

Annual Report

WLS + PSD

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[AstroCeNT](#)

Nicolaus Copernicus Astronomical Centre Warsaw

Research Tasks

2023

I. Analytic Model for Estimation of Light Yield = detected photons/deposited energy

- Simple Analytic Model, as v1 ✓
- Implementation of Rayleigh scattering and absorption effects to Analytic Model, as v2 ✓
- Comparison with Monte Carlo Simulation (Cenk Türkoğlu) ✓
- Validation of Absorption and scattering effects in larger volumes and non-symmetric Ar cells

II. Optical characterization ✓

- I. Silicon PhotoMultiplier (SiPM) reflectance measurement
- II. PolyEthylene Nephthlate (PEN) reflectance measurement

III. PEN characterization campaigns:

- Liquid Ar (LAr) measurements at University of Zürich ✓
- Vacuum UltraViolet measurement at Technical University of Munich ✓
- LAr measurements at CERN ✓
- Gas Ar (GAr) measurements at AstroCeNT [ongoing]

IV. Pulse Shape Discrimination (PSD)

- Validation of [PyTorch based MC PSD model](#) against Data (Group-5). [ongoing]
- Contribution to an [automatic data pipeline](#) for DEAP-3600 data analysis and PSD ✓

Doctoral Education

I. Courses

Completed following courses in the year 2023

- Experimental Search for Dark Matter ✓
- Inverse Probability Theory ✓

(Total 14 courses credited at Geoplanet Doctoral School and Warsaw University of Technology)

II. Research proposal

- Applied for a Preludium grant competition (2023) ✓

Other Activities

I. Participation in DEAP-3600

- Weekly meeting with Event Reconstruction Group
- Biannual collaboration meetings
- DEAP-3600 DAQ shifts
- Spotlight presentation on Pulse Shape Discrimination in DEAP-3600

II. Outreach Activities

- Scientific dissemination: sharing DEAP-3600 studies via social media
- Point of contact for Journal editors and partner institutions
- Set up Equity, Diversity and Inclusion (EDI) framework for DEAP-3600 collaboration

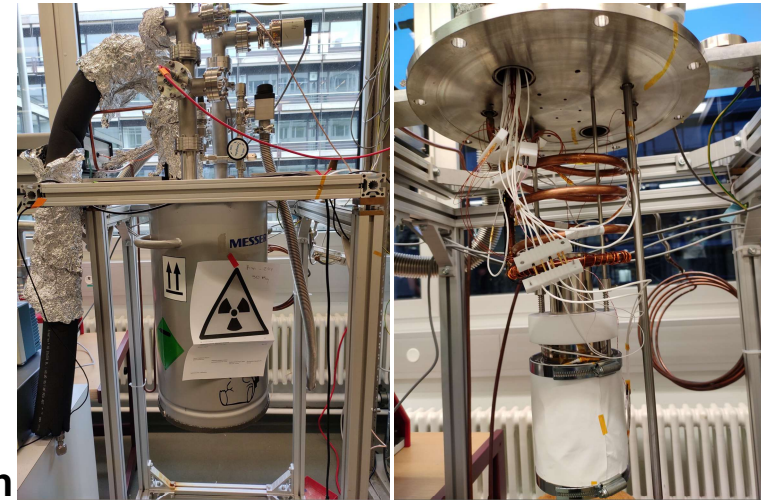
III. Colloquium

Attending colloquia at

- CERN (online)
- Faculty of Physics, University of Warsaw
- CAMK

Wavelength Shifter R&D

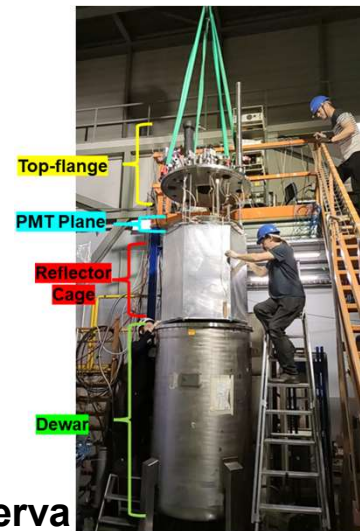
- **Wavelength shifter (WLS):** materials used for converting Ar scintillation light (128 nm) to visible for efficient detection.
- **Aim:** WLS for use in future very large detectors
- **Status:** Learning to use a newly commissioned setup (ArGSet) at AstroCeNT's lab in CEZAMAT.
- Setup soon to be fully ready for fast measurements of wavelength shifting efficiencies in Gas Argon.
- Collaboration b/w Group-1 & 2



LArS, Zurich



ArGSet, Warsaw

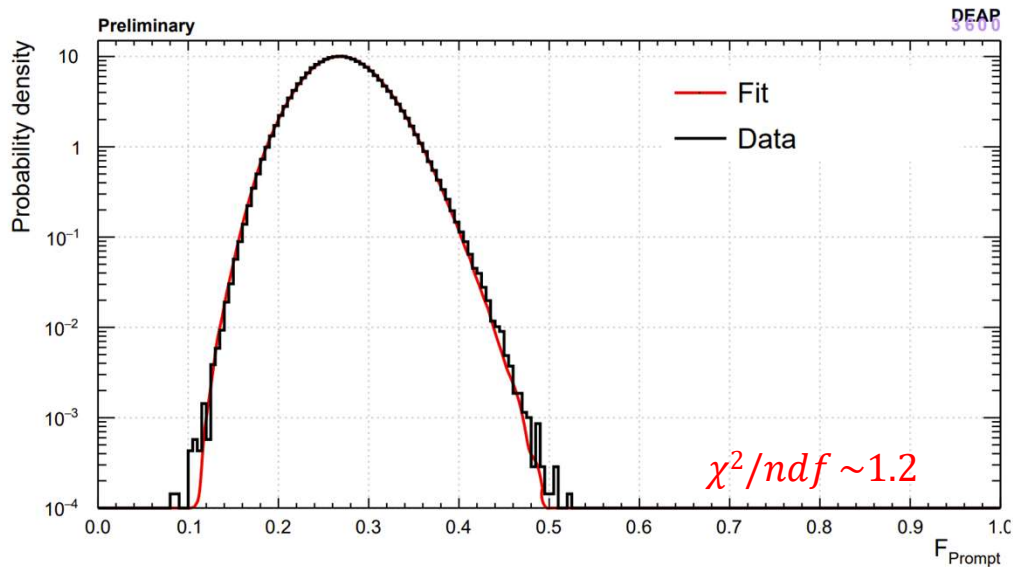


DWArF, Geneva

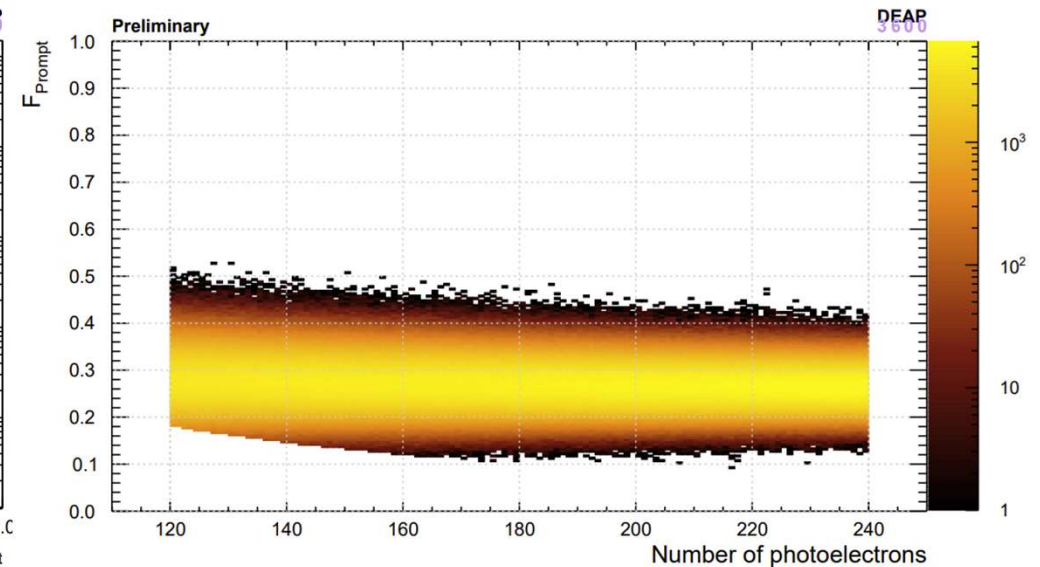


Pulse Shape Discrimination (PSD)

- PSD allows to reject e^- recoil generated from beta decay of radioactive Ar-39.
- PyTorch implementation by Manish Gupta (Group-5)
- Improvements to Monte Carlo PSD model [ongoing]



Model fit to DEAP-3600 detector data.



Parameter distribution for the best fit.



Thank You

Source: pw.edu.pl

astrocent.camk.edu.pl

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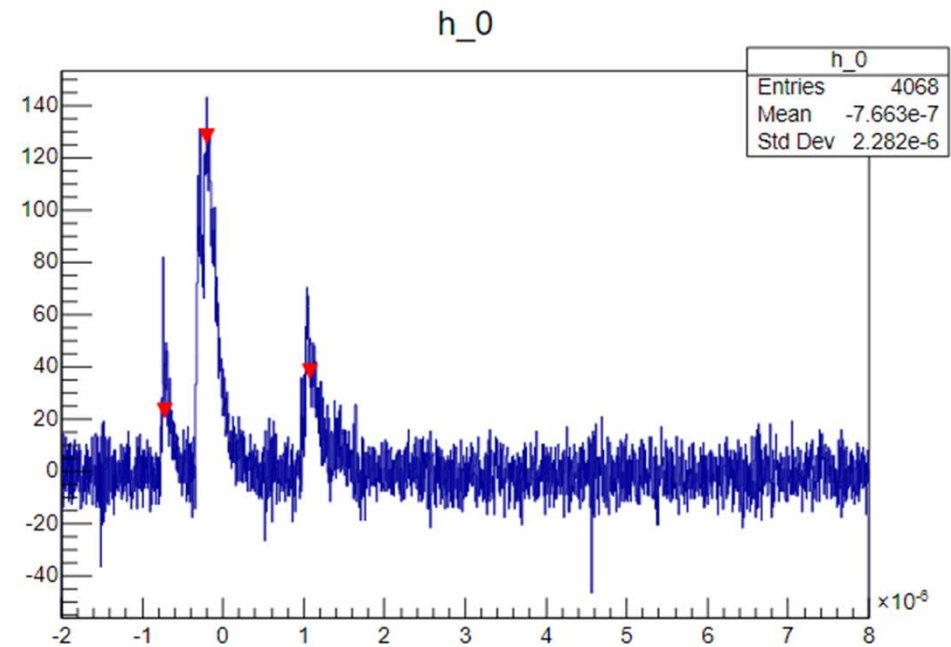
ArGSet

ArGSet

Wavelength shifting efficiency measurement with Gas Ar

Tasks

- Careful calibration of two SiPM
 - Estimation of breakdown voltage for either SiPM ✓
 - Fingerplot for both SiPM's



An event recorded with SiPM in ArGSet