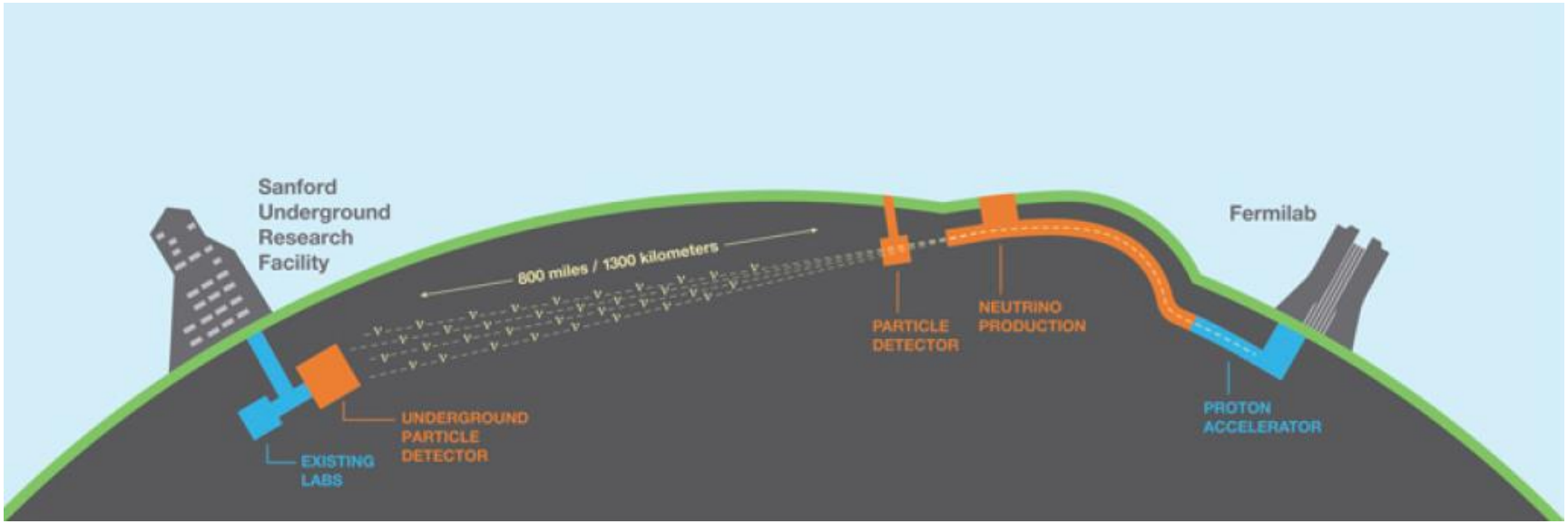
Dark Matter and the Nature of Neutrinos (part 1/2)



the DUNE group at IGFAE
Instituto Galego de Física de Altas Enerxías

P. Amedo (PhD), **D. J. Fernández-Posada** (technician), **D. González-Díaz** (Ramón y Cajal), **D. González-Caamaño** (IGFAE technician -20%), **S. Leardini** (PhD), **A. Saá-Hernández** (associate researcher)

and

L. Olano Vegas (master student, now at nanogune), **I. Pardo González** (master student, now at ICFO), **A. Sánchez Bravo** (master student, now at IFIC), **M. Morales** (PhD, on leave)

Main active topics and collaborations

IGFAE

Resistive-Protected Charge-Amplification Structures at low-T

Material development and characterization

ICG/IMATUS, Weizmann, U. Aveiro

IGFAE

New Light-Based Amplification Structures

Structure characterization and testing

Warsaw AstroCENT, U. Aveiro, CERN-RD51

IGFAE

3D Optical Readout for LAr-TPCs

T_0-readout (with X-ARAPUCAs)

U. Liverpool, CERN-Neutrino Platform

IGFAE

Fundamental studies of scintillation in pressurized gases

Measurements and microscopic modelling

U. Coimbra

R&D on Rare Event Searches

IGFAE

Enabling Primary Scintillation ('T_0') in a tracking argon-based TPC

Project coordinator

U. Vigo, IFIC

DUNE's ND-GAr (prototyping)

Main active projects

Xunta:
Grupo de Referencia Competitiva
(IP: José Benlliure)

AIDAinnova:
WP7 Gaseous Detectors, Task 7.4, IGFAE contribution
(IP: Diego González-Díaz)

FPN:
ULTIMATE: Unleashing Light Timing In a Massive Argon TPC Experiment
(IPs: Diego González-Díaz, Joaquín Collazo)

Dissemination 2021-2022

•R. Santorelli, E. Sánchez García, P. García Abia, **D. González-Díaz**, et al, *Spectroscopic analysis of the gaseous argon scintillation with a wavelength sensitive particle detector,* Eur. Phys. J. C 81(2021)7, 622.

•**S. Leardini** et al., *Time and band-resolved scintillation in time projection chambers based on gaseous xenon*, Eur. Phys. J. C 82(2022)5, 425

•**DUNE collaboration**, *DUNE Near Detector Conceptual Design Report*, Instruments 5(2021)4, 31.

•M. Kuzniak, **D. González-Díaz**, et al, *Development of very-thick transparent GEMs with wavelength-shifting capability for noble element TPCs*, Eur. Phys. J. C 81(2021)7,609.

• I. Riádigos, **D. González-Díaz**, V. Pérez-Muñuzuri, *Revisiting the limits of atmospheric temperature retrieval from cosmic ray measurements*, Earth and Space Science, 9, e2021EA001982

• **P. Amedo**, **D. González-Díaz**, B. J. P. Jones, *Neutral bremsstrahlung in TPCs,* JINST 17(2022)02, C02017.

•C. A. O. Henriques, **P. Amedo,** et al, *Neutral Bremsstrahlung emission unveiled*, Phys. Rev. X 12(2022)021005.

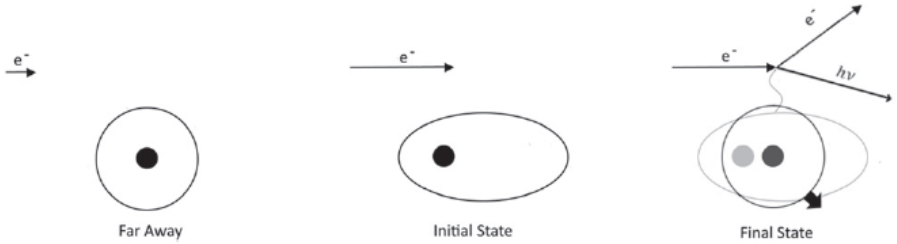
- ❑ Twelve more collaboration papers.
- ❑ Three Snowmass white papers.
- ❑ About ten presentations at workshops and conferences.
- ❑ Five publications in preparation.

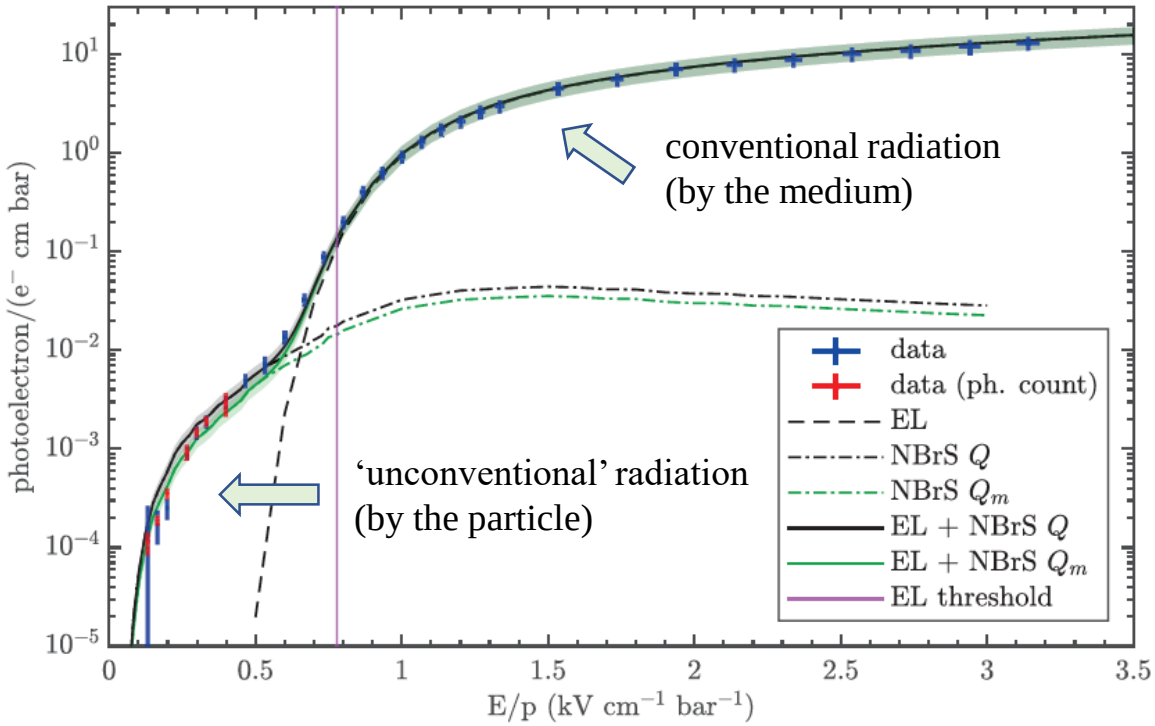
Three highlights: #1. Neutral Bremsstrahlung unveiled

PHYSICAL REVIEW X **12,** 021005 (2022)

Neutral Bremsstrahlung Emission in Xenon Unveiled

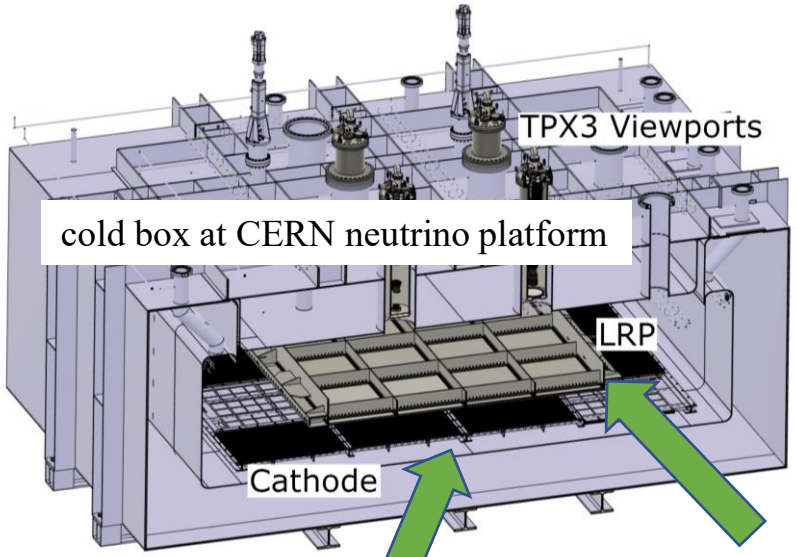
C. A. O. Henriques,[1,†] P. Amedo,[2] J. M. R. Teixeira,[1] D. González-Díaz,[2] C. D. R. Azevedo,[3] A. Para,[4] J. Martín-Albo,[5] A. Saa Hernandez,[2] J. J. Gómez-Cadenas,[6,7,‡] D. R. Nygren,[8,‡] C. M. B. Monteiro,[1,*] C. Adams,[9] V. Álvarez,[10] L. Arazi,[11]





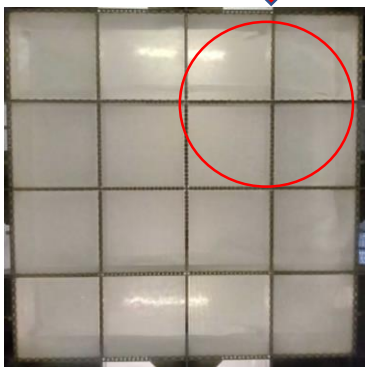
Three highlights: #2. Optical readout of a 4m^2 dual-phase argon TPC

- Successful demonstration of **3D** tracking at 4mm-sampling
- Done over 4m^2 tracking plane (260000 channels!)
- Collaboration with Liverpool Univ. and CERN Neutrino Platform



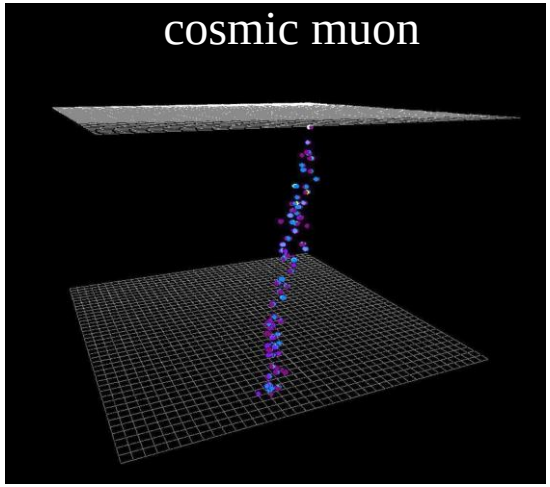
~1m^2 field-of-view per camera

S1 plane
(X-ARAPUCA)

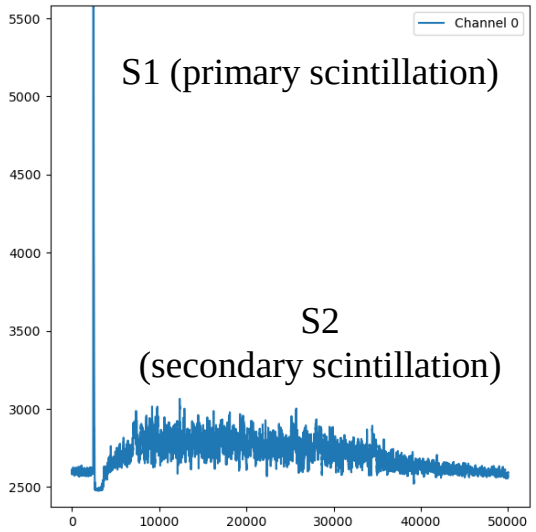


tracking plane
(4m^2 glass GEMs)

tracking plane



S1 plane

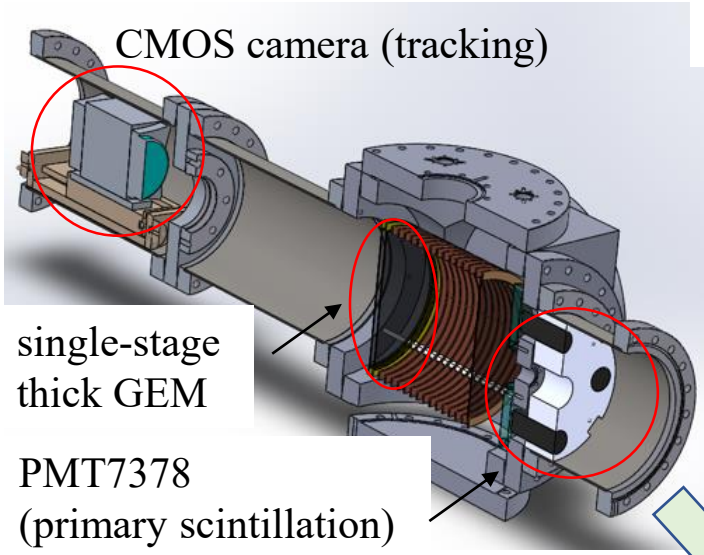


P. Amedo et al https://cds.cern.ch/record/2739360?ln=es

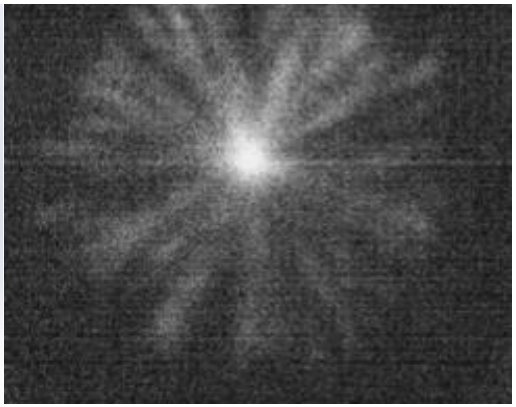
(campaign ended in May, analysis ongoing)

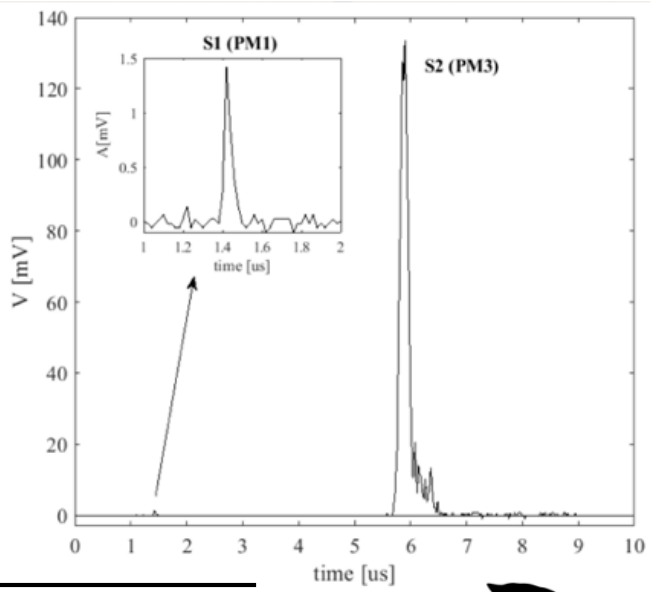
Three highlights: #3. Repurposing our OTPC demonstrator at IGFAE

- **past OTPC design** [before 2020] -> targeting fission studies:



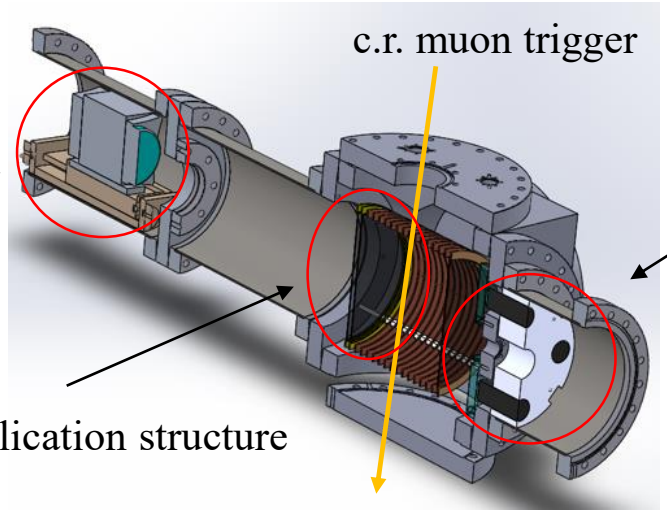
alpha tracks in CF_4 at 0.5bar



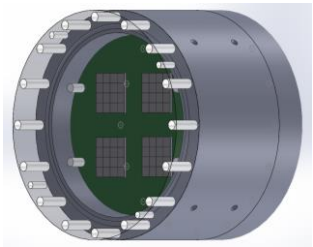


- **present OTPC design** [after 2022] -> targeting neutrino interactions:

Gaseous Argon T_0 GAT0

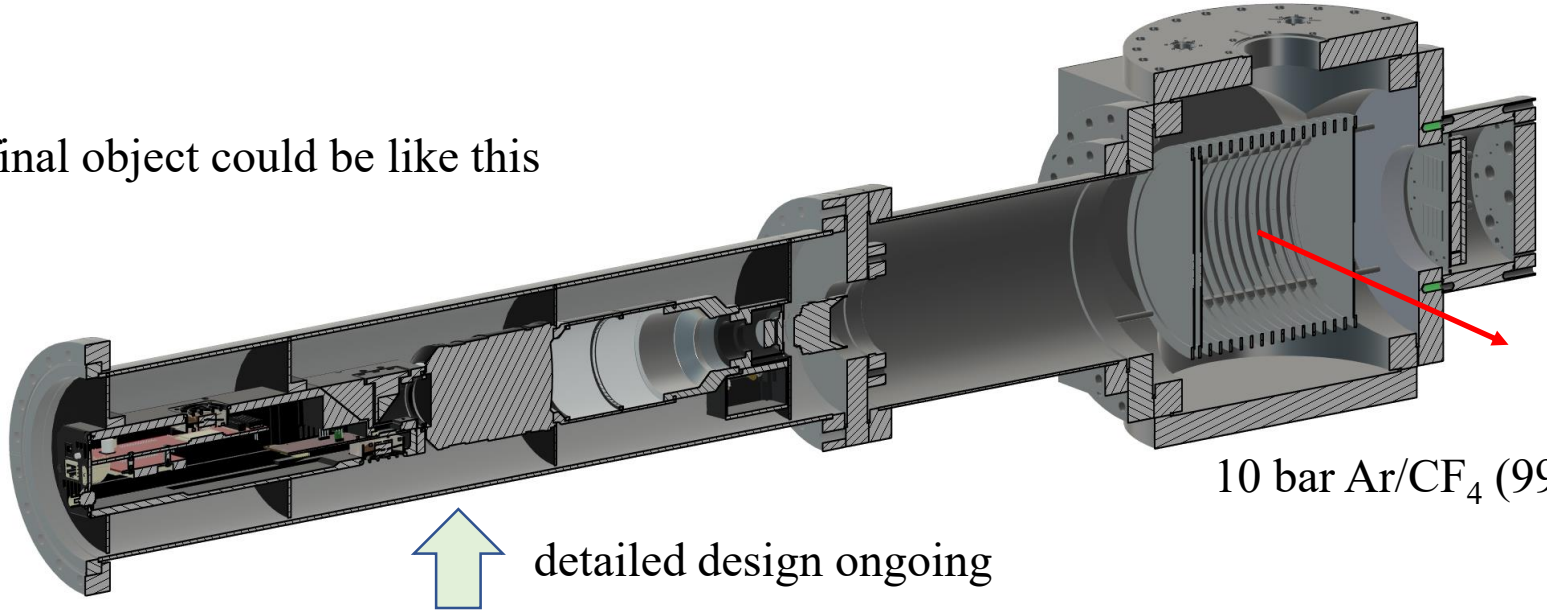


replace with SiPM sensor



Three highlights: #3. Repurposing our OTPC demonstrator at IGFAE

the final object could be like this



Goals:

- Demonstrate the improved spatial sampling and resolution compared to a classical TPC.
- Reconstruct T_0 with 1ns resolution.
- Demonstrate stability.

Strategy:

- Adaptation, system integration and commissioning will extend over 2022-2023.
- Use RD51 beam-line with muons and pions. Should happen by the end of 2023.
- Project supported by Spanish Ministry!.

We are a collaborative gang

if you are, too, and interested in this science

drop us an email!

Diego.Gonzalez.Diaz@usc.es

THANKS FOR YOUR ATTENTION