

SoLid: Searching for sterile neutrinos

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Neutrino oscillations

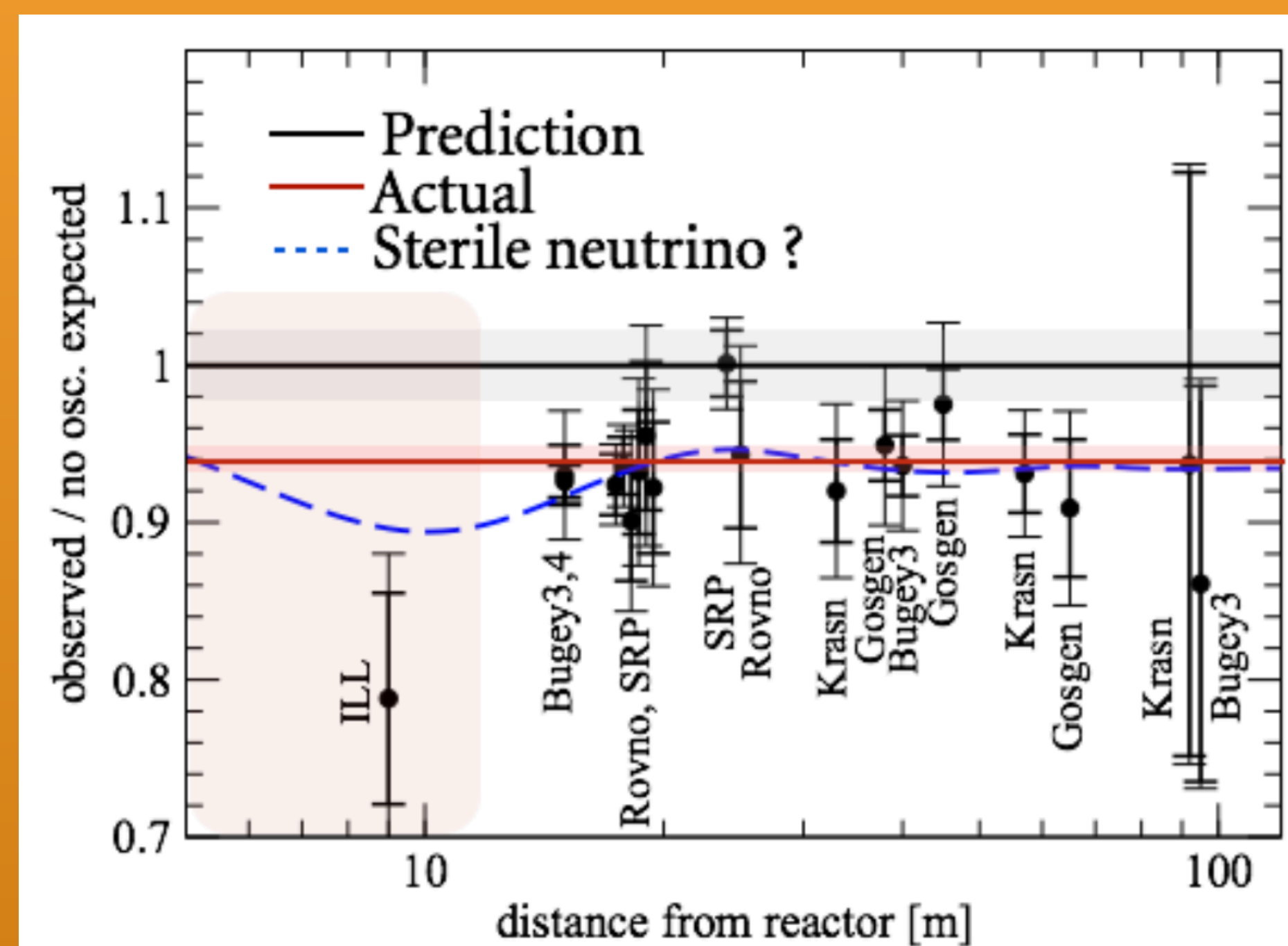
- Exactly 3 weakly interacting neutrino flavors (from Z boson decay)
- Neutrino flavors can oscillate into each other
-> Nobel Prize for Physics in 2015 [1]



- Well understood theory except for some anomalies

Reactor antineutrino anomaly

- $\bar{\nu}_e$ from reactors are not expected to oscillate at distances < 100 m
- Expect to detect the same $\bar{\nu}_e$ flux as created; instead a deficit of $\bar{\nu}_e$ is observed
-> "Reactor antineutrino anomaly" [2]



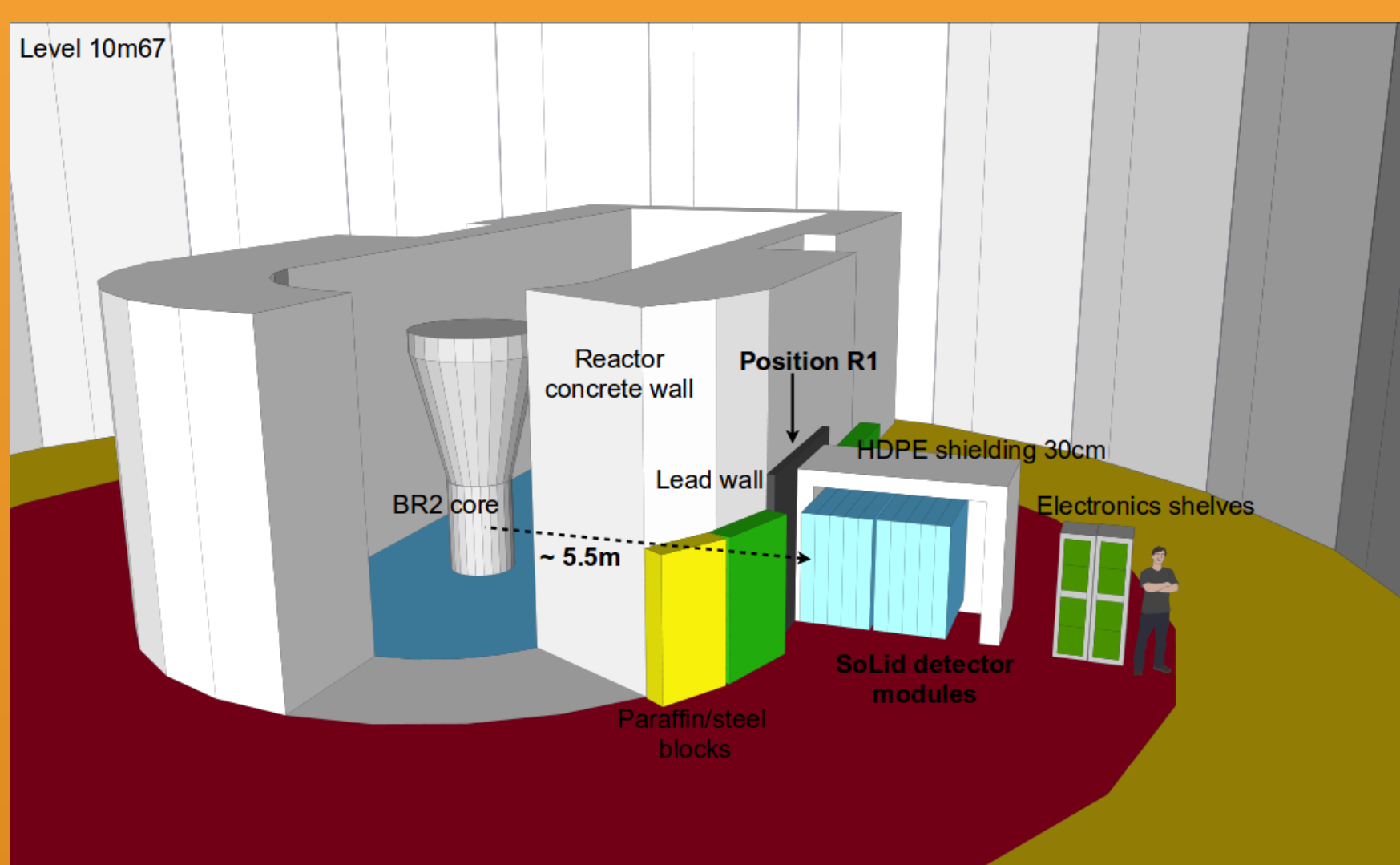
Possible explanations

- Uncertainties on reactor $\bar{\nu}_e$ flux calculation
- Problem on the detector side
- New Physics: oscillation into new type of neutrino
 - can not be weakly interacting
-> can not be detected
-> "Sterile Neutrino"
 - only explanation to predict distance-dependent signal

SoLid will investigate the reactor anomaly at the SCK in Mol, BE

SoLid @ BR2

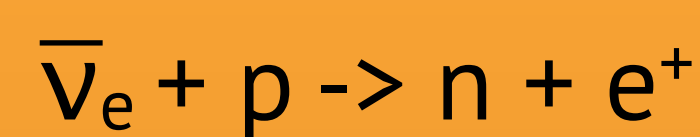
Search for Oscillation with a ^6Li Detector at the BR2 research reactor



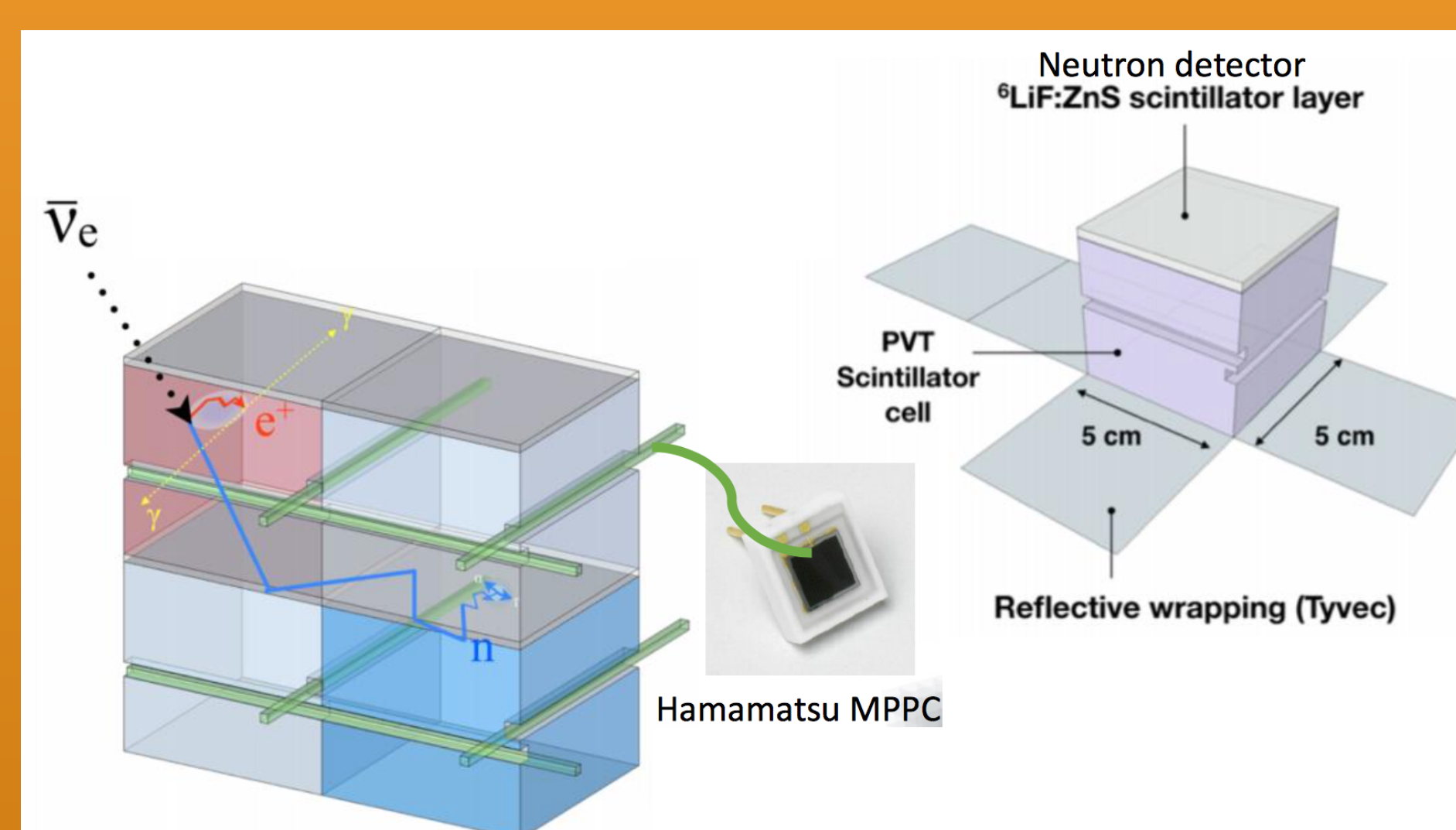
- Distance as close as 5.5 m
- Excellent background conditions
- Small core diameter -> point source behavior

Detector technology

Detection via inverse beta-decay (IBD)

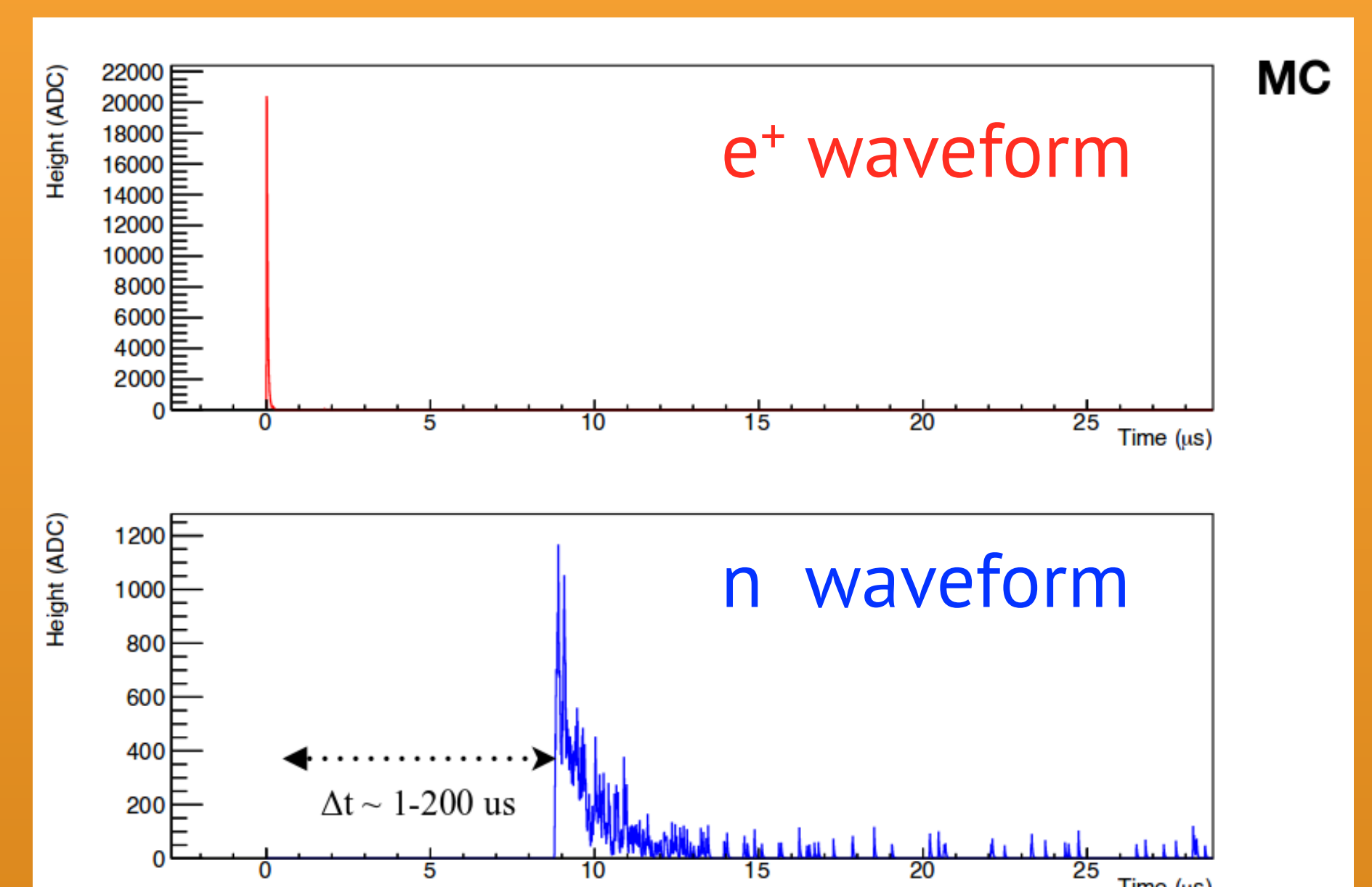


- e^+ interacts in PVT cube
- n captured by $^6\text{LiF:ZnS(Ag)}$ sheets
- $n + ^6\text{Li} \rightarrow ^3\text{H} + \alpha + 4.78 \text{ MeV}$
- ^3H and α excite ZnS followed by slow de-excitation



IBD identification

- Time and spatial correlation of e^+ and n absorption signal from an IBD event



- Pulse shape discrimination to identify the particles

SubModule 1 (SM1)

Demonstrate large scale use of the detector technology

- >2300 PVT cubes in 9 planes
- 288 kg prototype successfully installed & commissioned at BR2
- Analyses and simulation ongoing



Full SoLid detector

- 5 modules of 10 planes each
- 1.5 tonnes detector mass



Construction planned in Ghent for summer 2016
Data taking from second half of 2016

Thesis topics 2016-2017

- Construction of the full SoLid detector
- Commissioning of the planes as they become available and calibration with radioactive sources
- Simulation of the full detector



JOIN US IN THE SEARCH FOR
STERILE NEUTRINOS!