



Optical performance studies of the DarkSide-20k muon veto



on behalf of the DarkSide Collaboration

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Taisiia Smirnova Alec Peck Shawn Westerdale
University of California, Riverside

1. Introduction

DarkSide-20k is a next-generation liquid argon experiment designed for direct dark matter searches at the Gran Sasso National Laboratory. However, cosmogenic backgrounds impose strict requirements on muon veto performance, making the 650-ton Outer Veto subsystem essential for protecting the WIMP signal region. Reliable operation of the muon veto requires quantitative understanding of its optical response and material-dependent performance. Geant4 simulations were used to evaluate light yield and response uniformity.

2. Outer Veto Design

Total 32 PDUs

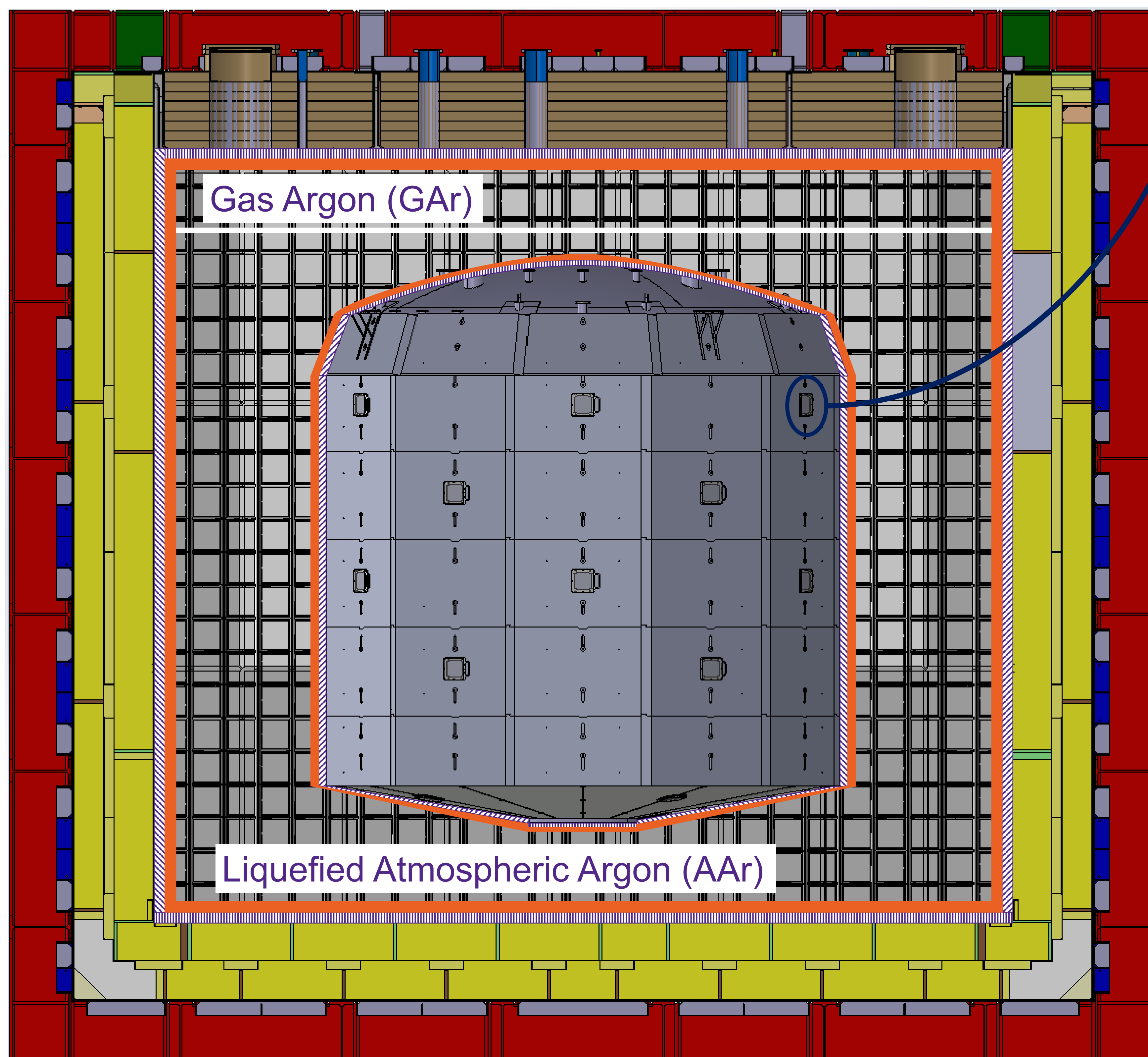


Fig.1. The preliminary schematic design DarkSide-20k with Membrane Cryostat, HDPE shield and Stainless Steel Vessel



128 nm LAr scintillation light

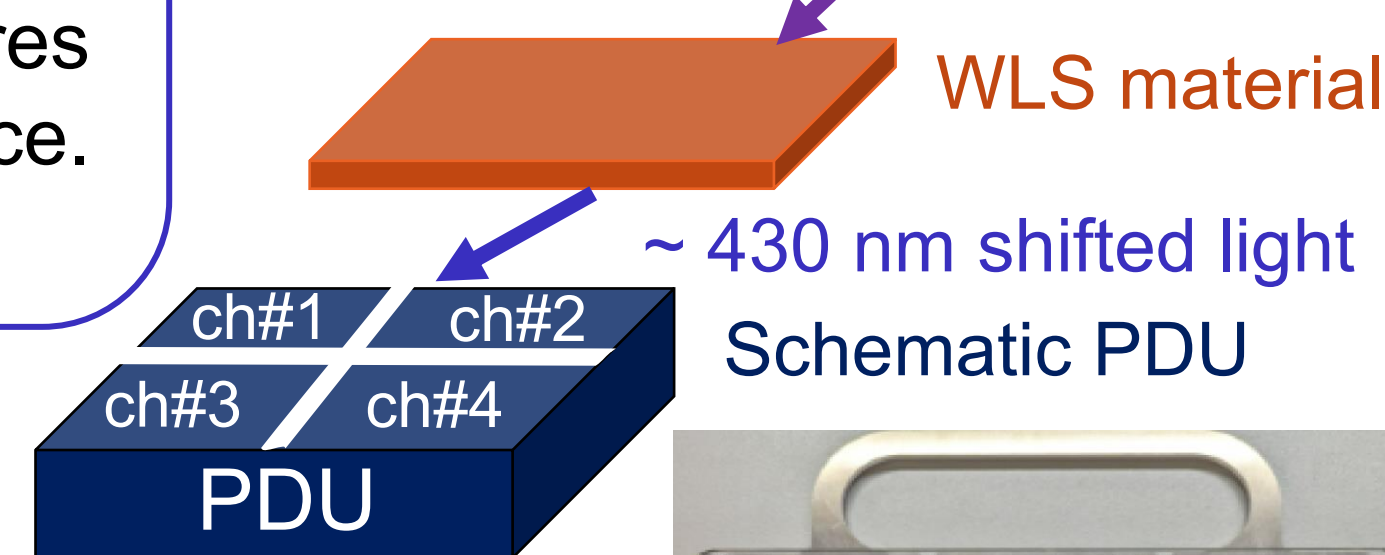


Photo of assembled PDU

Without PEN + Lumirror on the top OV
Reflector comparison: WLS PEN

Reflector	$LY \pm \sigma, p.e./MeV$
Lumirror	137.31 ± 49.12
ESR	133.98 ± 46.49
Tyvek	64.46 ± 35.09

WLS comparison: reflector Lumirror

WLS	$LY \pm \sigma, p.e./MeV$
PEN	137.31 ± 49.12
TPB	146.72 ± 54.57

3. Optical simulations

With PEN + Lumirror on the top OV

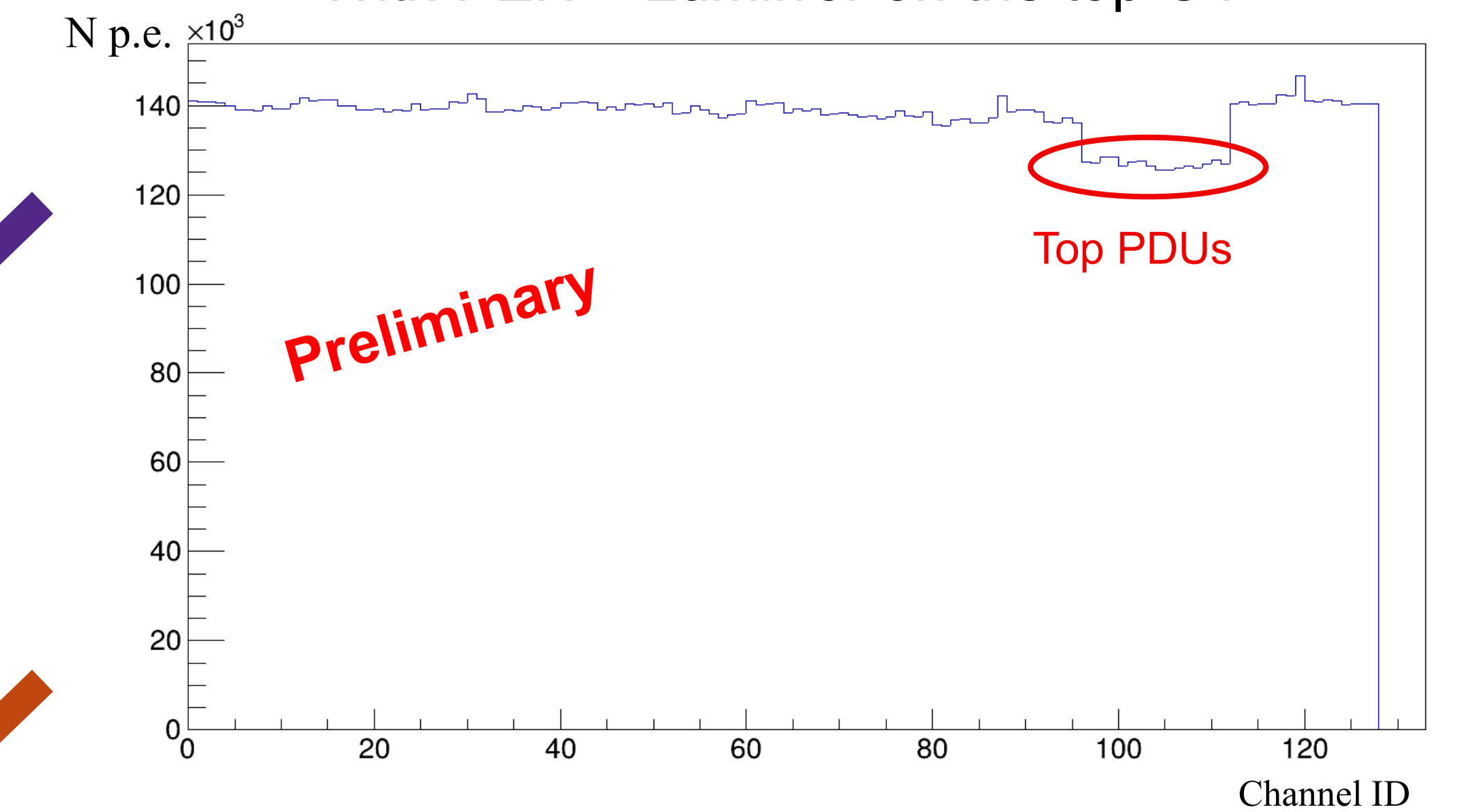


Fig.2. PDU channel response distribution

$$\langle LY \rangle = 178.242 \pm 28.22 p.e./MeV$$

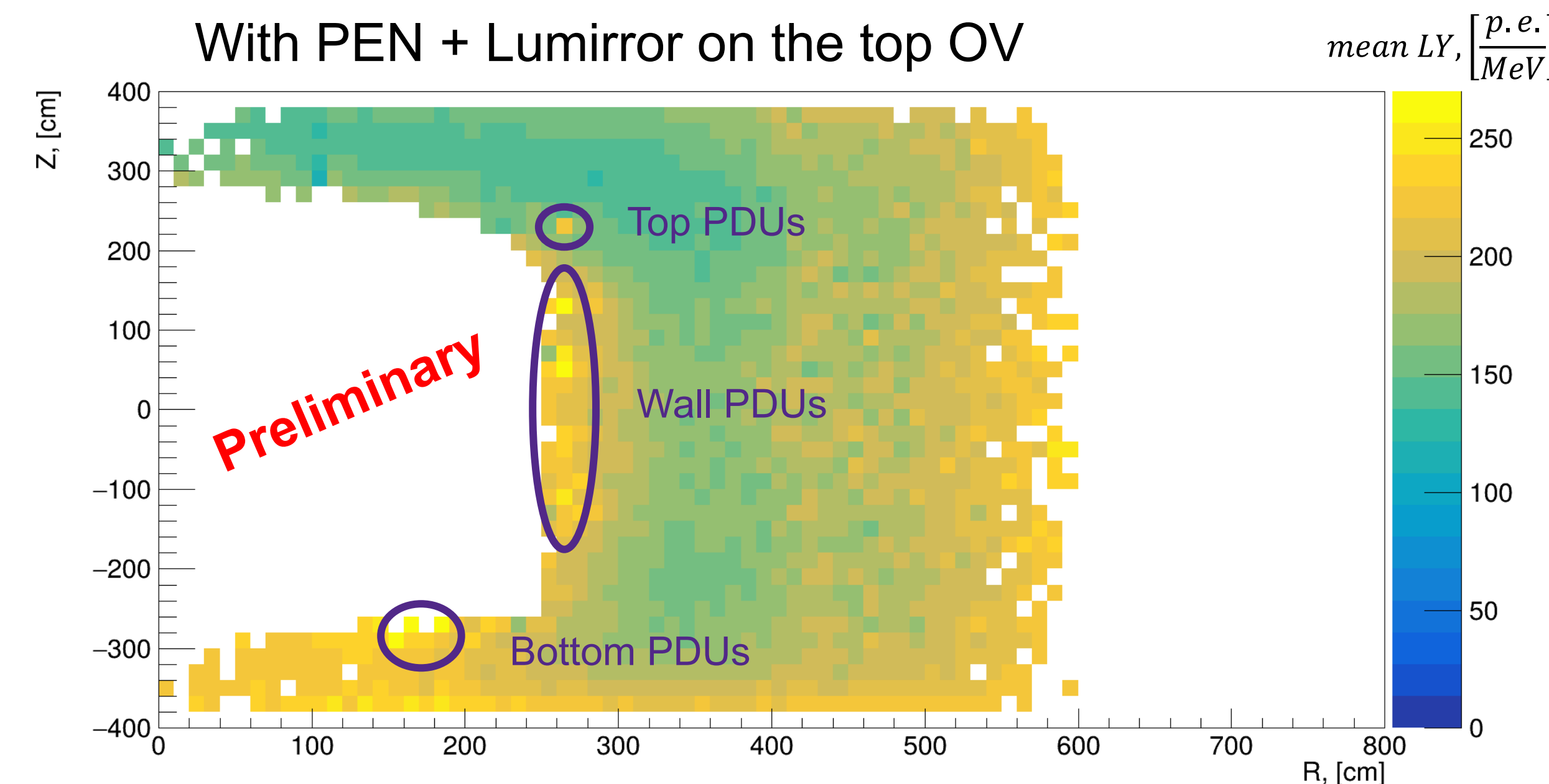


Fig.3. Mean LY map in R-Z coordinates

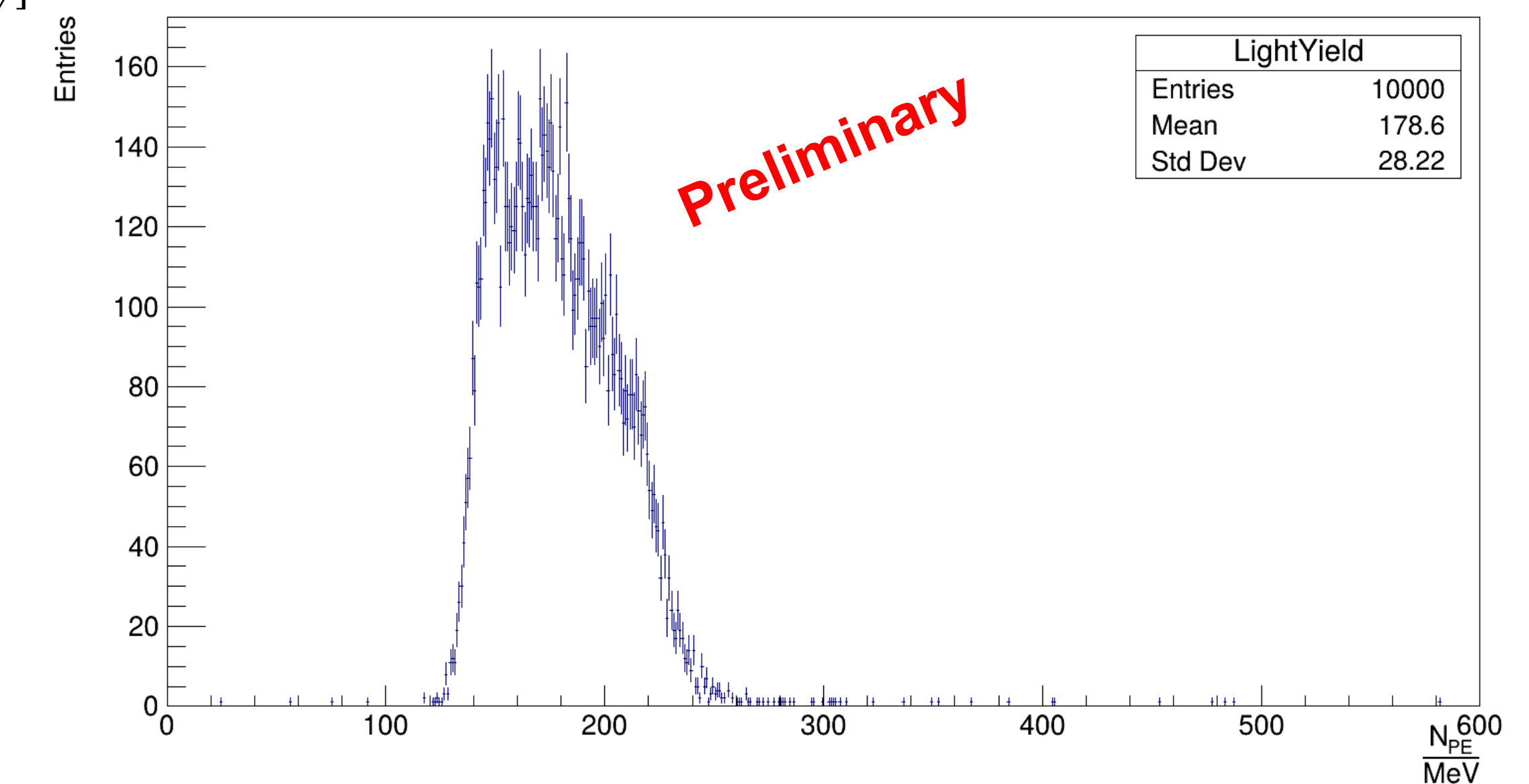


Fig.4. Simulated distribution of LY

4. Reconstruction: by Alec Peck

Azimuthal angle reconstruction

Vertical reconstruction

