

Gruppo II INFN Catania
*Sigle, Anagrafiche e
Richieste economiche 2025*

Emanuele Leonora
INFN-Catania

Consiglio di sezione
9 Luglio 2024

Riunione di Settembre @ Catania + Capo Passero



Riunione del 18-22 settembre

18 Sept 2023 09:00 - 22 Sept 2023 22:30 Europe/Rome

Catania DFA "Ettore Majorana" - Portogallo di Capo Passero "Centro Rosmini"

Oliverio Cremonesi (Istituto Nazionale di Fisica Nucleare)

Descrizione La riunione aperta del 18 Settembre

si svolgerà presso la sala INFN del DFA "Ettore Majorana" di Catania.

Le sessioni chiuse del 19, 20, 21 e 22 Settembre

si svolgeranno presso il Centro Rosmini / Chiesa Madre Greca di Divusa di Portogallo di Capo Passero.

<https://go.galileo.it/INFN/180923/4>

Informazioni su hotel e bus privati nel file pdf allegato

Contatti

Cremonesi@ct.infn.it
emanuele.leonora@ct.infn.it

MONDAY, 18 SEPTEMBER

- 09:30 - 18:30 **Sessione Aperta**
- 18:30 - 20:30 **Trasferimento in Bus (INFN) da DFA "Ettore Majorana" a Portogallo di Capo Passero: Bus transfer from DFA "Ettore Majorana" to Portogallo di Capo Passero**
- 20:30 - 22:30 **Cena sociale a Portogallo di Capo Passero**

4 giorni a Portogallo

TUESDAY, 19 SEPTEMBER

- 09:00 - 19:00 **Sessione Chiusa**
- 19:00 - 20:30 **Passeggiata verso Trullo di Capo Passero**

WEDNESDAY, 20 SEPTEMBER

- 09:00 - 19:00 **Sessione Chiusa**
- 19:00 - 21:00 **Visita Stazione KM3NET**

THURSDAY, 21 SEPTEMBER

- 09:00 - 19:00 **Sessione Chiusa**
- 19:00 - 21:30 **Degustazione prodotti tipici 1**

FRIDAY, 22 SEPTEMBER

- 09:30 - 13:00 **Sessione Chiusa**
- 13:30 - 15:15 **Trasferimento Bus Portogallo di Capo Passero - Aeroporto di Catania**

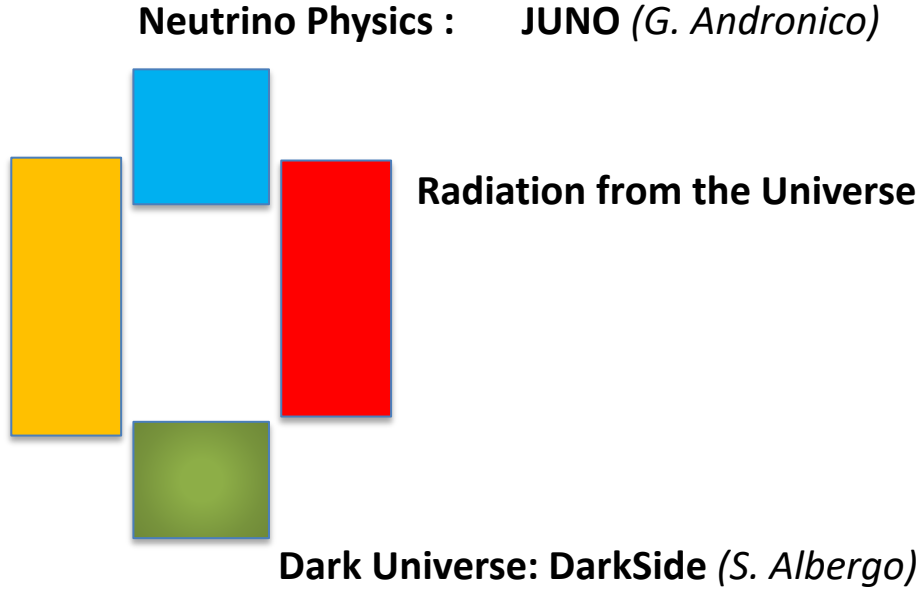


1 giorno in sezione
sala conferenze DFA

Il presidente O. Cremonesi ha ringraziato me e G. Riccobene LNS per l'organizzazione molto apprezzata

E' stata una riunione "molto siciliana": tanto tempo insieme, tanto sole, caldo e tanto buon cibo !

Gravitational waves,
gravitation and
quantum mechanics



Data	Ricercatori		Tecnologi		Servizi	FTE	FTE/PERS.
2024	15.3 fte	29 pers.	3.65 fte	5 pers	4	18.95	0.56

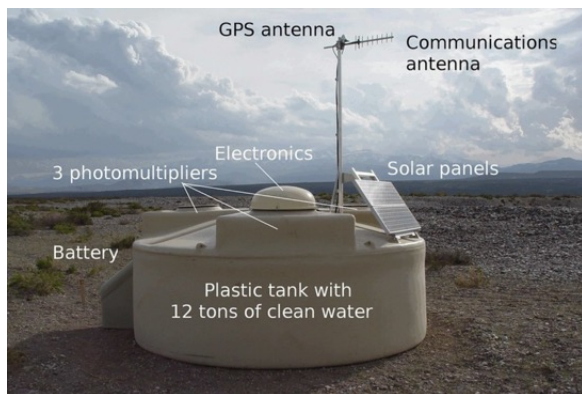
OBIETTIVO: rivelazione di EAS per lo studio di raggi cosmici di altissima energia ($10^{17}\text{eV} - 10^{21}\text{eV}$)

RIVELATORE: ibrido (3000 km^2) a 1400 s.l.m. nella Pampa nei pressi di Malargue (Mendoza-Argentina)

1600 + 71 rivelatori Cherenkov + 27 telescopi di fluorescenza + 185 radio sensori + upgrade AUGER prime

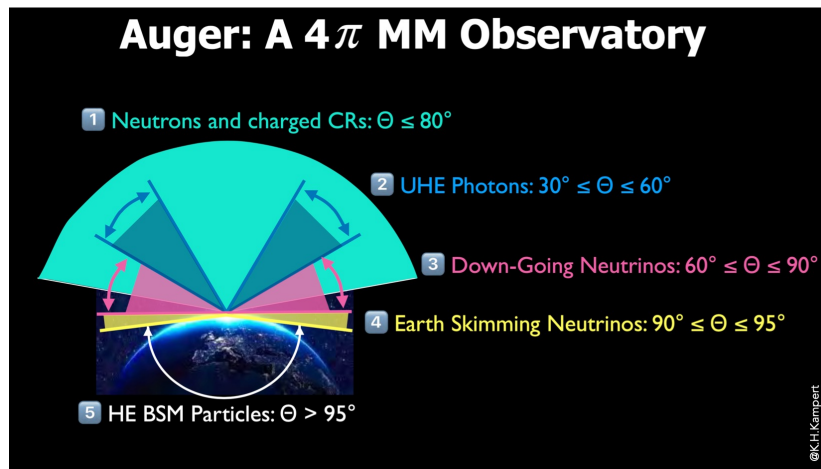
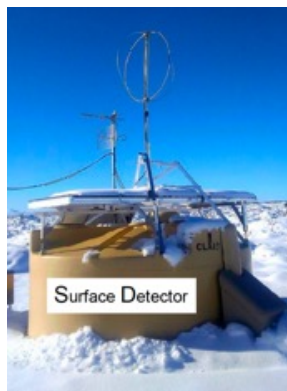
Auger Observatory: measures charged UHECRs

- Energy spectrum
- Nuclear composition
- Anisotropies
- information on UHE hadronic interactions



Auger Prime

Addition of plastic scintillators above each Surface Detector



(see A. Castellina CRIS-MAC 2024)

L' Upgrade AUGER PRIME è iniziato nel 2015 e sarà completato nel 2024 → cerimonia al CM in Argentina Novembre 2024

La presa dati dell'esperimento AUGER è stata estesa fino al 2030

Responsabilità internazionale **“Manutenzione elettronica HV/LV FD”** (R.Caruso);
Responsabilità internazionale **“AugerPrime SD electronics”** (G. Marsella)



proseguimento di (quasi) TUTTE le attività condotte nel 2024

A1) MAINTENANCE FD HV/LV

A2) FD and SD Shifts in situ

B1) Analisi dati star tracking & NSB Telescopi di Fluorescenza

B2) Studi di ricerca di Materia Oscura e correlazione con UHECRS

B4) Studio della composizione in massa del primario con Machine Learning e ANN

B5) Ottimizzazione del trigger del Rivelatore di Superficie

C1) Commissioning Upgrade SD Elettronica (SDE) per AUGERPRIME

Dear members of the Collaboration Board, dear colleagues,

please find attached the statements of the candidates for the election of the CB chairs. As a reminder, the candidates (in alphabetical order) are

CB Chair:

Jörg Hörandel
Julian Rautenberg
Federico Sanchez

CB Co-chair:

Rossella Caruso
Olivier Deligny
Jörg Hörandel
Julian Rautenberg

We are very grateful to the candidates for their willingness to stand and serve the Collaboration in these important positions.

Best regards,
Antonella and Markus



UNIVERSITÀ
degli STUDI
di CATANIA



DIPARTIMENTO DI FISICA E ASTRONOMIA
"ETTORE MAJORANA"

Catania, April 2nd 2024

Dear Collaborators,

I wish to warmly thank you for having nominated me to serve as possible CB Co-Chair.

I'm very honoured to know about the preferences on my name and that you believe me as a suitable candidate. Immediately I accepted to run as a candidate for Co-Chair in the

Anno 2023

- ***AugerPrime Surface Detector Electronics***, Pierre Auger Collaboration, JINST 18 (2023) P10016;
- ***Search for UHE Photons from Gravitational Wave Sources with the Pierre Auger Observatory*** Pierre Auger Collaboration, Astrophys. J. 952 (2023) 91;
- ***A Catalog of the Highest-Energy Cosmic Rays recorded during Phase I of Operation of the Pierre Auger Observatory***, Pierre Auger Collaboration, Astrophys. J. Suppl. S. 264 (2023) 50;
- ***Search for photons above 10^{19} eV with the surface detector of the Pierre Auger Observatory***, Pierre Auger Collaboration, JCAP 05 (2023) 021;
- ***Bounds from multi-messenger astronomy on the Super-Heavy Dark Matter***, M. Deliyergiyev, A. Del Popolo, M. Le Delliou, Phys.Rev.D 106 (2022) 6, 063002

Anno 2024

- ***Testing Hadronic-Model Predictions of Depth of Maximum of Air-Shower Profiles and Ground-Particle Signals using Hybrid Data of the Pierre Auger Observatory***, Pierre Auger Collaboration, Phys. Rev. D 109, 102001 (2024);
- ***Constraints on metastable superheavy dark matter coupled to sterile neutrinos with the Pierre Auger Observatory***, Pierre Auger Collaboration, Phys. Rev. D 109, L081101 (2024);
- ***Ground observations of a space laser for the assessment of its in-orbit performance***, Pierre Auger Collaboration, Optica 11 (2024) 263-272;
- ***Constraining models for the origin of ultra-high-energy cosmic rays with a novel combined analysis of arrival directions, spectrum, and composition data measured at the Pierre Auger Observatory***, Pierre Auger Collaboration, JCAP 01 (2024) 022;
- ***Radio Measurements of the Depths of Air Shower Maxima at the Pierre Auger Observatory***, Pierre Auger Collaboration, Phys. Rev. D 109 (2024) 022002;
- ***Demonstrating Agreement between Radio and Fluorescence Measurements of the Depth of Maximum of Extensive Air Showers at the Pierre Auger Observatory*** Pierre Auger Collaboration, Phys. Rev. Lett. 132 (2024) 021001;
- ***Impact of the Magnetic Horizon on the Interpretation of the Pierre Auger Observatory Spectrum and Composition Data***, Pierre Auger Collaboration, Accepted in JCAP

RICERCATORI/TECNOLOGI

	ruolo	%
1. Anastasi Gioacchino Alex	RTDA-PNRR UniCT	00
2. Caruso Rossella	Prof.Ass. UniCT (Resp. locale)	60
3. Del Popolo Antonino	Ric.. Univ. UniCT	80
4. Marsella Giovanni	Prof. Ord. UniPA	60
5. Shavar M. Pourmohammad	Dottorando Uni PA	100
6. Insolia Antonio	Prof. Ord. Uni CT (pensione)	00
TOTALE 6 persone		TOT. FTE = 3.0

Principali modifiche rispetto al 2024:

- *Variazione in persone (8) ed FTE (4.5)*
- *Perdita di Mario Buscemi (RTD B in Uni CT)*
- *0 % di Anastasi Gioacchino Alex come RTDA PNRR*

<u>Servizi</u>	<u>m/u</u>
Servizi Centro di Calcolo e Reti (CCR)	1.8
Officina e Progettazione Meccanica	2.0
Elettronica	5.0
Totale	8.8 m/u

Missioni Estere e Nazionali: 38.5 keuro

- Turni di misura FD (FD shift)
- Turni di manutenzione tecnica HV/LV;
- Turni di commissioning elettronica in situ per AugerPrime
- Meeting generali di Collaborazione nazionali e internazionali;
- Meeting di analisi;

Consumo: 2.0 keuro

- Metabolismo sul sito dell'Osservatorio

Manutenzione: 8.0 keuro (5 s.j.)

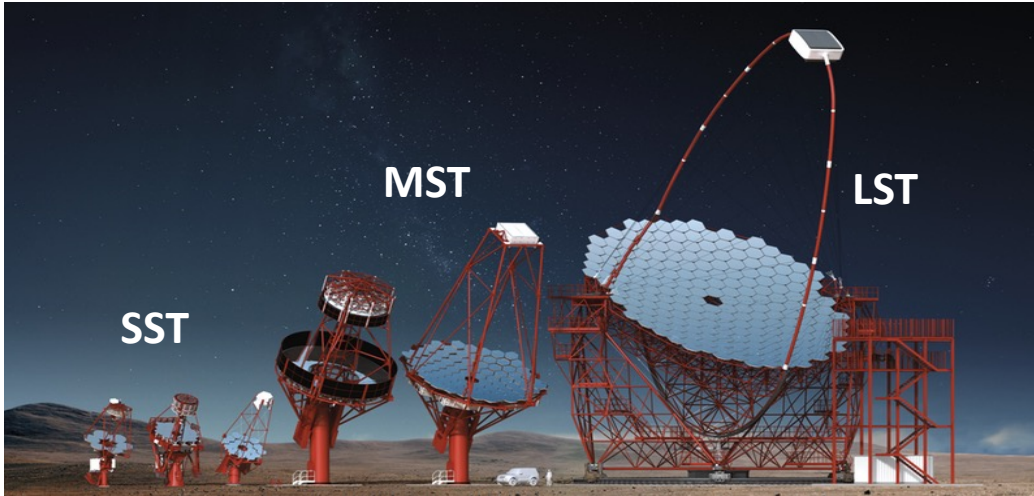
- Riparazione e manutenzione moduli CAEN sistemi HV/LV per FD (3 k)
- Sostituzione moduli guasti (5 k s.j.)

Trasporti: 14.0 keuro

- Trasporti sul sito Osservatorio Auger
- Spedizioni materiale e dispositivi CT-CAEN-Argentina

Il Cherenkov Telescope Array intende costruire due osservatori gamma, uno al NORD (CTA-N a la Palma Canarie) ed uno al sud (CTA-S Cile) con telescopi Cherenkov costruiti su tre modelli:

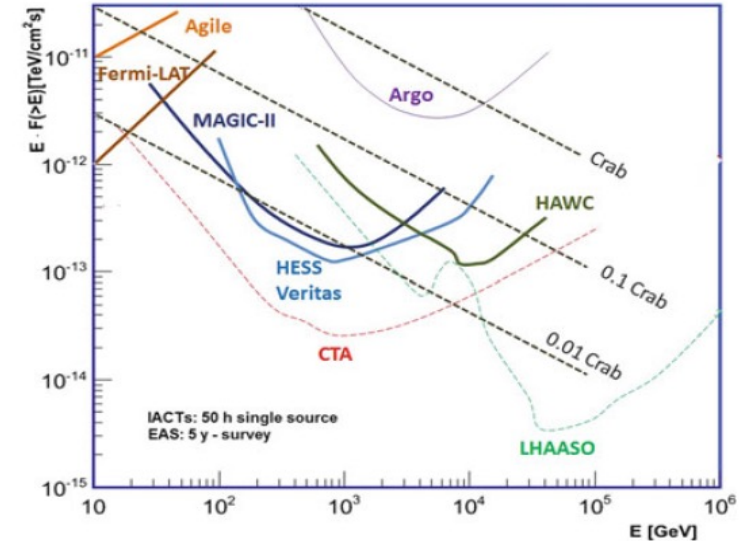
- **Large-Sized Telescopes (LSTs - Φ 23m)** ($E < 100$ GeV)
- **Medium-Sized Telescopes (MSTs - Φ 12m)** (100 GeV $< E < 10$ TeV)
- **Small-Sized Telescopes (SSTs - Φ 4m)** ($E > 10$ TeV)



CTAO-North site: LST-1 taken data since Jan 2020

LST-2, LST-3, LST-4: under construction;

South site: Partially funded through PNRR (2 LST + 5 SST)



Large energy range: from 10 GeV to beyond 10 TeV

Improvement in sensitivities in energy 0.1 – 10 TeV

WP1530 – 6 of CTA+ @UniPA

- Thanks to funds from WP1510 and WP1530-6, a SiPM test station has been set up in Viale delle Scienze Ed. 18.
 - Climate Chamber
 - Table with optical components (laser, dark box, etc)
 - Oscilloscope
 - Read-out system



pSCT activity @ INFN CT

- Optical bench
- Front-end electronics
- Data Acquisition



Neutrino Target-of-Opportunity: looking for gamma-ray counterparts to neutrino events from IceCube/Km3NeT

- Paper under the review of the CTA transient working group
- Innovations to the current approach presented in the paper:
 - KM3NeT discovery potential (coll. with G. Ferrara)
 - CTA+ simulation
 - New types of plausible neutrino/gamma emitters
- Co-Investigators of the LST observation proposal “Neutrino ToO (NToO) Observations “

Interest in looking for gamma-ray counterparts to GW events

Tirocinio for a master student in collaboration with A. Stamerra INAF Roma

The slide features a dark background with a satellite array and a flowchart. At the top, logos for the European Union, Italian Ministry of University and Research, Italian Government, INFN, CTA, and IN-FN are displayed. The main title is "Neutrino Target of Opportunity (NToO) - Innovations". A red-bordered box contains the text: "CTA will be able to look for a **gamma-ray counterpart** from a **neutrino source alert** and also monitor "hot-spots" that exceeds IceCube (IC) sensitivity". Below this, a red-bordered box asks "What are we simulating?" and lists:

- **Steady Sources** - constant neutrino flux
- **Transient Sources** - variable neutrino flux (e.g. neutrino-flaring blazar)

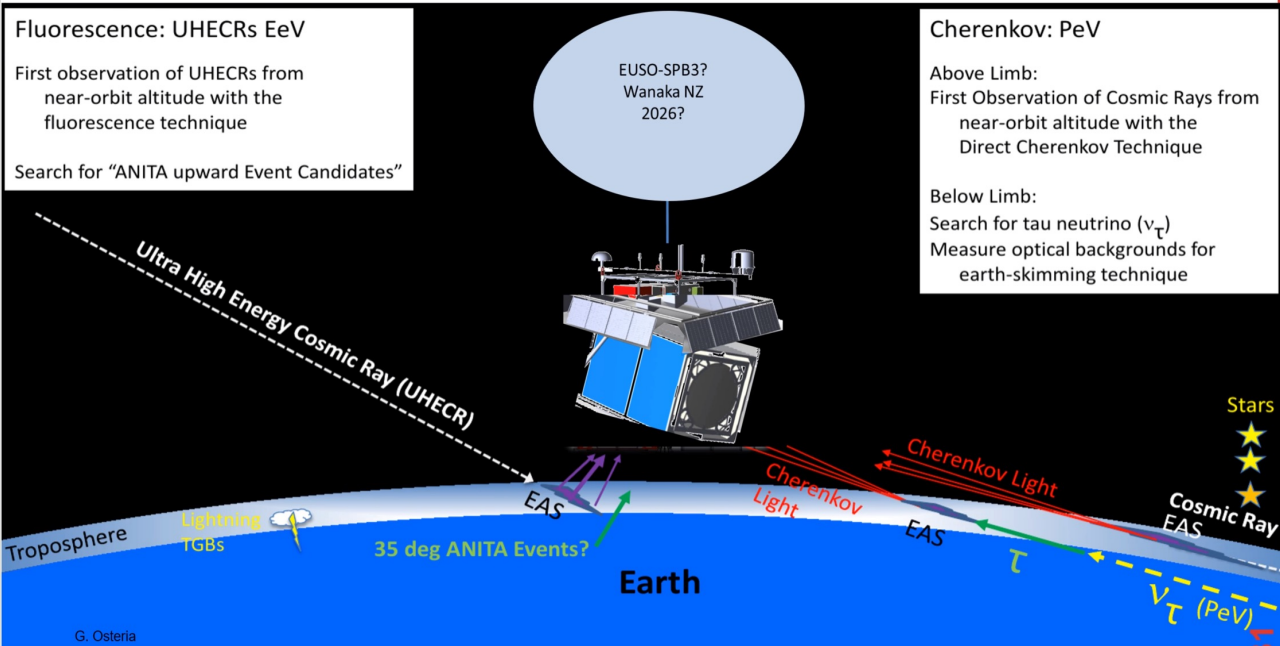
 At the bottom left, two boxes labeled "Neutrino Telescope" and "Cherenkov Telescope" are connected by a plus sign. On the right, a flowchart shows: "Neutrino Simulations (FIRESONG)" leading to "Neutrino Telescope Filter", which then branches to "IceCube" and "KM3NeT". Both lead to "Gamma Simulations", which then branches to "The Alpha configuration of the array" and "The new configuration of the array (CTA+)". Both configurations lead to "CTA performance".

Descrizione	Richieste (Keuro)	SJ	Totale (Keuro)
Missioni	33		20
Consumi	2		2
Inventariabile	2		2
Totale	37		37

- Missioni: Turni presa dati (La Palma, Arizona), meeting di collaborazione
- Consumi: Materiale per laboratorio
- Inventariabile: PC

Scientific goals: study UHE cosmic rays (10^{20} eV) looking down and using the atmosphere as a detector

- Air-showers per mezzo di luce Cherenkov dall'alto (top dell'atmosfera). 10ns. PeV scale
- Air-shower orizzontali per mezzo della fluorescenza. 1 us . EeV scale



Base NASA-CSBF (Columbia Scientific Balloon Facility) at Wanaka-Nuova Zelanda

Previsione: 30 km s.l.m. e 100 giorni di volo. Durata effettiva: 36 ore. Rivelatore inabissato nell'oceano

Causa accertata: difetti nel pallone NASA



Dal punto di vista tecnologico tutti gli strumenti hanno funzionato in maniera nominale

→ Immediata riprogrammazione (17 luglio 2023) con NASA ed ASI per un nuovo lancio per il 2026

ASTROPHYSICS RESEARCH AND ANALYSIS
(NNH23ZDA001N-APRA)
PANEL EVALUATION

Proposal No.: 23-APRA23-0025

PI/Institution: Olinto, Angela/University Of Chicago

Proposal Title: POEMMA-Balloon with Radio (PBR)

Brief Summary of Research Objectives:

A balloon mission borrowing in design from the possible future probe-class mission Probe Of Extreme Multi-Messenger Astrophysics (POEMMA) is proposed to be known as POEMMA-Balloon with Radio (PBR). PBR would fly on a sub-orbital ultra-long duration balloon (ULDB). The payload would include a Fluorescence Camera (FC) and a Cherenkov Camera (CC) along with a 50 - 550 MHz radio system optimized for the detection of extensive air-showers (EASs). The proposal covers the full construction, testing, flight, and data-analysis aspects of the mission. The mission science goals are to detect from altitude fluorescence signals generated by UHECRs, observe CR EASs, particularly in an energy range above the cosmic ray knee, in both optical and radio, and to search for very high energy neutrinos (VHENs) that are the target of opportunity (ToO) from multi-messenger alerts. PBR would advance the technology that would be required for a space-based platform, such as the conceptual POEMMA for utilizing the Earth's atmosphere to detect CRs and cosmic neutrinos.

OVERALL ADJECTIVAL RATING: Excellent/Very Good

21 GIUGNO 2024: NEWS!!
La NASA APPROVA il prossimo
lancio di Pallone aerostatico a
super-pressione per il 2026!

La missione si chiamerà
PBR (POEMMA Balloon & Radio)
e NON SPB3

Implementazione di nuove tecnologie:

- combinare entrambi i telescopi Cherenkov e di fluorescenza in un ibrido piano focale
- aggiungere low frequency radio instrument (TBC)

- **CALIBRAZIONE** dei SiPMs matrice focale del Telescopio Cherenkov per la missione PBR
Responsabilità internazionale: (R.Caruso);
- Il Laboratorio di R&D SiPMs di Catania (postazione SPB2) presso “Laboratorio di fotorivelatori per la Fisica Astroparticellare” – INFN Catania & DFA-UniCT) diviene **SITO di CALIBRAZIONE e TEST dei prototipi di Telescopio Cherenkov per l’intera Collaborazione internazionale PBR:**
- Previsti turni di misura e test da parte di altri gruppi italiani ed esteri.



- Progettazione, realizzazione, test, calibrazione e caratterizzazione **superficie focale SiPMs** per il **Telescopio Cherenkov** IN SEDE e presso i siti di realizzazione e integrazione elettronica di **NAPOLI** e **ROMA2** e caratterizzazione in condizioni realistiche di volo presso il **TurLab di TORINO;**



- **Monitoraggio atmosferico**, cloud imaging, analisi dati traiettorie meteore, etc.
- **Analisi dati CME solari e ricerca di Eventi Transienti Luminosi nei dati di MiniEURO e di SPB2** per ottimizzazione rapporto segnale/rumore e trigger Telescopi di Fluorescenza e Cherenkov.

RICERCATORI		%
1. Anzalone Anna	Ric. INAF/IASF PA	50
2. Caruso Rossella	Prof. Ass. UniCT (Resp.locale)	40
3. Del Popolo Antonino	Prof. Ass UniCT	20
4. Pagliaro Antonio	Ric. INAF/IASF PA	50
5. Petta Catia	Prof. Ass. UniCT	30

TOTALE: 5 unità	FTE TOT.	1.9
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Servizi

Elettronica 2 m/u

Principali modifiche rispetto al 2024:

- *Persone ed FTE stabili. Da 1.7 a 1.9*

Missioni Estere e Nazionali:

Richiesti 25 keuro

Meeting generali di Collaborazione nazionali e internazionali (USA/JAPAN);
Meeting Working Groups In Italia e negli USA
Turni di integrazione elettronica prototipi a Napoli e Roma
Turni di test e caratterizzazione prototipi presso TurLab Facility a Torino
Incontro Referees;

Consumo:

Richiesti 15 keuro

Metabolismo Laboratorio R&D SiPMs
Acquisto matrici SiPMs per superficie focale telescopio Cherenkov
Ottimizzazione banco ottico per finalizzazione sito calibrazione prototipi per Collab. Italia

Inventario:

Richiesti 20.0 keuro

Acquisto tavolo micrometrico XY
(NOTA: fondi 2024 stornati su altra sede e impiegati per acquisto urgente PMTs Telescopio Fluorescenza, su base accordo Referees e decisione CSN2)

TOTALE

Richiesti 50.0 keuro

Esperimento a LNGS Liquid Argon TPC in dual phase per la ricerca diretta di materia oscura in WIMPS



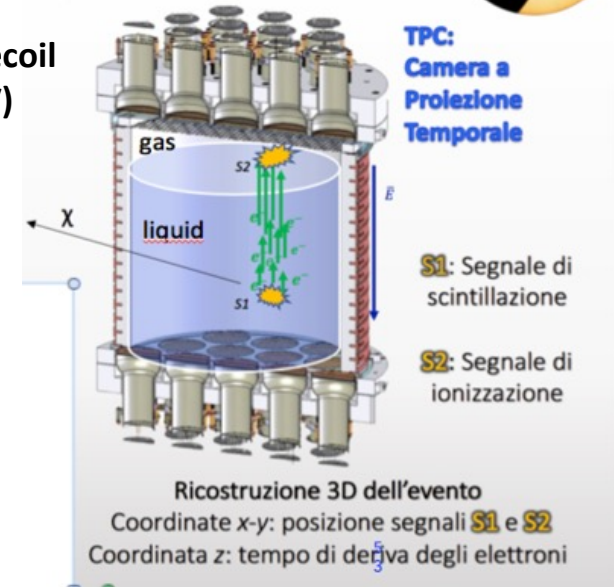
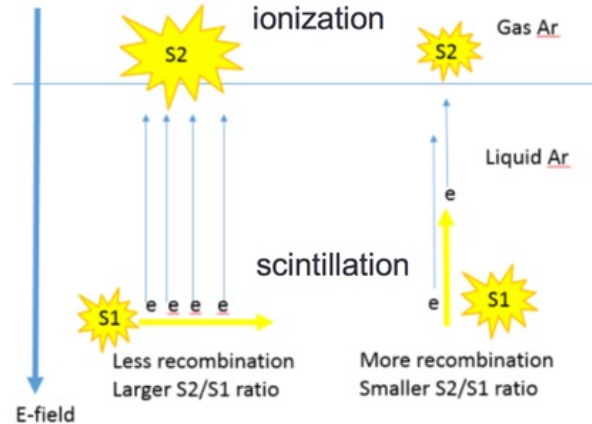
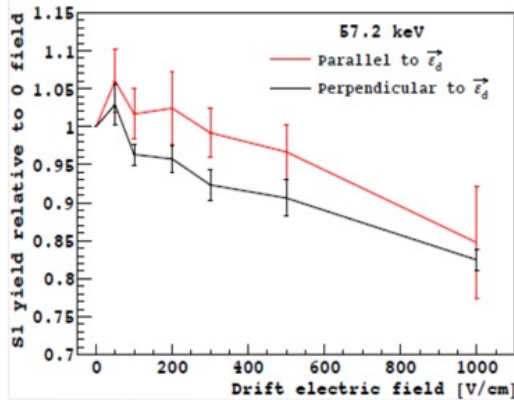
In INFN Catania le attività sono legate a RED (Catania-LNS INFN)

The ReD TPC is a miniaturized version of the DarkSide-20k TPC

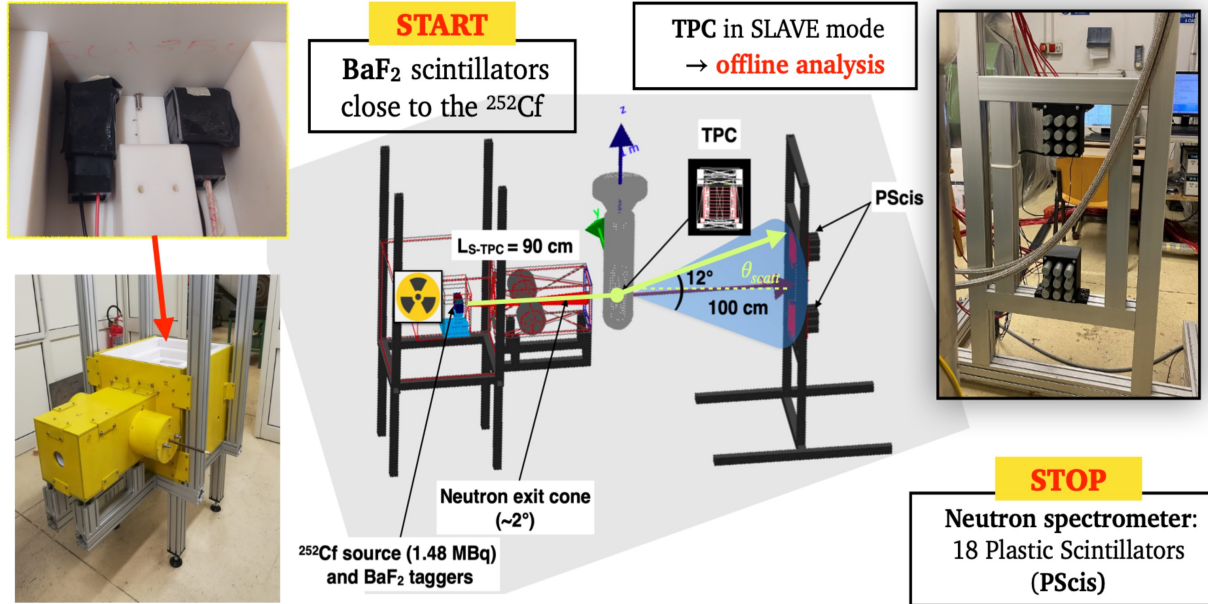


Main ReD project goals:

- demonstrate that a dual phase LAr TPC has sensitivity to the direction of Ar recoil
- characterize the response of the LAr TPC to very low-energy recoils (< few keV)



E' stato realizzato un laboratorio in INFN Catania per eseguire le misure di rinculo nucleare indotto da neutroni, utilizzando una sorgente di ^{252}Cf .



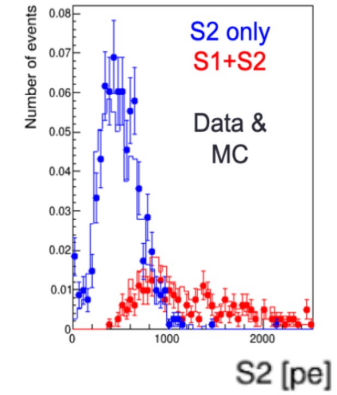
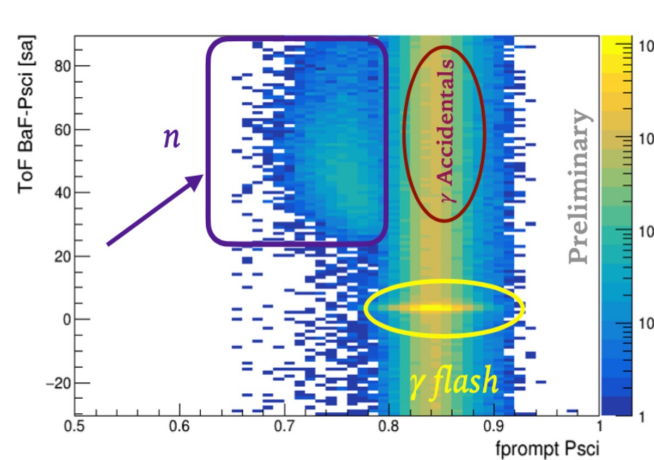
- nuclear recoils of a few keV
- close detectors (BaF₂) to tag fission events
- neutron spectrometers (PScis) to detect scattered neutrons

1 - Tagger detectors

- Selection of candidate **neutrons** by ToF BaF₂-PSci and PSD from the PSci (~ 28 events/h \rightarrow 0.3%)
 - ToF resolution ~ 0.7 ns
 - Event-by-event E_n at $<5\%$

2 - TPC offline analysis

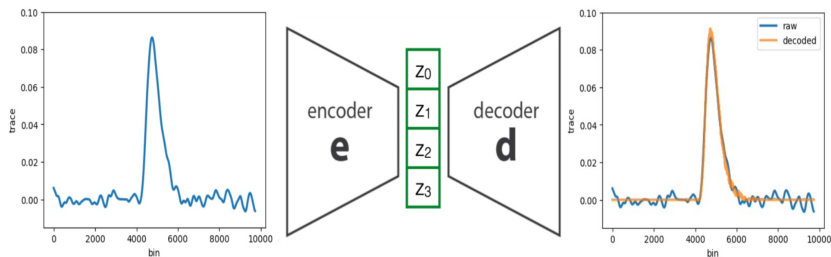
- Pulse finder and selection cuts:
 - One S2 within 65 μ s from BaF₂ and optionally, an S1 (< 100 PE)
 - If S1 available, consistent BaF-TPC ToF
 - No tails of previous S2 pulses
 - FIDUCIALIZATION: (x, y) in the central 4x4 cm region
- **Final sample**: ~ 820 passing all cuts, out of 2300 candidate neutron events w/ TPC signal
 - 75% are S2-only (\sim as in MC)



Convolutional AutoEncoders and their application

Self-supervised neural network architecture where data are compressed into a low dimensionality *latent space*, then reconstructed minimizing differences between original and output.

Implicitly highlighting features of a dataset, while disregarding noise and redundancies



- **input:** time series (~10,000 bins) resembling waveforms measured by the ReD TPC
- **architecture:** 3 Conv1D + avg. pooling layers, followed by 1 flattened dense layer (*details in backup*)
- **4-dimensional latent space** (i.e. each trace is compacted into only 4 values, named z_i)

(see *G. A. Anastasi CRIS-MAC 2024*)

PNRR: Spoke 2 of ICSC National Centre

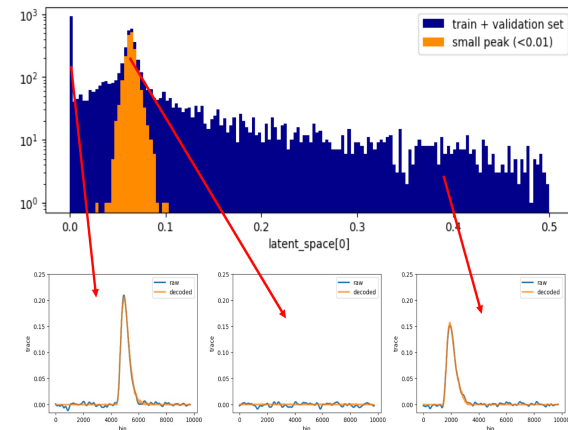
The use-case DAIDREAM within WP3

DAtA-driven **ID**entification of **R**are **E**vents in **A**stroparticle physics through **M**achine learning techniques

Application to a synthetic dataset

Synthetic waveforms: single-peaked log-normal shaped signal on top of non-gaussian noise. Generated signals have amplitude (i.e. peak value) distributed in $[-0, 1]$.

Characterizing result: waveforms with **negligible signals** encoded into a limited region of the latent space (nicknamed as “garage”) where the 4 z_i simultaneously assume specific values.



- Implementazione analisi Machine Learning ReD & DS-50
- Attività in Dark-side PROTO (0.2 Ton) e test beam al CERN
- Attività su ReD+ (Extra INFN) at LNS

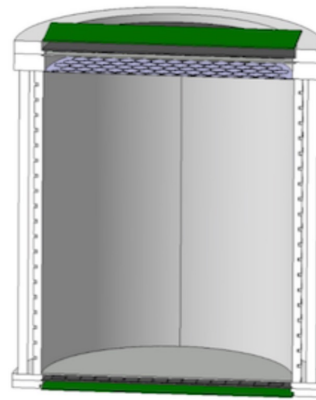
Al di fuori dei finanziamenti INFN è stato approvato un PRIN 2022:

ReD+, a low-energy characterization for low-mass Dark Matter searches with Argon

Future perspectives: ReD+, to cover down to 0.4 keV_{nr}



TPC exterior



TPC interior

- N.Pino “CHARACTERIZATION OF LOW-ENERGY RECOILS WITH THE RED EXPERIMENT”, Majorana International workshop, Modica 12–14 lug 2023
- N.Pino “Characterization of low-energy nuclear recoils in the LAr TPC of the ReD experiment” 109^o Congresso Nazionale SIF - 15th Sept. 2023 Salerno
- N.Pino “Study of low-energy nuclear recoils in liquid argon with the ReD experiment” Idding Conference, 20-22 Sep 2023 Madrid
- G.A. Anastasi “The Spoke 2 of the ICSC National Centre, with a focus on deep learning applications in astroparticle physics and satellite imagery” 213th CRIS-MAC, Trapani, 17-21 June 2024

Sebastiano Albergo	60%	PO (Responsabile locale)
Alessia Tricomi	10%	PO
Noemi Pino	100%	Dottoranda UniCT
Sebastiana Puglia	80%	RTD A UniCT
Gioacchino A. Anastasi	00%	RTD A UniCT PNRR
Marzio De Napoli	00%	RTD B UniCT
Totale FTE = 2.5		

Principali modifiche rispetto al 2024:

Servizi

Tecnologie avanzate	1 m/u
Elettronica	1 m/u
Officina e Progett. Meccanica	1 m/u

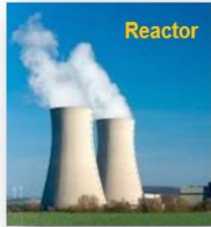
- *FTE stabili*
- *Ingresso di M. De Napoli RTB B Uni-CT con 00%*

		k€
Consumo	Metabolismo laboratorio	2.0
Missioni	- Meeting di collaborazione	2.0
	- Partecipazione a test beam	3.0
	- Turni test PROTO Napoli	5.0

JUNO is a shallow 20kt liquid scintillator multipurpose neutrino experiment
Short-baseline experiment TAO provides JUNO the reference spectrum

Rich physics program (reactor and “no-reactor” neutrinos):

- Neutrino Mass Ordering (3% energy resolution)
- Neutrino oscillation, precision measurements (< 0,5% precision)
- Supernovae neutrinos, geo and solar neutrinos
- Future JUNO-0 $\nu\beta\beta$



Reactor

~60 IBDs per day



Atmosphere

Several per day



Solar

Hundreds per day



Supernova

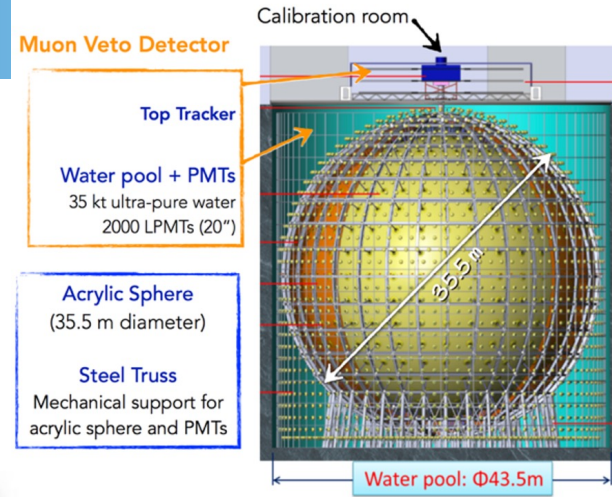
~5000 IBDs for CCSN @10 kpc



Earth

Several IBDs per day

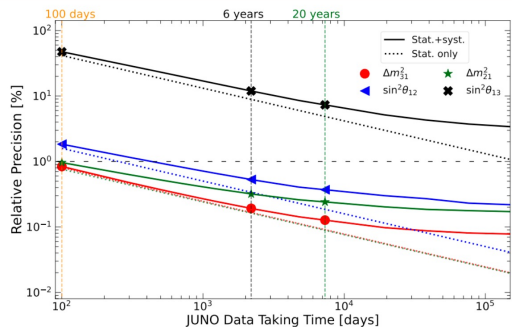
+ New physics



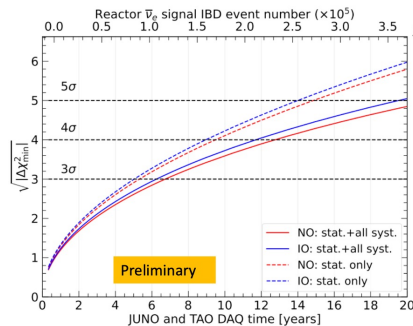
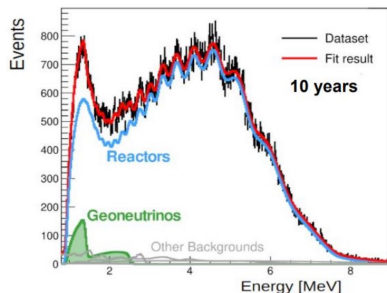
Central detector (CD)
 Water pool (WP)
 Top tracker (TT)
 About 700 m underg.

Detector in RUN in 2025

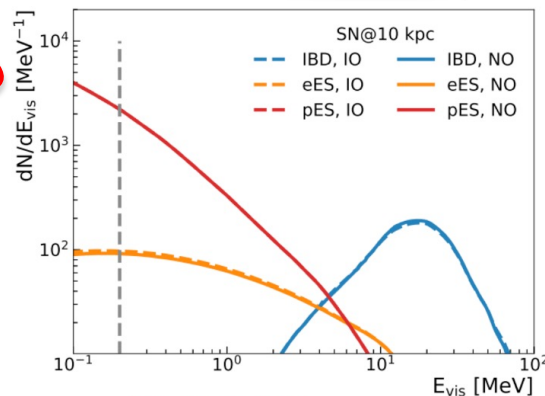
**Precision oscillation measurements
< 0.5% in 6 years**



**JUNO will collect the largest dataset
of geoneutrinos in ~ 1 year**

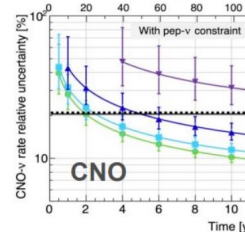
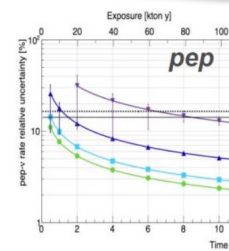
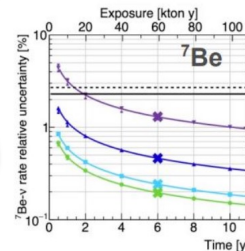


**JUNO NMO median
sensitivity: 3 σ @ ~ 6 yrs**



JCAP 01 (2024) 057

**SN neutrinos: 3 detection channels, all flavors
Excellent capability for early warning**



JUNO @ different radio-purity scenarios:

- min. requirement for NMO
- 10 x Borexino Phase-I
- Borexino Phase-I
- Borexino Phase-III (U/Th 10⁻¹⁷ g/g)

... Borexino result

[arXiv:2303.03910, accepted by JCAP]

**JUNO improve ν
solar measurements**



JUNO TAO: stazione test SiPM in INFN Catania 2023-2024:

Integrazione e configurazione varie parti (in corso)

Configurazione parte acquisizione dati

Integrazione con PCB

Caratterizzazione elementi distribuzione luce (fibre, diffusori)

Sviluppo SW necessario

2024: misure con SiPM disponibili

2025: Probabile qualche misura agli inizi del 2025

Attività 2025

Partecipazione al commissioning del sistema di gestione del liquido scintillante di JUNO Central Detector

N. Guardone, N. Giudice, ...

Computing Steering Group. Chair: Giuseppe Andronico
documentare le richieste di computing dell'esperimento, proporre modifiche al piano di acquisizione, verificare l'uso delle risorse

Offline: Coordinamento JUNO DCI Network

G. Andronico, R. Bruno

Offline: studio potenziamento del codice e adattamento a supercomputer

G. Andronico, R. Bruno, E. Tramontana, A. Pulvirenti

Nome	Contratto	Qualifica	Aff.	%
Andronico Giuseppe (RL)	Dipendente	Primo Tecnologo	CSN II	60
Bruno Riccardo	Dipendente	Tecnologo	CSN II	30
Tuvè Cristina	Associato	Prof. Associato	CSN II	50
Tramontana Emiliano	Associazione tecnologica	Prof. Associato		20
Pulvirenti Alfredo	Associazione tecnologica	Prof. Associato		20
			Totale FTE	1.8

Servizio	Mesi uomo
Servizio Elettronica	2
Servizio Tecnologie Avanz.	1
Totale	3

Principali modifiche rispetto al 2024:

- FTE variati da **2.8** a **1.8**
- Pensionamento S. Aiello **(30%)**
- Fine dottorato C. Lombardo **(80%)**
- G. Andronico terminerà nel 2024 collaborazione con PNRR causa problemi di sinergia con JUNO
- Associazione E. Tramontana, A. Pulvirenti in corso

Capitolo	Descrizione	Richiesta
Missioni	Meeting di collaborazione internazionale (Cina) 2 eventi, 3 persone in totale	8.0
	Meeting di collaborazione europea 2 eventi, 3 persone in totale	5.5
	Meeting di collaborazione italiana 1 evento, 3 persone	2.0
	L2 computing: partecipazione eventi LHCONe 3 meeting di cui almeno 2 in Europa, 1 persona N.B.: Giuseppe Andronico è L2 computing e rappresentante JUNO in LHCONe	2.5
	L2 computing meeting in Cina 2 sessioni di lavoro da 2 settimane su DCI e offline, 1 persona N.B.: Giuseppe Andronico è L2 computing	3.5
	Commissioning Sistema LS: 2 tecnici x 3 settimane	9,0
Totali		30,5
Consumo	Metabolismo per il gruppo di Catania	4
Totali		4

Two neutrino detectors under construction in the Mediterranean Sea

ORCA (Oscillation Research with Cosmics in the Abyss, France)

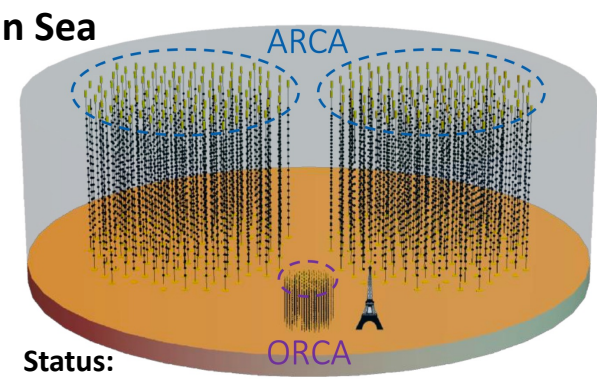
Atmospheric neutrinos. Main goal: neutrino oscillations

($E_\nu \sim \text{MeV} - 100 \text{ GeV}$) → GOAL: 7 Mton of instrumented water

ARCA (Astroparticle Research with Cosmics in the Abyss, Italy)

Cosmic neutrinos. Main goal: neutrino astronomy

($E_\nu \sim \text{TeV} - \text{PeV}$) → GOAL: 1 km³ of instrumented water (1 Gton)

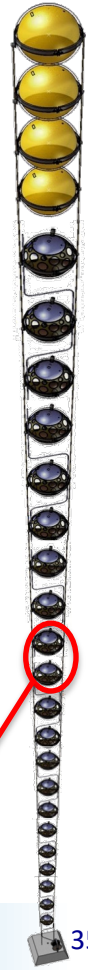
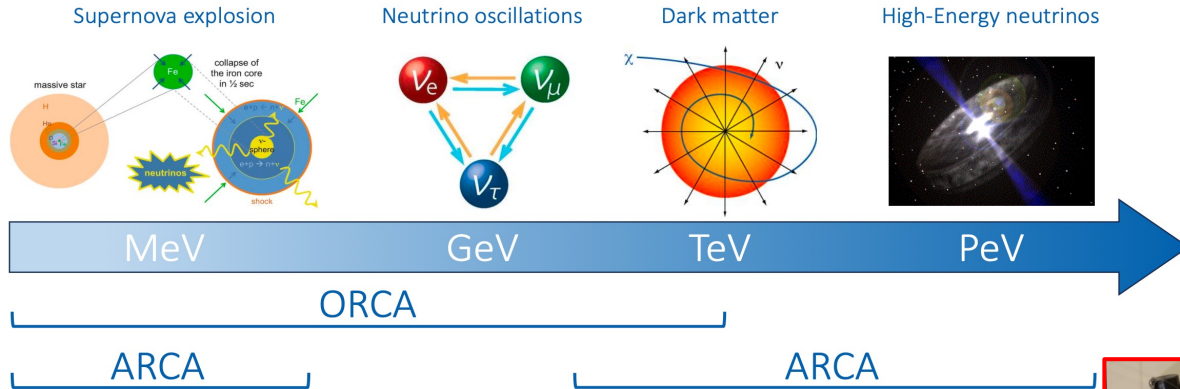


Status:

ORCA: 18DU (15%); ARCA: 28DU (12%)

Same technology for a multi-energy scale science program

	ARCA	ORCA
Location	Italy (Sicily)	France (Toulon)
Depth	3450 m	~2500m
Distance from shore	~100 km	40 km
Number of DUs	230 (115 x 2)	115
Instr. water volume	1 Gton	0.7 Mton
DU height	~750 m	~200 m
DU horizontal spacing	90 m	20 m
DU vertical spacing	36 m	9 m
DOMs/DU	18	18
PMTs/DOM	31	31



KM3NeT Junction BOX design and production:

- **Junction Box Project Manager:** N. Randazzo
- **Marine operation:** N. Randazzo

Km3NeT Digital Optical Module (DOM) production:

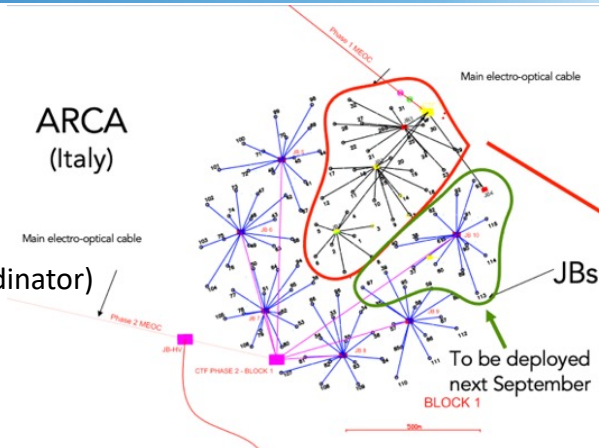
- **Integration Site Responsible:** E. Leonora (DOM deputy coordinator)
- **DOM production:** F. Longhitano
- **Local Quality Supervisor:** R. Bruno

KM3NeT acoustic positioning system (ARCA + ORCA) :

- **Production of the underwater voltage supply systems for the Italian and France marine sites:** F. Longhitano

KM3NeT softwares and Analisisys:

- **Responsible of the new DOM testing enviroment :** R. Bruno
- **KM3NeT Convener for DATA quality and Analisisys:** A. Sinopoulou
- **Multimessenger Astronomy:** I. Tosta e Melo





For the 2024 edition, **Riccardo Bruno from the INFN of Catania** has been selected to receive the GAP-ECS award.

This recognition is in honor of his work on developing a software suite essential for testing and validating WWRS DOMs.

Thanks to his work, more than 600 DOMs have been produced, enabling the deployment of 19 DUs in the upcoming marine campaign in September

In 2024 54 WWRS DOMs has been produced in Catania.

Other 18 for the end of July.

Thanks to the 3 PNRR technicians involved we reached a rate of 3 DOMs at week

4 Battery Packs have been produced for the next marine campaign of September

Other 2 wil be produced for November 2024

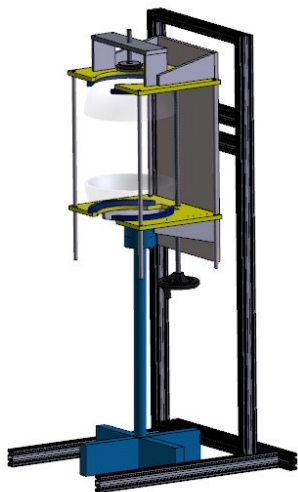
Involved in the refurbishment of DOMs from Detection Units recovered from Sea (site of Harbour in Catania)

- Refurbishment of 18 DOMs of ARCA DU 66
- Refurbishment of 1 DOM of DU 46



Partecipazione della parte tecnica a tutte le attività di INFN Catania

- Servizio Tecnologie Avanzate
- Servizio officina e progettazione meccanica
- Servizio Calcolo e Reti



Construction of a second DOM integration site in Catania thanks to PNRR funds
(Edificio 10. Secondo piano. Cittadella Universitaria)

2 procedures for construction (RUP O. Conti, servizio tecnico INFN-CT)

New tools and instrumentation to increase the rate of the DOM production

2 procedures for purchasing of 2 gel mixing machines (RUP E. Leonora)

2 machines to rotate and close the DOM (designed by INFN Catania F. Longhitano. F. Librizzi)

3 Procedures for purchasing tools and machines (RUP F. Longhitano, R. Bruno)

estimated cost tools and construction: 480 k euros

estimated time: ready for September 2024



6 Junction Box for the ARCA-site:

procedures for 7.5 M euro (RUP N. Randazzo)

All these goals have been possible thanks to INFN-CT administration

1st Astrophysics in the New Era of MM Astronomy International Conference

Poços de Caldas, Brazil – December 4-8th 2023



Iara Tosta e Melo has organized in Brazil a conference about Multi Messenger
A. Sinopoulou and E. Leonora have been invited for a talk



13th Cosmic-Ray International Studies and Multi-messenger Astroparticle Conference

E. Leonora in the LoC of CRIS-MAC 2024



Notte dei Ricercatori 2023



International Cosmic Day 2023



Giornata Europea del Mare



Pint of Science

Ricercatori e tecnologi

• Nunzio Randazzo	70%	(Dipendente) Resp. Locale
• Emanuele Leonora	80%	(Dipendente)
• Fabio Longhitano	80%	(Dipendente)
• Riccardo Bruno	70%	(Dipendente)
• Anna Sinopoulou	100%	(Borsa di studio stranieri, 2 anni)
• Iara Tosta e Melo	10%	(RTD A PNRR KM3NeT4RR)

Totale 4.1 FTE

Servizi

Servizio Tecnologie avanzate	3.7 m/u
G. Imperiale	100% (PNRR)
E. Cafici	100% (PNRR)
G. Richichi	100% (PNRR)
Servizio Progettazione meccanica	4 m/u
Servizio di calcolo e reti	1 m/u

Principali modifiche rispetto al 2024:

- *Pensionamento di S. Aiello (70%)*
- *Persone e FTE quasi stabili (4.6)*

		k€
Consumo	Consumabile per 2 siti integrazione DOM	20
Missioni	<ul style="list-style-type: none"> - Meeting di collaborazione - Integrazione test JB presso producers - Test e assemblaggio a Malta - Marine Operations 	80
Trasporti	DOM transportation to DU integration site	25

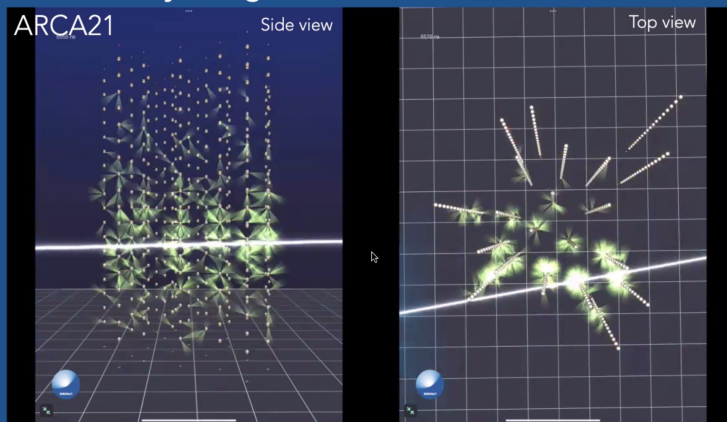
UHE KM3NeT Neutrino event

Dati analizzati provenienti da 21 DU

19 DU su 21 sono state interessate dall'evento

I tempi di rivelazione del segnale segnale di luce Cherenkov in acqua sono compatibili con un evento di traccia di muone

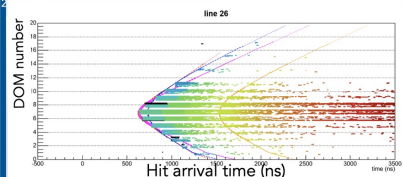
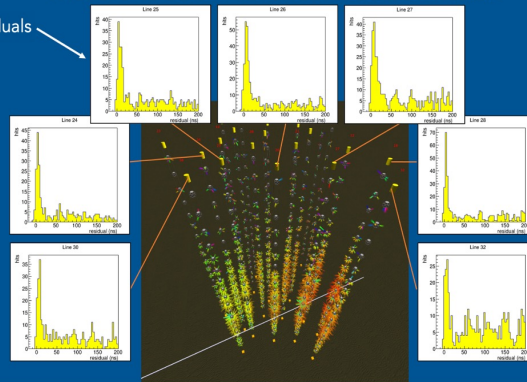
A very energetic cosmic event detected



A very energetic cosmic event detected

The event is well reconstructed as a track

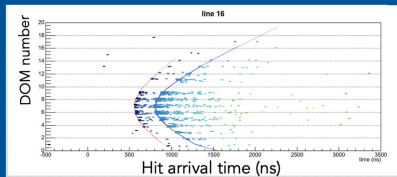
Time residuals



From the track and shower reconstructions

A muon track and three showers detected

Hit times are fully consistent with photons from Cherenkov emission

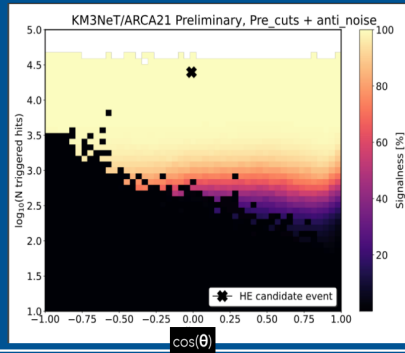
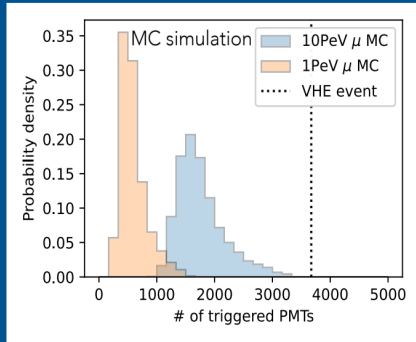


THE EVENT WITH THE HIGHEST ENERGY

A very energetic cosmic event detected

The event is an horizontal event (1° above the horizon) with energy above 10PeV

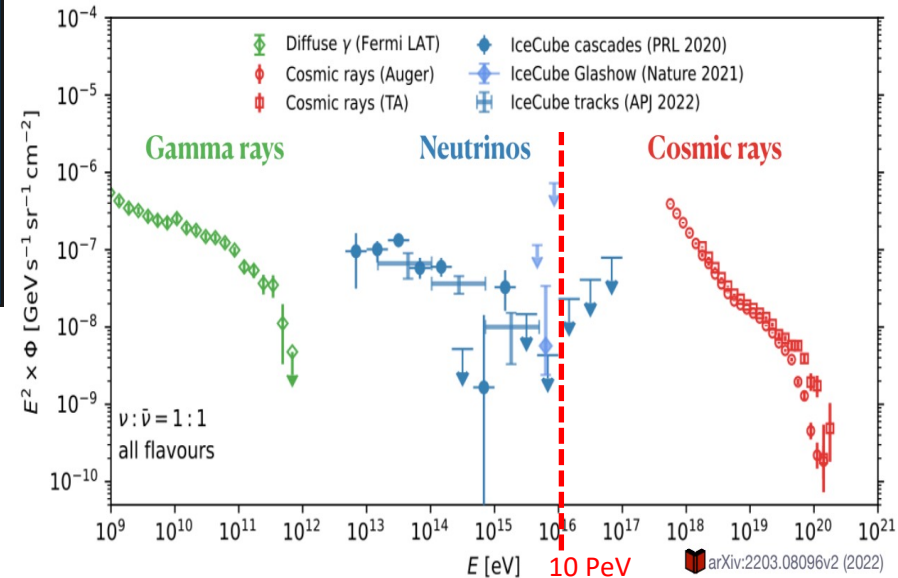
Huge amount of light detected 🌟 35% of the total number of PMTs were triggered

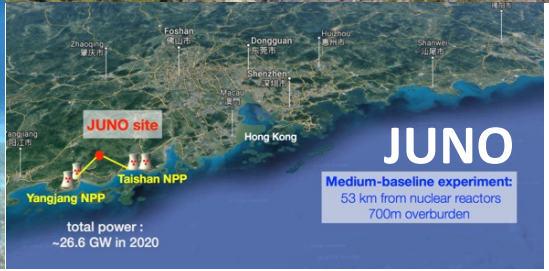
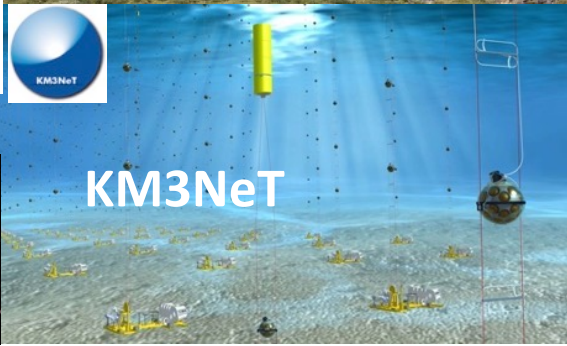
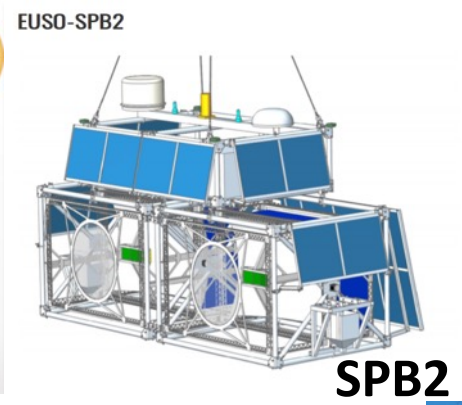


Verifica in corso: evento di neutrino cosmico $E > 10$ PeV

Direzione quasi orizzontale

Evento di neutrino a più alta energia mai rilevato





Dal Gruppo 2 GRAZIE PER L'ATTENZIONE

Presentazioni dettagliate per ogni sigla in:
<https://agenda.infn.it/event/42241/> (meeting Gruppo 2 del 02/07/2024)