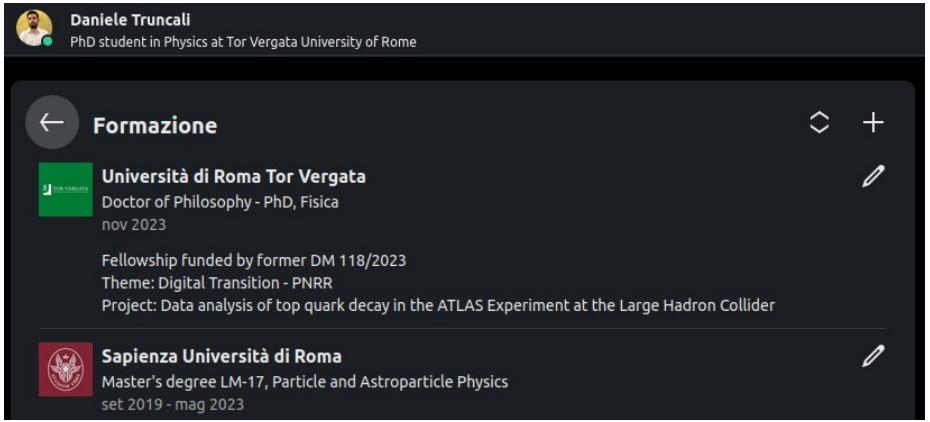
INFN Rome 2 ATLAS Meeting Group

TOR VERGATA
UNIVERSITÀ DEGLI STUDI DI ROMA

Daniele Truncali 21/12/2023 Aula Grassano

My education



Thesis title: Test of the electromagnetic calorimeter of the SAND detector for the DUNE long baseline neutrino experiment at LBNF

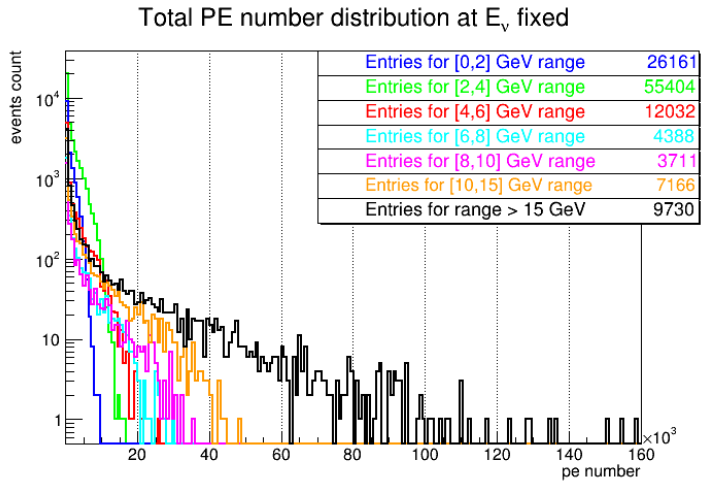
Advisors: Proff. Antonio Di Domenico, Paolo Gauzzi

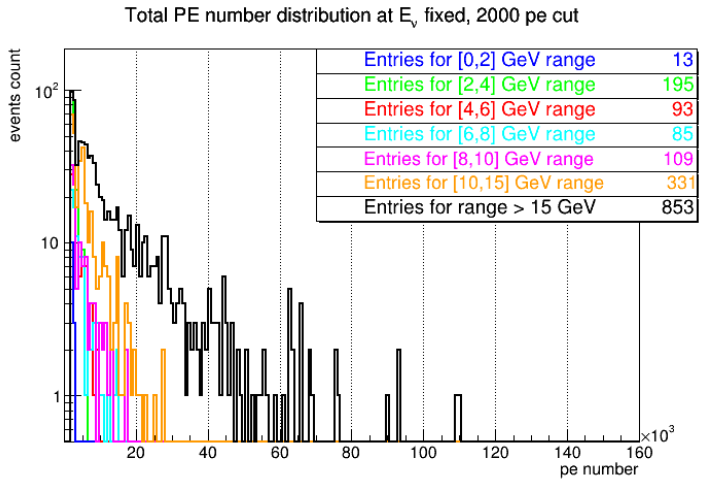
Content: This experiment, which will take place at FermiLab, aims to conduct precise studies in **ν physics** and search for **CP violation** in the ν sector.

Specifically, my research focused on the **ECAL** of the **SAND Near Detector** and involved studying the optimization of the working point of the readout channels for ν interactions.

I conducted investigations using both **MC simulations** and **experimental tests** at LNF. The outcome of this work is crucial in determining the final front-end electronics for the SAND calorimeter.

MC simulation results

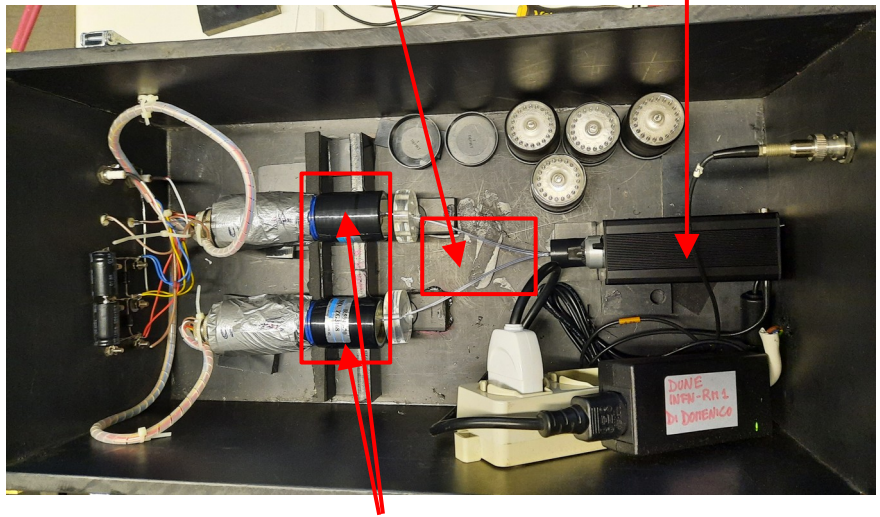


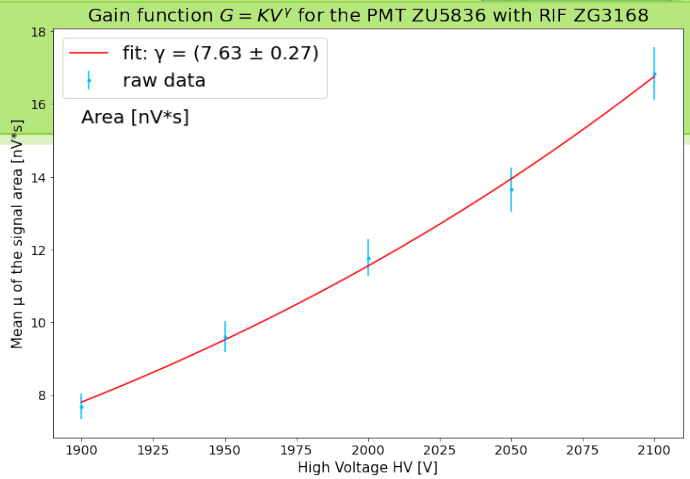


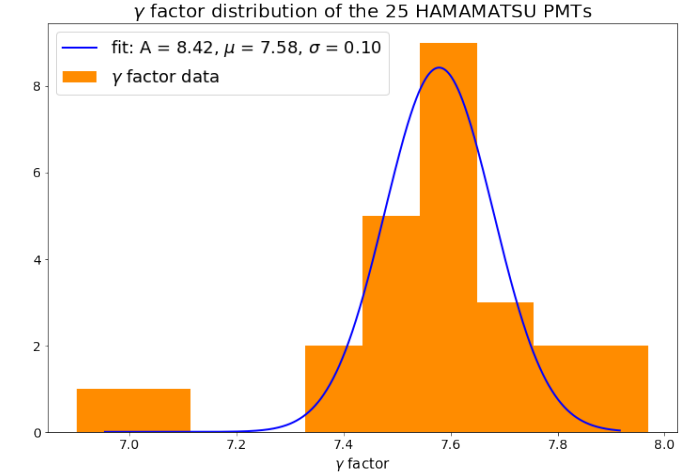
E_ν range = [0,10] GeV	
Events number	101,696
Events cells number	2,184,901

Fraction of events with at least one cell above PE threshold	[%]
1000 PE threshold	2.58
2000 PE threshold	0.49
3000 PE threshold	0.13
4000 PE threshold	$3.64 \cdot 10^{-2}$

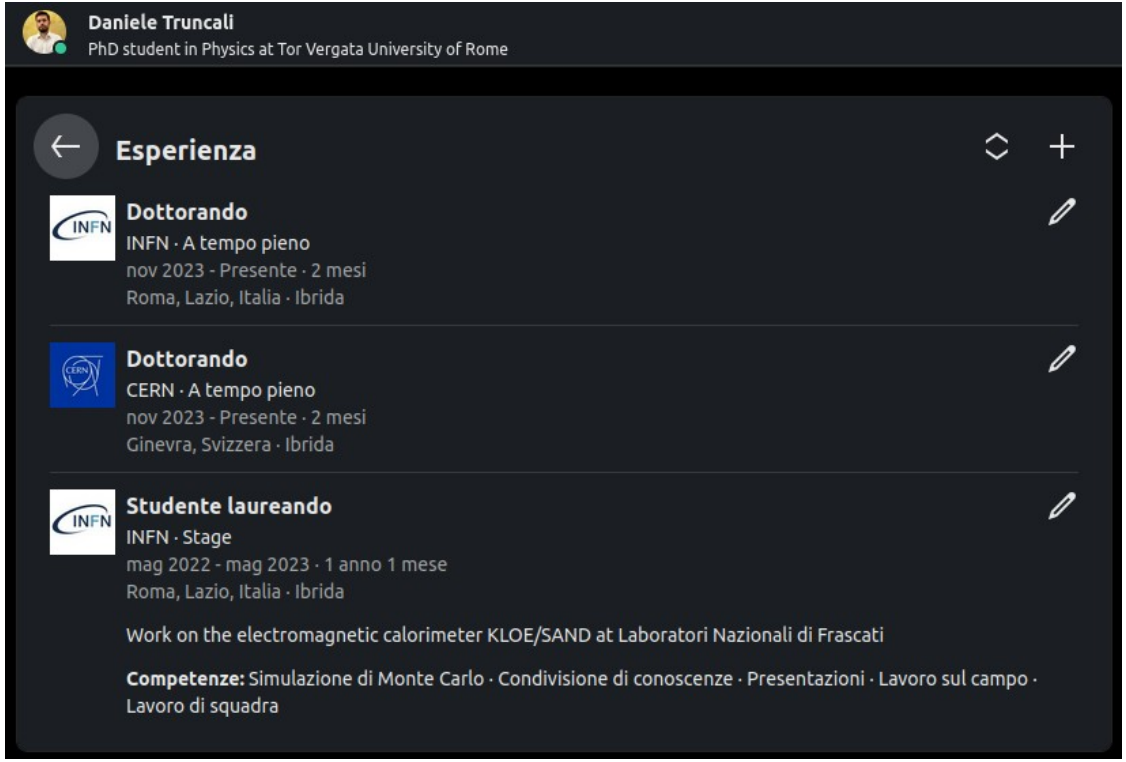
Experimental test results







My experience



Daniele Truncali
PhD student in Physics at Tor Vergata University of Rome

Esperienza

Dottorando
INFN · A tempo pieno
nov 2023 - Presente · 2 mesi
Roma, Lazio, Italia · Ibrida

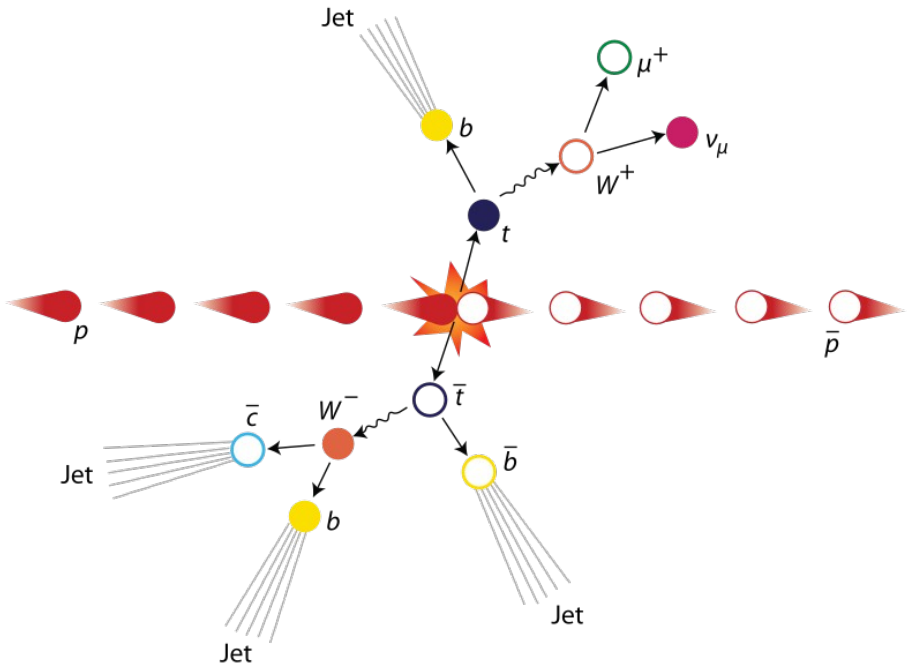
Dottorando
CERN · A tempo pieno
nov 2023 - Presente · 2 mesi
Ginevra, Svizzera · Ibrida

Studente laureando
INFN · Stage
mag 2022 - mag 2023 · 1 anno 1 mese
Roma, Lazio, Italia · Ibrida

Work on the electromagnetic calorimeter KLOE/SAND at Laboratori Nazionali di Frascati

Competenze: Simulazione di Monte Carlo · Condivisione di conoscenze · Presentazioni · Lavoro sul campo · Lavoro di squadra

Topic of my PhD experience



- The aim of my PhD project will be the **data analysis** of the **top quark decay** for the **ATLAS** experiment, with a focus on the **CP violation measurements in the B originating from the top quark.**
- The process of interest involves the **semileptonic decay of the b quarks into muons** → Application for the ATLAS Software Development Grant on the **muon validation project** (one of the references is Marco Vanadia)

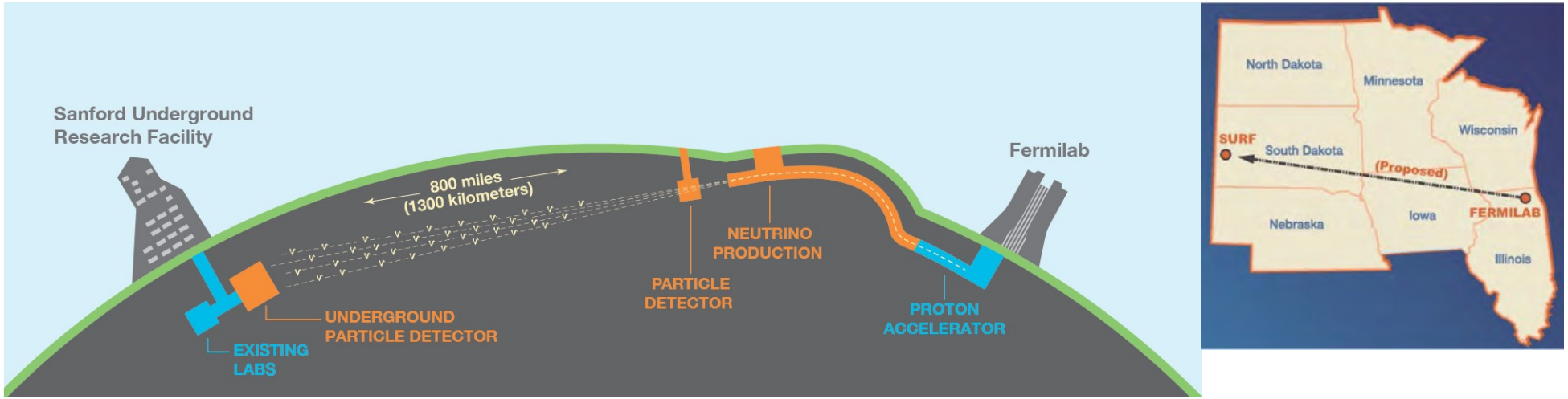
1st year schedule of the PhD

- **Participation to the ATLAS week** (12 – 16 February 2024);
- **Definition of qualification task**:
  - Phenomenology of top decays;
- **PhD courses starting on March – April**:
  - Machine Learning for Physics (held by Michele Buzzicotti);
  - Introduction to Unix and ROOT (held by Marco Vanadia);
- **Physics Master course**:
  - Statistical Data Analysis (held by prof. Umberto De Sanctis).

THANK YOU FOR YOUR ATTENTION!

BACKUP SLIDES

DUNE scheme

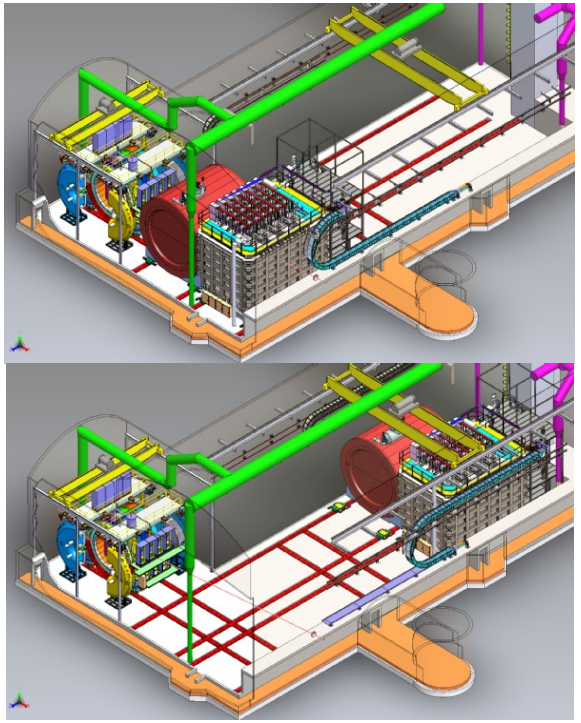

Sanford Underground
Research Facility
800 miles
(1300 kilometers)
Fermilab
NEUTRINO
PRODUCTION
PARTICLE
DETECTOR
UNDERGROUND
PARTICLE DETECTOR
EXISTING
LABS
PROTON
ACCELERATOR
North Dakota
Minnesota
Wisconsin
SURF
South Dakota
(Proposed)
FERMILAB
Nebraska
Iowa
Illinois

Near Detector

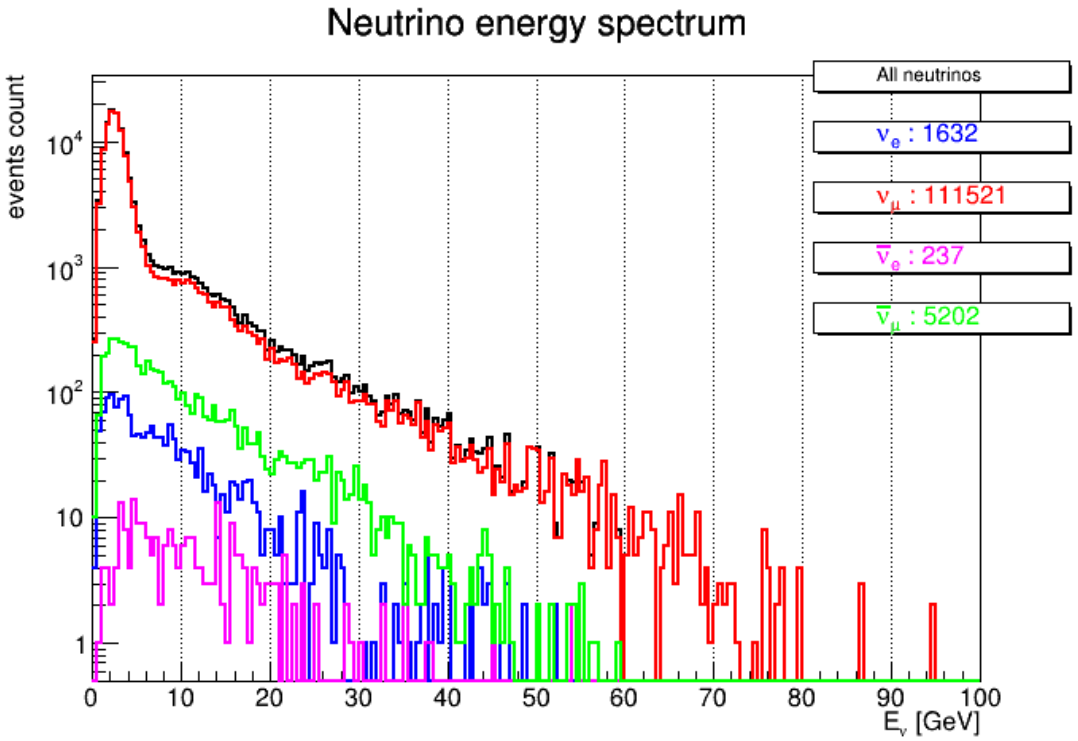
The **ND** system consists of **3 subdetectors**, two of which will be **movable** while the other one will be **fixed**:

- ArgonCube **(ND-Lar)**;
- Multi-Purpose Detector MPD **(ND-Gar)**;
- System for on-Axis Neutrino Detection **SAND**

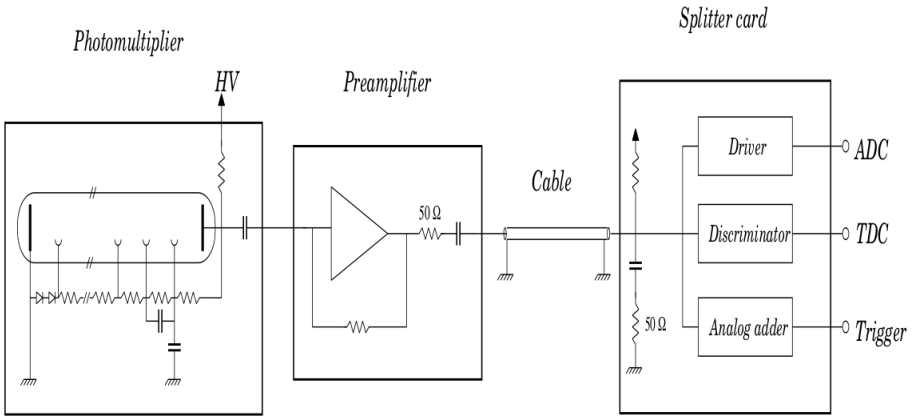
The ND is used to **measure the beam flux** prior to oscillation and **reduce systematic uncertainties** originating from ν energy reconstruction.



MC neutrino energy spectrum



PMT dynamic range



G_{PM} ($\times 10^5$)	G_{tot} ($\times 10^6$)	N_{pe}(max)	signal amplitude (mV/pe)	N_{pe}(min) (V_{TH} = 5 mV)	MeV at module center
4.2	1.04	$\sim$ 2000	0.87	$\sim$ 6	6.0
5.5	1.38	$\sim$ 1500	1.16	$\sim$ 4	4.0
8.3	2.1	$\sim$ 1000	1.74	$\sim$ 3	3.0
10	2.5	$\sim$ 800	2.18	$\sim$ 2	2.0

Some FEE constraints:

- **Minimum** discriminator threshold V_{TH} = 5 mV;
- **Preamplifier** linearity range = [0, 4.7] V;
- $V_{dis} = 0.5 \cdot V_{preamp}(max) \cdot C_{att}$ = 1.74 V
- $G_{tot} = G_{PM}\, G_{preamp}$
- $(Npe\ G_{PM})(max) = 83 \cdot 10^7$

PMT signal stretching