ICARUS

CATIA PETTA

Dipartimento di Fisica e Astronomia
"E. Majorana"
Università di Catania
INFN, Sezione di Catania
NP01 & SBN Collaborations

INFN Sezioni partecipanti
PD – LNGS (DTZ) – PV – CT – MIB - NA (DTZ)

H2020, M. Sklodowska-Curie
R&I No. 822185 INTENSE

The ICARUS collaboration at SBN (2023, >150 physicists)

P. Abratenko[19], A. Aduszkiewicz[21], F. Akbar[23], M. Artero Pons[15], J. Asaadi[24], M. Babicz[2], W.F. Badgett[5], L.F. Bagby[5], B. Baibussinov[15], B. Behera[4], V. Bellini[7], O. Beltramello[2], R. Benocci[13], J. Berger[4], S. Berkman[5], S. Bertolucci[6], M. Betancourt[5], K. Biery[5], M. Bonesini[13], T. Boone[4], B. Bottino[8], A. Braggiotti[15], J Bremer[2], S. Brice[5], V. Brio[7], C. Brizzolari[13], J. Brown[5], H. Budd[23], A. Campani[8], A. Campos[27], D. Carber[4] , M. Carneiro[1], H. Carranza[24], D. Casazza[8], A. Castro[3], M. Cicerchia[15], S. Centro[15], G. Cerati[5], M. Chalifour[2], A.Chatterjee[26],D. Cherdack[21], S. Cherubini[11], N. Chitirasreemadam[25], T. Coan[18], A. Cocco[14], M. R. Convery[17], S. Copello[16], A. De Roeck[2], S. Di Domizio[8], D. Di Ferdinando[6], L. Di Noto[8], M. Diwan[1], S. Donati[25], J. Dyer[4], S. Dytman[22], S. Dolan[2], F. Dolek[27], L. Domine[17], R. Doubnik[5], F. Drielsma[17], C. Fabre[2], A. Falcone[13], C. Farnese[15], A. Fava[5], F. Ferraro[8], F. Garcia[17], C. Gatto[14], M. Geynisman[5], D. Gibin[15], A. Gioiosa[25], W. Gu[1], M. Guerzoni[6], A. Guglielmi[15], S. Hahn[5], A. Heggestuen[4], B. Howard[5], R.Howell[23], J. Hrivnak[2], C. James[5], W. Jang[24],L. Kashur[4],W. Ketchum[5], J.S. Kim[23], D.H. Koh[17], U. Kose[2], J. Larkin[1], G. Laurenti[6], G. Lukhanin[5], A. Maria[26], C. Mariani[27], C. Marshall[23], S. Martinenko[1], N. Mauri[6], A. Mazzacane[5], K.S. McFarland[23], D.P. Mendez[1], G. Meng[15], A. Menegolli[16], O.G. Miranda[3], D. Mladenov[2], A.Mogan[4], N. Moggi[6], N.Montagna[6], A. Montanari[6], C. Montanari[5,b], M. Mooney[4], G. Moreno Granados[3], J. Mueller[4], M. Murphy[27], D. Naples[22], M. Nessi[2], T. Nichols[5], S. Palestini[2], M. Pallavicini[8], V. Paolone[22], R. Papaleo[11], L. Pasqualini[6], L. Patrizii[6], G. Petrillo[17], C. Petta[7], V. Pia[6], F. Pietropaolo[2,a], F. Poppi[6], M. Pozzato[6], A. Prosser[5], G. Putnam[20], X. Qian[1], A. Rappoldi[16], R. Rechenmacher[5], L. Rice[22], E. Richards[22], F. Resnati[2], A.M. Ricci[25], A.Rigamonti[2], G.L. Raselli[16], M. Rosemberg[19], M. Rossella[16], C. Rubbia[9], G. Savage[5],A. Scaramelli[16],D. Schmitz[20],A. Schukraft[5], F. Sergiampietri[2], G. Sirri[6], J. Smedley[23], A. Soha[5],L. Stanco[15],J. Stewart[1],N.B. Suarez[22], H.Tanaka[17], M. Tenti[6], K.Terao[17] , F. Terranova[13], V.Togo[6], D.Torretta[5], M.Torti[13], Y.T. Tsai[17], S.Tufanli[2], T. Usher[17], F.Varanini[15], S. Ventura[15], M.Vicenzi[1], C. Vignoli[10], B.Viren[1], D. Warner[4], Z. Williams[24], P. Wilson[5], R.J. Wilson[4], J. Wolfs[23], T. Wongjirad[19], A. Wood[21], E. Worcester[1], M. Worcester[1], M. Wospakrik[5], H. Yu[1], J. Yu[24], A. Zani[12], C. Zhang[1], J. Zennamo[5], J. Zettlemoyer[5], S. Zucchelli[6], M. Zuckerbrot[5]

Spokesperson: C. Rubbia, GSSI

1. Brookhaven National Lab., USA
2. CERN, Switzerland
3. CINVESTAV, Mexico,
4. Colorado State University, USA
5. Fermi National Accelerator Lab., USA
6. INFN Bologna and University, Italy
7. INFN Catania and University, Italy
8. INFN Genova and University, Italy
9. INFN GSSI, L'Aquila, Italy
10. INFN LNGS, Assergi, Italy
11. INFN LNS, Catania, Italy
12. INFN Milano, Milano, Italy
13. INFN Milano Bic. and University, Italy
14. INFN Napoli, Napoli, Italy
15. INFN Padova and University, Italy
16. INFN Pavia and University, Italy
17. SLAC National Accelerator Lab., USA
18. Southern Methodist University, USA
19. Tufts University, USA
20. University of Chicago, USA
21. University of Houston, USA
22. University of Pittsburgh, USA
23. University of Rochester, USA
24. University of Texas (Arlington),USA
25. INFN Pisa and University, Italy
26. Ramanujan Faculty Phys. Res. India
27. Virginia Tech Institute

a On Leave of Absence from INFN Padova
b On Leave of Absence from INFN Pavia

12 INFN groups, 12 US institutions, CERN, 1 Mexican institution, 1 Indian Institution

outline

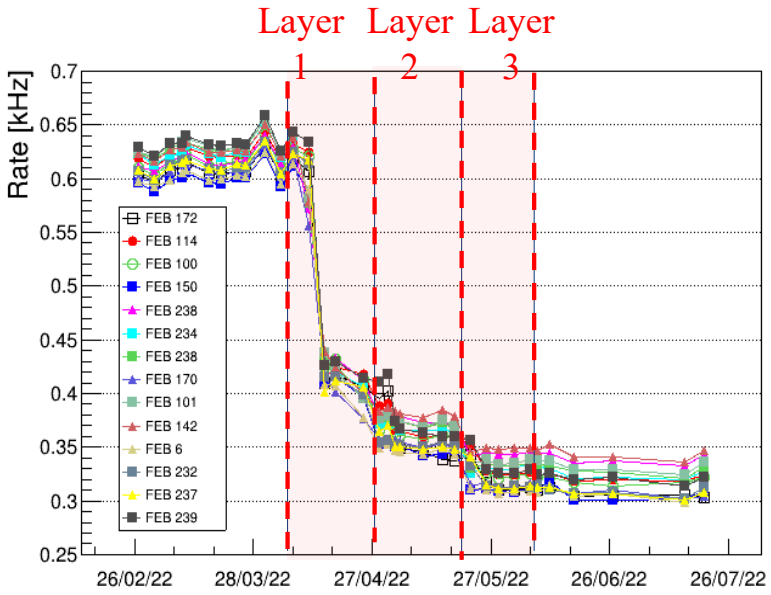
- Status of ICARUS detector
- INFN Catania group: composition and activities

ICARUS Installation, Commissioning and Data taking

Dec. '21: CRT installation to recognize cosmics

June '22: overburden installation to reduce cosmics

Steady data taking with BNB, NuMI beams since March 2021, in parallel with commissioning activities.
Cosmic rays, ν_μ, and ν_e samples collected for trigger/calibration/event reconstruction studies.

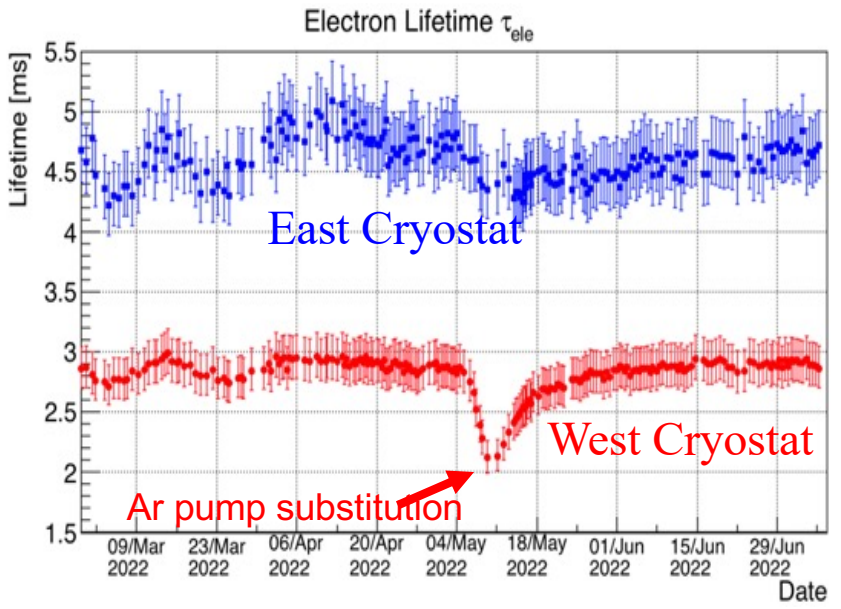


- Installation of concrete overburden (3 layers ~2.85 m thickness) lasted to June 7 2021 concluding the ICARUS detector installation:
  - Cosmic rates reduced by ~2 and start of ICARUS physics data taking!

Run 1: first ICARUS physics run, June 9th – July 10th 2022

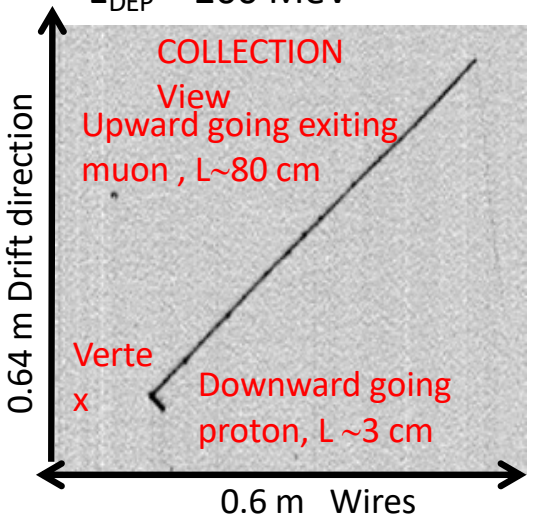
- ICARUS operated in physics mode with TPC, PMT, Top/Side CRT in stable conditions taking data with a PMT signal trigger in coincidence with NuMI or BNB beam spill;

- The cryogenic system performed smoothly guaranteeing a LAr purity adequate for data taking, with a free e-lifetime measured by cosmic μs at ~4.5 ms (~ 3 ms) for East (West) cryostat.

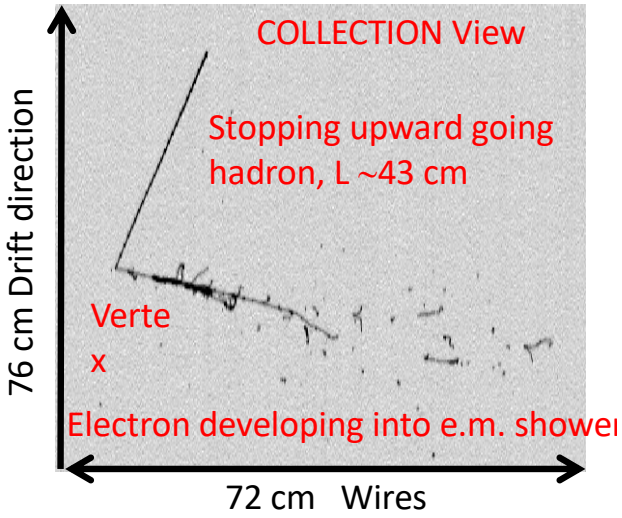


- Data acquisition largely successful, with ~93% collection efficiency for both BNB/NuMI:
  - Total collected beam amounts to ~6.8 10^{19} POT for NuMI and ~4.1 10^{19} POT for BNB.

BNB CCQE νμ candidate, E_{DEP} ~ 200 MeV



Contained NuMI CCQE νe, candidate, E_{DEP} ~ 800 MeV



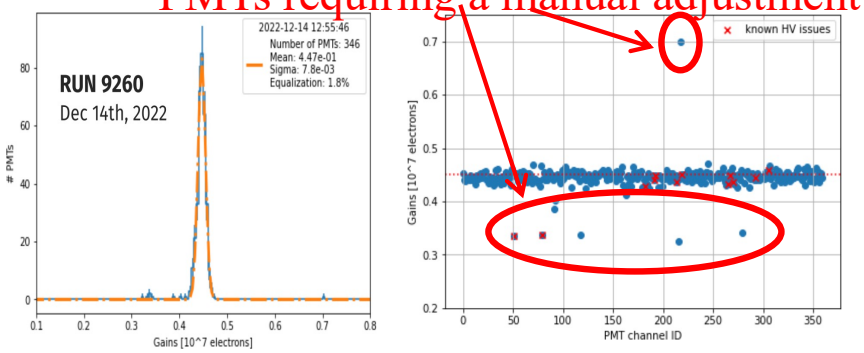
PMT Activities on the 2022 summer shutdown and beyond

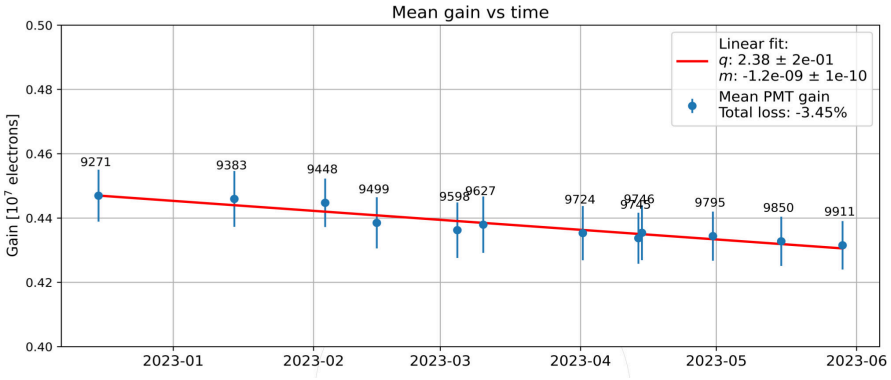
- **PMTs gain** equalized to G=4.5x10^6 within ~2% spread by adjusting the applied tensions with a semi-automatic procedure based on the recognition of single phe's from γ background.

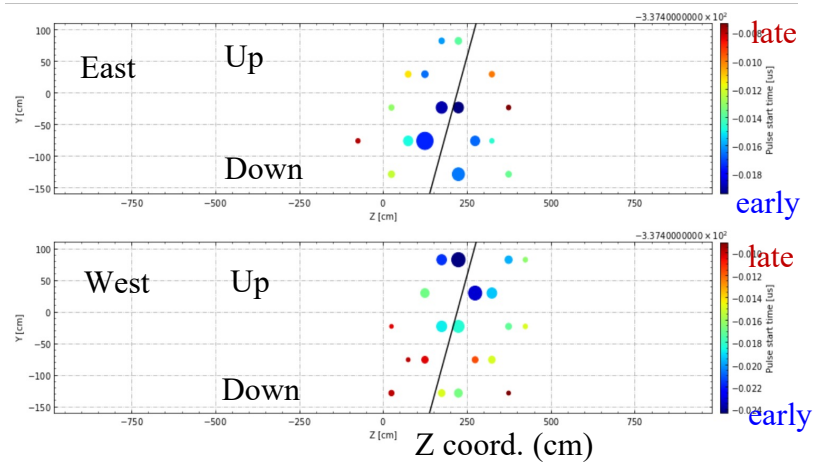
  Light detection system regularly monitored to identify possible variations requiring new calibrations showing an impressive stability since December 2022.

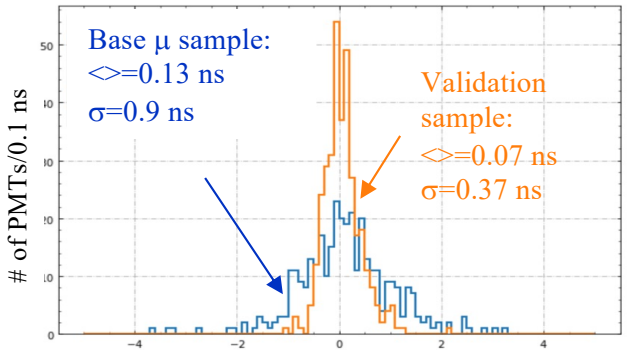
- **PMTs timing** regularly measured exploiting the laser system and cosmic μs for the precise time reconstruction of interactions

PMTs requiring a manual adjustment





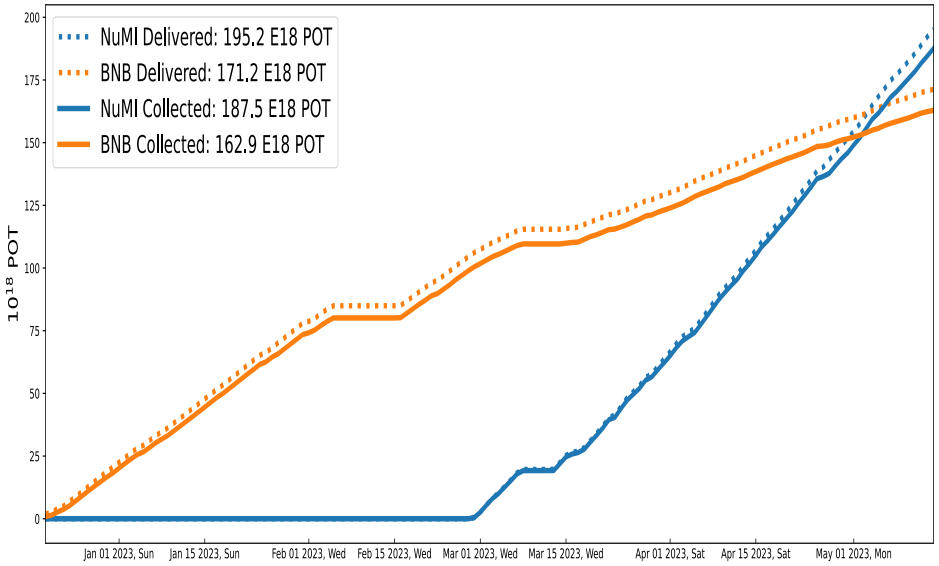




residuals used for recursive corrections of each PMT's transit time up to 0.4 ns

Run 2 Data taking: from December ‘ 22 to July 9 2023

- Run 2 started on Dec. ’22 taking data smoothly with an acquisition efficiency >95 % using the improved trigger system.
- Occasional beam stops due to technical problems on beam-lines were used for detector calibration/tests .
- Collected events statistics: 1.6 10^{20} POT BNB and ~1.9 10^{20} POT NuMI.



First ICARUS published paper:

Eur. Phys. J. C (2023) 83:467
https://doi.org/10.1140/epjc/s10052-023-11610-y

THE EUROPEAN PHYSICAL JOURNAL C

Regular Article - Experimental Physics

ICARUS at the Fermilab Short-Baseline Neutrino program: initial operation

P. Abratenko[1], A. Aduszkiewicz[2], F. Akbar[3], M. Artero Pons[4], J. Asaadi[5], M. Aslin[6,27], M. Babicz[7,28,29], W. F. Badgett[6], L. F. Bagby[6], B. Baibussinov[4], B. Behera[8], V. Bellini[9], O. Beltramello[7], R. Benocci[10], J. Berger[8], S. Berkman[6], S. Bertolucci[11], R. Bertoni[10], M. Betancourt[6], M. Bettini[4], S. Biagi[12], K. Biery[6], O. Bitter[6,30],

Gruppo ICARUS a Catania 2023

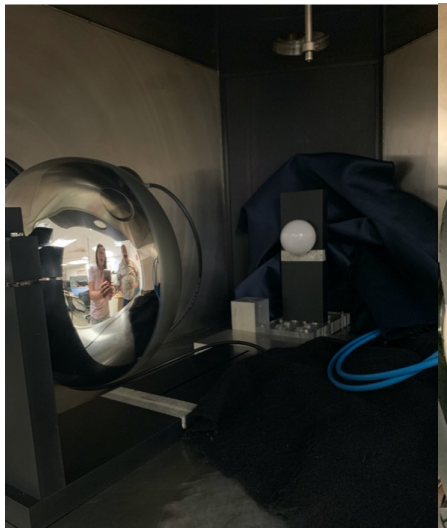
Composizione

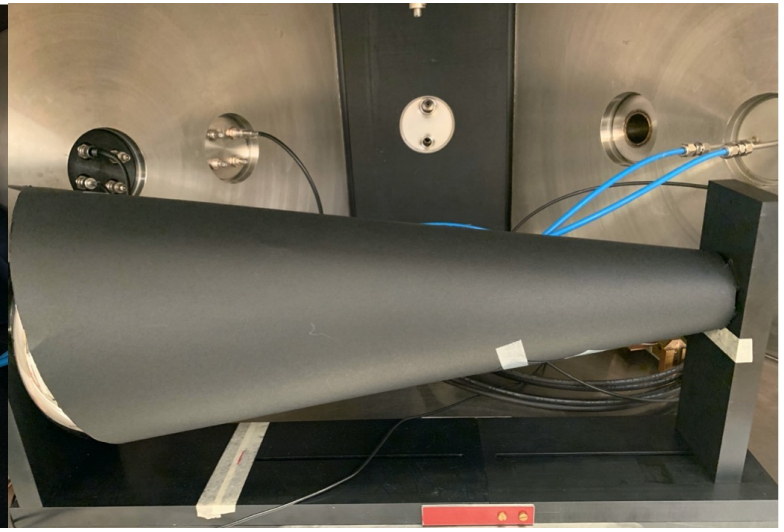
Vanessa Brio (ass. INFN dall'1 giugno), Vincenzo Bellini, Catia Petta, Clara Saia (tesista UniCT del Corso di Laurea Magistrale)

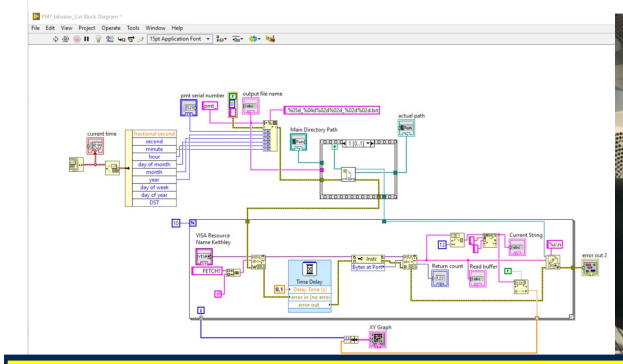
Attività in corso e previste nel 2024

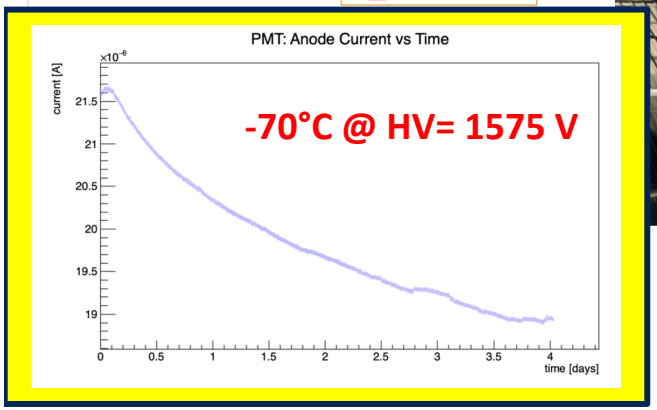
- *Ricostruzione dei segnali ottici dal PMT System, calibrazione in tempo e in guadagno dei PMT, manutenzione e ottimizzazione del PMT System, PMT expert shifts*
- *Analisi dei dati dalle misure di stabilità del guadagno dei PMT di Icarus al variare della temperature*
- ICARUS *Remote Shifts*

ICARUS gain stability test









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A. Di Mattia, R. Persiani, F. Librizzi, A. Grimaldi, D. Sciliberto, G. Saccà