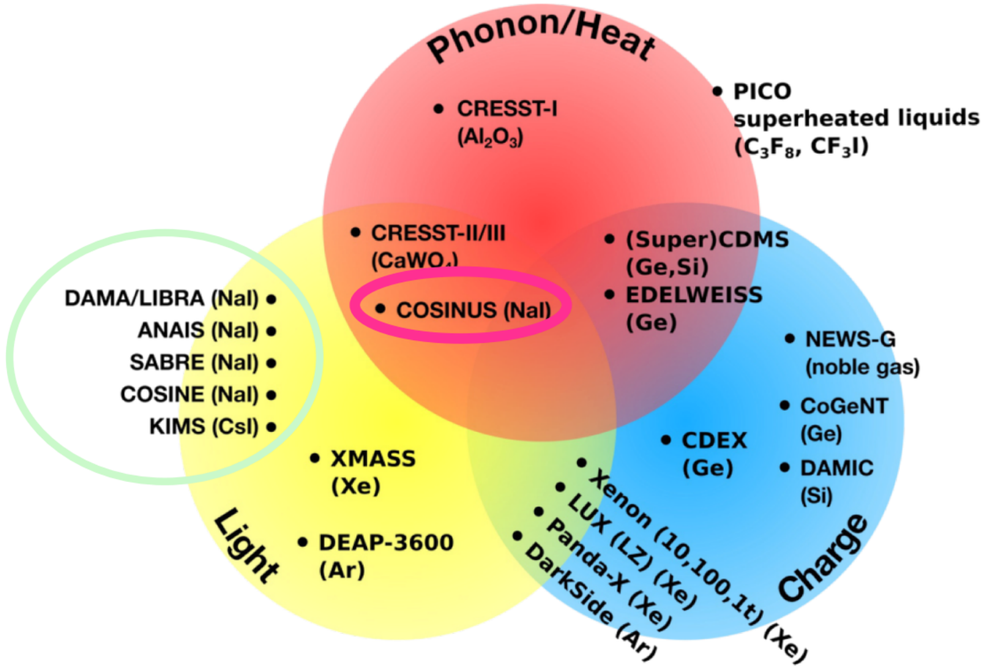
COSINUS – Search for dark matter with cryogenic NaI detectors

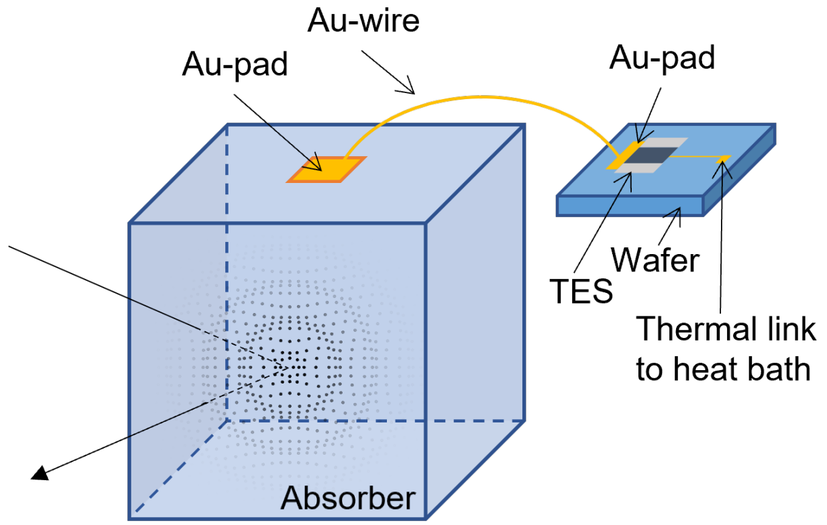
Andrei Puiu and Andrea Melchiorre
2024 GSSI science fair

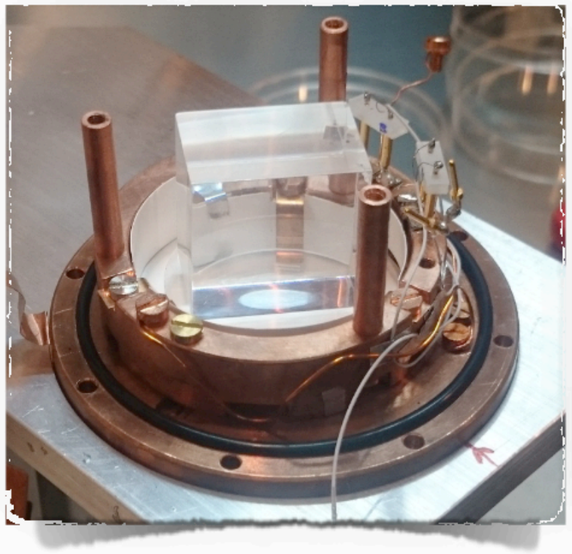
The COSINUS Experiment

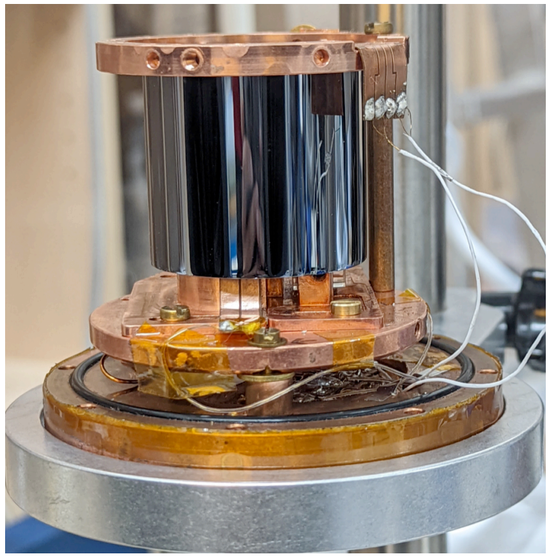


Credits to: F. Reindl

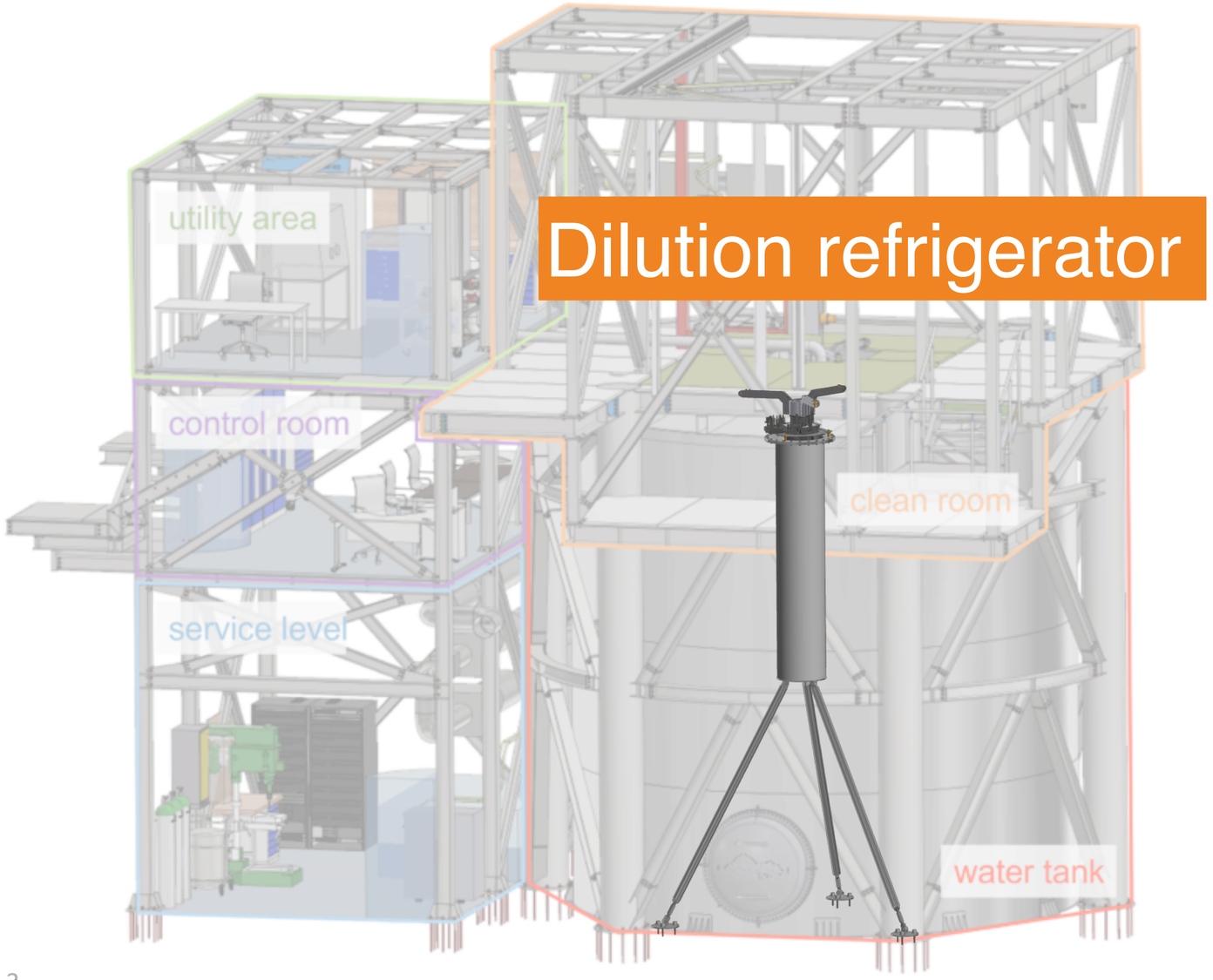
- Goal: a model independent test of the DAMA/LIBRA experiment
  - NaI target material - same as D/L
  - Same location, LNGS Hall B
- NaI as a cryogenic calorimeter
  - First ever
  - **Event by event particle Discrimination**







Experimental Setup



Dilution refrigerator

COSINUS - Hall B

COSINUS - Abruzzo: GSSI-LNGS-UnivAQ

Gianni Profeta

Professor

Alessandro Filipponi

Professor

UNIVERSITÀ DEGLI STUDI DE L'AQUILA

GRAN SASSO SCIENCE INSTITUTE

Natalia Di Marco

Professor

Matthew Stukel

Post-Doc

Stefano Pirro

Researcher

Andrei Puiu

Researcher

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Laboratori Nazionali del Gran Sasso

Paolo Martella: LNGS

Marco Balata: LNGS

Umberto Di Sabatino: LNGS

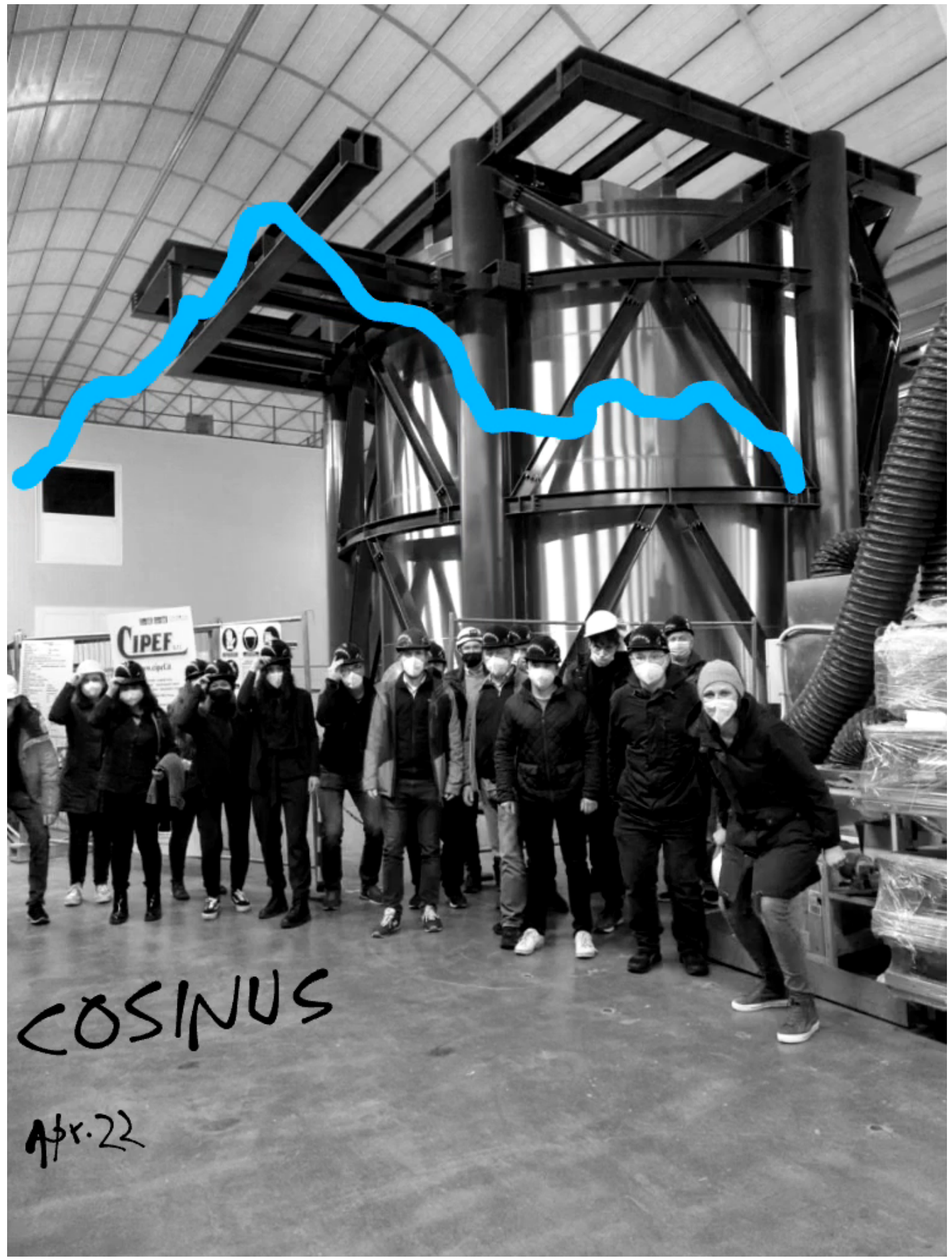
Fernando Ferroni

Senior Professor

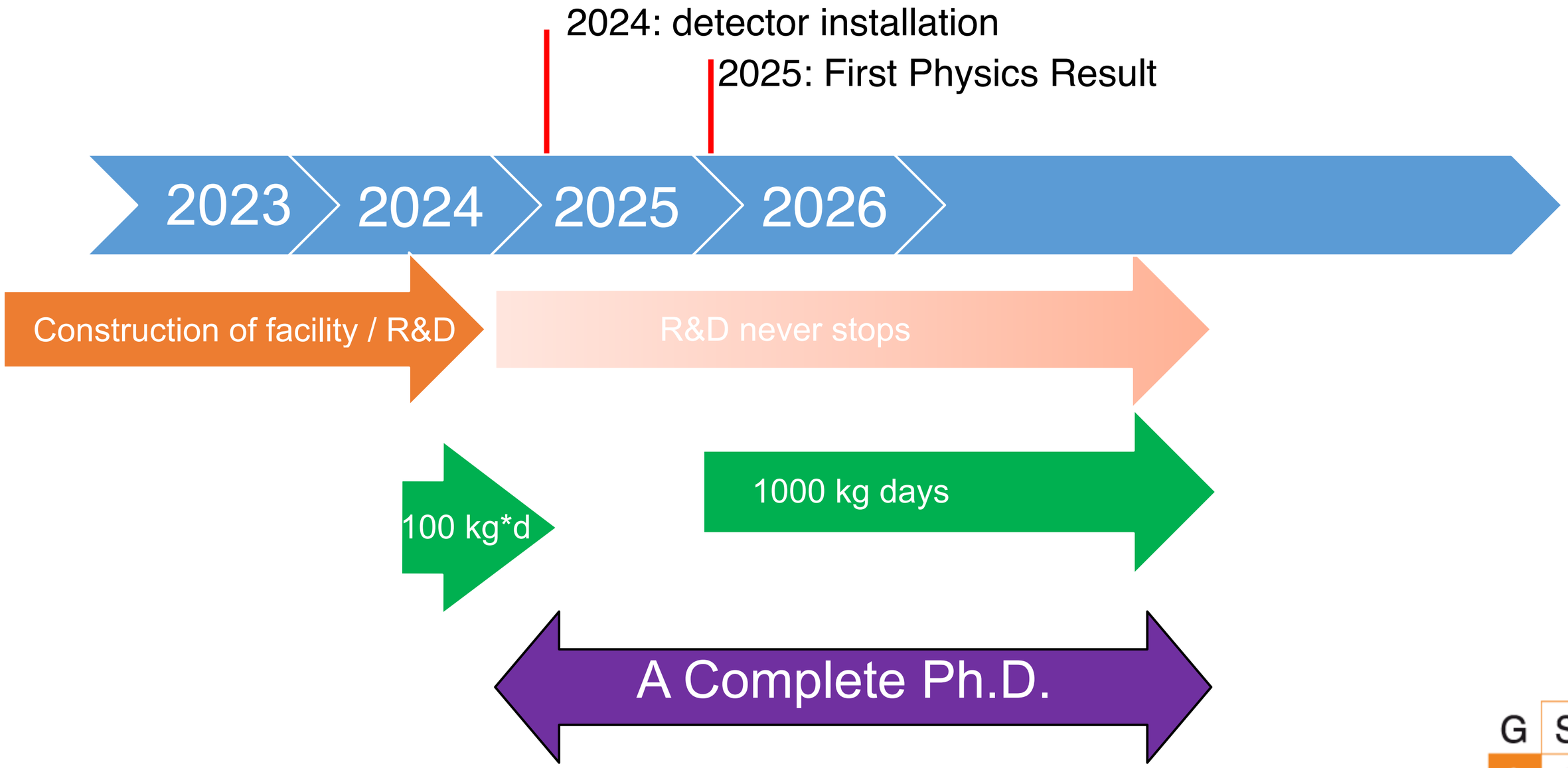
Lorenzo Pagnanini

Professor

COSINUS ITN'L CREW

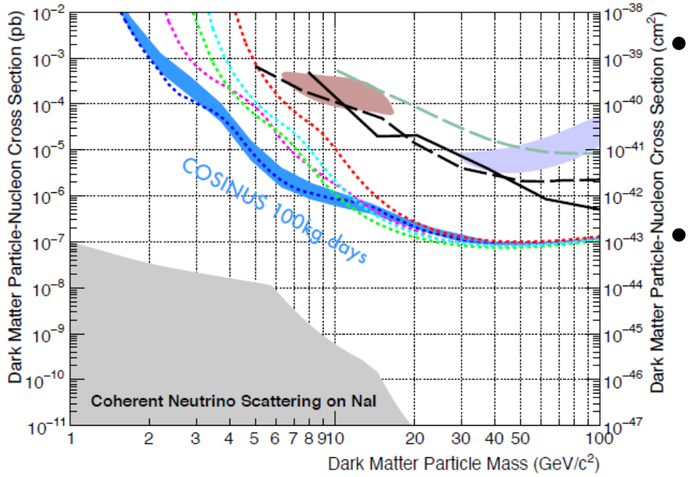


COSINUS timeline and activities



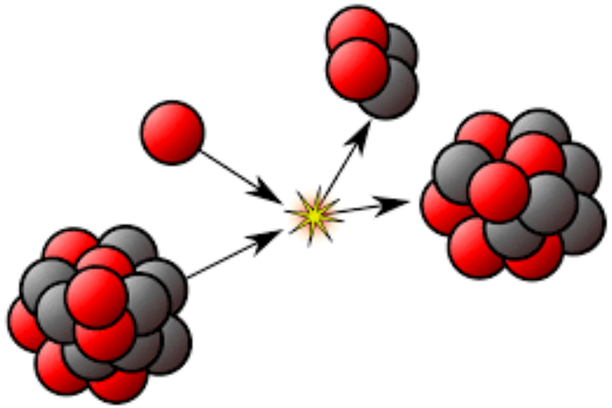
COSINUS study fields

Particle Physics



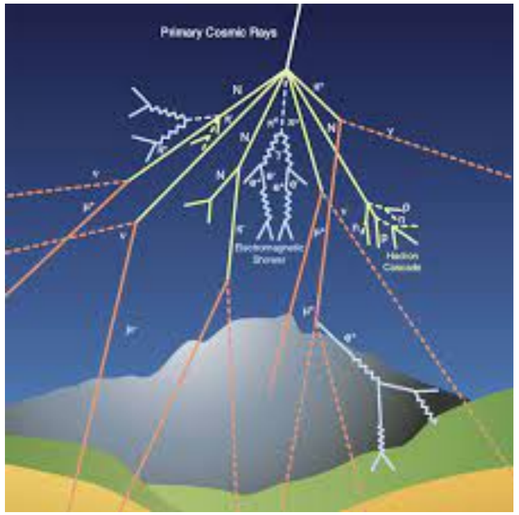
- Verification of the DAMA/LIBRA result
- Search for low mass dark matter using the Migdal effect in COSINUS

Nuclear Physics



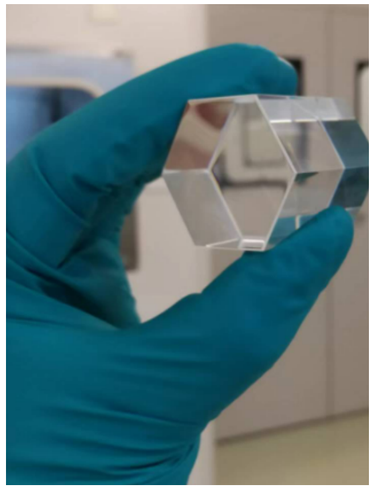
- Cosmogenic activation of the COSINUS NaI Crystals
- Measurements of rare-isotopes in NaI
  - I-129, Na-22

Astrophysics



- Cosmogenic, radiogenic and ambient background modelling
- Water Cherenkov detector setup

Cryogenic detectors R&D



- Crystal coating technique R&D
- NaI with NTD sensors: Threshold and Energy Resolution
- Commissioning of the COSINUS cryostat

Highlights

- COSINUS will investigate the unique DAMA/LIBRA dark matter result
- Hands on experience with cutting-edge cryogenic detectors
- COSINUS is in a very exciting time in it's development
  - A Ph.D. student would get to see a complete experimental life-cycle
  - From setup to final results
- COSINUS offers many projects in a wide-range of fields
- Come visit our poster if you have any questions

DAREDEVIL
DARk mattEr DEVices for Low energy detection

DAREDEVIL local team - the real bocconcini

Gianni Profeta

Professor

Alfredo Ferella

Professor

UNIVERSITÀ DEGLI STUDI DE L'AQUILA

GRAN SASSO SCIENCE INSTITUTE

Natalia Di Marco

Professor - PI

Cesare Tresca

Researcher

Andrea Melchiorre

PhD candidate

Andrei Puiu

Researcher

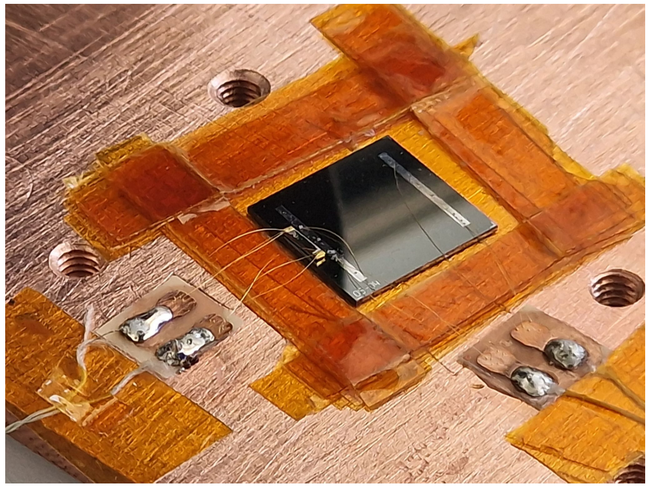
Consiglio Nazionale delle Ricerche

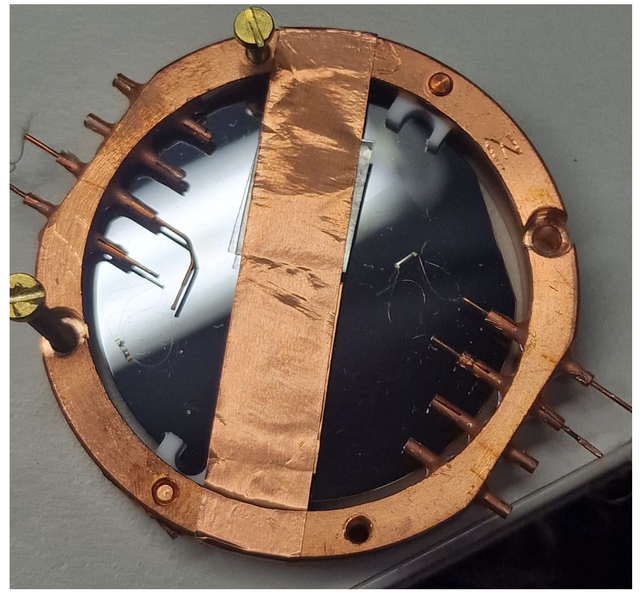
SPIN

INFN Laboratori Nazionali del Gran Sasso

DAREDEVIL goal

- sub-GeV DM mass candidate
- Innovative detection technique at 10 mK
- Novel crystal targets, Dirac crystals, Weyl crystals, special semiconductors
- Gallium Arsenide as DM target
- CdTeHg tunable band gap semiconductor

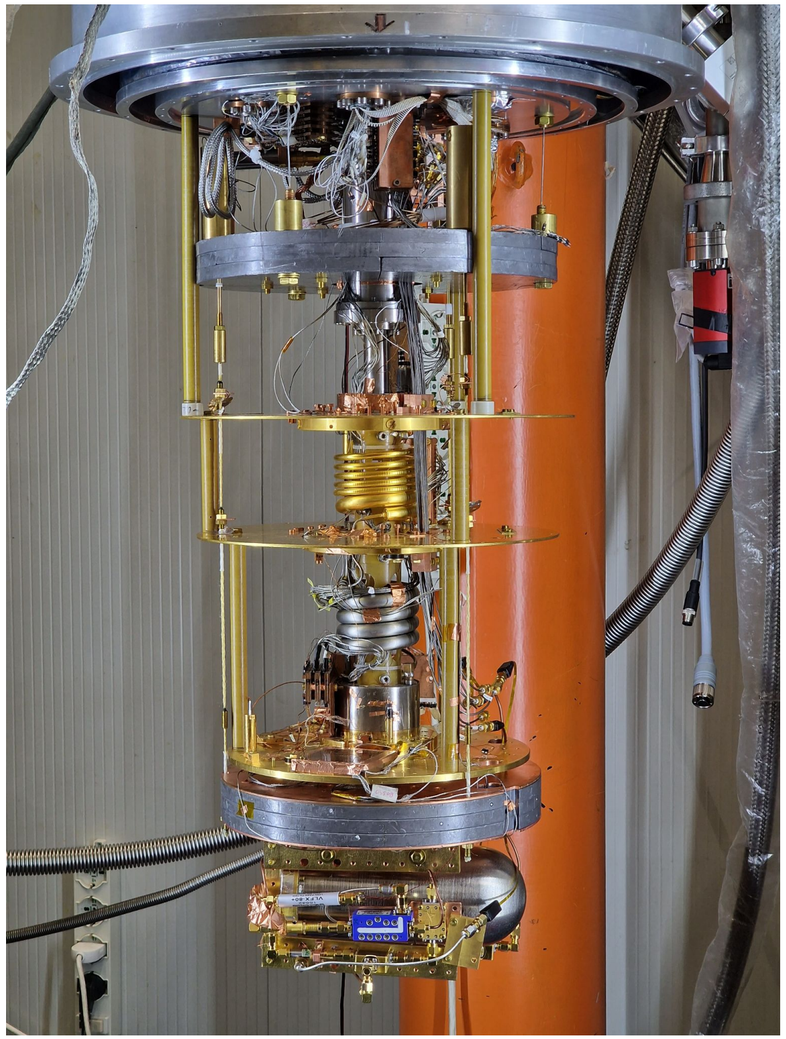




DAREDEVIL Theses opportunities

- Low Temperature Detector development with cutting edge techniques i.e. TES, SQUID, NTD for very low threshold
- Data analysis tuned for LTD signals processing -> high performance filtering techniques
- Simulations: DM models and interaction in unique target material.

- Anyway, check Andrea Melchiorre's poster.



Thank you

For your attention
and patience