Alice Manna

Curriculum Vitae

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Personal Details

First name	Alice
Surname	Manna
Nationality	Italian
Place and date of birth	Fossombrone (PU), March 18, 1991

I am an experimental nuclear physicist mainly specialised in the field of neutron-induced reactions. My experience has grown in Italian national frameworks, such as universities and laboratories, and international ones, mainly at Laboratoire de Physique des 2 infinis Irène Joliot-Curie – IJCLab at Orsay and at the n_TOF facility at CERN. I am in my third year of post-doc and I have had the opportunity to follow several neutron capture and neutron activation measurements, both the experimental campaigns and the data analyses. In addition, my main work focuses on the absolute cross section measurement of ^{235}U(n,f) induced by high energy neutrons.

Work Experience

September 2021 - present — **Research Fellow,**

Alma Mater Studiorum University of Bologna,
School of Physics and Astronomy.

March 2022 - February 2024 — **Project Associate,**

CERN, European Organization for Nuclear Research, Geneva, Switzerland,
Associated member of the CERN personnel for research activities related to the neutron time of flight (n_TOF) facility

June - December 2021 — **n_TOF Collaboration Fellowship (6 months),**

CERN, European Organization for Nuclear Research, Geneva, Switzerland,

July 2018 - June 2019 — **Cooperation Associate (similfellow),**

CERN, European Organization for Nuclear Research, Geneva, Switzerland,
Associated member of the CERN personnel for research activities related to the n_TOF facility.

Education

2017 - 2021   **PhD in Nuclear Physics,**

Alma Mater Studiorum University of Bologna,
Ph.D in Physics and Astronomy.

Ph.D thesis: *"Measurement of the $^{235}U(n,f)$ cross section relative to the neutron-proton elastic scattering up to 500 MeV at n_TOF"*
Supervisors: Dott. Cristian Massimi, Prof. Gianni Vannini.

May - August 2017   **Scholarship (3 months),**

Alma Mater Studiorum University of Bologna,
School of Physics and Astronomy, Title: "Analysis of nuclear reaction data".

September 2014 - March 2017   **Master degree in Nuclear and Subnuclear Physics,**

Alma Mater Studiorum University of Bologna,
School of Physics and Astronomy

Master thesis: *"Prototipo di un rivelatore per la misura di flusso di neutroni di alta energia (Prototype of a detector for high energy neutron flux measurement)"*
Supervisors: Dott. Cristian Massimi, Prof. Gianni Vannini, Dott. Sergio Lo Meo.
Final grade 110/110 cum laude.

September 2010 - March 2014   **Bachelor degree in Physics,**

Alma Mater Studiorum University of Bologna,
School of Physics and Astronomy

Bachelor thesis: *"Cattura neutronica su ^{235}U: studio della regione delle risonanze risolte (Radiative neutron capture cross section on ^{238}U: study the resolved resonance region)"*
Supervisors: Prof. Gianni Vannini, Dott. Cristian Massimi
Final grade 106/110.

2005 - 2010   Secondary School Diploma, "Liceo Scientifico G. Torelli", Fano
Scientific maturity.

Scientific responsibilities and coordination activities

March 2022 - present   **Responsible** of the n_TOF NEAR Station at CERN: the experimental area placed at 3 meters from the spallation target suitable for neutron induced activation measurements.

June 2021 - present   **Responsible** for two detection setup - Parallel Plate Avalanche Counters (PPACs) for fission measurements at n_TOF.

September 2018 - present	Co-author of 16 experimental measurements at the n_TOF facility.
February 2022 - present	**Spokeperson** of:

- **Addendum** *Measurement of the $^{235}U(n,f)$ cross section relative to n-p scattering up to 1 GeV.* Report CERN-INTC-2024-014.
  The detector is under development.

- **Addendum** *Neutron capture cross section measurements by the activation method at n_TOF/EAR2.* Report CERN-INTC-2023-043.
  Data analysis is currently ongoing.

- **Proposal** *Neutron capture cross section measurements by the activation method at the n_TOF NEAR Station.* Report CERN-INTC-2022-008.
  Data analysis is currently ongoing.

- **Letter of Intent** *Characterization of the FOOT neutron detectors for nuclear fragmentation measurements at the n_TOF facility.* Report CERN-INTC-2022-020.
  Data analysis is currently ongoing.

September 2018 - present	**Local Responsible** at n_TOF (CERN) for:

- Proposal *Measurement of $^{28,29,30}Si(n,\gamma)$ capture cross sections to explain isotopic abundances in presolar grains.* Data analysis is currently ongoing and the experimental data taking will restart in 2024.

- Proposal *Measurement of the neutron capture cross section of Ni-64.* Data analysis is currently ongoing.

- Proposal *Measurement of $^{94,95,96}Mo(n,\gamma)$ relevant to Astrophysics and Nuclear Technology.* Data analysis is currently ongoing.

- Proposal *Measurement of the neutron capture cross section of Gadolinium-160.* Data analysis is currently ongoing.

- Proposal *Measurement of the $^{235}U(n,f)$ cross section relative to n-p scattering up to 1 GeV.* In the process of publishing in PRC and PRL.

September 2023 - March 2024	**Member of the organizing committee** of the n_TOF Nuclear Physics Winter School 2024, 21-26 January 2024, Saint Gervais-les-Bains
September 2022 - March 2023	**Co-editor of conference proceeding (NPA-X)** EPJ Web of Conferences Volume 279 (2023)
May - September 2022	**Member of the organizing committee** of the Nuclear Physics in Astrophysics Conference (NPA-X), 5-9 September 2022, CERN

Teaching activities and supervision of students

2023 - present **Tutor** (Prot. n. 361572)

of the course of General Physics 2 (Electromagnetism) for the Degree course of Electrical and Automation Engineering

Alma Mater Studiorum Università di Bologna

2022 - present **Co-Supervisor** of 1 PhD Student

Università degli studi di Perugia, Dipartimento di Fisica e Geologia.

2022 - present **Co-Supervisor** of 2 Master Student

Alma Mater Studiorum Università di Bologna, Scuola di Scienze, Dipartimento di Fisica e Astronomia.

2018 - present **Co-Supervisor** of 3 Bachelor Students

Alma Mater Studiorum Università di Bologna, Scuola di Scienze, Dipartimento di Fisica e Astronomia.

2019 - 2021 **Tutor** (Prot. n. 322011 and Prot. n. 60678)

2 years of the course of General Physics 2 (Electromagnetism) for the Degree course of Electrical and Automation Engineering

Alma Mater Studiorum Università di Bologna

Honors and Awards

July 2022 **Selected as eligible candidate at the selection panel for research position at INFN**

September 2019 **Awards SIF-SoNS "Neutrons Matter"**

For significant measurements of cross sections induced by neutrons of energies above 200 MeV, produced at spallation sources, and for the use of innovative techniques and their applications to the study of high-energy fission reactions.

November 2018 **Best oral contribution for the Quarto Incontro Nazionale di Fisica Nucleare INFN2018**, Catania

Title of the oral contribution "Measurement of the ^{235}U(n,f) cross section relative to n-p scattering up to 1 GeV at n_TOF".

September 2018 **Best poster contribution for the European Nuclear Physic Conference 2018**, Bologna

Title of the poster "A Proton Recoil Telescope for fast neutrons at the n_TOF facility at CERN".

Outreach Activities

March 2024 *20th Particle Therapy MasterClass for high-school students*, Bologna, Italy
INFN - IPPOG

Local organizer

Conferences

March 1, 2024 **IReNA - International Research Network for Nuclear Astro-physics** - online

Invited Talk: *Measurement of the $^{235}U(n,f)$ cross section relative to n-p scattering up to 500 MeV at the n_TOF facility at CERN.*

October
9 - 13, 2023 **Technical Meeting on Neutron Data Standards**
IAEA - Wien

Invited Talk: *Absolute cross section of the $^{235}U(n,f)$ in the energy range between 10 and 450 MeV at CERN n_TOF.*

October
18 - 21, 2022 **Technical Meeting on Neutron Data Standards**
IAEA - Wien

Invited Talk: *Measurement of the cross section of $^{235}U(n,f)$ induced by high-energy neutrons relative to n-p elastic scattering performed at the n_TOF facility at CERN.*

July
24 - 29, 2022 **International Conference on Nuclear Data for Science and Technology**, online

Talk: *Measurement of the $^{235}U(n,f)$ cross section relative to n-p scattering up to 500 MeV at the n_TOF facility at CERN.*

September,
12 - 17, 2021 **Applied Nuclear Physics (ANP) conference**, Prague
Talk: *Measurement of the $^{235}U(n,f)$ cross section relative to n-p scattering up to 500 MeV at the n_TOF facility at CERN.*

September,
14 - 18, 2020 **106° Congresso Nazionale della Società Italiana di Fisica**, online
Talk: *Misura ad n_TOF della sezione d'urto $^{235}U(n,f)$ relativa alla diffusione elastica n-p fino ad 1 GeV.*

September,
23 - 27, 2019 **105° Congresso Nazionale della Società Italiana di Fisica**,
Gran Sasso Science Institute, L'Aquila - Italia
Talk: *Misura ad n_TOF della sezione d'urto $^{235}U(n,f)$ relativa alla diffusione elastica n-p fino ad 1 GeV.*

May
19 - 24, 2019 **International Conference on Nuclear Data for Science and Technology**, Pechino - Cina

Talk: *Setup for the measurement of the $^{235}U(n,f)$ cross section relative to n-p scattering up to 1 GeV .*

November,   **Quarto Incontro Nazionale di Fisica Nucleare INFN2018**, Catania

7 - 9, 2018   **Talk:** *Measurement of the $^{235}U(n,f)$ cross section relative to n-p scattering up to 1 GeV at n_TOF.*

September   **European Nuclear Physic Conference 2018**, Bologna

2 - 7, 2018   **Poster:** *A Proton Recoil Telescope for fast neutrons at the n_TOF facility at CERN.*

November,   **Terzo Incontro Nazionale di Fisica Nucleare INFN2016**, Frascati

14 - 16, 2016   **Poster:** *Geant4 simulations of a Proton Recoil Telescope for the measurement of the n_TOF neutron flux between 100 and 1000 MeV.*

Schools

June 6 - 11, 2018   **XXX National Seminar of Nuclear and Subnuclear Physics "Francesco Romano"**, Otranto

Talk: *High energy neutron induced fission cross section in ^{235}U.*

March 18 - 24, 2018   **15th Rußbach School on Nuclear Astrophysics**, Rußbach

Talk: $^{154}Gd(n,\gamma)$ *cross section measurement at the n_TOF facility at CERN.*

January 15 - 19, 2018   **3rd n_TOF Winter School**, Zermatt.

November 6 - 10, 2017   **Neutron Resonance Analysis School**, Joint Research Centre (JRC) - Geel.

July 20 - 24, 2015   **Re-writing Nuclear Physics textbooks: 20 years with radioactive ion beam physics**, University of Pisa, National Laboratories of Legnaro.

Skills

Basic   Simulation framework Geant4

Operating system Mac OS X

System-design platform and development environment for a visual programming language from National Instruments LabVIEW

Kit NCSU Cadence Design (CDK)

Data analysis language Python

Intermediate	Resonance analysis with R-Matrix Code SAMMY
	Programming language C/C++
	Operating system Linux and Microsoft Windows
	Microsoft Office tool Excel (Office e OpenOffice)
	Data analysis framework ROOT e GNUPLOT
Advanced	Microsoft Office tools: Word, Power Point, Outlook
	Word processor and document markup language LaTex
	Knowledge of nuclear physics laboratory equipment

Languages

Mothertongue	Italian
Other Languages	English, French

	English	French
∘ Understanding	Advanced	Basic
∘ Writing	Intermediate	Basic
∘ Speaking	Intermediate	Basic

Bologna, April 19, 2024

Research activity

May 2016 - present **Associate Istituto Nazionale di Fisica Nucleare**
Section of Bologna

My research activity is in the field of experimental Nuclear Physics. I am working in the n_TOF experiment at CERN. My PhD is focused on the measurement of the ^{235}U(n,f) cross section relative to the neutron-proton elastic scattering (this latter reaction was used to extract the neutron flux). The aim of the project was to study the fission cross section induced by high energy neutron (from 10 to 500 MeV) for the first time. The experimental setup used in the measurement campaign consisted of:

1. two chambers for the fission reaction: an ionisation chamber for the low energy region (up to 200 MeV) and a chamber containing three Parallel Plate Avalanche Counters (PPACMon1) for the energy region up to 1 GeV.

2. three telescopes based on plastic scintillators and silicon detectors, which were developed and characterised to detect the protons (Proton Recoil Telescope, PRT) from a C_2H_4 target for the measurement of the neutron flux over the whole energy range of interest; two telescopes are under the responsibility of the INFN and one of the Physikalisch-Technische Bundesanstait (PTB).

In this framework I conducted research activities at national (Laboratori Nazionali del Sud - LNS) and international (CERN) laboratories. In particular, I have been involved in:

* Characterisation of detectors: development, assembly and optimisation of telescopes made by INFN. I took part in the characterisation (determination of energy resolution and temporal resolution) of the plastic scintillators that make up the PRT, at the LNS in Catania by means of mono-energetic proton beams and γ sources.

* Monte Carlo simulations with Geant4: optimisation of telescope design, optical properties of detectors and responses to γ sources, monoenergetic protons and neutrons.

* Experimental measurement of the ^{235}U(n,f) reaction at n_TOF: I actively participated in the installation of the experimental apparatus and the entire data acquisition phase (September - October 2018) by performing measurement shifts and dealing with the daily monitoring of data quality throughout the measurement campaign.

* Data analysis using ROOT, CERN's data analysis package: I was responsible for analysing data acquired by the two INFN telescopes and the PPACMon1 fission chamber. The results obtained have been presented at collaboration meetings and at international conferences as posters and oral presentations.

The description and characterisation of the experimental set-up was published in: *A. Manna, E. Pirovano et al., JINST 18, P04024 (2023)* and *E. Pirovano, A. Manna et al., JINST 18, P11011 (2023)*. Other two articles are in preparation.

In parallel, I participated in the measurement of the ^{155,157}Gd(n,γ) cross section, of interest for Boron Neutron Capture Therapy, for the development of neutrino detectors and dark matter experiments and, mainly, for nuclear technologies. The measurement campaign was conducted in the first experimental area of n_TOF using four liquid scintillators to detect the electromagnetic cascade that follows a neutron capture reaction. I participated in the assembly of the experimental apparatus, energy calibrations and the daily monitoring of the data during the measurement campaign. I then followed all the steps of

the analysis, from the evaluation and subtraction of the background, via the Monte Carlo simulations (GEANT4), and resonance analysis for the parameterisation of the neutron capture cross section measurement. The results of this project are presented in the publication *M. Mastromarco, A. Manna et al., Eur. Phys. J. A 55, 9 (2019).*

Following the shut-down phase of CERN (2019-2021), the experimental activity of n_TOF resumed in July 2021. Thanks to the knowledge acquired concerning the Parallel Plate Avalanche Counter, I have been in charge of the two detectors PPACMon1 and PPACMon2 (one chamber for each experimental area) for the beam commissioning phase. I actively participated in the assembly of one of the two detectors at the Laboratoire de Physique des 2 infinis Irène Joliot-Curie – IJCLab at Orsay, and the finalisation at CERN. I have been responsible for PPACMon1 and PPACMon2 for their installation, their daily monitoring and I am currently in charge of the analysis of the data that have been acquired. These detectors are of fundamental importance during commissioning for the measurement of neutron fluxes over the entire energy spectrum of n_TOF: from thermal energy to GeV. In addition, they are the only ones that can provide the spatial profile of the beam.

With the physics program restarting at n_TOF, I was the local responsible at CERN for several neutron capture measurements cross sections, relevant for both astrophysics and nuclear technologies, for which currently the data analysis is ongoing: ^{94,95,96}Mo(n,γ), ^{160}Gd(n,γ), ^{30}Si(n,γ) and ^{64}Ni(n,γ).

I am spokeperson of a proposal approved by the INTC scientific Committee of CERN about activation measurements. It concerns the shaping and characterization of the neutron flux in a newly built experimental area placed at a very short distance from the spallation source. The main idea behind the proposed measurements is that, by means of a suitable filtering setup, the energy distribution of the neutron beam in the NEAR station can be shaped to resemble Maxwellian-like distributions corresponding to different thermal energies kT. This technique might pave the way for neutron cross section measurement for several isotopes, in particular bottleneck nuclei, i.e. with very small cross section, and branching point isotopes, unstable nuclei with short half-life whose decay effectively competes with further neutron capture. The first results of this work are illustrated in *G. Gervino, et al., Universe 8, (2022).*

A synergy project between the n_TOF and FOOT experiments started in 2022, which aims, among other things, to optimise and study the response of various neutron detectors to be possibly included in the FOOT setup. I am spokeperson of a letter of intent approved by the INTC for the characterisation and study of neutron detection efficiencies of BC501-A liquid scintillators and BGO crystals, to be used coupled with a charged particle veto (plastic scintillator) placed in front.

Recently, the ISOLDE and n_TOF Experiments Committee approved a proposal, for which I am the spokeperson, that aim to extend at higher energy the measurement of the neutron-induced fission cross section of ^{235}U relative to the neutron-proton elastic scattering cross section. In order to extract the cross section up to 1 GeV a recoil proton detector, with excellent time resolution (better than 300 ps) capable of working in EAR1 of n_TOF, is currently under development.

In the meantime, I cover a coordination and support role for the n_TOF detector development and for the needed actions for the good operation of the experimental setups. In addition, I am one of the contact persons for n_TOF with the CERN service and infrastructure for the various Physics-related needs/actions of the collaboration.