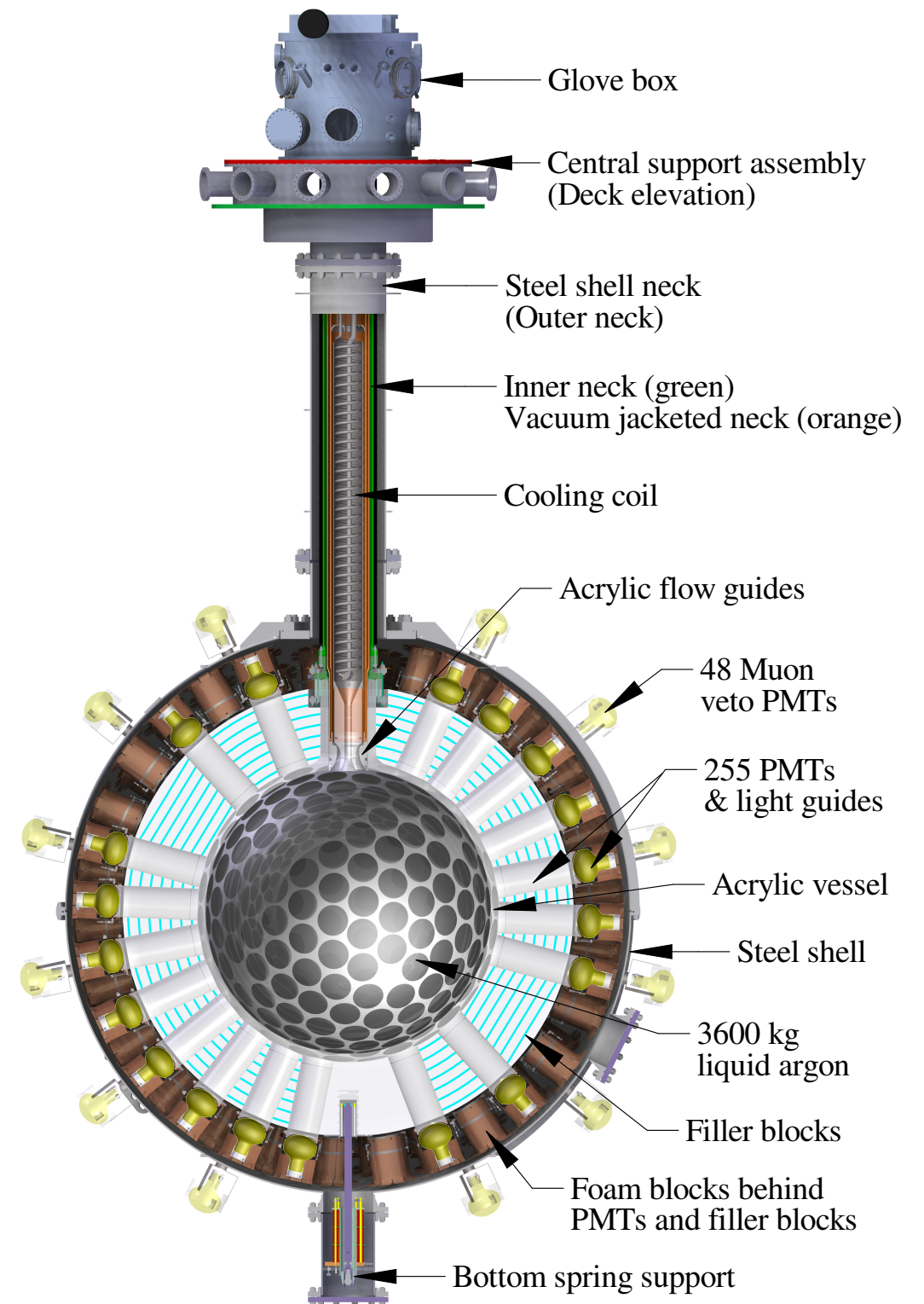# Early studies of detector optical calibrations for DEAP-3600

Berta Beltran, UofA, for the DEAP collaboration
CAP, 16 June 2015

DEAP-3600

- Single phase scintillation dark matter detector

- 85 cm radius acrylic vessel

- 3600 kg of LAr as detector medium

- 255 pmts will detect scintillation light

- LED data with vacuum in the vessel has been collected.

Glove box

Central support assembly (Deck elevation)

Steel shell neck (Outer neck)

Inner neck (green)
Vacuum jacketed neck (orange)

Cooling coil

Acrylic flow guides

48 Muon veto PMTs

255 PMTs & light guides

Acrylic vessel

Steel shell

3600 kg liquid argon

Filler blocks

Foam blocks behind PMTs and filler blocks

Bottom spring support

2

LED data with vacuum inside the acrylic vessel

22 LED sources mounted in PMTs around the detector

PMTs

Light Guides

Acrylic Vessel

Optical Fibre

PMT

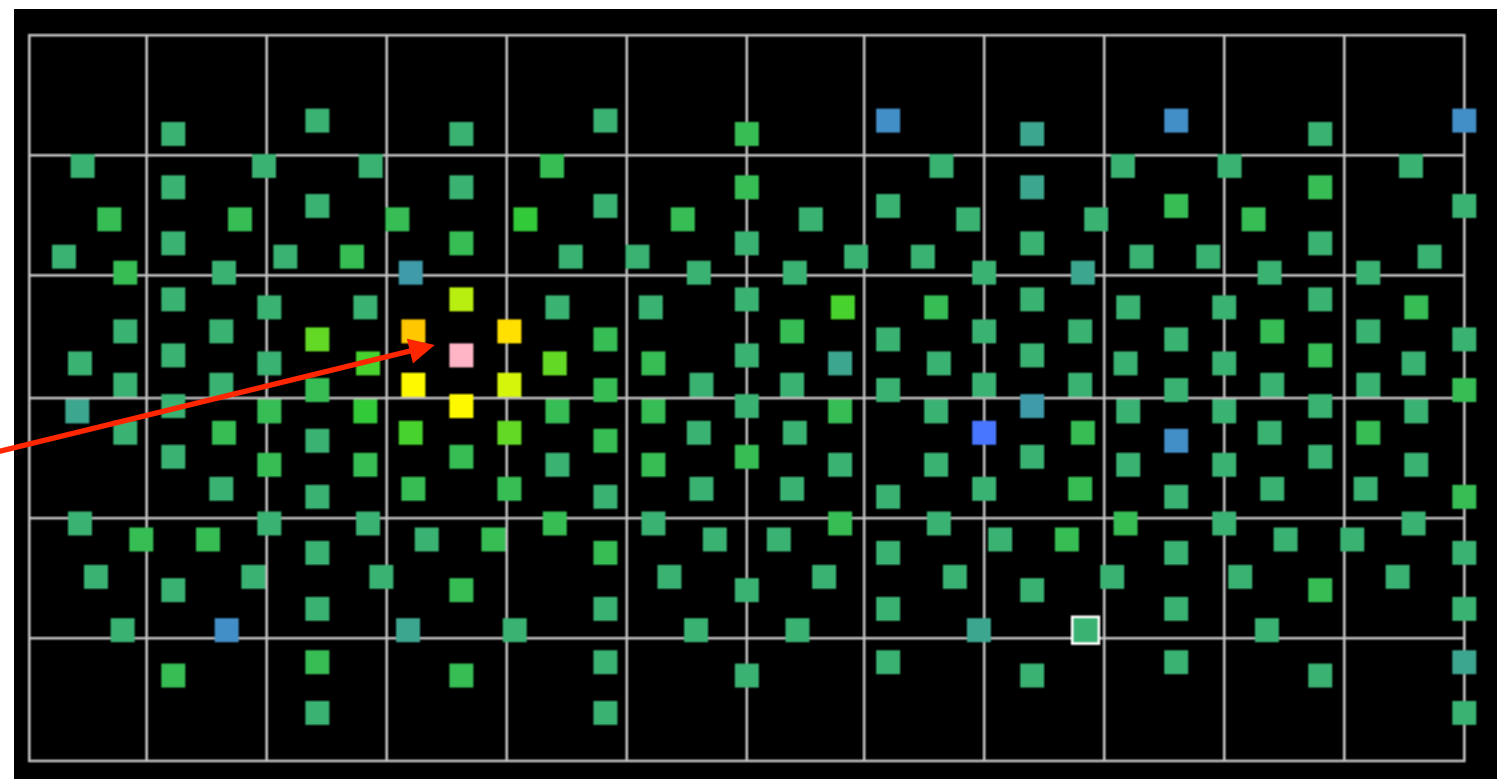Acrylic & Aluminium Reflector

LG
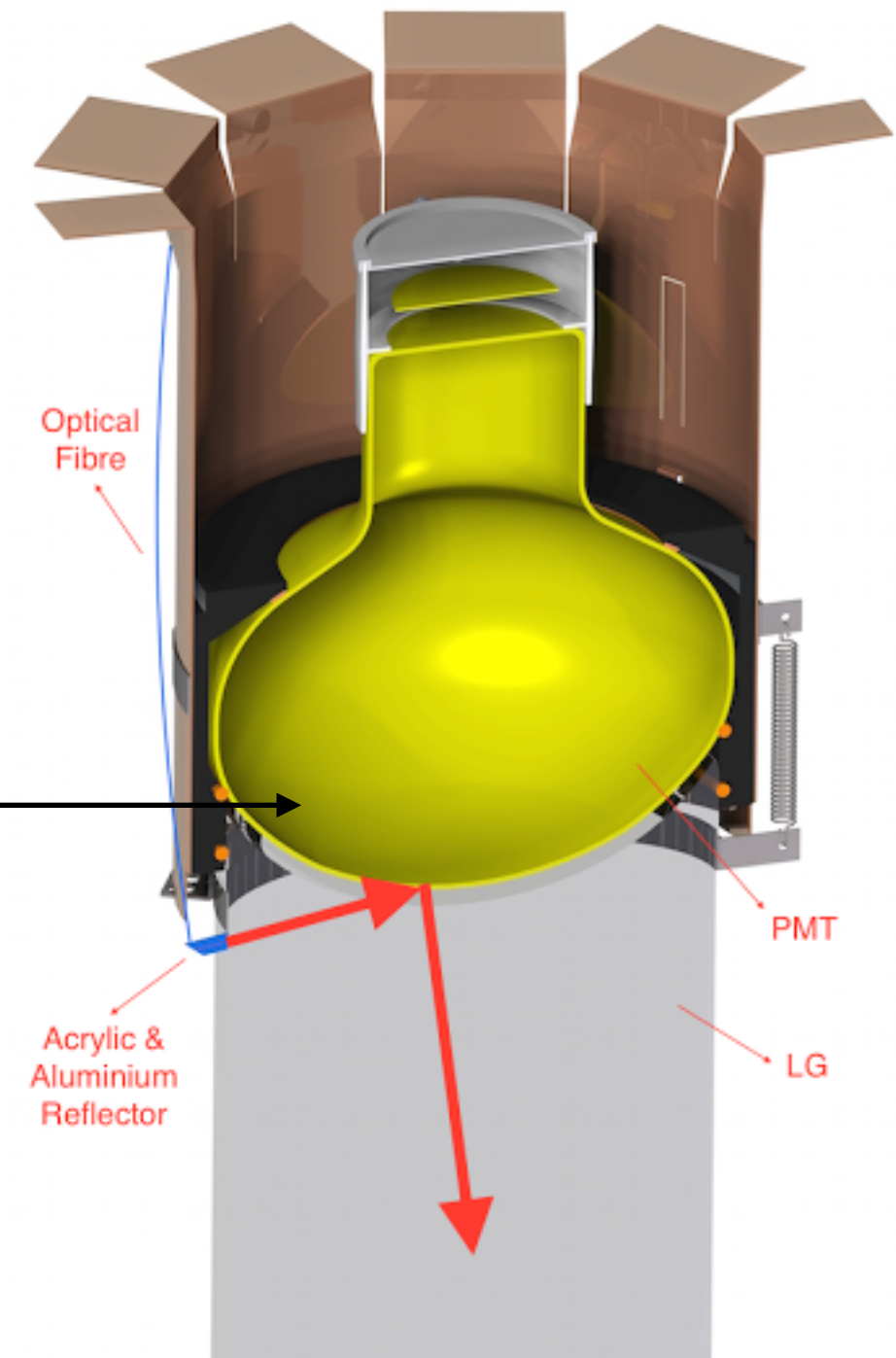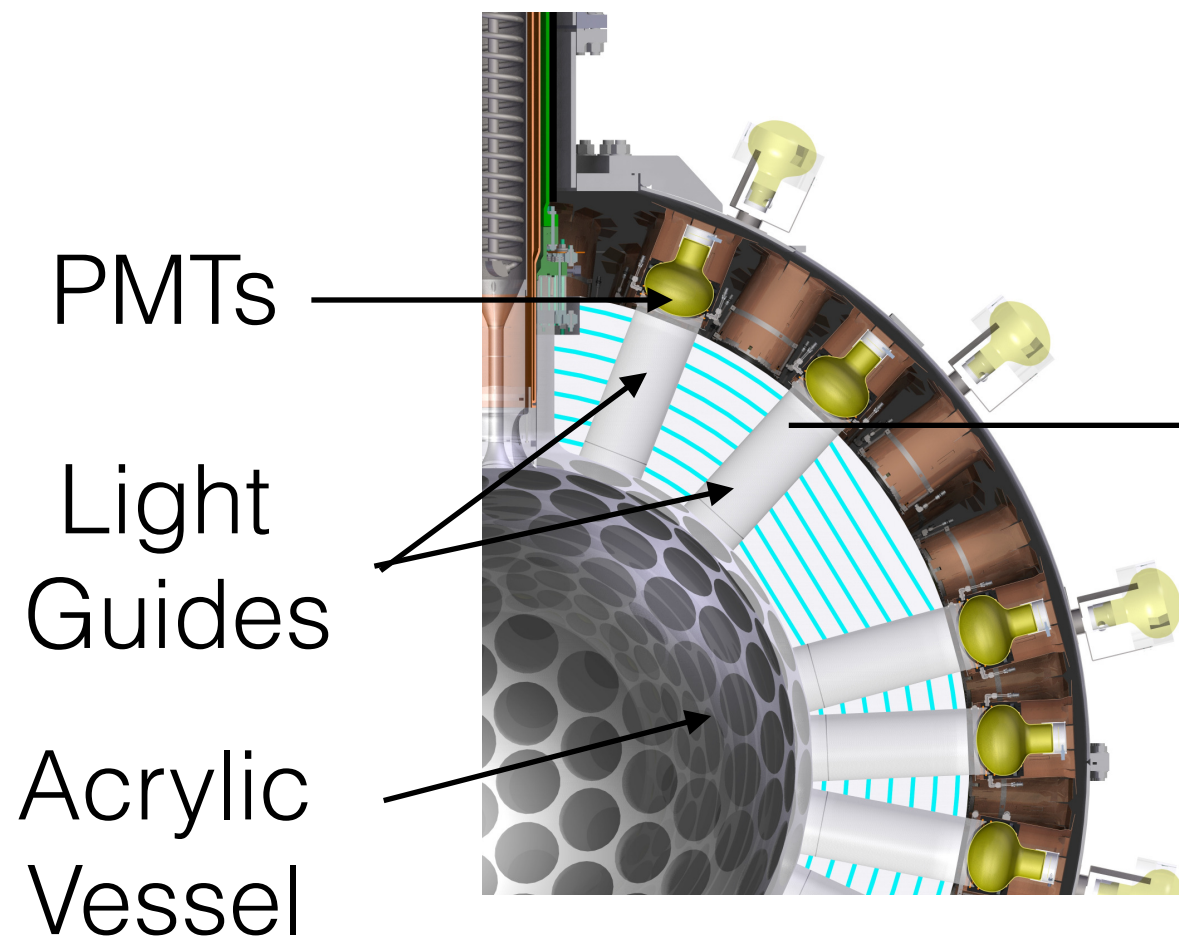
First LED data

‣We have collected good quality LED optical calibration data with vacuum inside the detector during March, April and May 2015.

‣The PMTs are working properly within expected dark rate levels and behaviour.

‣The DAQ has proven to be stable over time and to perform according to specifications.
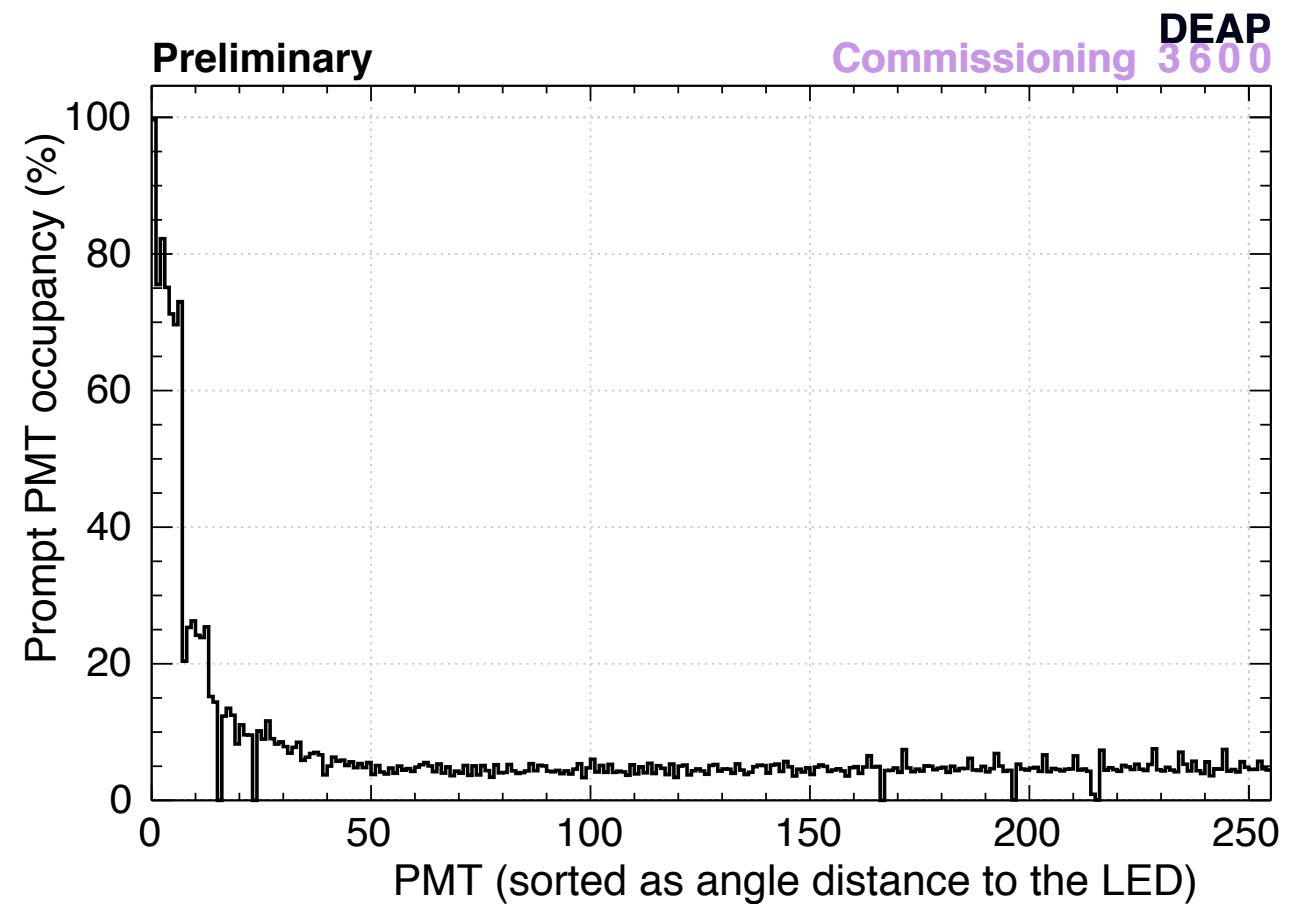
LED data

T=89.7°
P=-25.0°
G=1.4°

PMT hits for one LED run
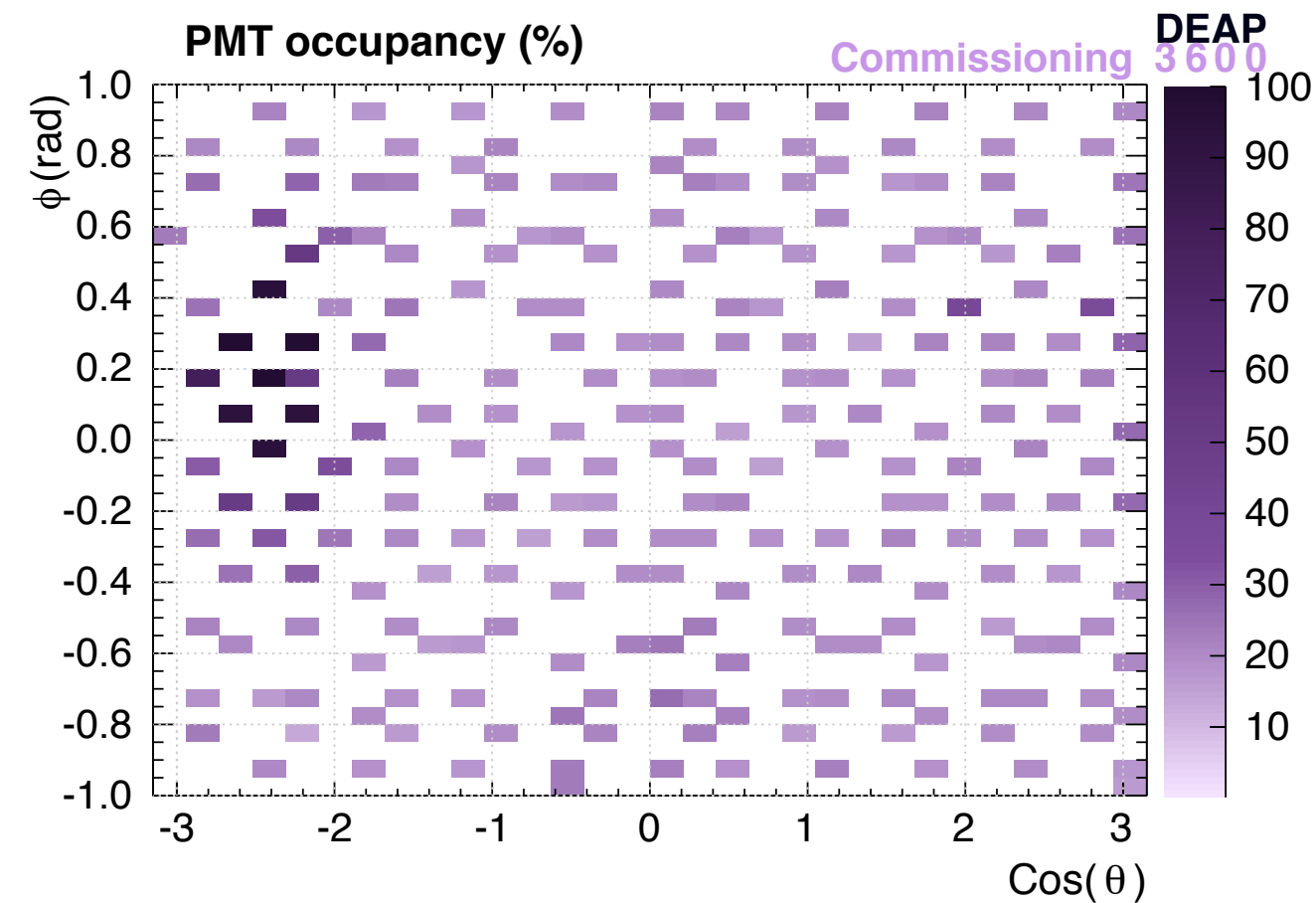Color scale represents
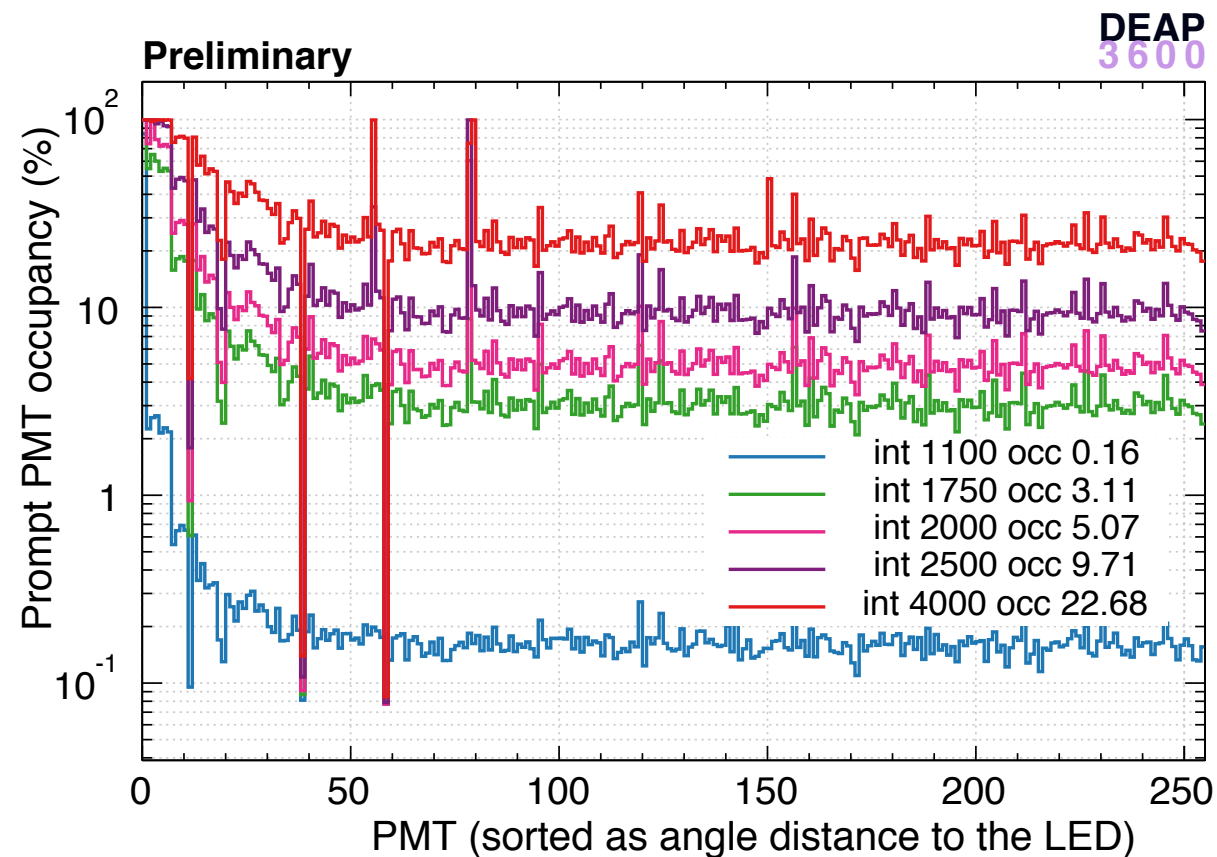charge collected in a PMT
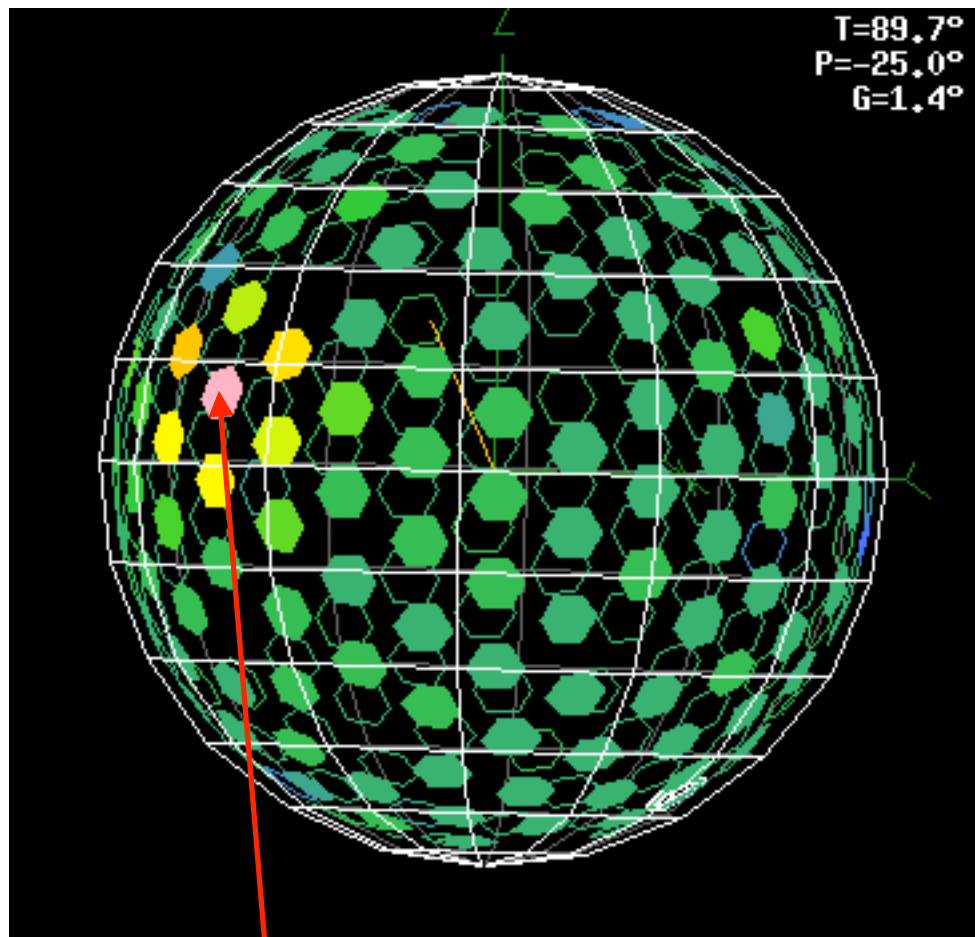
LED PMT

Theta

Phi

LED Data analysis

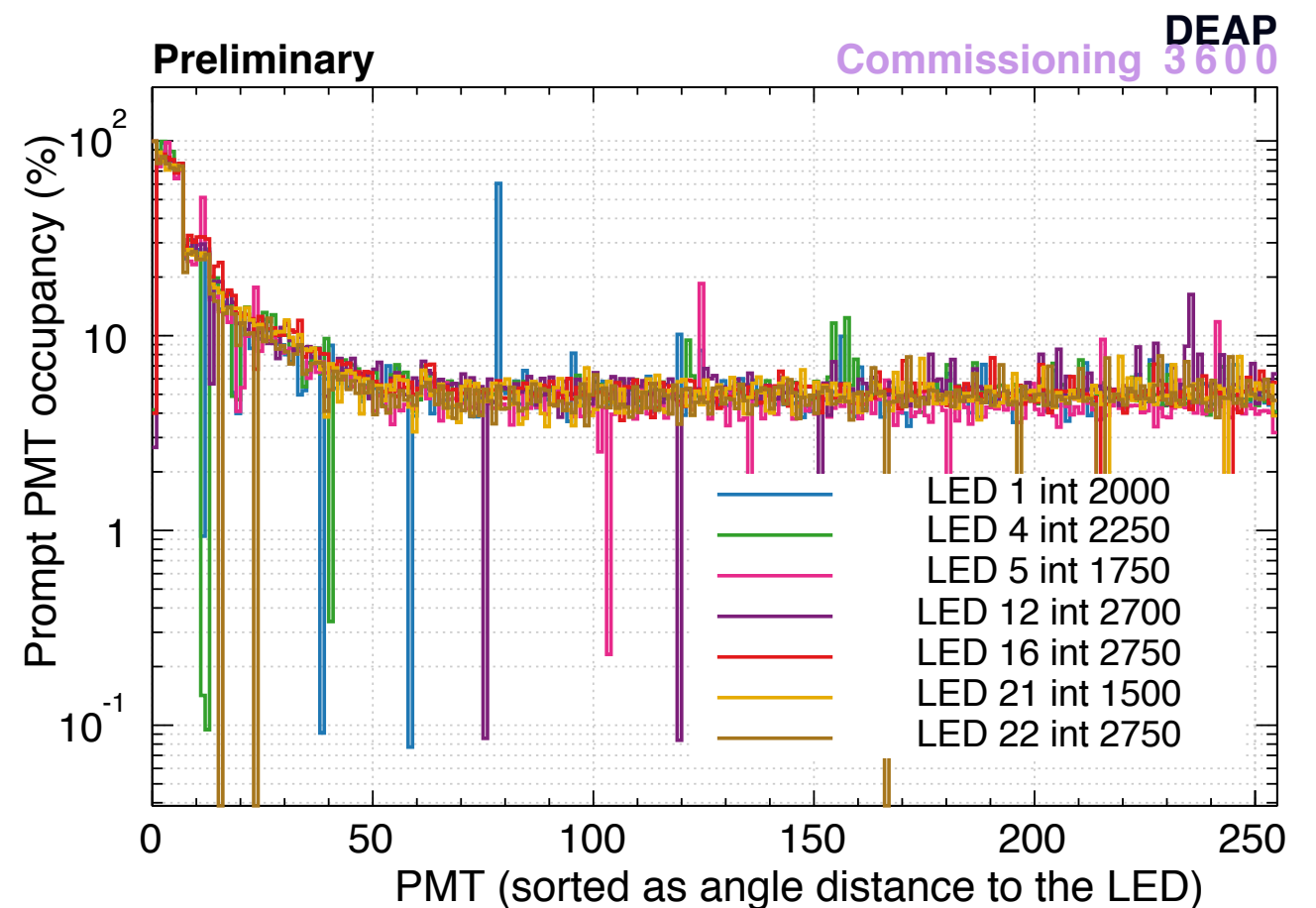Occupancy (%)= number of hits in a pmt / total number of LED events
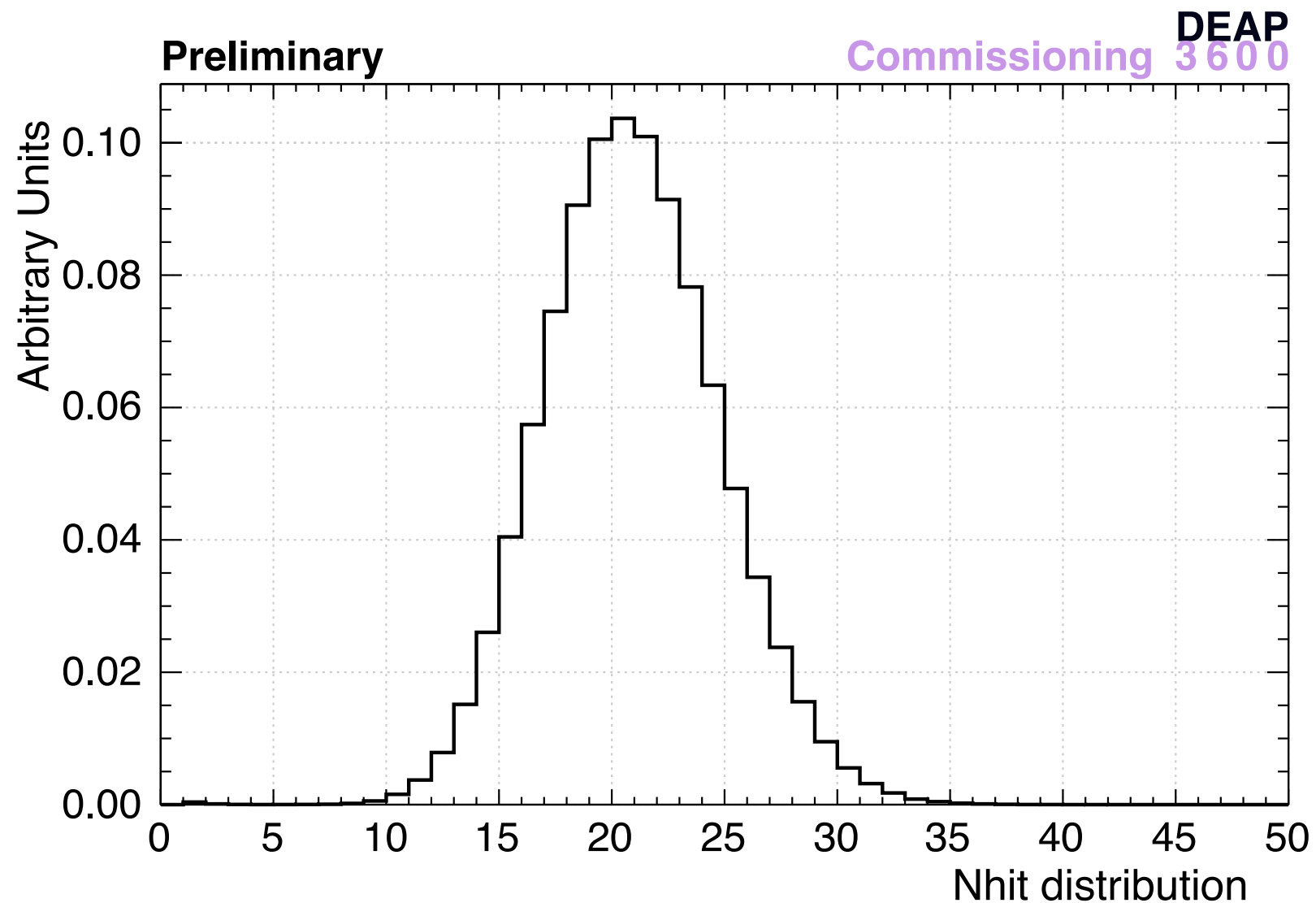
LED Data analysis

▶ Occupancy, same LED source at different intensities

▶ Different LED sources at similar occupancies. Detector optically homogeneous
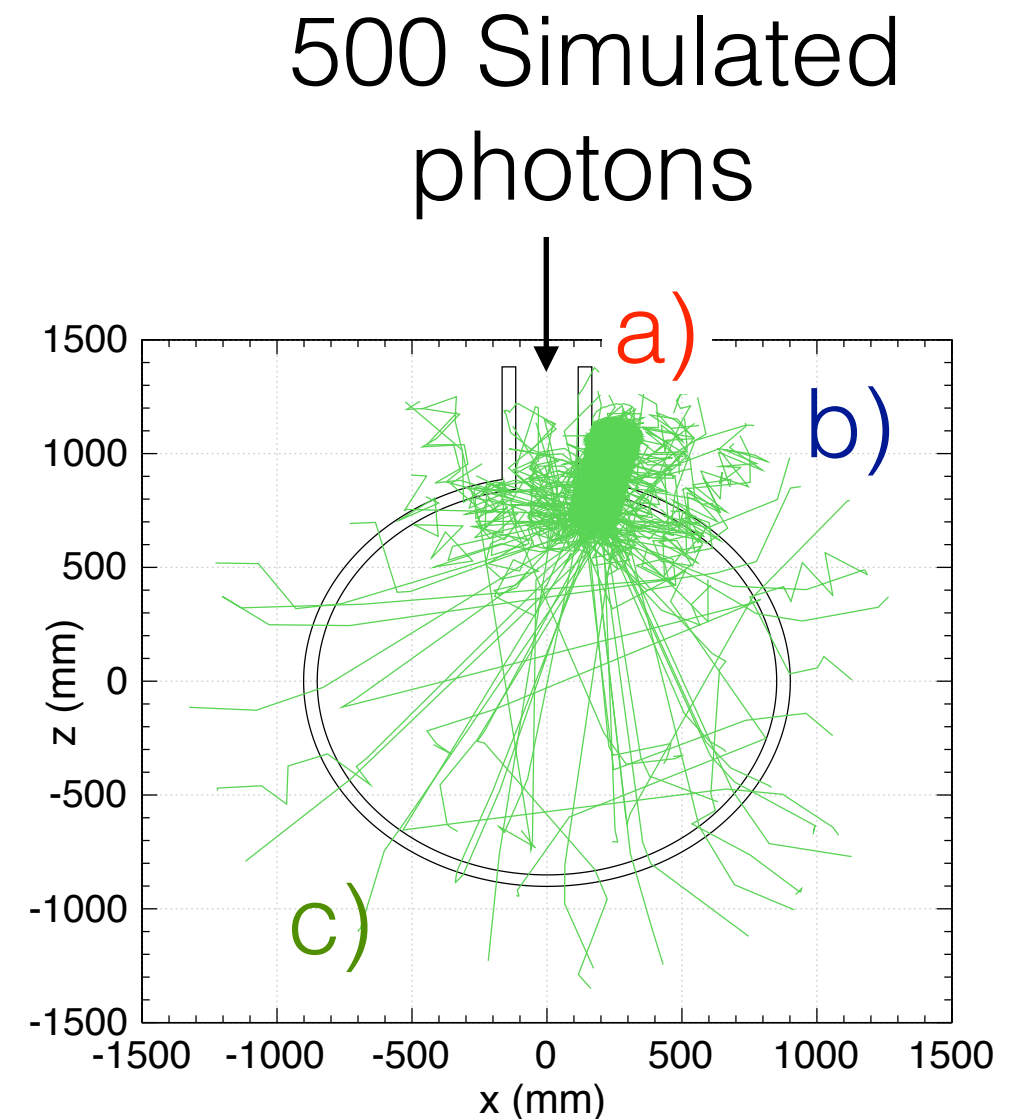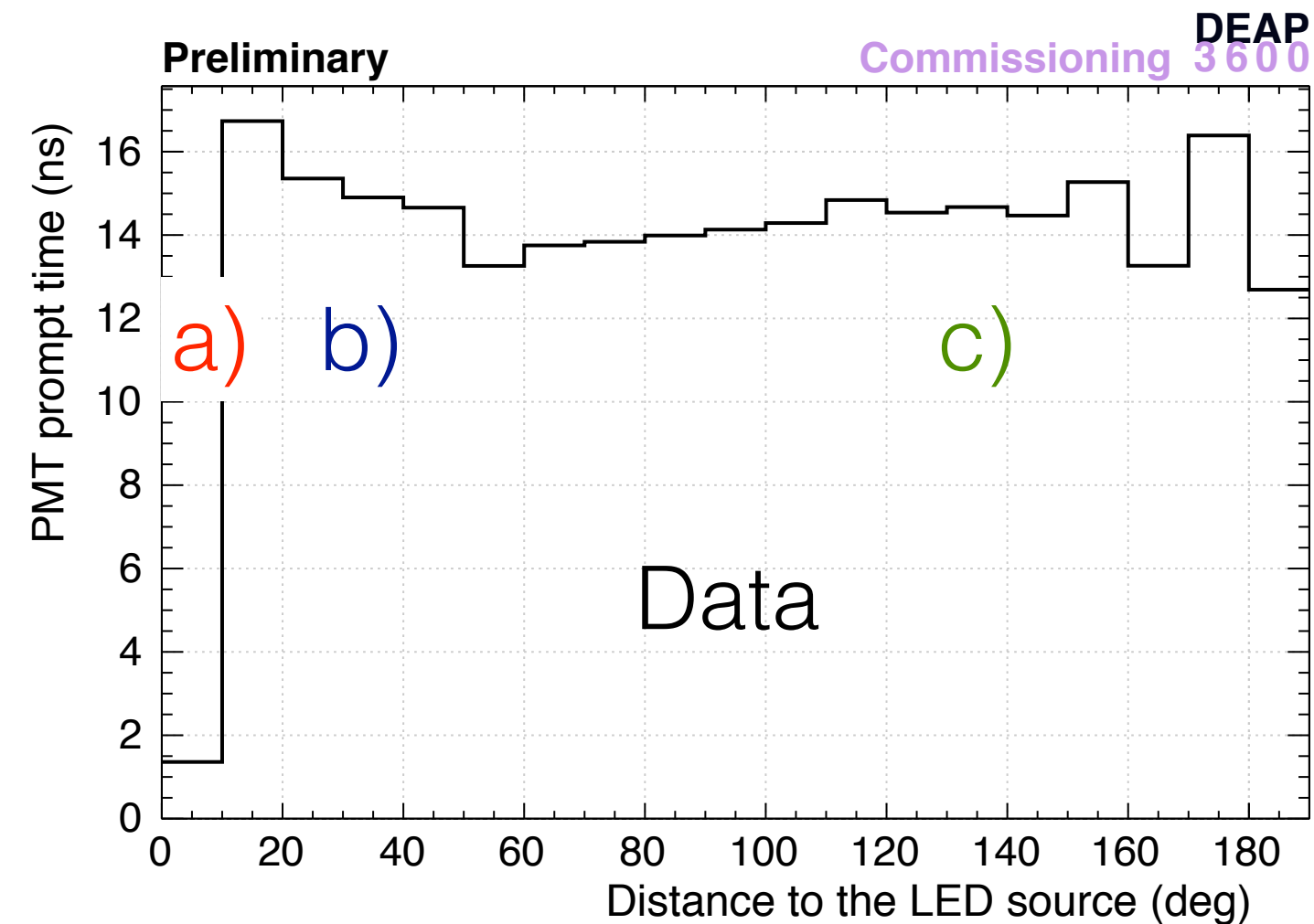
LED Data analysis

Nhit = number of PMTs that fired in an event

LED Data analysis

Events average time distribution

DEAP-3600 MC and data analysis package (RAT)

▶Reproducing different physics process relevant for DEAP-3600:

▶Custom detector geometry and material optical properties list.

▶Use well defined GEANT4 engine to propagate particles and photons.

▶Use of the NEST engine to simulate noble liquid scintillation process.

▶ Custom data analysis processors supported by the ROOT framework.
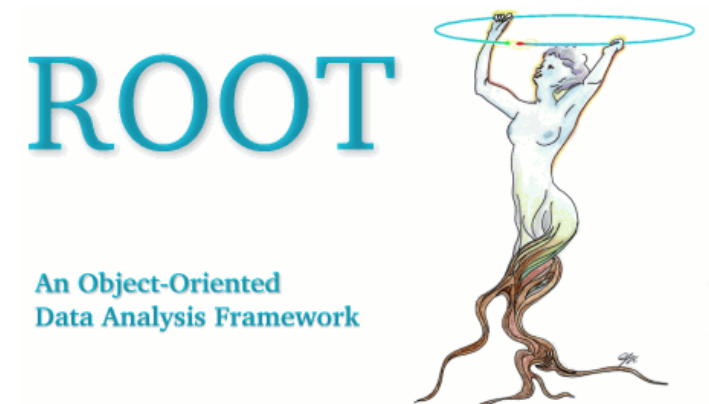
DEAP-3600 Optical properties in RAT

‣ Need good knowledge of the optical properties of the materials involved:

   ‣ Refractive index, absorption and scattering lengths

   ‣ Optical transmission between boundaries.

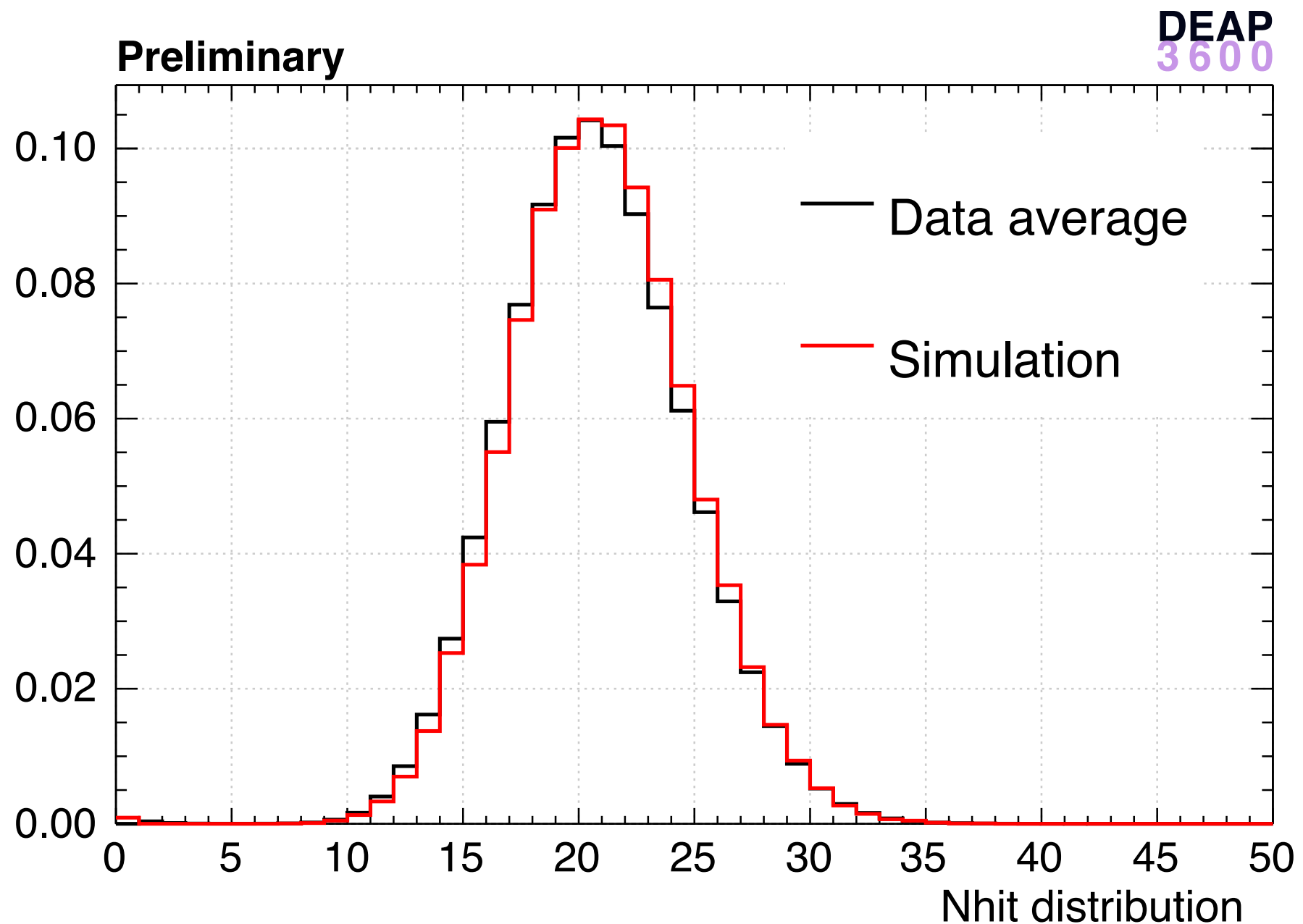‣ Some come from the literature, some have been measured by the DEAP-3600 collaboration.
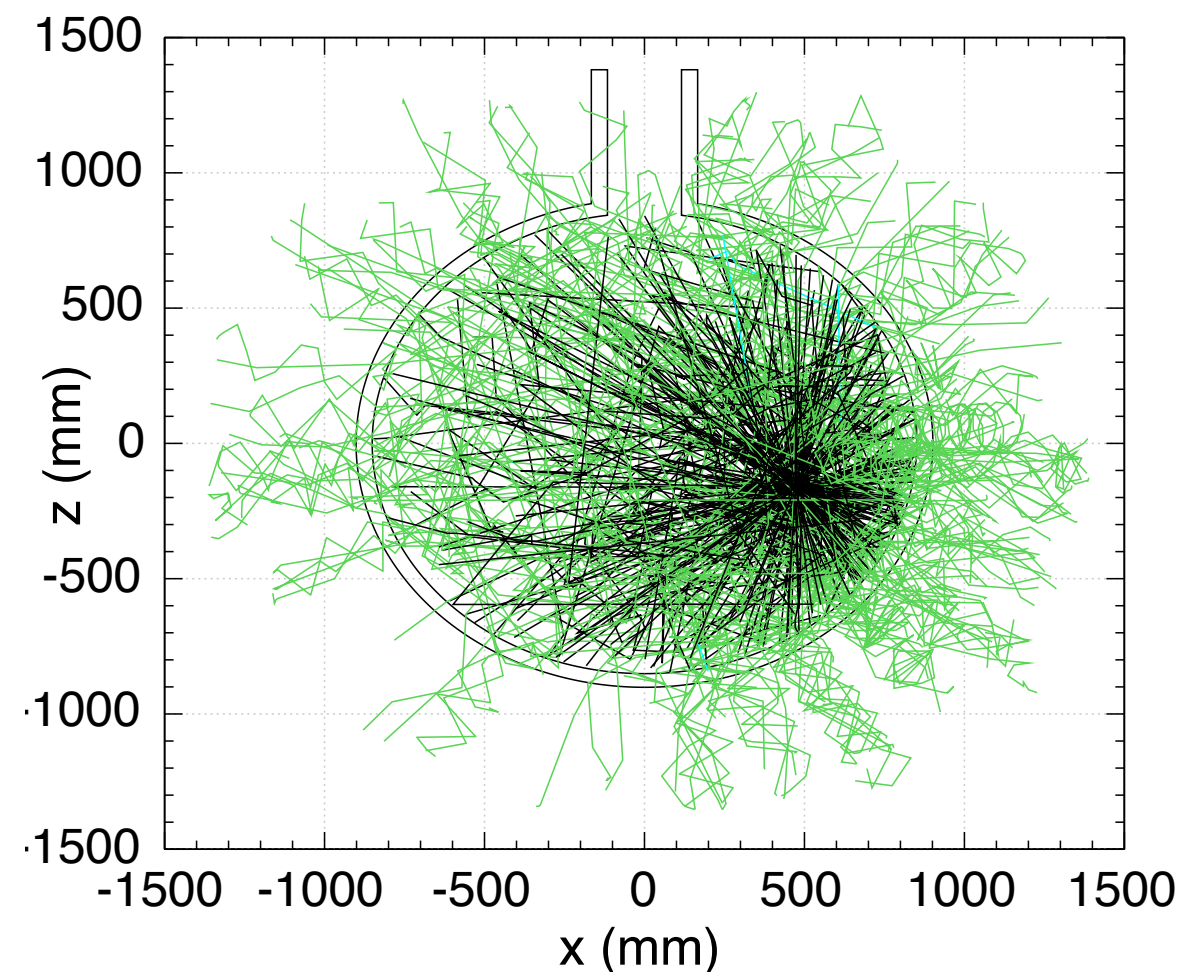
*A100 GeV Wimp event simulation (**black**) scintillation photons (**green**)TPB shifted photons*
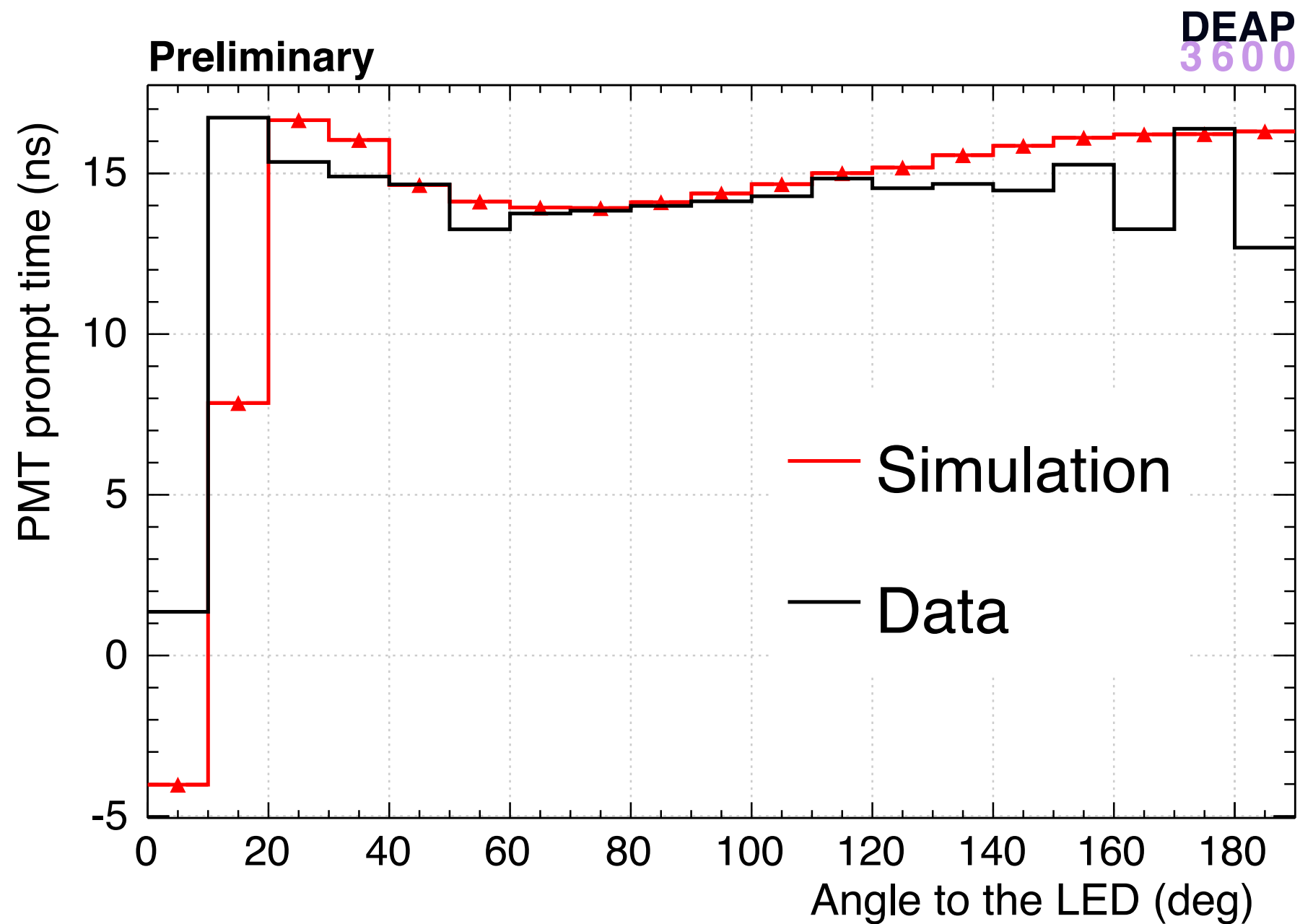
Comparing LED data with out of the box simulations
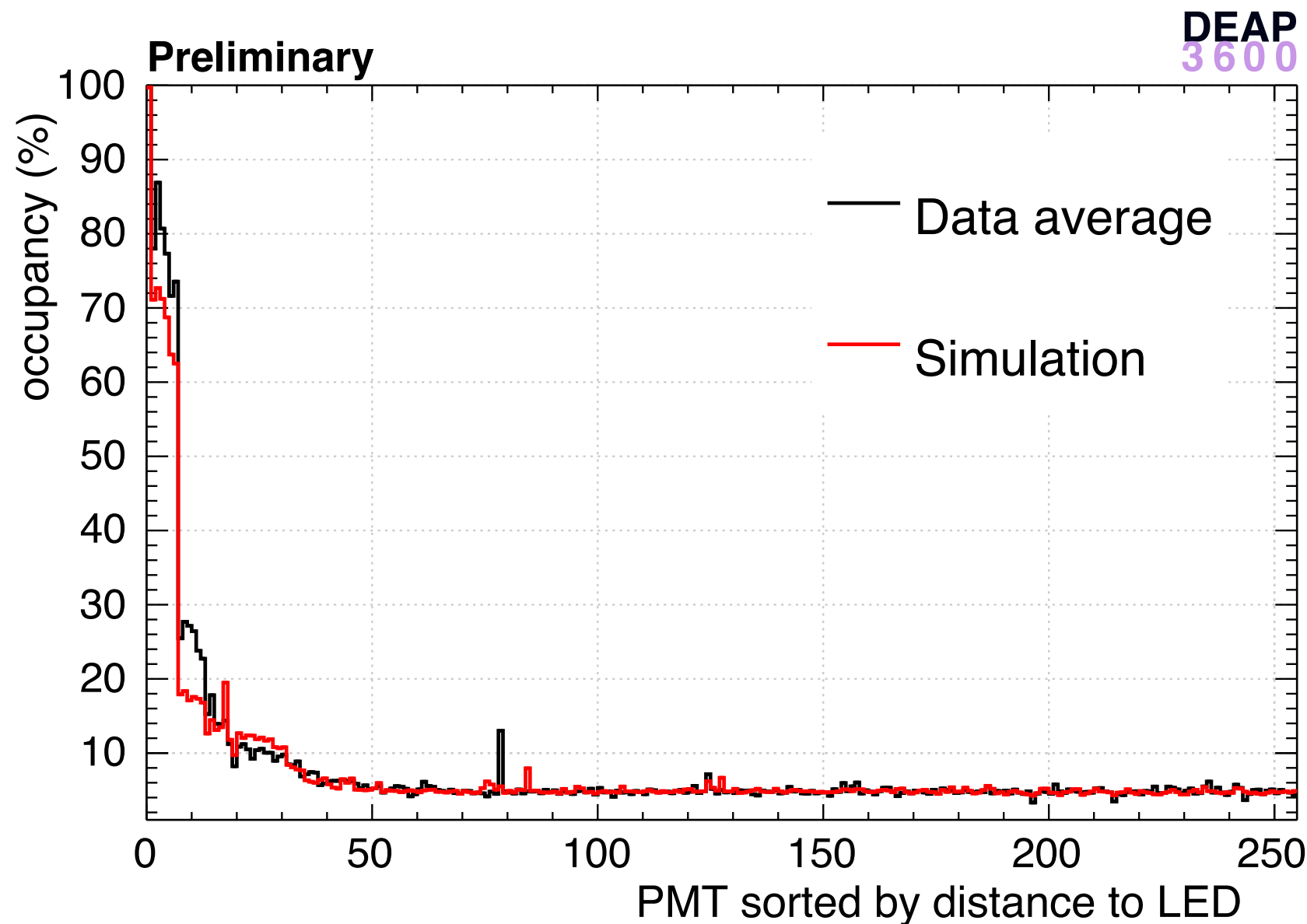
▸Qualitatively the out of the box simulation reproduces the main features of the data.

Comparing LED data with out of the box simulations

Comparing LED data with out of the box simulations

Summary

▸The DEAP-3600 has collected good quality LED optical calibration data.

▸A full Monte Carlo simulation of DEAP-3600 has been developed.

▸LED data the detector is being used to test the optical parameters of the simulation.

Acknowledgements

▸Thanks to CFI, NSERC, the provinces of Alberta and Ontario and SNOLab for funding and support.