THE PHOTON DETECTION SYSTEM OF SBND EXPERIMENT

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on behalf of SBND PDS collaboration

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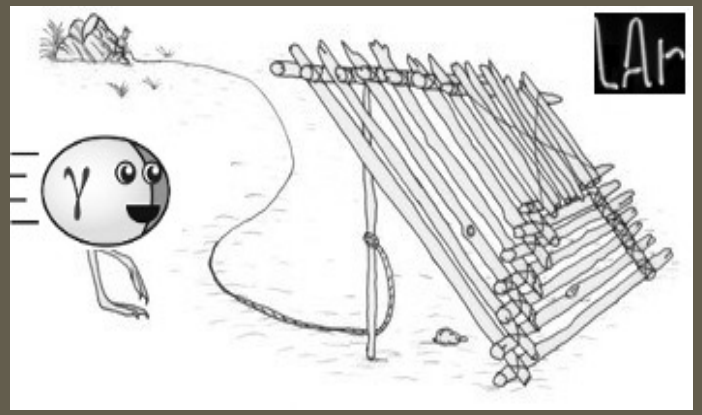
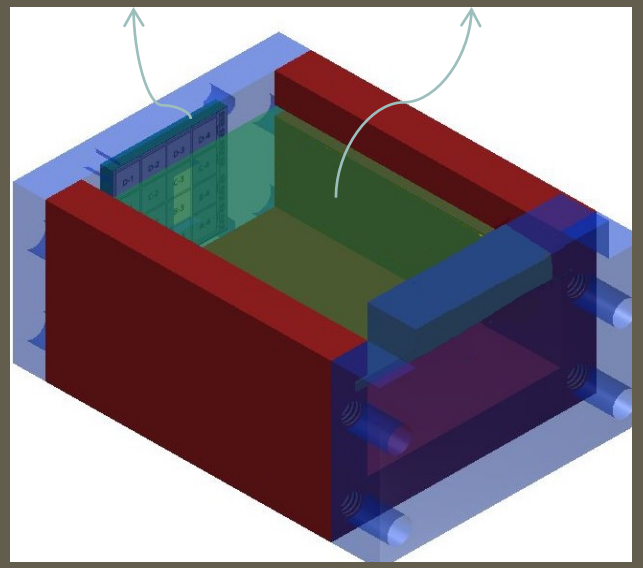
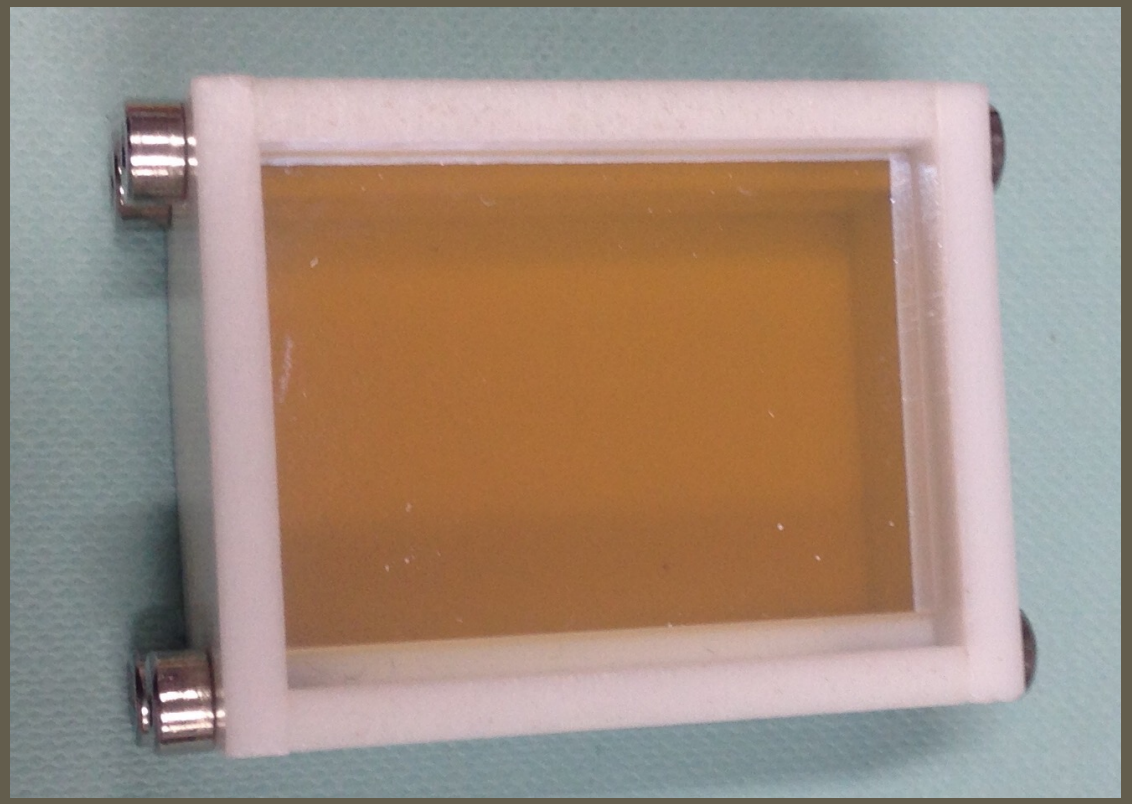
ARAPUCA

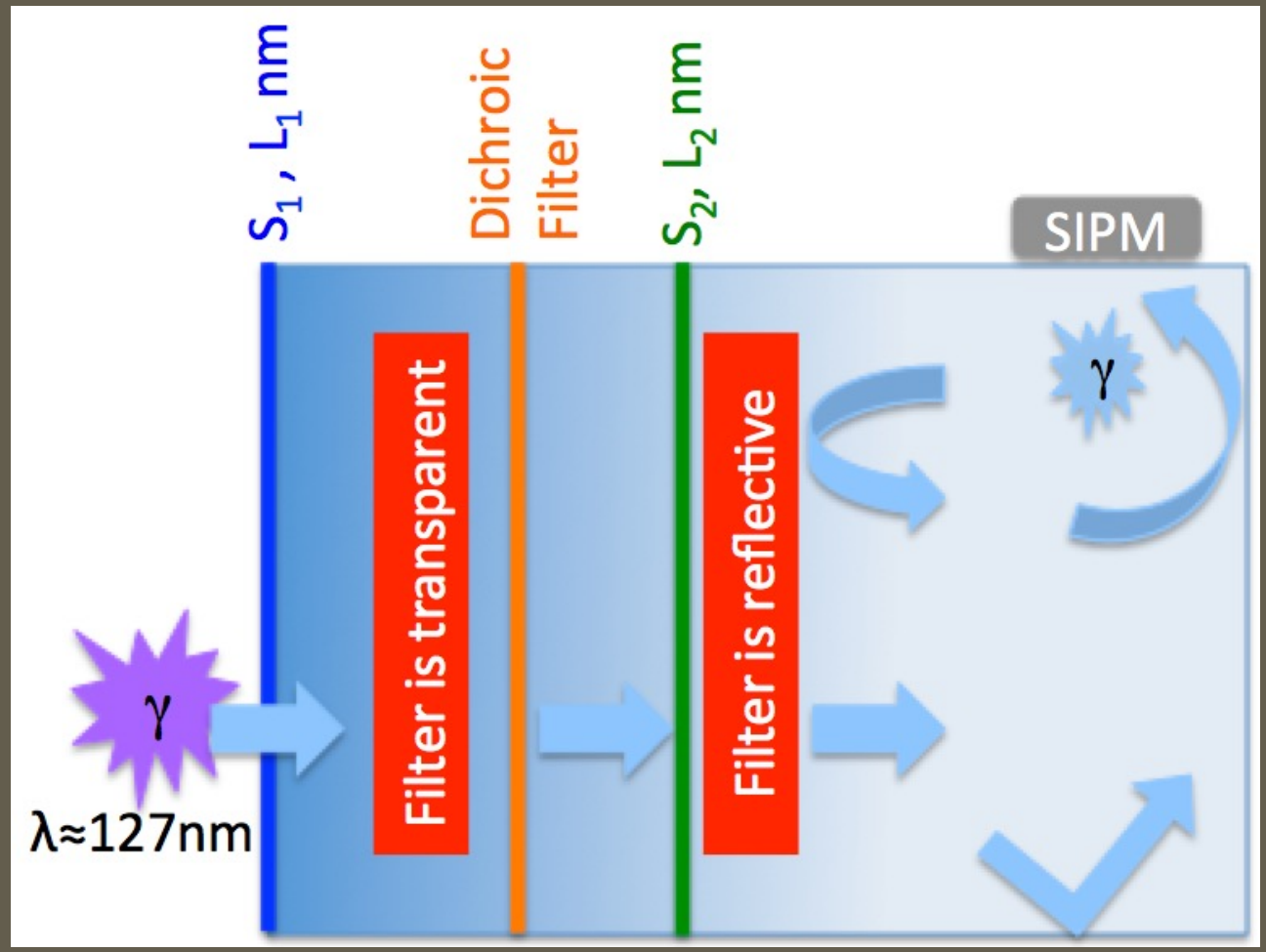
ARAPUCA in the language of *native Brazilian* means ***trap*** for birds







ARAPUCA WORKING PRINCIPLE



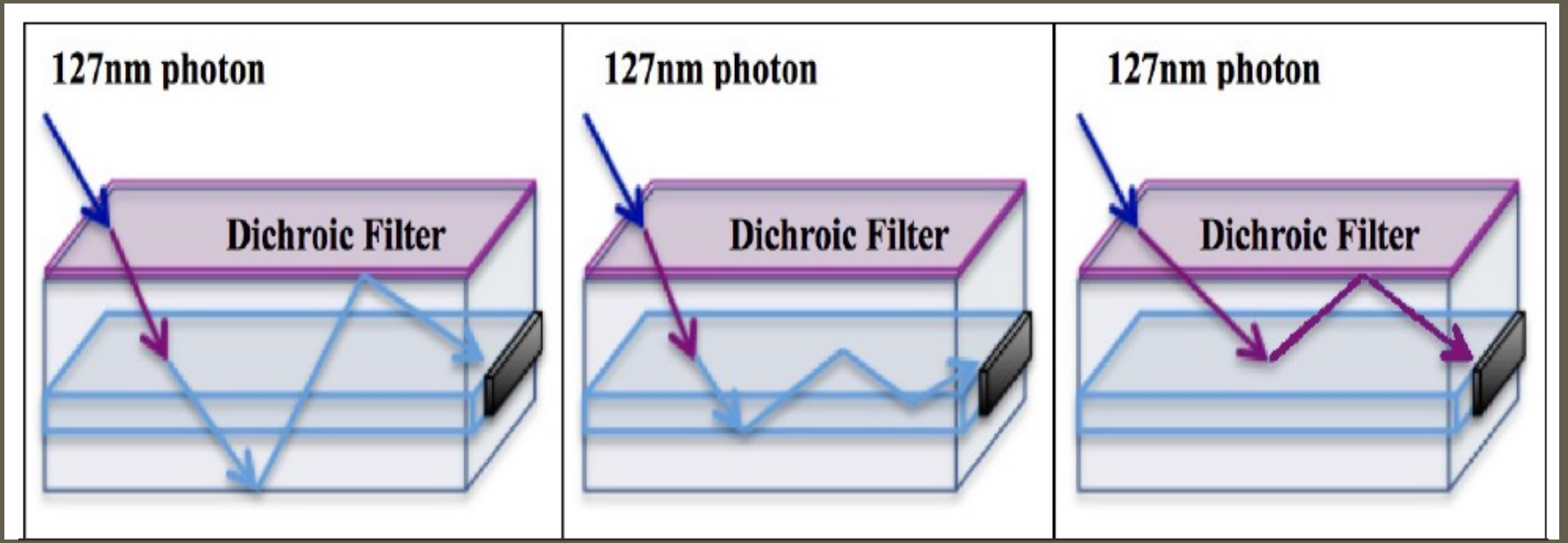
S1 → PTP 350nm emission
Filter → 400nm cutoff
S2 → TPB 430nm emission

430nm > filter cutoff

Filter became reflective and the photon is trapped !!!!

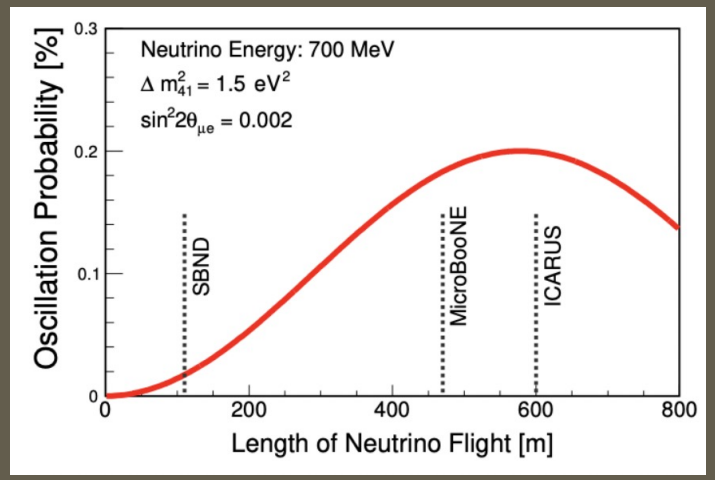
https://iopscience.iop.org/article/10.1088/1748-0221/11/02/C02004

X-ARAPUCA WORKING PRINCIPLE

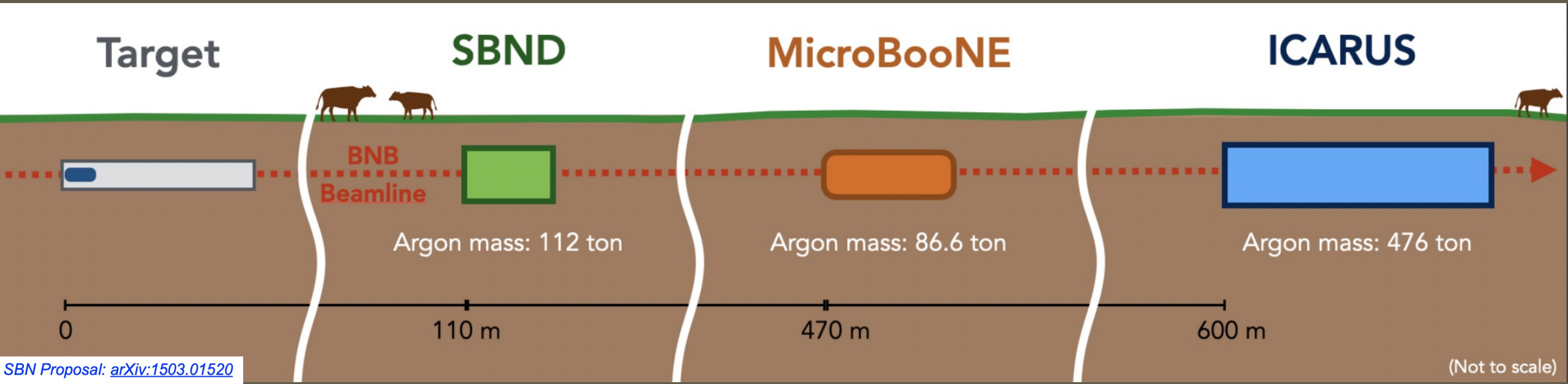


http://iopscience.iop.org/article/10.1088/1748-0221/13/04/C04026/meta

SHORT BASELINE NEUTRINO PROGRAM



- Three Liquid Argon TPC detector along of BNB to study short range neutrino oscillation
- eV-scale sterile neutrinos
- Neutrino argon interactions at GeV energy scale
- Search for rare physics process in the neutrino sector



SBN Proposal: arXiv:1503.01520

SHORT BASELINE NEUTRINO DETECTOR

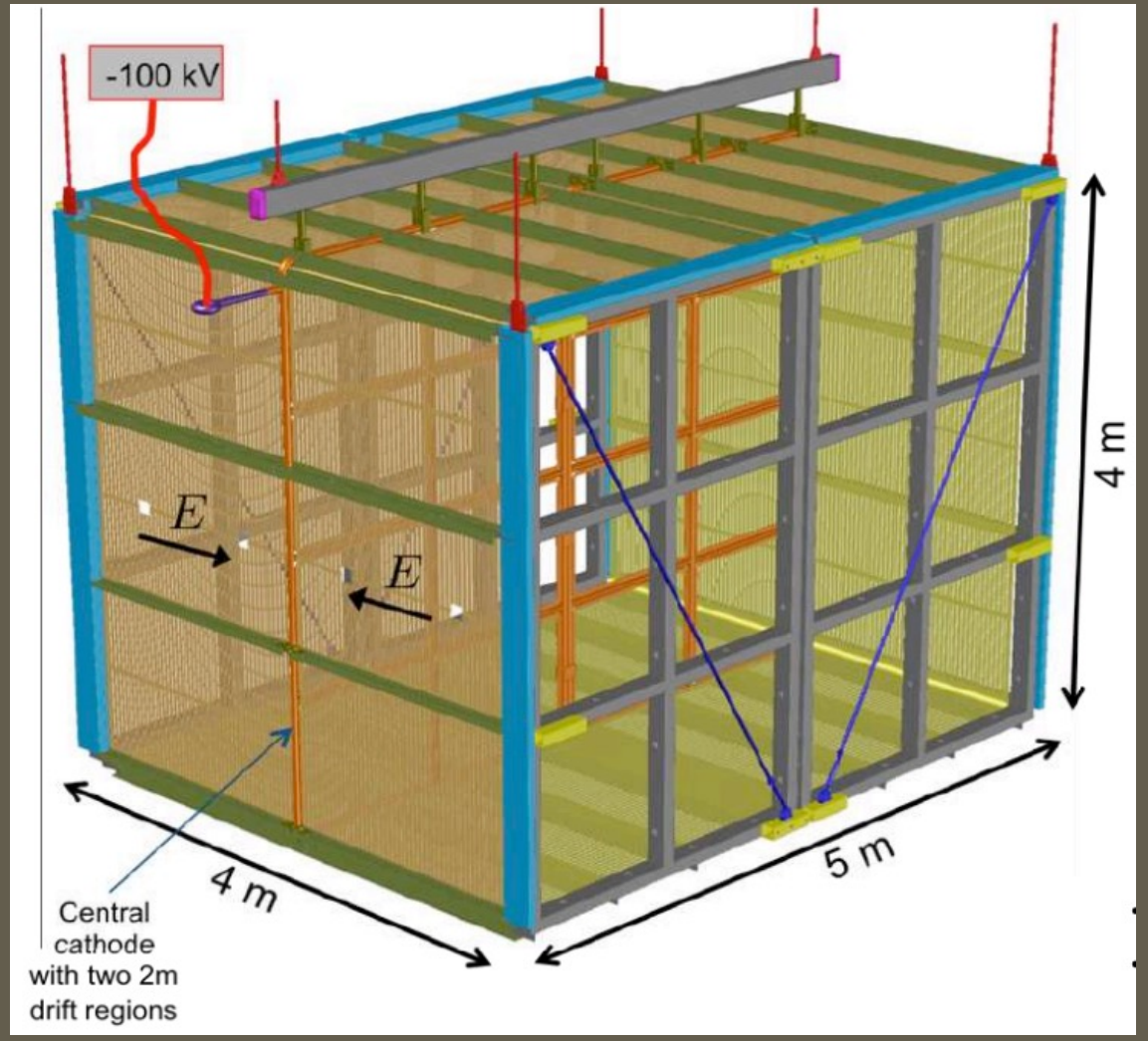
LAr Time Projection Chamber

- 112-ton active LAr volume
- 2 TPC with 2m drift lenght (1,28ms drift time at 500V/cm
- Cathode Plane Assembles (CPA) -middle
- Anode Plane Assembles (APA) – at the ends
- APA has 3 wire planes with 3mm pitch and spacing: vertical (y) and ± 60° (U&V)
- Photon Detection system

120 8”PMTs (96 coated with TPB)

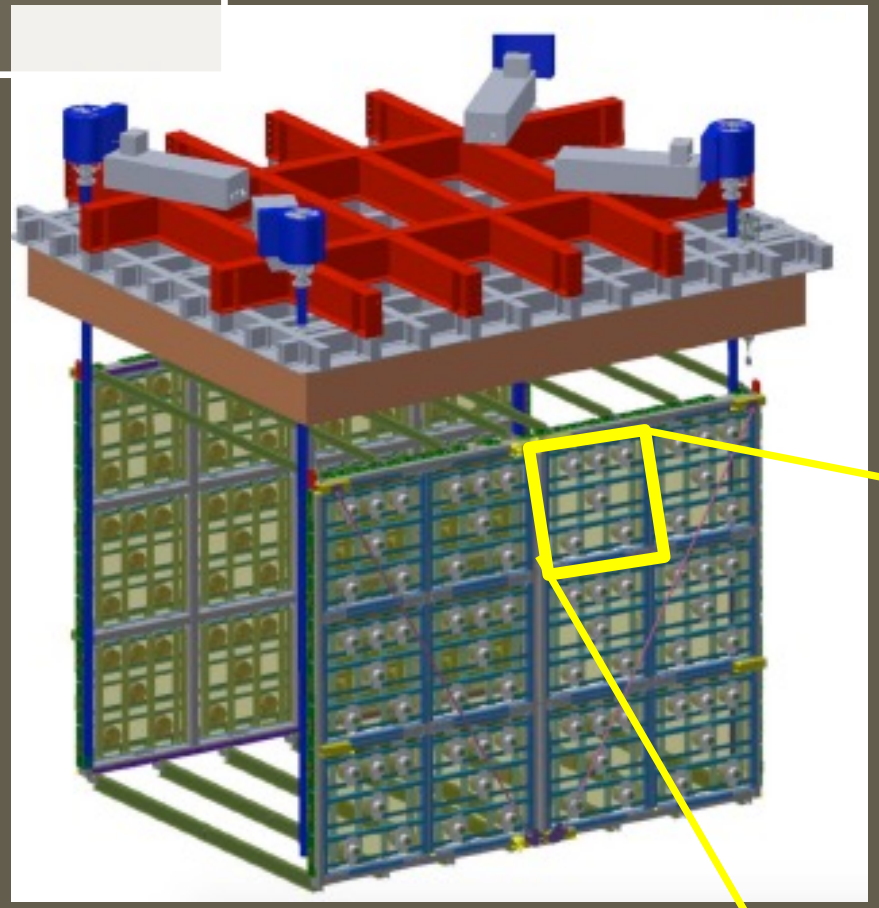
192 X-ARAPUCA modules (VIS and VUV)

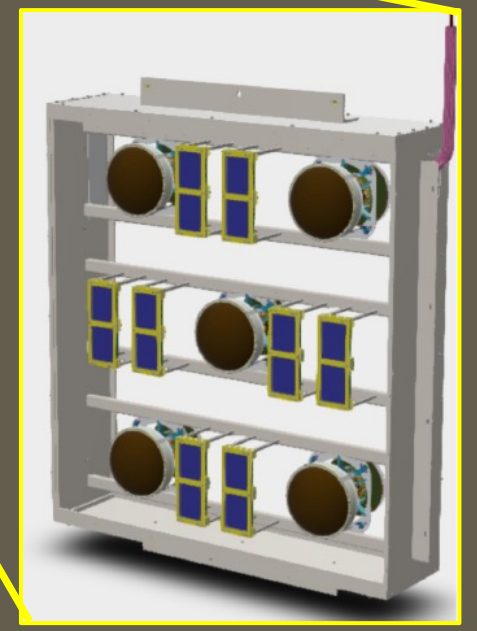
TPB coated reflector foils on the cathode



PHOTON DETECTION SYSTEM

- 120 8” Hamamatsu PMT’ with 96 TPB coated + 24 uncoated
- 192 X-ARAPUCA sensitive for direct (VUV) and reflected visible light (VIS)





Hamamatsu R5912-mod (cryogenic)

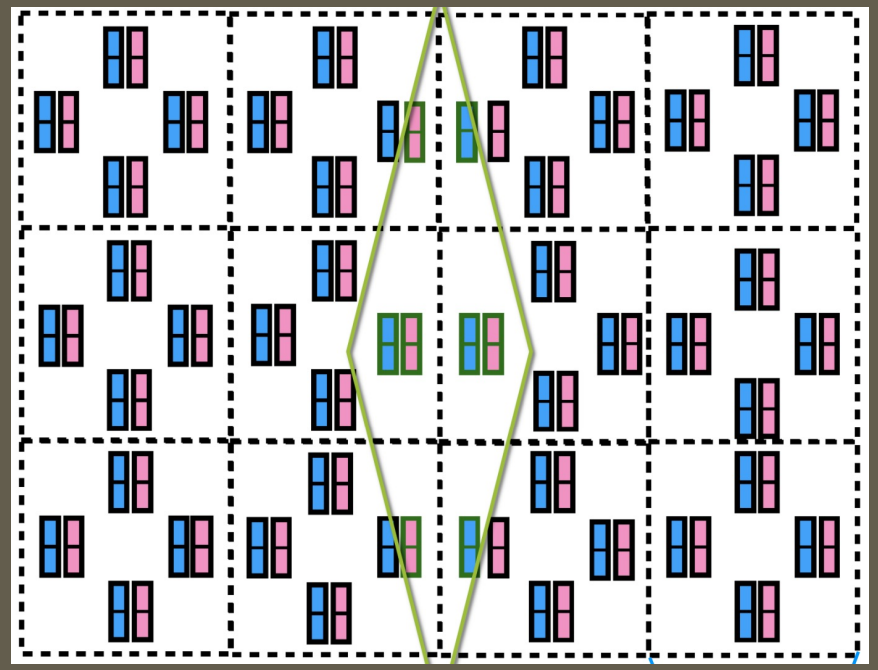
X-ARAPUCA System

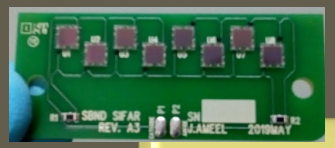
DAPHNE System Modules

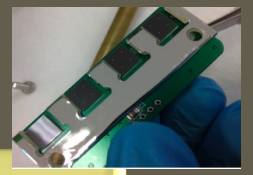
Labels: **020-195**

APSAIA System Module

Labels: **001-016**







- **192 modules**
  - **176 DAPHNE** readout (SensL SiPM)
    - 88 VUV light (Even)
      - 400nm cutoff pTP coating EJ286
    - 88 Visible light (Odd)
      - 450nm cutoff EJ280
  - **16 APSAIA** readout (Hamamatsu SiPM)
    - 8 VUV light (Even)
      - 400nm cutoff pTP coating Glass to Power
      - Blu
    - 8 Visible light (Odd)
      - 450nm cutoff Glass to Power
      - Green

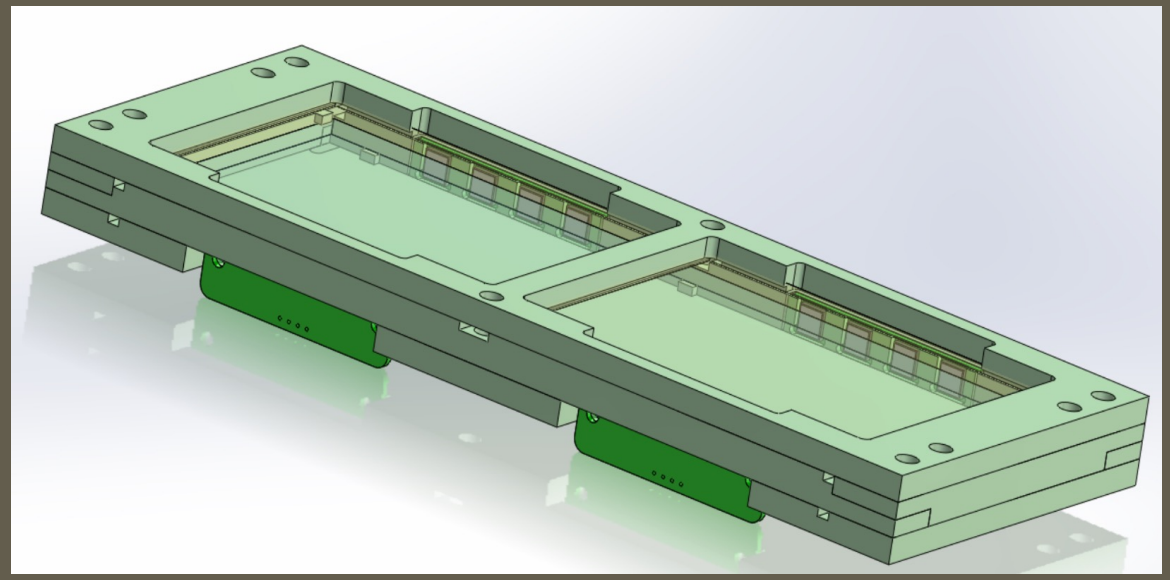
Glas to Power	2.9 +- 0.1 %
ELJEN	1.8 +- 0.1%
	2.2 +- 0.5%

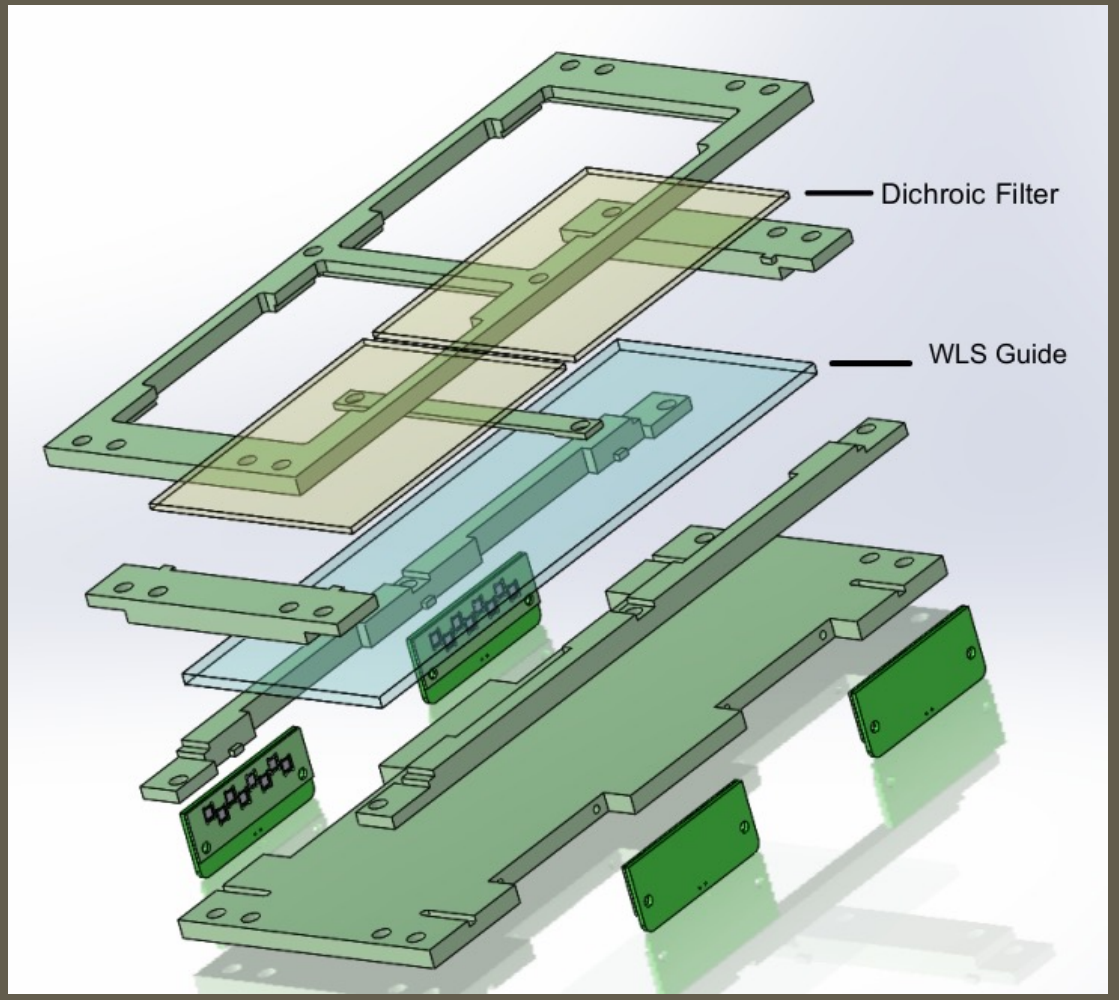
https://arxiv.org/abs/2104.07548

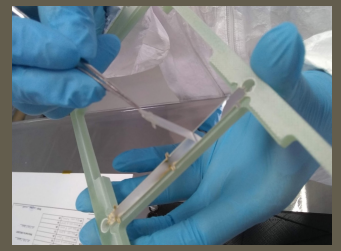
https://arxiv.org/abs/2106.04505

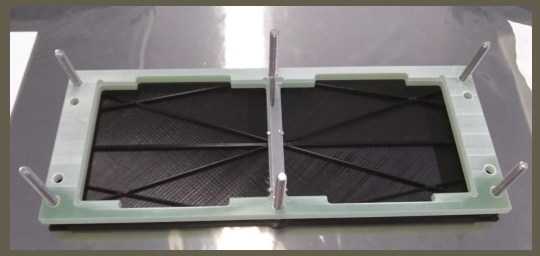
← Efficiency measured with 2 independent measurements

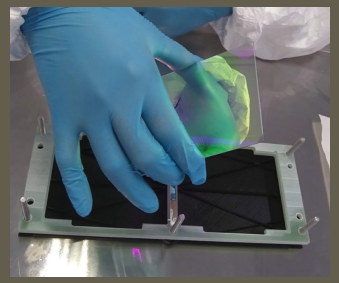
X-ARAPUCA MODULE

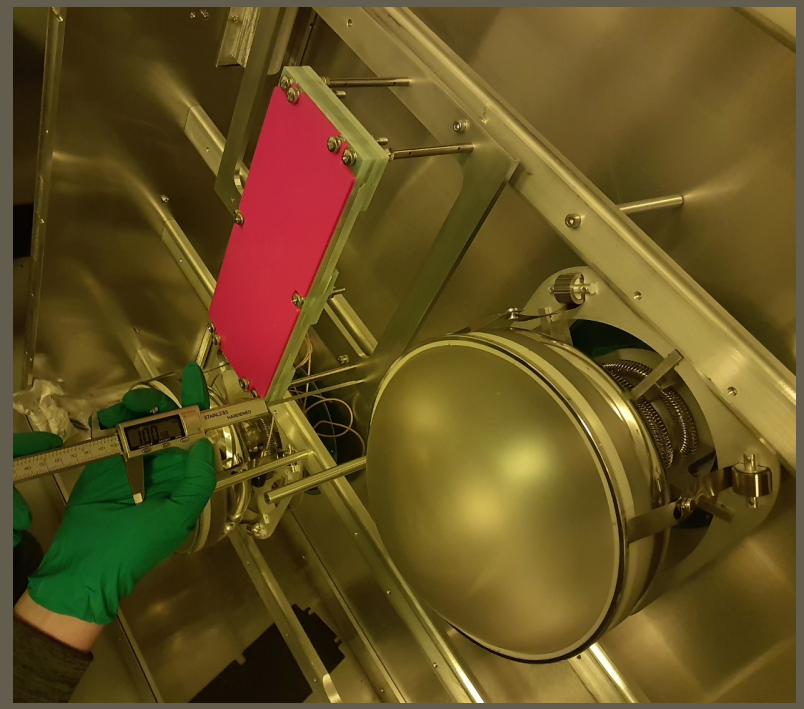


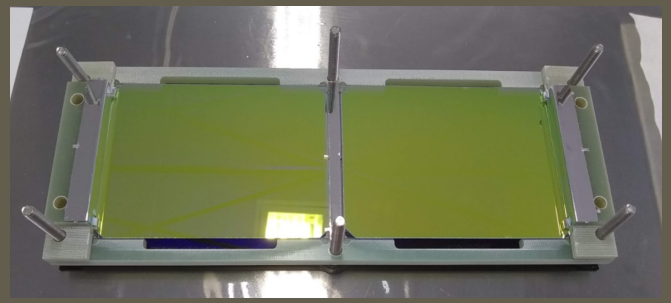


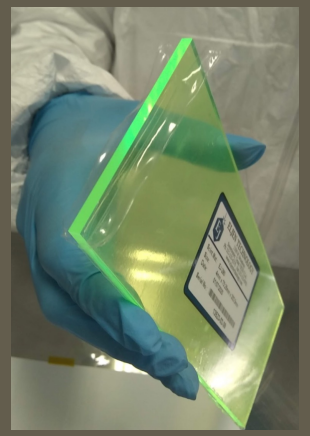


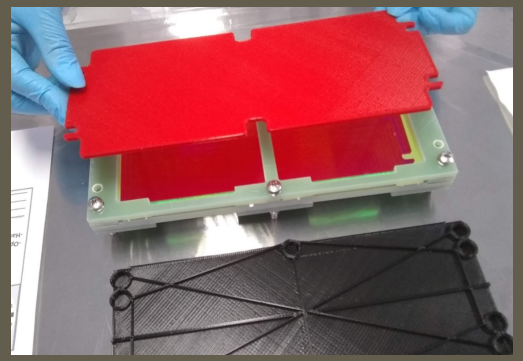


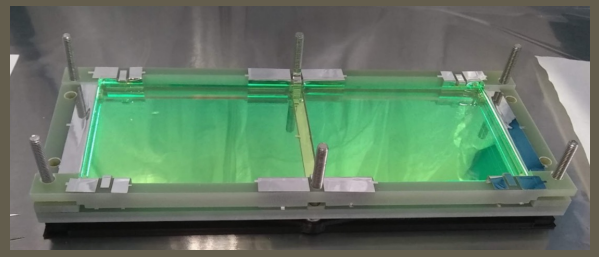


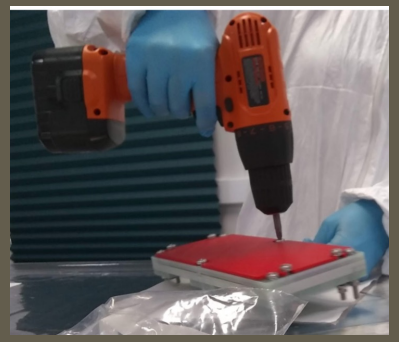


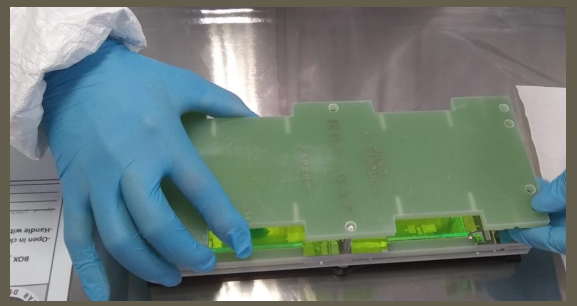


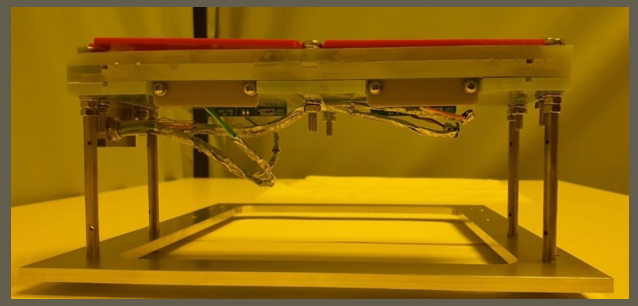












credits M.C.Bazetto and H.Frandini

Acknowledgement

This work is supported by FAPESP through the process

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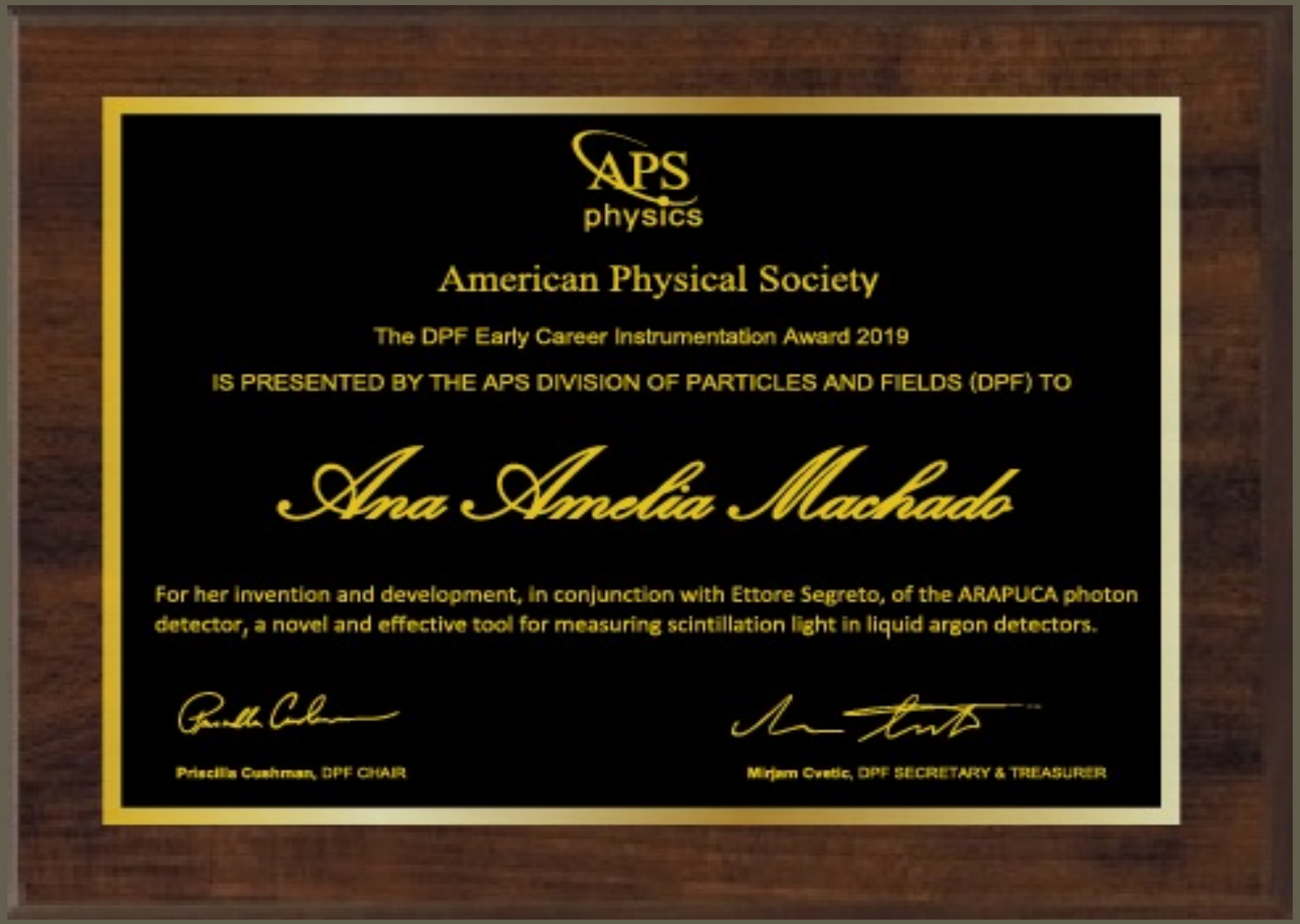
APS
physics
American Physical Society
The DPF Early Career Instrumentation Award 2019
IS PRESENTED BY THE APS DIVISION OF PARTICLES AND FIELDS (DPF) TO
Ana Amelia Machado
For her invention and development, in conjunction with Ettore Segreto, of the ARAPUCA photon detector, a novel and effective tool for measuring scintillation light in liquid argon detectors.
Priscilla Cushman, DPF CHAIR
Mirjam Cvetic, DPF SECRETARY & TREASURER