

# RIUNIONE DI GRUPPO 1

## SEZIONE DI NAPOLI

16/01/2024



Hyper-K  
T2K  
Super-K



CMS



ATLAS  
EXPERIMENT



FCC

LHC

100 KM LONG

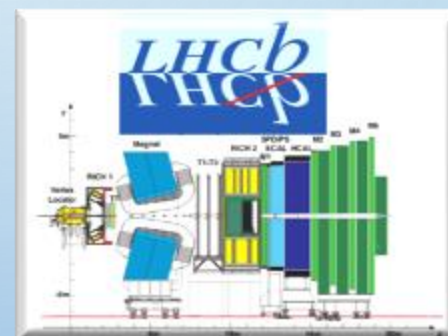
100 km Circumference



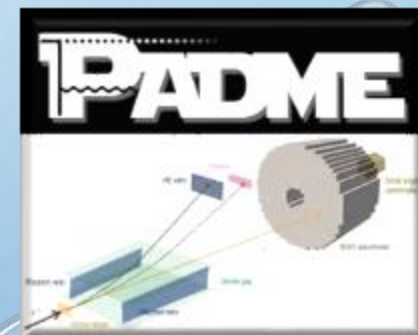
DUNE DEEP UNDERGROUND NEUTRINO EXPERIMENT



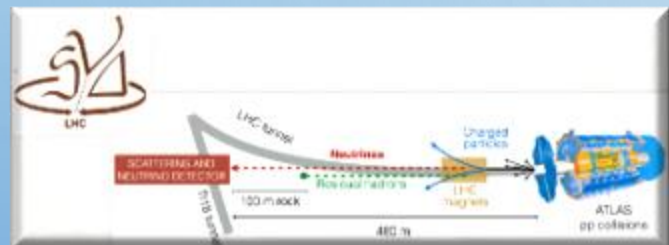
Belle II



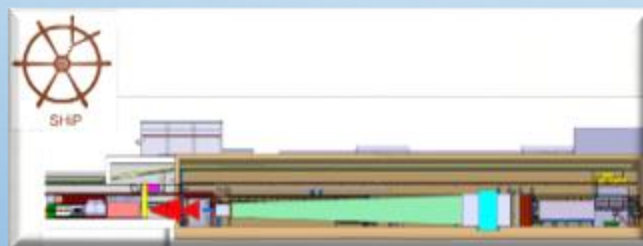
LHCb  
LHCb



PADME



LHC



SHIP



$\mu$   
g-2



RHUM  
Resistive  
High  
granularity  
Micromegas



NA62

NA62

# Riunione Gruppo 1 - Napoli

Thursday 16 Jan 2025, 09:00 → 19:00 Europe/Rome

2G26

Francesco Alessandro Corvetti (Istituto Nazionale di Fisica Nucleare)

## Indico page

Description: La riunione di Gruppo 1 si terrà in aula 2G26.

Link zoom: <https://oem.zoom.us/j/68194851871?pwd=AbJcVbQjYDRlg6QjH0HsSp2o7FFa95c.1>

09:00 → 09:30 **DUNE** 30m

Speakers: Francesco Di Capua (Università Federico II di Napoli), Francesco Di Capua (Istituto Nazionale di Fisica Nucleare)

DUNE\_Gr1-Napoli...

09:30 → 10:00 **HYPER\_K** 30m

Speaker: Gianfranca De Rosa (Istituto Nazionale di Fisica Nucleare)

HyperK-Gr1-160120...

10:00 → 10:30 **SND@LHC/SHIP** 30m

Speaker: Antonia Di Crescenzo (Istituto Nazionale di Fisica Nucleare)

2025\_01\_15\_Neutri...

10:30 → 11:20 **Lightning talks (I)**

10:30 **Search for neutrino interactions in the emulsion target** 8m

Speaker: Fabio Alicante

20250116\_FA.pdf

10:40 **Design of the magnet for the detector upgrade** 8m

Speaker: Daniele Centanni (Istituto Nazionale di Fisica Nucleare)

2025\_01\_16\_DCent...

10:50 **Neutrino astronomy for multi-messenger studies in Super-Kamiokande** 8m

Speaker: Aurora Langella (Istituto Nazionale di Fisica Nucleare)

Presentazione\_Gr1...

11:00 **HK mPMT electronics overlook** 8m

Speaker: Alessandro Di Nola (Istituto Nazionale di Fisica Nucleare)

alessandro\_electro...

11:20 → 11:40 **Coffe break** 20m

11:40 → 12:10 **Comunicazioni del coordinatore** 30m

Speaker: Francesco Alessandro Corvetti (Istituto Nazionale di Fisica Nucleare)

Slides\_rifunione\_CS...

12:10 → 12:40 **CMS** 30m

Speakers: Alberto Orso Maria Iorio (Istituto Nazionale di Fisica Nucleare), Orso Maria Iorio

CMS Status 2024-5...

12:40 → 14:00 **Lunch Break** 1h 20m

14:00 → 14:30 **ATLAS** 30m

Speaker: Francesco Cirotto (Istituto Nazionale di Fisica Nucleare)

14:30 → 15:00 **FCC** 30m

Speaker: Marcello Campajola (Istituto Nazionale di Fisica Nucleare)

15:00 → 15:30 **Lightning talks (II)**

15:00 **Muon system: Run 2 studies and GEM MED Upgrade at CMS** 8m

Speaker: Leonardo Favilla

LFavilla\_Gr1\_1601...

15:09 **Small Pad MicroMegas R&D for Future Colliders** 7m

Speaker: Simone Pema

Lightning talk Simo...

15:17 **Highlights dal Test Beam per il calorimetro elettromagnetico di IDEA al CERN** 7m

Speaker: Lucrezia Borriello (Istituto Nazionale di Fisica Nucleare sezione Napoli)

Lightning talks Lucre...

15:24 **Attività di simulazione per FCC** 6m

Speaker: Antonio D'Avanzo (Istituto Nazionale di Fisica Nucleare)

FCC\_simulation\_Gr...

15:30 → 16:00 **NA62** 30m

Speaker: Marco Mira (Istituto Nazionale di Fisica Nucleare)

16:00 → 16:30 **BELLE2** 30m

Speaker: Guglielmo De Nardo (Istituto Nazionale di Fisica Nucleare)

16:30 → 16:50 **GMINUS2** 20m

Speaker: Michele Iacovacci (Istituto Nazionale di Fisica Nucleare)

Mi Stato di g2 al Fe...

16:50 → 17:05 **PADME** 15m

Speaker: Paolo Inigo (Istituto Nazionale di Fisica Nucleare)

17:05 → 18:20 **Lightning talks (III)**

17:05 **Validation of DUNE Photon Detection System with ProtoDUNE data** 8m

Speaker: Gabriel Botogoske

17:15 **Misura di  $B \rightarrow \tau \nu$  a Belle II** 10m

Speaker: Giovanni Gaudino (Istituto Nazionale di Fisica Nucleare)

250116-iv-Gaudino...

17:25 **Search for  $K^+ \rightarrow \mu^+ \nu A', A' \rightarrow e^+ e^-$**  10m

Speaker: Ilaria Rosa (Istituto Nazionale di Fisica Nucleare)

KmuonA\_Gruppo1...

17:35 **Misura BR  $K \rightarrow \pi \nu \nu$  in NA62** 10m

Speaker: Renato Fiorenza (INFN Napoli)

Fiorenza\_2025-01-1...

































# COMUNICAZIONI DEL COORDINATORE

Paolo Iengo

Adelina D'Onofrio

Leonardo Merola

Vincenzo Izzo

Bernardino Spisso

Raffaele

## CSN1-INFN 2025



### • Riunioni del 2025:

- 19-20 Febbraio Presidenza INFN
- 7-9 Maggio Pisa
- 14-16 Luglio *da definire*
- 8-12 Settembre Otranto (LE)
- 24-25 Novembre *da definire*

Search

|    |                     |  |  |
|----|---------------------|--|--|
| AD | Adelina D'Onofrio   |  |  |
| AV | Anna Vanacore       |  |  |
| BS | Bernardino Spisso   |  |  |
| FC | Francesco Cirotto   |  |  |
| g  | giulio              |  |  |
| IR | Ilaria Rosa         |  |  |
| LM | Leonardo Merola     |  |  |
| mm | marco mirra         |  |  |
| OI | Orso Iorio          |  |  |
| PI | Paolo Iengo         |  |  |
| R  | Raffaele            |  |  |
| SL | Salvatore Loffredo  |  |  |
| SM | Stefano Mastroianni |  |  |
| vi | Vincenzo Izzo       |  |  |

# DUNE

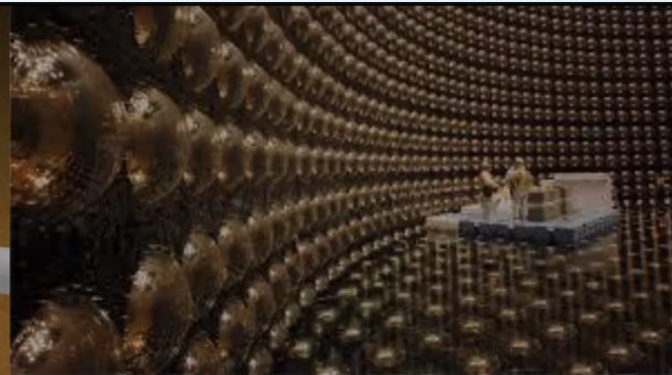
## DUNE activities in Naples

### Main involvement in the Photon Detection System

- Characterization of the PDS module (Megacell)
- PDE of SiPMs at cryogenic temperatures
- European site for evaporation of the wavelength shifter
- Active participation to ProtoDUNE (analysis and simulation)
- Proposal for a new design for Far Detector 3
  - Simulation and performance study
  - In situ R&D small prototypes

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| ER | Elvira Rossi        |  |  |
| A  | Adele               |  |  |
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| CB | Cristiano Bozza     |  |  |
| FC | Francesco Cirotto   |  |  |
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| mm | marco mirra         |  |  |
| PI | Paolo lengo         |  |  |
| SM | Stefano Mastroianni |  |  |
| VT | Valeri Tioukov      |  |  |

# HYPER-K T2K SUPER-K



Hyper-K  
T2K  
Super-K

Gianfranca De Rosa  
Per il gruppo Hyper-K di Napoli 1

- |    |                     |  |  |
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| ER | Elvira Rossi        |  |  |
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| SM | Stefano Mastroianni |  |  |
| VT | Valeri Tioukov      |  |  |



# SND@LHC/SHIP

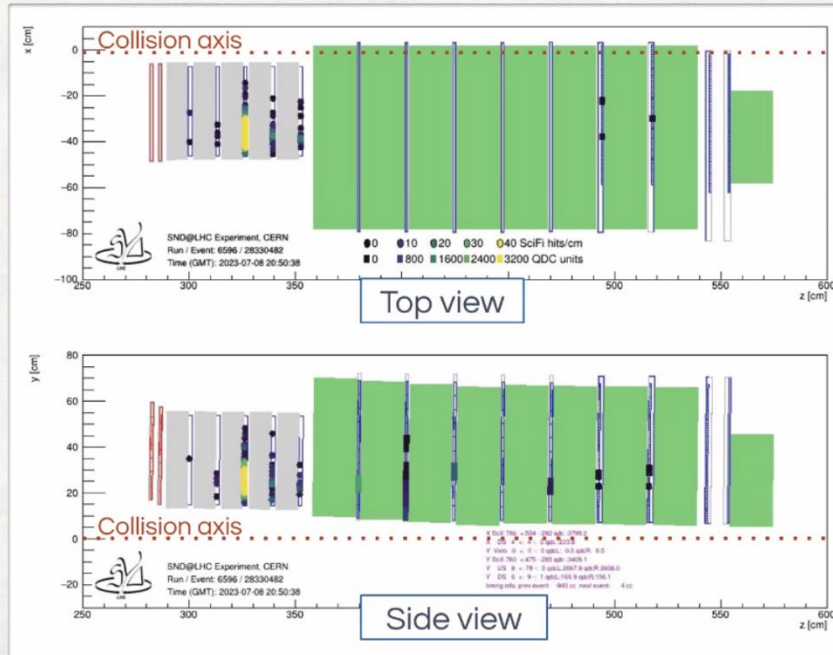
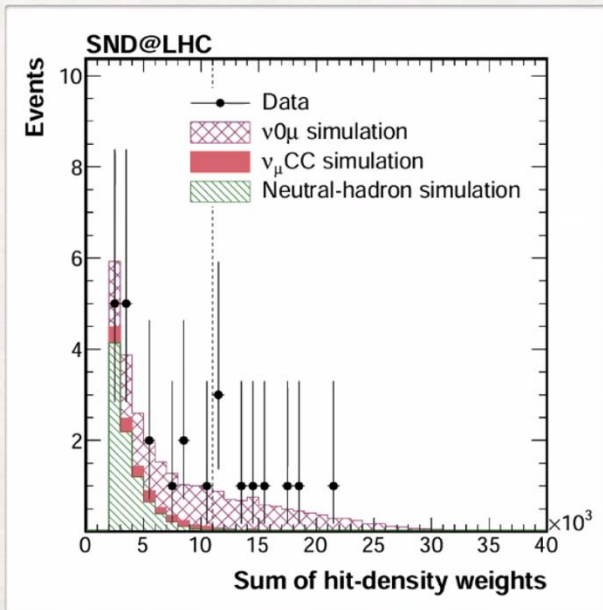
## 0 $\mu$ NEUTRINO OBSERVATION

- First observation of neutrino interactions without a muon in the final state based on **2022-2023** data
- 9** observed **0 $\mu$  v-candidates**
- Observation significance **6.4 $\sigma$**
- Evidence for  **$\nu_e$  interactions** at 6.4 $\sigma$

Submitted to PRL  
arXiv:2411.18787

Observation of collider neutrinos without final state muons with the SND@LHC experiment

Display of a 0 $\mu$  v-candidate event



10

|           |                     |  |  |
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| <b>ER</b> | Elvira Rossi        |  |  |
| <b>AD</b> | Adelina D'Onofrio   |  |  |
| <b>AL</b> | Aurora Langella     |  |  |
| <b>CB</b> | Cristiano Bozza     |  |  |
| <b>FC</b> | Francesco Ciotto    |  |  |
| <b>g</b>  | giulio              |  |  |
| <b>IR</b> | Ilaria Rosa         |  |  |
| <b>mm</b> | marco mirra         |  |  |
| <b>OI</b> | Orso Iorio          |  |  |
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| <b>SM</b> | Stefano Mastroianni |  |  |
| <b>VT</b> | Valeri Tioukov      |  |  |
| <b>vi</b> | vincenzo izzo       |  |  |

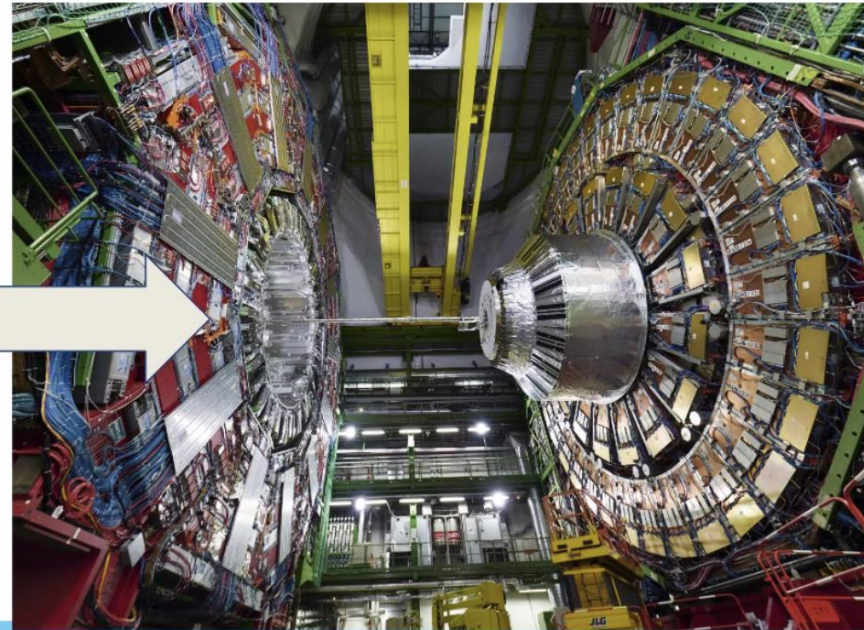
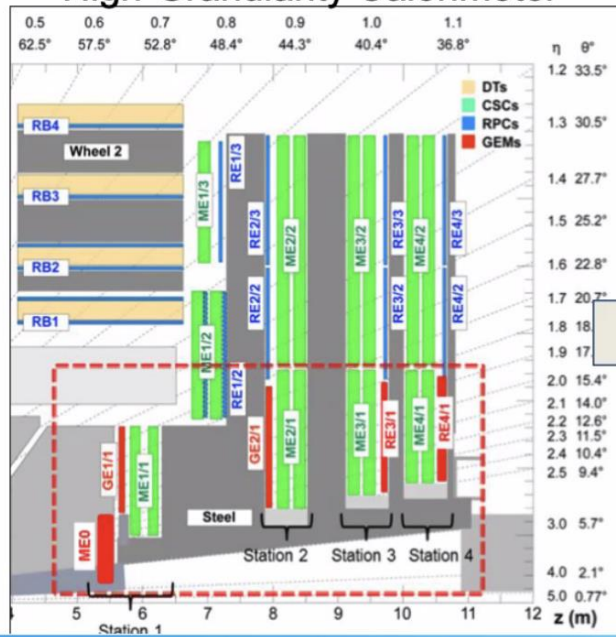
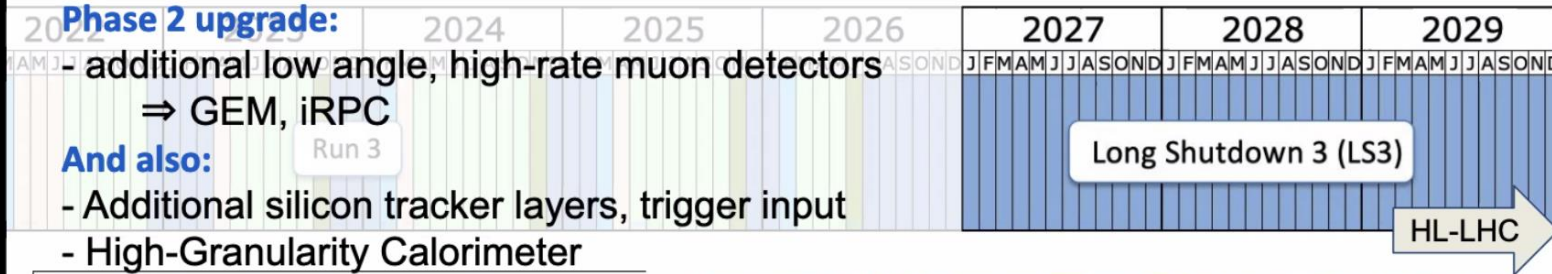
## Looking forward

### Phase 2 upgrade:

- additional low angle, high-rate muon detectors  
⇒ GEM, iRPC

### And also:

- Additional silicon tracker layers, trigger input
- High-Granularity Calorimeter

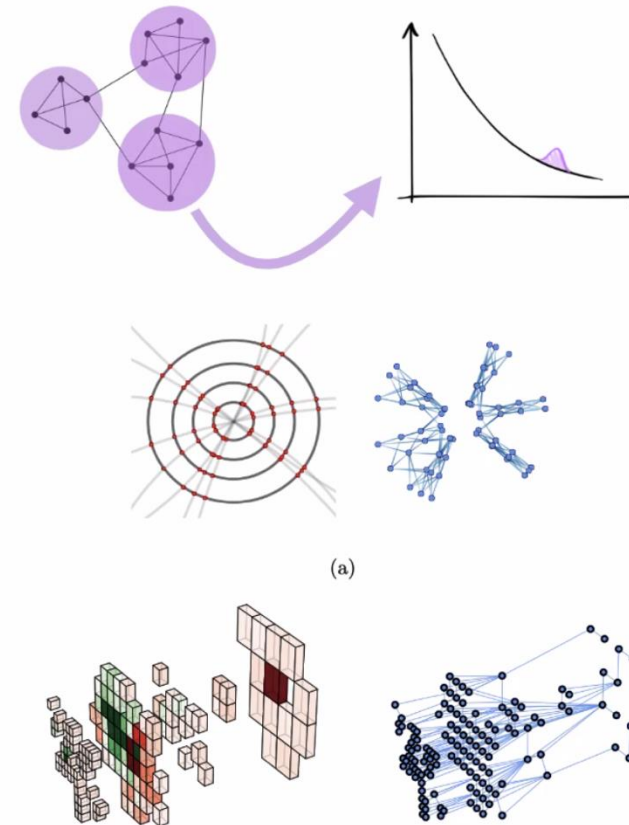


Alberto Orso Maria Iorio

- ER Elvira Rossi
- vi vincenzo izzo
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- FC Francesco Ciotto
- g giulio
- LM Leonardo Merola
- mm marco mirra
- OI Orso Iorio
- PI Paolo Iengo
- SL Salvatore Loffredo
- VD Vincenzo Del Piano
- R Raffaele

## GRAPH ANOMALY DETECTION FOR NEW PHYSICS SEARCHES

- Graph-structured data are ubiquitous across science, engineering, and many other domains
  - ↳ Used to describe and analyze relations and interactions
  - ↳ Can encapsulate object or event information
  - ↳ Can be employed in particle physics!
- Our strategy: **to represent jets as graphs and then apply machine learning to build an anomaly detection algorithm**
  - ↳ Targeting heavy resonance searches with hadronic final states in Run-3
  - ↳ Exploit event-based graphs to detect anomalies
- Jet information can be used as input features for neural network architectures.
  - ↳ A significant improvement in performances can be achieved by employing a set of features with basic information (**low-level**) such as information coming directly from the detectors.
  - ↳ Jet constituents represent challenging input features to achieve this goal

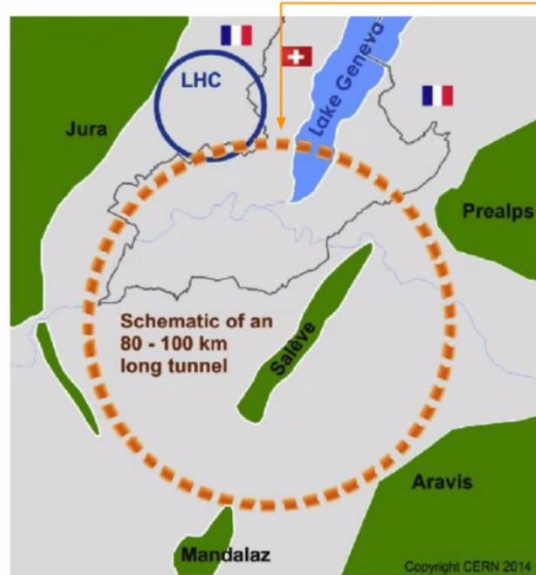


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| vi | vincenzo izzo       |  |  |

## The FCC integrated program

The 2020 European Strategy concluded that an  $e^+e^-$  Higgs factory is the highest priority next collider.

→ In 2021 CERN has launched the international **Future Circular Collider (FCC)** feasibility Study



FCC is a comprehensive long-term programme maximising physics opportunities:

- **stage 1 (FCC-ee):** an Higgs factory, electroweak and top factory at highest luminosities
- **stage 2 (FCC-hh):** as natural continuation at energy frontier (~100 TeV)

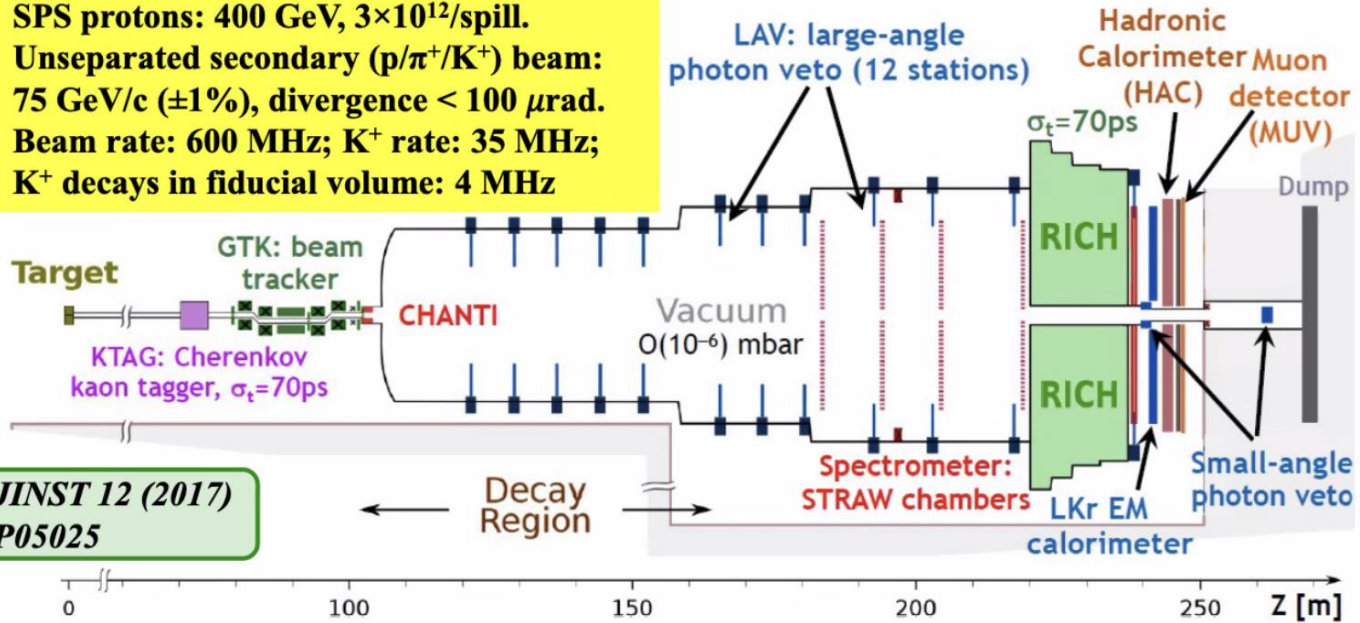
Both sharing same technical infrastructures



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| R  | Raffaele            |  |  |
| SM | Stefano Mastroianni |  |  |
| vi | vincenzo izzo       |  |  |

## Beamline and detector

SPS protons: 400 GeV,  $3 \times 10^{12}/\text{spill}$ .  
 Unseparated secondary ( $p/\pi^+/K^+$ ) beam:  
 75 GeV/c ( $\pm 1\%$ ), divergence  $< 100 \mu\text{rad}$ .  
 Beam rate: 600 MHz;  $K^+$  rate: 35 MHz;  
 $K^+$  decays in fiducial volume: 4 MHz



JINST 12 (2017)  
P05025

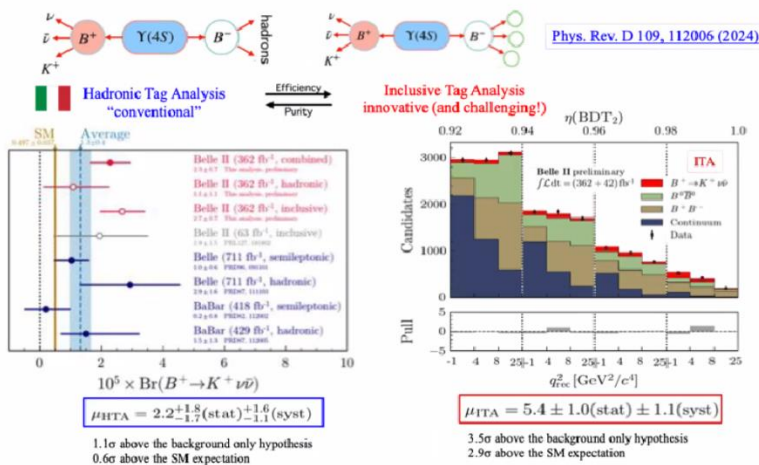
- ✓ **Excellent time resolution:**  $\mathcal{O}(100 \text{ ps})$  to match beam and daughter particle information
- ✓ **Kinematics:** rejection of main  $K$  modes  $10^{-4}$  via kinematics reconstruction
- ✓ **PID capability (RICH+LKr+MUV):**  $\mathcal{O}(10^{-7})$  muon suppression for  $15 \text{ GeV} < p < 35 \text{ GeV}$
- ✓ **High-efficiency photon veto:**  $10^{-7}$  rejection of  $\pi^0$  for  $E(\pi^0) > 40 \text{ GeV}$

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| MN | Marco Napolitano    | <input type="checkbox"/>            | <input type="checkbox"/>            |
| BS | Bernardino Spisso   | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| FD | Francesco Di Capua  | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
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| PI | Paolo Iengo         | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| SL | Salvatore Loffredo  | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| SM | Stefano Mastroianni | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| vi | vincenzo izzo       | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |



# BELLE2

## Evidence for $B \rightarrow K \nu \bar{\nu}$



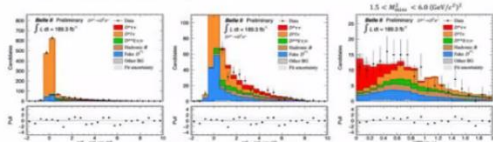
## R(D\*) measurement at Belle II

- Long-standing  $\sim 3\sigma$  anomaly in Flavor Physics:

$$R(D^{(*)}) = \frac{\mathcal{B}(\bar{B} \rightarrow D^{(*)} \tau \bar{\nu}_\tau)}{\mathcal{B}(\bar{B} \rightarrow D^{(*)} \ell \bar{\nu}_\ell)}$$

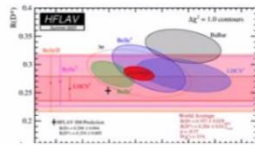
Phys. Rev. D 110, 072020 (2024)

- First Belle II measurement (using only  $\sim$ half of the Run1 data):



$$R(D^*) = 0.262^{+0.041}_{-0.039} (\text{stat.})^{+0.035}_{-0.032} (\text{syst.})$$

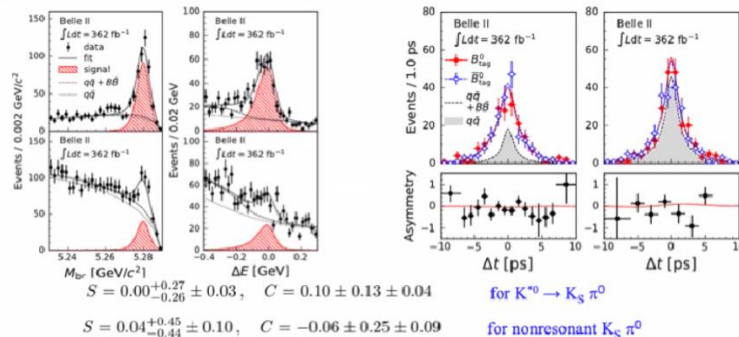
- Not yet competitive with the other measurements, but **40% better sensitivity** than Belle with equivalent luminosity!



## Time dependent $B^0 \rightarrow K_S \pi^0 \gamma$

- The SM predicts that the photon is  $\sim 100\%$  right(left)-polarized for  $B^0$  ( $B^0$ ) decays;
- Any significant CP violation would be a sign of new physics;

arXiv:2407.09139, accepted by PRL

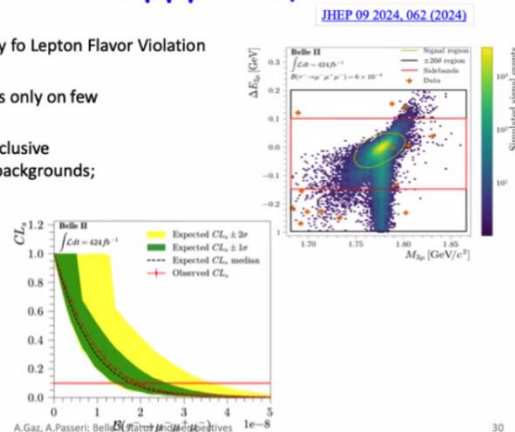


## Search for LFV in $\tau \rightarrow \mu \mu \mu$ decays

- Belle II will dominate the sensitivity for Lepton Flavor Violation searches in the coming years;
- Competition with hadron machines only on few channels, most notably  $\tau \rightarrow 3\mu$ ;
- Compared to Belle/BaBar: more inclusive analysis and better control of the backgrounds;
- World leading upper limit!

Most stringent limit to date

|                 | UL at 90% C.L. on $\mathcal{B}(\tau \rightarrow 3\mu)$                                  |
|-----------------|---|
| ATLAS           | $3.8 \times 10^{-7}$ ( $\mathcal{L} = 20.3 \text{ fb}^{-1}$ )                           |
| LHCb            | $4.6 \times 10^{-8}$ ( $\mathcal{L} = 3.0 \text{ fb}^{-1}$ )                            |
| CMS             | $2.9 \times 10^{-8}$ ( $\mathcal{L} = 131 \text{ fb}^{-1}$ )                            |
| Belle           | $2.1 \times 10^{-8}$ ( $\mathcal{L} = 782 \text{ fb}^{-1}$ )                            |
| BaBar           | $3.3 \times 10^{-8}$ ( $\mathcal{L} = 486 \text{ fb}^{-1}$ )                            |
| <b>Belle II</b> | <b><math>1.9 \times 10^{-8}</math> (<math>\mathcal{L} = 424 \text{ fb}^{-1}</math>)</b> |



ER Elvira Rossi

MN Marco Napolitano

BS Bernardino Spisso

FD Francesco Di Capua

g giulio

IR Ilaria Rosa

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SL Salvatore Loffredo

SM Stefano Mastroianni

vi vincenzo izzo

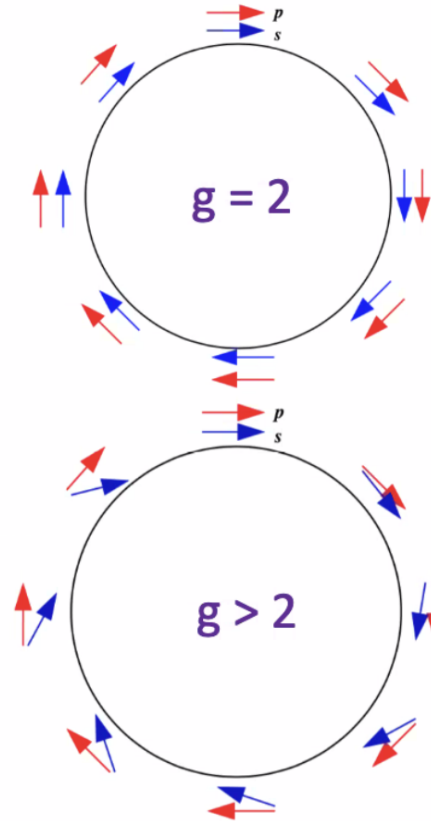
# GMINUS2

## Perché un anello di accumulazione con B uniforme?

- Il muone con momento  $\mathbf{p}$  (freccia rossa) e spin  $\mathbf{s}$  (freccia blu) subisce la rivoluzione del ciclotrone e la precessione di spin in un campo magnetico  $\mathbf{B}$  ( si assume che  $\mathbf{s}$  e  $\mathbf{p}$  siano perpendicolari a  $\mathbf{B}$ )
- La differenza tra le velocità angolari della precessione di spin  $\omega_s$  e rivoluzione ciclotrone  $\omega_c$  è

$$\vec{\omega}_a = \vec{\omega}_s - \vec{\omega}_c = - \left( \frac{g\mu - 2}{2} \right) \frac{q\vec{B}}{m} = -a_\mu \frac{q\vec{B}}{m}$$

- Se  $g = 2$  esattamente, i vettori di spin e momento rimarrebbero bloccati insieme  $\rightarrow \omega_a = 0$
- Invece lo spin precede più velocemente e, alle condizioni del Fermilab, fa una rotazione aggiuntiva di  $12^\circ$  per giro. Dopo circa 30 giri si riallinea all'impulso.



ER Elvira Rossi

BS Bernardino Spisso

FD Francesco Di Capua

g giulio

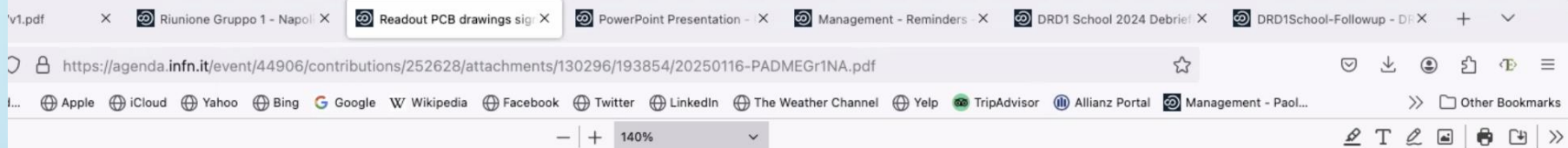
IR Ilaria Rosa

PI Paolo Iengo

SM Stefano Mastroianni

vi vincenzo izzo

# PADME



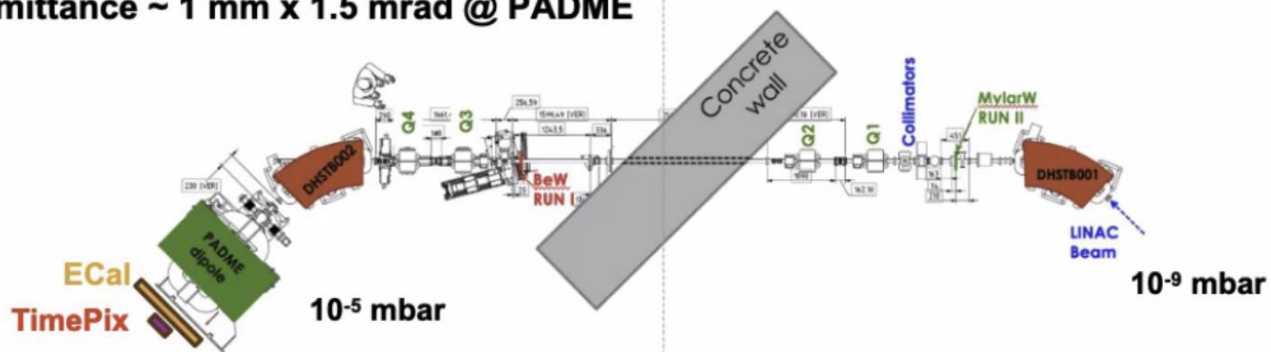
## Positron Annihilation into Dark Matter Experiment (PADME)

**Positrons from the DAFNE LINAC up to 550 MeV,  $O(0.5\%)$  energy spread**

**Repetition rate up to 49 Hz, macro bunches of up to 300 ns duration**

**Intensity must be limited below  $\sim 3 \times 10^4$  POT / spill against pile-up**

**Emittance  $\sim 1 \text{ mm} \times 1.5 \text{ mrad}$  @ PADME**



### Past operations:

- Run I  $e^-$  primary, target,  $e^+$  selection, **250  $\mu\text{m}$  Be** vacuum separation [2019]
- Run II  $e^+$  primary beam, **125  $\mu\text{m}$  Mylar™** vacuum separation, 28000  $e^+$ /bunch [2019-20]
- Run III dipole magnet off,  $\sim 3000$   $e^+$ /bunch, 47 scan points  $s^{1/2} \sim 17 \text{ MeV}$  [2022]

- er elvira rossi (me)
- PI Paolo lengo
- ER Elvira Rossi
- BS Bernardino Spisso
- FD Francesco Di Capua
- g giulio
- IR Ilaria Rosa
- P Paolo
- SM Stefano Mastroianni
- vi vincenzo izzo

The background is a light blue gradient with several realistic water droplets of various sizes scattered across the surface. The droplets have highlights and shadows, giving them a three-dimensional appearance. The text 'LIGHTNING TALKS' is centered in the middle of the image.

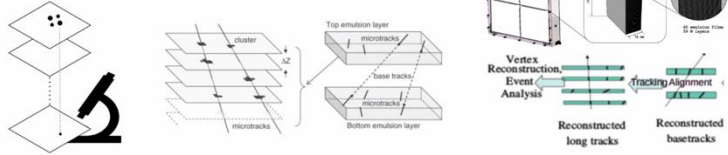
# LIGHTNING TALKS

# SPEAKER: FABIO ALICANTE

## Emulsion Data reconstruction in SND@LHC

1. Emulsion films scanning (online cluster processing).
2. Correct microscope stage effects.
3. Link two layers of each emulsion film.
4. Align consecutive films.
5. Reconstruct tracks and vertices.

Local effects and corrections!

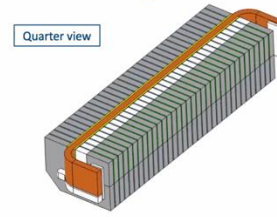


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| AD | Adelina D'Onofrio   |  |
| AL | Aurora Langella     |  |
| FC | Francesco Cirotto   |  |
| g  | giulio              |  |
| IR | Ilaria Rosa         |  |
| mm | marco mirra         |  |
| OI | Orso Iorio          |  |
| PI | Paolo Iengo         |  |
| SM | Stefano Mastroianni |  |
| VT | Valeri Tioukov      |  |
| vi | vincenzo izzo       |  |

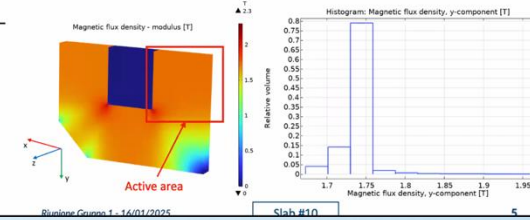
# Speaker: Daniele Centanni

## Electromagnetic design of the magnet

- ✓ Low power consumption
- ✓ Magnetised iron slabs
- ✓ Coil mass compliant with constraints on the crane maximum load
- ✓ Vertical 1.75 T uniform magnetic field
- ✓ High field homogeneity in the active region



| Magnet feature                       | Value       |
|--------------------------------------|-------------|
| Cross section [m <sup>2</sup> ]      | 1.151 x 0.8 |
| Iron length [m]                      | 1.964       |
| Total length [m] (including coil)    | 2.267       |
| Reference magnetic flux density [T]  | 1.75        |
| Magnetomotive force [kAturns]        | 13.0        |
| Conductor size [mm <sup>2</sup> ]    | 23 x 23     |
| Current density [A/mm <sup>2</sup> ] | 0.89        |
| Electrical power [kW]                | 1.19        |
| Coil mass (copper + resin) [tons]    | 0.87        |
| ±steel mass - single slab [tons]     | 0.327       |
| Overall mass (iron + coil) [tons]    | 12.0        |



|    |                     |  |
|----|---------------------|--|
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| AL | Aurora Langella     |  |
| FC | Francesco Cirotto   |  |
| FD | Francesco Di Capua  |  |
| g  | giulio              |  |
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# Speaker: Aurora Langella

## Astrophysical neutrino sources

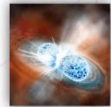
Several astrophysical objects are suggested as sources of neutrinos, mainly those which are considered or confirmed to be cosmic rays acceleration sites (hadronic processes). Some of these are:



Core collapse supernovae (CC-SNe). First confirmed transient source of neutrinos (SN1987A)



Supernova remnants (SNRs) with shocks accelerating cosmic rays.



Binary systems involving compact objects producing jets and accreting matter (e.g. BNS mergers, Microquasar).



Pulsar wind nebulae (PWNe) powered by rapidly spinning neutron stars.

Most of these sources are particularly interesting for multi-messengers astrophysics.

|    |                     |  |
|----|---------------------|--|
| AL | Aurora Langella     |  |
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| FC | Francesco Cirotto   |  |
| FD | Francesco Di Capua  |  |
| g  | giulio              |  |
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| vi | vincenzo izzo       |  |

# Speaker: Alessandro Di Nola

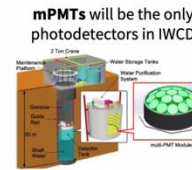
## Photodetectors

Hyper-Kamiokande will be instrumented with **20,000 20"** photomultipliers

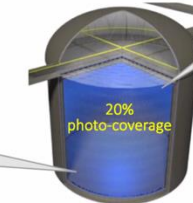
The PMT used are the newly developed Hamamatsu R12860

PMT improvements compared to the previous ones used in SK:

- higher pressure resistance
- double detection efficiency
- half time&charge resolutions



20" R12860-HQE B&L PMT



In addition to the 20" PMTs, Hyper-K will be equipped with **808 multi-PMT optical modules** called mPMTs

Each mPMT is equipped with 19 Hamamatsu R14374 PMTs

|    |                     |  |
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| g  | giulio              |  |
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# Speaker: Leonardo Favilla

## The Phase-2 Upgrade of the CMS Muon Detectors

□ The muon system is challenged by high particle rates in the forward region of the CMS detector

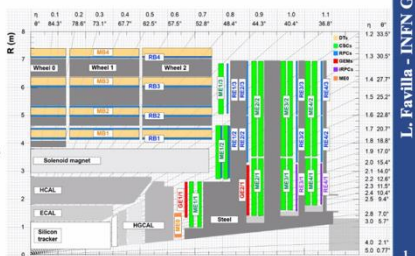
- Inst. Lumi:  $2 \times 10^{34} \text{cm}^{-2}\text{s}^{-1}$  (LHC)  $\rightarrow$   $5 + 7.5 \times 10^{34} \text{cm}^{-2}\text{s}^{-1}$  (HL-LHC)
- Pileup: 60 (LHC)  $\rightarrow$  140 + 200 (HL-LHC)
- Several upgrades taking place to handle such a harsh environment  $\rightarrow$  [link to CMS-TDR-016](#)

□ Main purpose:

- $|\eta| < 2.4$   $\rightarrow$  Enhance identification and triggering capabilities
- $|\eta| > 2.4$   $\rightarrow$  Extend muon identification and triggering

□ Three new GEM detectors:

- LS2: **GE1/1** ( $1.5 < |\eta| < 2.2$ )
- LS3: **GE2/1** ( $1.6 < |\eta| < 2.4$ ) & **ME0** ( $2.0 < |\eta| < 2.8$ )



□ CMS Napoli group involved in:

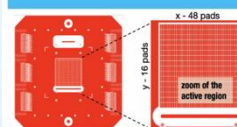
- GE1/1 operation
- GE2/1 and ME0 construction & commissioning
- High-Voltage Power System design & maintenance

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# SPEAKER: SIMONE PERNA

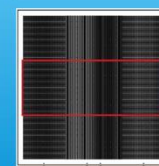
## Test-Beam

### DLC-20



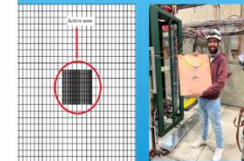
- 768 pad di dimensioni  $1 \times 3 \text{mm}^2$ .
- Gap drift a 7 mm.
- Gap ampli a  $128 \mu\text{m}$ .

### Paddy-400



- 4800 pad di dimensioni  $1 \times 8 \text{mm}^2$ .
- Gap drift a 5 mm.
- Gap ampli a  $128 \mu\text{m}$ .

### Paddy-2000



- Area Attiva:  $50 \text{cm} \times 40 \text{cm}$
- Ha pad di dimensioni  $1 \times 8 \text{mm}^2$  nella zona centrale e  $10 \times 10 \text{mm}^2$  nella zona periferica.
- Gap drift di 6 mm.
- Gap ampli di  $150 \mu\text{m}$ .

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# Speaker: Lucrezia Borriello

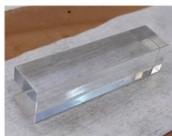
## Dual Readout with Crystals

- Include in the IDEA detector design an additional layer of homogeneous material for the Calorimeter that allows to improve the energy resolution

IDEA calorimeter baseline  
Cherenkov and Scintillation  
fiber based  
 $\sigma_e/E$  (EM)  $\sim 13\%/VE$   
 $\sigma_e/E$  (HAD)  $\sim 31\%/VE$

Calorimeter homogeneous  
medium=crystal  
 $\sigma_e/E$  (EM)  $\sim 3\%/VE$   
 $\sigma_e/E$  (HAD)  $\sim 30\%/VE$

- discriminating the Cherenkov signal from the Scintillation signals inside different crystal samples:



Cherenkov signal: prompt  
Scintillation signals: longer

|               | time | spectrum      |
|---------------|------|---------------|
| Cherenkov     | fast | $1/\lambda^2$ |
| Scintillation | slow | peaked        |

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- OI Orso Iorio
- PI Paolo Iengo
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- SM Stefano Mastroianni
- vi vincenzo izzo

# Speaker: Antonio D'Avanzo

## WHAT: SIMULATING CRYSTALS RESPONSE IN GEANT4

- Study of the expected response of crystals for dual-readout electromagnetic calorimeter at FCC-ee
  - Simulation of scintillation/cerenkov light detection with SiPMs
- Fully customizable simulation of test beam setup in July 2024
  - Provided with optical photons tracing, crystal rotation and several materials
  - Able to reproduce data taking configurations to compare with data
  - Built with Geant4 toolkit on INFN IBISCO cluster in Naples




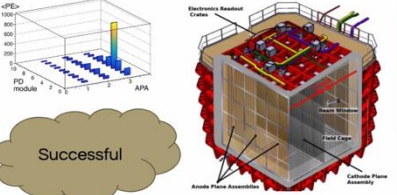
- ER Elvira Rossi
- AD Adelina D'Onofrio
- FD Francesco Di Capua
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- g giulio
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- OI Orso Iorio
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- R Raffaele
- SM Stefano Mastroianni
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# Speaker: Gabriel Botogoske

## Proto-DUNE HD @ CERN

### Proto-DUNE SP

→ 0.42 kton fiducial LAr  
→ 6 APAs

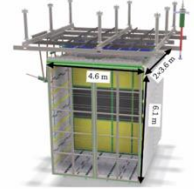



Successful

### Proto-DUNE HD

→ 0.28 kton fiducial LAr  
→ 4 APAs  
→ Moved to X-ARAPUCA

– 2 different WLS and SiPMs (Hamamatsu and FBK)



APA 1- Full streaming mode  
APA 2-4: Self Trigger mode

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BS Bernardino Spisso

FD Francesco Di Capua

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PI Paolo Iengo

SM Stefano Mastroianni

# Speaker: Giovanni Gaudino

## Event Selection and dataset

One B meson is fully reconstructed using a multivariate algorithm, Full Event Interpretation (FEI) with Hadronic Tagging.

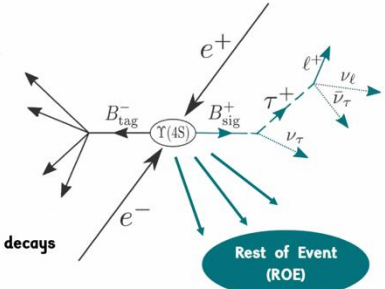
- $O_{FEI} > 10^{-2}$
- $-0.15 < \Delta E = E_B^* - \sqrt{s}/2 < 0.1 \text{ GeV}$
- $M_{bc}c^2 = \sqrt{s/4 - (p_B^*)^2} > 5.27 \text{ GeV}$

### Backgrounds

- $e^+e^- \rightarrow q\bar{q}$
- $e^+e^- \rightarrow \tau^+\tau^-$
- $e^+e^- \rightarrow B^+B^-$
- $e^+e^- \rightarrow B^0\bar{B}^0$

### Signal is searched through $\tau$ decays

- $\tau^+ \rightarrow e^+ \nu_e \bar{\nu}_\tau$
- $\tau^+ \rightarrow \mu^+ \nu_\mu \bar{\nu}_\tau$
- $\tau^+ \rightarrow \pi^+ \bar{\nu}_\tau$
- $\tau^+ \rightarrow \rho^+ \bar{\nu}_\tau$  with  $\rho^+ \rightarrow \pi^+ \pi^0$



Rest of Event (ROE)

- 0 Extra Tracks
- Extra Clusters clean-up

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# Speaker: Ilaria Rosa

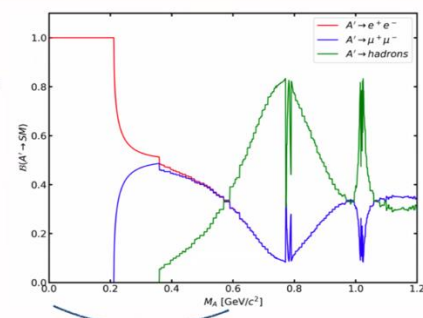
## Dark photon: a detailed view

New vector field  $F'_{\mu\nu}$  symmetric under a new U(1) symmetry feebly interacting with the SM fields

A minimal extension to the SM: kinetic mixing with the SM hypercharge

$$-\frac{\epsilon}{2} F'_{\mu\nu} B_{\mu\nu}$$

$M(A')$  and  $\epsilon$  are free parameters



Decay width dominated by lepton antilepton final states for  $M(A') < 700 \text{ MeV}$

IR Ilaria Rosa

ER Elvira Rossi

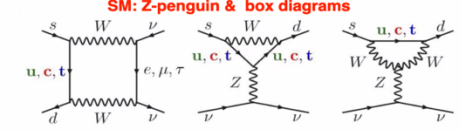
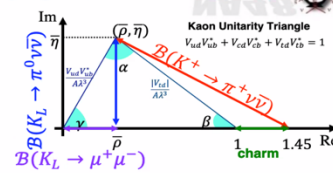
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# Speaker: Renato Fiorenza

## $K \rightarrow \pi \nu \bar{\nu}$ : Precision test of the SM

### SM: Z-penguin & box diagrams

$B(K \rightarrow \pi \nu \bar{\nu})$  highly suppressed in SM

- GIM mechanism & maximum CKM suppression  $s \rightarrow d$  transition:  $\sim \frac{m_t}{m_W} |V_{ts}^* V_{td}|$
- Theoretically clean  $\Rightarrow$  high precision SM predictions, high sensitivity to BSM
- Dominated by short distance contributions
- Hadronic matrix element extracted from  $B(K \rightarrow \pi l \nu)$  decays via isospin rotation

| Decay Mode                               | SM [Buras et al. EPJC 82 (2022) 7, 615] | SM [d'Ambrosio et al. JHEP 09 (2022) 146] | Experimental Status                           |
|--|---|---|---|
| $B(K^+ \rightarrow \pi^+ \nu \bar{\nu})$ | $(8.60 \pm 0.42) \times 10^{-11}$       | $(7.86 \pm 0.61) \times 10^{-11}$         | $(10.6_{-3.5}^{+4.1}) \times 10^{-11}$ (NA62) |
| $B(K_L \rightarrow \pi^0 \nu \bar{\nu})$ | $(2.94 \pm 0.15) \times 10^{-11}$       | $(2.68 \pm 0.30) \times 10^{-11}$         | $< 2.2 \times 10^{-9}$ (KOTO)                 |

Differences in SM calculations from choice of CKM parameters: [Eur.Phys.J.C 84 (2024) 4, 377]

NA62 (2016–18 data): [JHEP 06 (2021) 093]  
KOTO (2021 data): [arXiv:2411.11237]

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