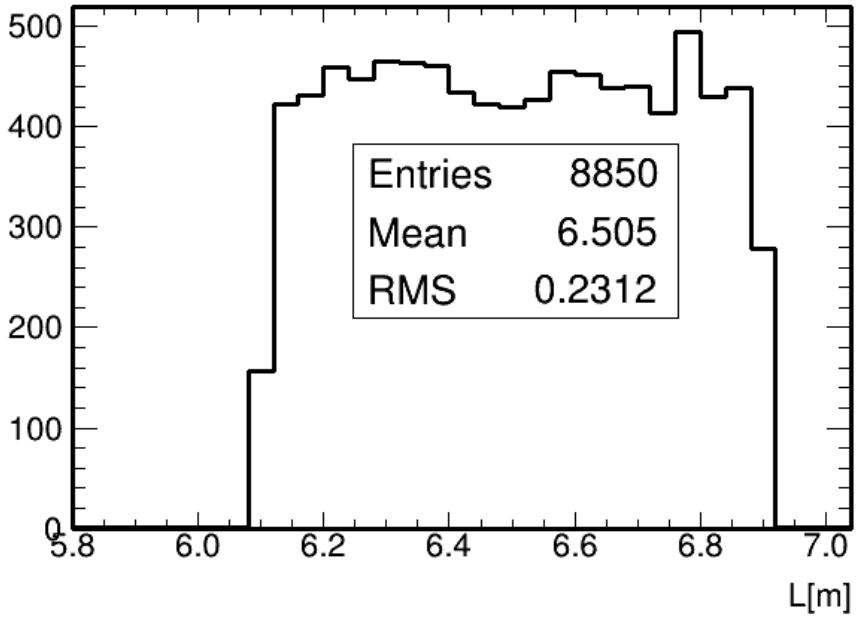
We have to compute the similar number for solid angles.

Reactor-Detector Distance Distributions

An older estimation provide a L distribution not compatible with the our analysis. The differences are not understood for a moment → inputs needed.



Older estimation



Our estimation: "punctual" detector @6.6m from BR2

Preliminary norm. err. estimation

No. of fissions:	3 %
Fission Spectrum:	2 %
No of protons in Tg:	(?) 2 %
Distance:	4.3 %
Detection Efficiency:	(?) 5 %
	Total: 7.8 %

These numbers are only some very preliminary estimations → need inputs

Conclusions

Preliminary estimations of the antineutrino event rate and associated uncertainties for Nemenix.

Need inputs from different working groups: analysis, simulation, reactor, etc.

A lot of work need to be done: solid angle corr., better parameters + errors estimation, etc.