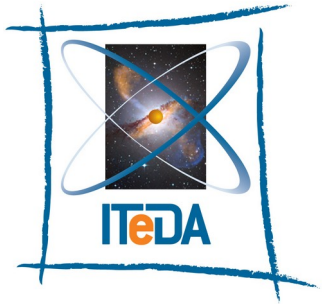


Contributions of Argentina & the ITeDA's group

Federico Sánchez

Workshop CUIA

May, 2022



CNEA - CONICET - UNSAM



**PIERRE
AUGER**
OBSERVATORY

Outline

1. Engineering array contributions

- Site survey's
- The TANGO array @ Buenos Aires

} ~ 1995 - 2005

2. Construction & deployment contributions

- The Liner factory @ UTN, Mendoza
- The electronic & PMT testing facility (SDECO)

} ~ 2005 - 2008

3. Upgrade contributions

- AMIGA: surface detector infills + underground scintillators

↑ Auger: science
↓ Upgrade: R&D
~ 2015 - 20XX



1. Engineering array contributions

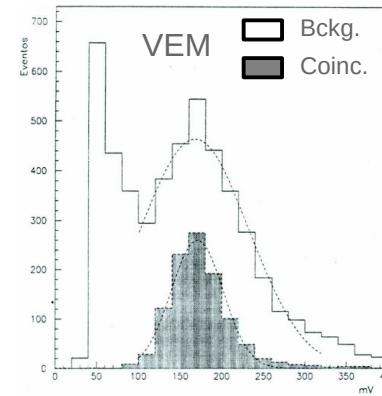
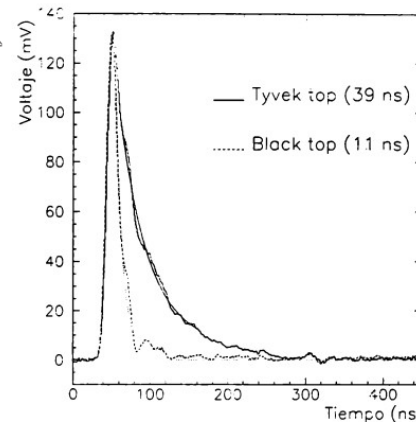
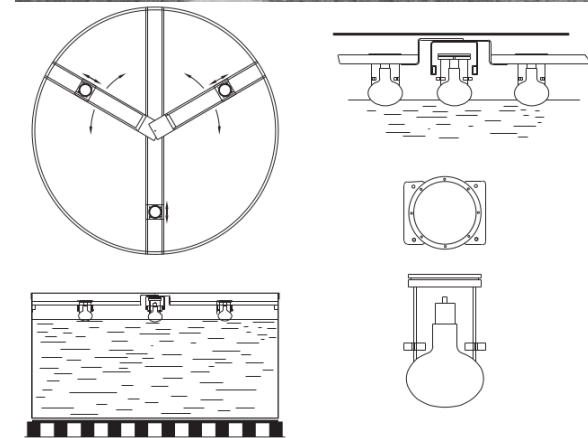
- Site survey's
- The TANGO array @ Buenos Aires

The first **real-scale prototype** of Water-Cherenkov detector (WCD)



Optimization of WCD design

- PMTs position
- Water level
- Liner reflectivity (black/white top)
- Bacteriological activity
- Online calibration procedures
- Simulation validation



INSTITUTE OF PHYSICS PUBLISHING
 J. Phys. G: Nucl. Part. Phys. **28** (2002) 1499–1509
 PI: S0954-3899(02)34870-9

RESEARCH NOTES FROM COLLABORATIONS

Site survey for the Pierre Auger observatory

I Allekotte¹, P Bauleo², C Bonifazi², A Ceballos³, B Fick⁴,
 A Etchegoyen^{2,9}, A Ferrero², A Filevich^{2,9}, B García^{5,9}, K Gibbs⁴,
 A Letessier-Selvon⁶, J C Meza⁷ and A C Rovero^{8,9}
 (for the Pierre Auger Collaboration)

NH
 ELSEVIER
 Nuclear Instruments and Methods in Physics Research A 406 (1998) 69–77

NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH Section A

A water tank Cherenkov detector for very high-energy astroparticles

P. Bauleo, A. Etchegoyen¹, J.O. Fernández Niello^{*1}, A.M.J. Ferrero, A. Filevich¹,
 C.K. Guérard², F. Hasenbalg, M.A. Mostafá, D. Ravnigani, J. Rodríguez Martino

NH
 ELSEVIER
 Nuclear Instruments and Methods in Physics Research A 463 (2001) 175–182
 www.elsevier.nl/locate/nima

NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH Section A

Remote particle density calibration of a water Cherenkov detector using crossing-through muons

P. Bauleo*, C.B. Bonifazi, A. Filevich¹, A. Reguera
 Departamento de Energía Nuclear de Energía Atómica, Avenida del Libertador 8250, 1429 Buenos Aires, Argentina

Available online at www.sciencedirect.com
 SCIENCE @ DIRECT®
 ELSEVIER
 Nuclear Instruments and Methods in Physics Research A 545 (2005) 602–612
 www.elsevier.com/locate/nima

NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH Section A

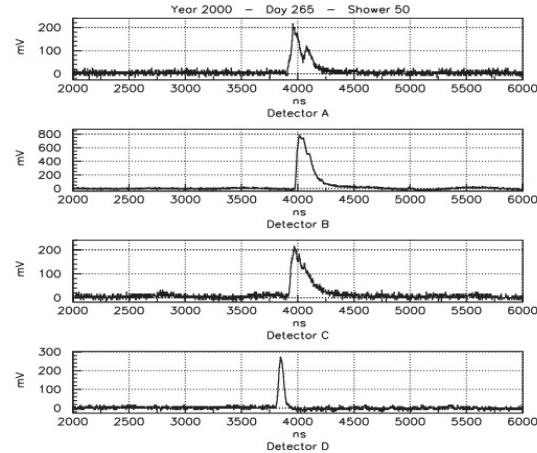
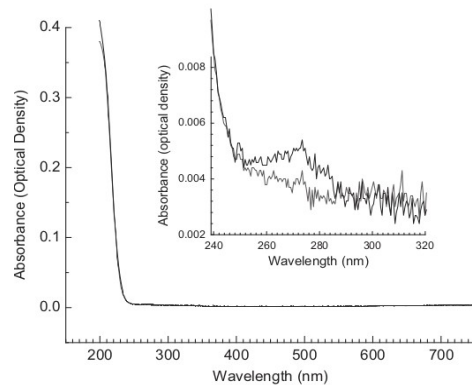
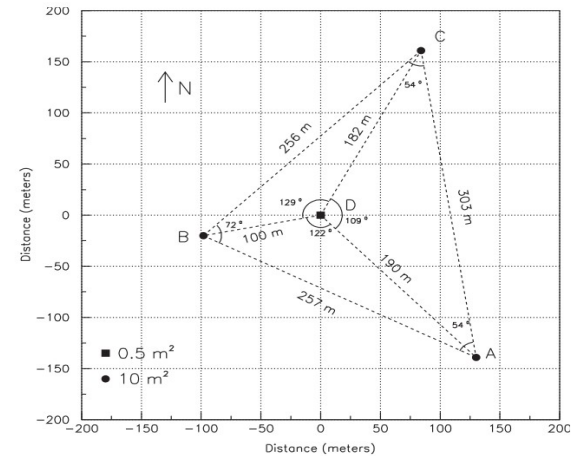
Muon-track studies in a water Cherenkov detector

A. Etchegoyen^{a,*1}, P. Bauleo^{a,2}, X. Bertou^{b,3}, C.B. Bonifazi^{a,4}, A. Filevich^{a,1},
 M.C. Medina^a, D.G. Melo^a, A.C. Rovero^{c,1}, A.D. Supanitsky^a, A. Tamashiro^{a,5},
 For the Pierre Auger Collaboration⁶

1. Engineering array contributions

- Site survey's
- The TANGO array @ Buenos Aires

The TANdar Ground Observatory



Optimization of

- Shower reconstruction algorithm validation
- Shower & event simulations
- Monitoring and long-term calibration

Available online at www.sciencedirect.com

SCIENCE @ DIRECT®

ELSEVIER

Nuclear Instruments and Methods in Physics Research A 516 (2004) 414–424

NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH Section A

www.elsevier.com/locate/nima

TANGO Array.

1. The instrument

P. Bauleo*, C. Bonifazi, A. Filevich¹, A. Reguera²

Departamento de Física, Comisión Nacional de Energía Atómica, Avenida del Libertador 8250, Buenos Aires 1429, Argentina

Available online at www.sciencedirect.com

SCIENCE @ DIRECT®

ELSEVIER

Nuclear Instruments and Methods in Physics Research A 516 (2004) 425–435

NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH Section A

www.elsevier.com/locate/nima

TANGO Array.

2. Simulations

P. Bauleo*, C. Bonifazi, A. Filevich¹

Departamento de Física, Comisión Nacional de Energía Atómica, Avenida del Libertador 8250, (1429) Buenos Aires, Argentina

Contents lists available at SciVerse ScienceDirect

Nuclear Instruments and Methods in Physics Research A

journal homepage: www.elsevier.com/locate/nima

ELSEVIER

NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH

Long term biological developments in water Cherenkov detector media

M. Venturini^a, A. Filevich^{a,*}, R. Pizarro^a, J. Ibáñez^a, P. Bauleo^b, **J. Rodríguez Martino**



2. Construction & deployment contributions

- The Liner factory @ UTN, Mendoza



- ISO 9001-2000 Certification
- Many students formed

2. Construction & deployment contributions


- The electronic & PMT testing facility (SDECO)




F. Suarez

Stays @ Argentinean/Italian groups

Available online at www.sciencedirect.com

 ScienceDirect

 ELSEVIER

Nuclear Instruments and Methods in Physics Research A 591 (2008) 453–466

www.elsevier.com/locate/nima

NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH Section A

Testing of photomultiplier tubes for use in the surface detector of the Pierre Auger observatory

D. Barnhill^a, **F. Suarez^{b,*}**, K. Arisaka^a, B. Garcia^c, J.P. Gongora^d, A. Lucero^c, I. Navarro^c, T. Ohnuki^a, A. Risi^d, A. Tripathi^a



The SDECO facility plays a key factor for testing, maintenance, repairing both PMTs and associated electronics

2. Construction & deployment contributions

- WCD deployment



A. Lucero

Stays @ Argentinean/Italian groups



Available online at www.sciencedirect.com

ScienceDirect

Nuclear Instruments and Methods in Physics Research A 591 (2008) 453–466

NUCLEAR
INSTRUMENTS
& METHODS
IN PHYSICS
RESEARCH
Section A

www.elsevier.com/locate/nima

Testing of photomultiplier tubes for use in the surface detector of the Pierre Auger observatory

D. Barnhill^{a,*}, F. Suarez^{b,**}, K. Arisaka^a, B. Garcia^c, J.P. Gongora^a, A. Lucero^c, Navarro^c, T. Ohnuki^a, A. Risi^d, A. Tripathi^a



The local staff (technicians and engineers) played a fundamental role in the largest cosmic rays Observatory ever built

3. Upgrade contributions

- AMIGA: surface detector inflills + underground scintillators

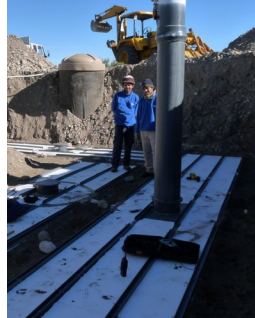
Surface detector (SD)

Underground Muon detector (UMD)

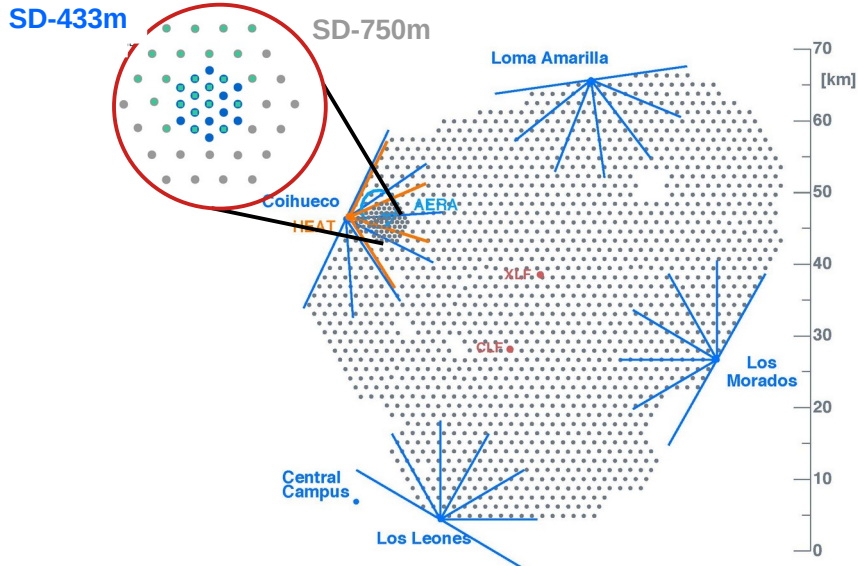
100% duty cycle

100% duty cycle

SD-750m 23.5 km ² 61 WCDs E_{thr} 0.1 EeV	SD-433m 1.9 km ² 19 WCDs E_{thr} 0.03 EeV
---	---



UMD-750m 23.5 km ² 61 WCDs E_{thr} 0.1 EeV	UMD-433m 1.9 km ² 19 WCDs E_{thr} 0.03 EeV
--	--



Available online at www.sciencedirect.com
 ScienceDirect
 Nuclear Instruments and Methods in Physics Research A 566 (2006) 302–311
 ELSEVIER
 www.elsevier.com/locate/nima

Enhancing the Pierre Auger Observatory to the 10^{17} – $10^{18.5}$ eV range:
 Capabilities of an Infill Surface Array
 M.C. Medina^{a,*}, M. Gómez Berisso^{b,2}, I. Allekotte^b, A. Etchegoyen^{a,2},
 G. Medina Tanco^c, A.D. Supanitsky^a

Astroparticle Physics 29 (2008) 461–470
 Contents lists available at ScienceDirect
 Astroparticle Physics
 journal homepage: www.elsevier.com/locate/astropart
 ELSEVIER

Underground muon counters as a tool for composition analyses
 A.D. Supanitsky^{a,d,*}, A. Etchegoyen^{a,c}, G. Medina-Tanco^d, I. Allekotte^b, M. Gómez Berisso^{b,c}, M.C. Medina^a

Jinst PUBLISHED BY IOP PUBLISHING FOR SISSA
 RECEIVED: March 9, 2011
 REVISED: May 6, 2011
 ACCEPTED: May 24, 2011
 PUBLISHED: June 13, 2011

AMIGA at the Auger Observatory: the scintillator module testing system
 M. Platino,^{a,1} M.B. Hampel,^{a,c} A. Almela,^{a,c} A. Krieger,^a D. Gorbeña,^{a,c} A. Ferrero,^a
 G. De La Vega,^{b,7} A. Lucero,⁷ F. Suarez,^a N. Videla,^{b,d} O. Wainberg^{b,c} and
 A. Etchegoyen^{a,*}

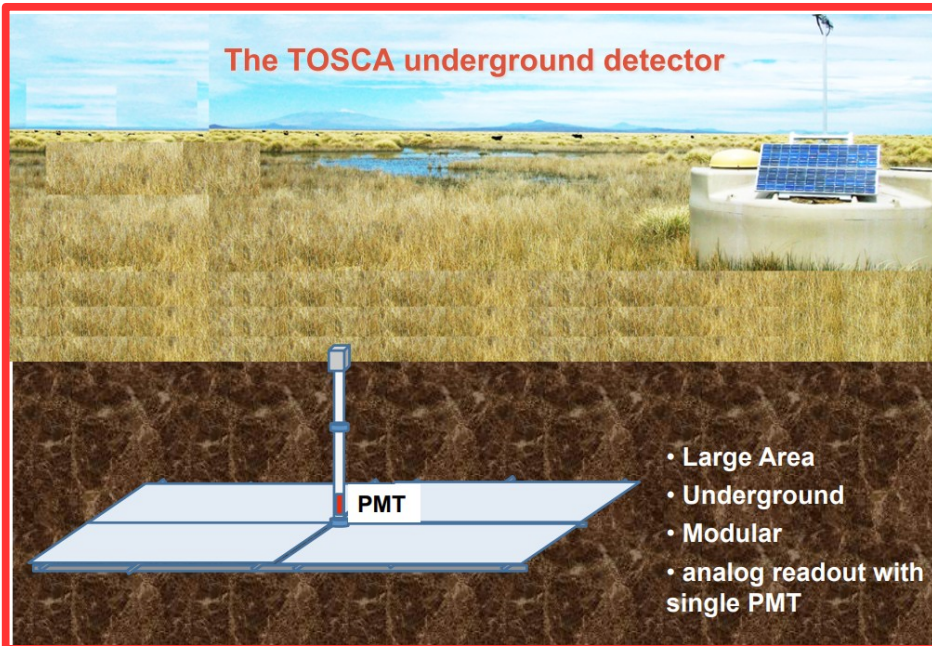
Eur. Phys. J. C (2020) 80:751
<https://doi.org/10.1140/epjc/s10052-020-8055-y>

THE EUROPEAN PHYSICAL JOURNAL C
 Regular Article - Experimental Physics
 *
 Direct measurement of the muonic content of extensive air showers between 2×10^{17} and 2×10^{18} eV at the Pierre Auger Observatory
 The Pierre Auger Collaboration^{*}
 The Pierre Auger Observatory, Av. San Martín Norte 306, 5613 Malargüe, Mendoza, Argentina; <http://www.auger.org>

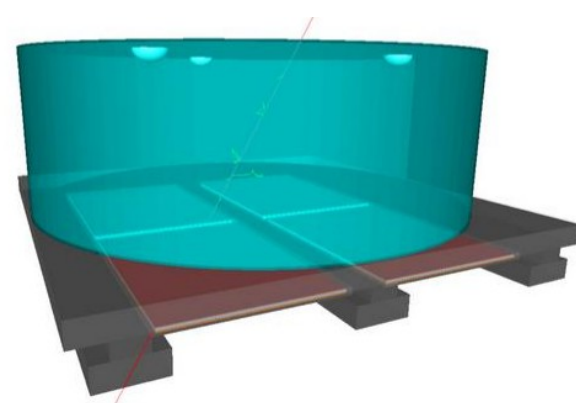
*Twins analysis (see Gaia's talk)

3. Upgrade contributions

- AMIGA: surface detector infills + underground scintillators



Muon Auger RPC Tank Array



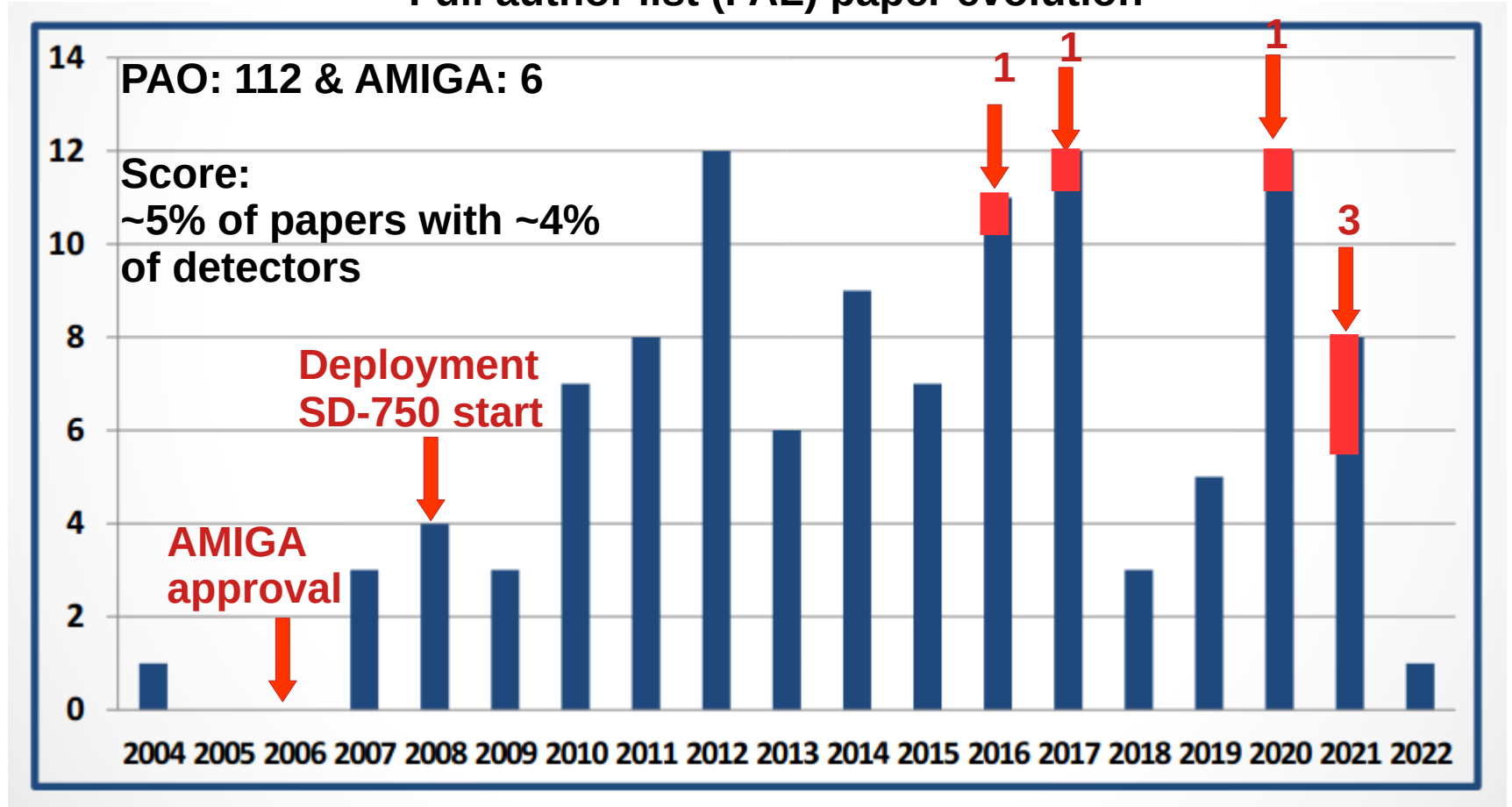
Internal challenge to measure directly muons in EAS in the context of PAO (first) life extension

- 1) improved electronics
- 2) lower the costs
- 3) strengthen the mechanical design



Scientific productivity in FAL-publication units

Full author list (FAL) paper evolution



Up to 2019 (Arg. only): 33 researchers, 39 finished PhD (first one in 2001) and 22 on-going PhD