Curriculum Vitæ
Brunetti Giulia

Personal Information

Researcher at Università Milano-Bicocca
Physics Department "Giuseppe Occhialini"
Piazza della Scienza, 3
20126 Milano, Italy
Contact: giulia.brunetti@unimib.it
Field of interest: experimental particle physics
Nationality: Italian

Academic Qualification

2011 PhD in Physics (Experimental Particle Physics)
Date: 20/05/2011
Bologna University and Université Claude Bernard Lyon 1 in joint supervision (Convention de cotutelle).
Thesis: "Neutrino velocity measurement with the OPERA experiment in the CNGS beam", Advisors: Dr. D. Autiero, Dr. M. Sioli
Dottorato con borsa

2007 Master degree in Physics (second level degree course)
marks 110 (/110) cum laude (Particle Physics)
Date: 20/07/2007
Bologna University
Thesis: "Neutrino beam studies for the OPERA experiment", Advisor: Prof. G. Giacomelli

2004 Degree in Physics (first level degree course)
marks 110(/110) cum laude (Astrophysics)
Date: 15/10/2004
Bologna University
Thesis: "Evidence of the presence of dark matter in galaxies and galaxy clusters", Advisor: Prof. G. Giovannini

National Scientific Qualification

ASN: National Scientific qualification (*Abilitazione Scientifica Nazionale*) as associate professor in the Italian higher education system, call 2018/2020, Academic Recruitment Field 02/A - Physics of fundamental interactions. Validity: from 06/11/2020 to 06/11/2032

Professional Experience, Education and Study Experience

2020→Current **Researcher at University Milano-Bicocca**
ENUBET project and DUNE experiment
(RTD-A, Starting 01/09/2020)

2020 **Postdoctoral Reasearch Fellow** – Padova University
ENUBET project and DUNE experiment
(01/06/2020 → 31/08/2020)

2017 → 2020 **INFN Researcher – Padova.**
ENUBET project and DUNE experiment
(Art.36 Ricercatore INFN. 02/05/2017 → 01/04/2020)

2014 → 2017 **Fermilab Research Associate**.
NOvA and DUNE experiments
(Fermilab Research Associate, 13/01/2014 → 17/04/2017)

2013 **Post-Doc at LHEP-Bern University in collaboration with CERN** within the LAGUNA/LBNO Project
(LHEP Post-Doc 01/03/2012 → 31/07/2013)

2013 Visiting Scientist at CERN working on the FP7/EU LAGUNA-LBNO Design Study

2011 → 2012 **Post-Doc at LHEP-Bern University**. OPERA experiment
(LHEP Post-Doc 01/08/2011 → 29/02/2012)

2008 → 2011 **PhD student in Physics at Bologna University in joint supervision with the École Doctorale de Physique et d'Astrophysique (PHAST) - Université Claude Bernard Lyon1**

2009→2010 Stay at the IPN Lyon (Institut de Physique Nucleaire) within the funded projects:
- Vinci Program of the Università Italo Francese/Université Franco Italienne
- Marco Polo Program of Bologna University

2004 → 2007 **Student at Bologna University** – Mathematics, Physics and Natural Sciences Faculty
Degree Course: Physics
Curriculum: Fundamental Interactions

2006 Thesis work: 3 months at CERN and 3 months at IPN Lyon (France) within the funded project of the Bologna University: Mathematics, Physics and Natural Sciences Faculty Scholarships for research periods abroad

2000 → 2004 **Student at Bologna University** - Mathematics, Physics and Natural Sciences faculty
Degree Course: Physics

Schools Attended
- **NuSTEC** (Neutrino Scattering Theory Experiment Collaboration), Fermilab, 21-29 October 2014.
- **SIF International School of Physics "Enrico Fermi"**, course CLXXXII "Neutrino Physics and Astrophysics" in collaboration with the International School on AstroParticle Physics (ISAPP), Varenna, 26 July

- 5 August 2011
- "**6th Official FLUKA Course – CERN 2008"**, CERN, 22-27 June 2008
- **"XVIII Giornate di Studio sui Rivelatori"** (School on particle physics detectors), Centro Congressi di Villa Gualino, Torino, 19-22 February 2008

ROLES & RESPONSIBILITIES

2019 → current — ENUBET WP1 Coordinator – Design and optimization of the ENUBET transfer line

2016 → 2017 — Convener of the *NOvA Beam simulation and data working group*

2017 — Advisor for the "*NuMI Target Monitoring Advisory Group*" at Fermilab charged from Fermilab Program Planning to identify and advise on requirements and monitoring options of the NuMI target in the post-MINOS+ era.

2015 → 2016 — Member of the *NuMI Operations* group dedicated to the NuMI beam at Fermilab and link between the Accelerator Division and the MINOS, MINERvA and NOvA experiments

---

PRESENTATION AT CONFERENCES AND SEMINARS

- **ICHEP 2024, 42nd International Conference on High Energy Physics,** 17–24 Jul 2024, Prague, Czech Republic. Poster: "The photo-detection system and double calorimetry in DUNE"
- **Neutrino 2024** - XXXI International Conference on Neutrino Physics and Astrophysics, June 16-22, 2024 Milan, Italy. Talk: "The ENUBET monitored neutrino beam and its implementation at CERN"
- **11th international symposium on Large TPCs for low-energy rare event detection,** 11-13 Dec 2023, Paris, France. Talk: "The ENUBET neutrino cross section experiment"
- **XX International Workshop on Neutrino Telescopes,** 23–27 Oct 2023, Venice, Italy. Talk: "The photo-detection system and double calorimetry in DUNE"
- **Neutrino 2022** - XXX International Conference on Neutrino Physics and Astrophysics, 30 May-4 June 2022, Virtual Seoul, Korea. Poster: "Light-charge combined calorimetry in DUNE"
- **NuFact 2021**, 6-11 Sep 2021, Cagliari, Italy. Talk: "The ENUBET project: a monitored neutrino beam"
- **2021 SNOLAB VIRTUAL SEMINAR SERIES,** April 19, 2021, Seminar: "The ENUBET Project - Monitored Neutrino Beams"
- **EPS-HEP 2019**, July 10-17, 2019, Ghent, Belgium. Talk: "A high precision narrow-band neutrino beam: the ENUBET project"
- **NuPhys 2018**, December 19-21, 2018, London, UK. Poster: "The ENUBET Beamline"
- **NuFact 2018,** August 13-18, 2018, Virginia Tech, Blacksburg, Virginia,

US. Talk: “Status of the ENUBET project”

- **Neutrino 2018** - XXVIII International Conference on Neutrino Physics and Astrophysics, June 4-9, 2018, Heidelberg, Germany. Poster: “ENUBET - Enabling high precision flux measurements in conventional neutrino beams”
- **IFAE 2018** -“Incontri di Fisica delle Alte Energie" – April 4-6, 2018, Milan, Italy. Talk: “ENUBET - Enhanced NeUtrino BEams from kaon Tagging”
- **Neutrino Seminar Series**, March 16, 2017, Fermilab. Seminar: “Dual-Phase Liquid Argon Time Projection Chambers”
- **PSI2016 – Workshop on the Physics of fundamental Symmetries and Interactions** , October 16 – 20, 2016, PSI Zurich. Talk: “New results from NOvA”
- **New Perspectives - Young Researcher Conference**, June13 – 14, 2016 Fermilab. Talk: “Measurement of the ν_μ induced Neutral Current π^0 production cross section with the NOvA Near Detector
- **MIAMI2012**, December 13 - 20, 2012 Fort Lauderdale, Florida. Talk: “OPERA neutrino experiment results”
- **SMU** (Southern Methodist University) **Dallas**, November 26, 2012. Seminar: “Recent results from the OPERA experiment”
- **AEC (Albert Einstein Center) Workshop**, Bern University, December 7, 2011. Seminar: “Measurement of the neutrino velocity with the OPERA detector in the CNGS beam”
- **GDR Neutrino 2011**, November 28-29, 2011, LAPP (Laboratoire d'Annecy Le Vieux de Physique des Particules), Annecy-le-Vieux. Talk: “Updates on the neutrino velocity measurement with OPERA”
- **EPFL** (École Polytechnique Fédérale de Lausanne) **Lausanne,** November 28, 2011. Seminar: “Measurement of the neutrino velocity with the OPERA detector in the CNGS beam”
- **INFN** (Istituto Nazionale di Fisica Nucleare) **Bologna**, Bologna, November 24, 2011. Seminar: “Measurement of the neutrino velocity with the OPERA experiment in the CNGS beam”

TEACHING EXPERIENCE AND STUDENT SUPERVISION

2021-2023

- Laboratory I - Department of Physics, Milano-Bicocca University
- A.A. 2023-2024 60 hours
- A.A. 2022-2023 60 hours
- A.A. 2021-2022 60 hours
- A.A. 2020-2021 50 hours

2021-2022

- Co-supervisor of 2 Master Degree Thesis, DUNE experiment:

“Light reconstruction in the DUNE far detector”, G. Cavallaro, Milano-Bicocca University, June 2022

“Study of low energy electrons in DUNE with and without xenon doping”, R. Angalone, Milano-Bicocca University, March 2022

2018-2019 Laboratory of Physics 1 - School of Engineering, Padova University
A.A. 2019-2020, 40 hours
A.A. 2018-2019, 40 hours
A.A. 2017-2018, 40 hours

2015 Organizer of the lecture series: "Neutrino University – Neutrino Summer Lecture series", Fermilab, June-August 2015.
https://npc.fnal.gov/neutrino-university-past-series/

2014-2016
- Supervision of 2 PhD students (NOvA Experiment)
- Supervisor of a Master Degree Thesis, "Neutrino Beam Simulations and Data Checks for the NOvA Experiment", M. Del Tutto, Rome University Sapienza, October 2015. DOI: 10.2172/1230042 FERMILAB-MASTERS-2015-06 Experiment: FNAL-E-0929
http://inspirehep.net/record/1404343
- Supervision of 2 students in the framework of *Fermilab summer students* program (NOvA Experiment). The program gives to university students the opportunity to work with scientists on particle physics experiments and experience current research methods of high-energy physics research.

2008 Laboratory course for high-school students in the framework of the "Open Laboratories" project of the Physics Department at the Bologna University

---

Scientific Publications

Articles and Personal Proceedings

- A. Abed Abud et al. (DUNE Collaboration) (2024), "DUNE Phase II: scientific opportunities, detector concepts, technological solutions", **JINST 19 P12005**

- A. Abed Abud et al. (DUNE Collaboration) (2024), "First measurement of the total inelastic cross section of positively charged kaons on argon at energies between 5.0 and 7.5 GeV", **Phys.Rev.D 110 092011**

- A. Abed Abud et al. (DUNE Collaboration) (2024), "Performance of a Modular Ton-Scale Pixel-Readout Liquid Argon Time Projection Chamber", **Instruments 8 41 (2024)**

- A. Abed Abud et al. (DUNE Collaboration) (2024), "The DUNE Far Detector Vertical Drift Technology. Technical Design Report", **JINST 19 T08004 (2024)**

- M. Andreotti et al. (2024), Cryogenic characterization of Hamamatsu HWB MPPCs for the DUNE photon detection system, **JINST 19 T01007**

- F. Acerbi et al., Design and performance of the ENUBET monitored neutrino beam, **Eur. Phys. J. C (2023) 83:964**

- A. Abed Abud et al. (The DUNE Collaboration) (2023), Reconstruction of interactions in the ProtoDUNE-SP detector with Pandora, **Eur. Phys. J. C 83 (2023) 618**

- A. Abed Abud et al. (The DUNE Collaboration) (2023), Impact of cross-section uncertainties on supernova neutrino spectral parameter fitting in the

Deep Underground Neutrino Experiment, **Phys. Rev. D 107, 112012**

- A. Abed Abud et al. (DUNE Collaboration) (2023), Identification and reconstruction of low-energy electrons in the ProtoDUNE-SP detector, **Phys. Rev. D 107, 092012**

- A. Abed Abud et al. (DUNE Collaboration) (2023), Highly-parallelized simulation of a pixelated LArTPC on a GPU, **JINST 18 P04034**

- M. Torti, et al. (ENUBET Collaboration) (2022), The NP06/ENUBET Project: Towards a Monitored Neutrino Beam. **Moscow Univ. Phys. 77, 415–417 (2022)**

- A. Abed Abud et al. (DUNE Collaboration) (2022), Separation of track- and shower-like energy deposits in ProtoDUNE-SP using a convolutional neural network, **Eur. Phys. J. C 82, 903 (2022)**

- A. Abed Abud et al. (DUNE Collaboration) (2022), Scintillation light detection in the 6-m drift-length ProtoDUNE Dual Phase liquid argon TPC, **Eur. Phys. J. C 82, 618 (2022)**

- A. Abed Abud et al. (DUNE Collaboration) (2022), Low exposure long-baseline neutrino oscillation sensitivity of the DUNE experiment, **Phys. Rev. D 105, 072006**

- C. C. Delogu et al., The ENUBET experiment, **International. Journal. of Modern Physics A, Vol. 37, No. 07, 2240017 (2022)**

- A. Abed Abud et al. (DUNE Collaboration) (2022), Design, construction and operation of the ProtoDUNE-SP Liquid Argon TPC, **JINST 17 P01005**

- G. Brunetti for the ENUBET Collaboration (2021), The ENUBET project: a monitored neutrino beam, **Proceedings of Science Vol. 402**, Proceeding NuFACT2021

- A. Abed Abud et al. (DUNE Collaboration) (2021), Deep Underground Neutrino Experiment (DUNE) Near Detector Conceptual Design Report, **Instruments 2021, 5(4), 31**

- M. Andreotti et al (2021), Coded masks for imaging of neutrino events, **Eur. Phys. J. C 81, 1011 (2021)**

- B. Abi et al (DUNE Collaboration) (2021), Searching for Solar KDAR with DUNE, **JCAP10(2021)065**

- A. Branca, G. Brunetti, A. Longhin, M. Martini, F. Pupilli, F. Terranova (2021). A New Generation of Neutrino Cross Section Experiments: Challenges and Opportunities. **Symmetry 2021, 13, 1625**

- The WA105 collaboration, B. Aimard et al (2021), Performance study of a 3x1x1 m^3 dual phase liquid Argon Time Projection Chamber exposed to cosmic rays, **JINST 16 P08063**

- DUNE Collaboration (2021), Supernova neutrino burst detection with the deep underground neutrino experiment, **Eur. Phys. J. C (2021) 81:423**

- B. Abi et al (DUNE Collaboration) (2021), Prospects for beyond the Standard Model physics searches at the Deep Underground Neutrino Experiment, **Eur. Phys. J. C 81, 322 (2021)**

- B. Aimard et al (2021), Study of scintillation light collection, production and propagation in a 4 tonne dual-phase LarTPC, **JINST 16 P03007**

- M. Torti et al (2020), A high precision narrow-band neutrino beam: The ENUBET project, **International Journal of Modern Physics A 35(34-35) (2020) 2044017**

- M. Pozzato et al. (2020), Silicon Photomultipliers for the decay tunnel instrumentation of the ENUBET neutrino beam, **Nucl. Instrum. Methods Phys. Res. A, 983 (2020), 164482**

- B. Abi et al (DUNE Collaboration) (2020), First results on ProtoDUNE-SP liquid argon time projection chamber performance from a beam test at the CERN Neutrino Platform, **JINST 15 (2020) P12004**

- B. Abi et al (DUNE Collaboration) (2020), Neutrino interaction classification with a convolutional neural network in the DUNE far detector, **Phys. Rev. D 102, 092003**

- B. Abi et al (DUNE Collaboration) (2020), Long-baseline neutrino oscillation physics potential of the DUNE experiment, **Eur. Phys. J. C 80, 978 (2020)**

- B. Abi et al (DUNE Collaboration) (2020),

Volume I. Introduction to DUNE, **JINST 15 (2020) T08008**

Volume III. DUNE far detector technical coordination, **JINST 15 (2020) T08009**

Volume IV. The DUNE far detector single-phase technology, **JINST 15 (2020) T08010**

- F. Acerbi et al (2020), The ENUBET positron tagger prototype: construction and testbeam performance, **JINST 15 (2020) P08001**

- E. Parozzi et al. (2020), The ENUBET ERC project for an instrumented decay tunnel for future neutrino beams, **Nucl. Instrum. Methods Phys. Res. A, 958, (2020), 162162**

- F. Acerbi et al. (2020), Polysiloxane-based scintillators for shashlik calorimeters, **Nucl. Instrum. Methods Phys. Res. A, 956 (2020), 163379**

- M. Pari et al. (2019), Shashlik calorimeters: Novel compact prototypes for the ENUBET experiment, **Nucl. Instrum. Methods Phys. Res. A, 936 (2019) 148-149**

- F. Acerbi et al., Irradiation and performance of RGB-HD Silicon Photomultipliers for calorimetric applications, **JINST 14 (2019) P02029**

- G. Brunetti, ENUBET-Enhanced NeUtrino BEams from kaon Tagging, **Nuovo Cim. C 2019, 42(4), 191795**

- B. Aimard et al., A 4 tonne demonstrator for large-scale dual-phase liquid argon time projection chambers, **JINST 13 (2018) P11003**

- G. Brunetti, The ENUBET neutrino beam - Enabling high precision flux measurements in conventional neutrino beams, XXVIII International Conference on Neutrino Physics and Astrophysics. (2018) **Neutrino2018 Proceedings** – Poster

- G. Brunetti et al, Status of the ENUBET project, **Proceedings of Science Vol. 341,** Proceeding NuFACT2018

- G. Ballerini et al., Testbeam performance of a shashlik calorimeter with fine-grained longitudinal segmentation, **JINST 13 (2018) P01028**

- NOvA Collaboration (P. Adamson et al.), Search for active-sterile neutrino mixing using neutral-current interactions in NOvA, **Phys.Rev.**

D96 (2017) no.7, 072006

- NOvA Collaboration (P. Adamson et al.), Constraints on Oscillation Parameters from ν_e Appearance and ν_μ Disappearance in NOvA, **Phys.Rev.Lett. 118 (2017) no.23, 231801**

- NOvA Collaboration (P. Adamson et al.), Measurement of the Neutrino Mixing Angle θ23 in NOvA, **Phys.Rev.Lett. 118 (2017) no.15, 151802**

- NOvA Collaboration (P. Adamson et al.), First Measurement of Electron Neutrino Appearance in NOvA, **Phys. Rev. Lett. 116 (2016) no.15, 151806**

- NOvA Collaboration (P. Adamson et al.), First measurement of muon-neutrino disappearance in NOvA, **Phys.Rev. D93 (2016) no.5, 051104**

- OPERA Collaboration (N. Agafonova et al.), Evidence for $\nu\mu\rightarrow\nu\tau$ appearance in the CNGS neutrino beam with the OPERA experiment, **Phys.Rev. D89 (2014) no.5, 051102**

- OPERA Collaboration (N. Agafonova et al.), New results on $\nu_\mu\rightarrow\nu_\tau$ appearance with the OPERA experiment in the CNGS beam. **JHEP 1311 (2013) 036,** Erratum: JHEP 1404 (2014) 014

- OPERA Collaboration (N. Agafonova et al.), Search for $\nu_\mu\rightarrow\nu_e$ oscillations with the OPERA experiment in the CNGS beam, **JHEP 1307 (2013) 004,** Addendum: JHEP 1307 (2013) 085.

- OPERA Collaboration (T. Adam et al.), Measurement of the neutrino velocity with the OPERA detector in the CNGS beam using the 2012 dedicated data, **JHEP 1301 (2013) 153**

- T. Feldmann, D. Piester, A. Bauch, D. Autiero, P. Alvarez, J. Serrano, G. Brunetti, Relative calibration of the time transfer link between CERN and LNGS for precise neutrino time of flight measurements, November 26 - 29, 2012. **44th Annual Precise Time and Time Interval (PTTI) Systems and Application Meeting, Proc.**

- G. Brunetti (2012), Neutrino Velocity Measurement with the OPERA Experiment - Time of Flight Measurement with the CNGS Neutrino Beam, **LAP Lambert Academic Publishing, ISBN-13 978-3-659-22444-7**

- OPERA Collaboration (N. Agafonova et al.), Search for $\nu_\mu\rightarrow\nu_\tau$ oscillation with the OPERA experiment in the CNGS beam, **New J.Phys. 14 (2012) 033017**

- OPERA Collaboration (T. Adam et al.), Measurement of the neutrino velocity with the OPERA detector in the CNGS beam, **JHEP 1210 (2012) 093**

- OPERA Collaboration (N. Agafonova et al.), Momentum measurement by the multiple Coulomb scattering method in the OPERA lead-emulsion target, **New J.Phys. 14 (2012) 013026**

- OPERA Collaboration (N. Agafonova et al), Study of neutrino interactions with the electronic detectors of the OPERA experiment, **New J.Phys. 13 (2011) 053051**

- OPERA Collaboration (N. Agafonova et al.), Observation of a first ν_τ candidate event in the OPERA experiment in the CNGS beam, **Phys.Lett. B 691 (2010) 138-145**

- OPERA Collaboration (N. Agafonova et al.), Measurement of the

atmospheric muon charge ratio with the OPERA detector, **Eur.Phys.J. C67 (2010) 25-37**

- R. Acquafredda et al., The OPERA experiment in the CERN to Gran Sasso neutrino beam, **JINST 4 (2009) P04018**

- N. Agafonova et al., The detection of neutrino interactions in the emulsion/lead target of the OPERA experiment, **JINST 4 (2009) P06020**

- OPERA Collaboration (A. Anokhina et al.), Study of the effects induced by lead on the emulsion films of the OPERA experiment, **JINST 3 (2008) P07002**

- OPERA Collaboration (A. Anokhina et al.), Emulsion sheet doublets as interface trackers for the OPERA experiment, **JINST 3 (2008) P07005**

INTERNAL NOTES AND REPORTS

- DUNE Collaboration, Highly-parallelized simulation of a pixelated LArTPC on a GPU, Dec 19, 2022, 25 pp. FERMILAB-PUB-22-926-LBNF

- DUNE Collaboration, DUNE Offline Computing Conceptual Design Report, Oct 28, 2022, 229 pp. FERMILAB-DESIGN-2022-01

- ENUBET Collaboration (F. Acerbi et al.)
NP06/ENUBET annual Report for the SPSC (2022), CERN-SPSC-2022-016/SPSC-SR-310
NP06/ENUBET annual Report for the SPSC (2021), CERN-SPSC-2021-013/SPSC-SR-290
NP06/ENUBET annual Report for the SPSC (2020), CERN-SPSC-2020-009/SPSC-SR-268

- DUNE Collaboration (B. Abi et al.), Experiment Simulation Configurations Approximating DUNE TDR, Mar. 8, 2021, 15 pp. FERMILAB-FN-1125-ND, e-Print: 2103.04797 [hep-ex]

- DUNE Collaboration (B. Abi et al.), Deep Underground Neutrino Experiment (DUNE), Far Detector Technical Design Report (2020), Volume II: DUNE Physics, FERMILAB-PUB-20-025-ND, FERMILAB-DESIGN-2020-02, e-Print: 2002.03005 [hep-ex]

- G. Brunetti, J. Cooper, D. Kalra, J. Tripathi, Off-Axis Beam Studies for NOvA, Nova Internal Note, Part 1 October 2016 and Part 2 April 2018. NOVA Document 16233-v1

- DUNE Collaboration (B. Abi et al.), The Single-Phase ProtoDUNE Technical Design Report, Jun 21, 2017, 178 pp. FERMILAB-DESIGN-2017-02, arXiv:1706.07081

- DUNE Collaboration (R. Acciarri et al.): Long-Baseline Neutrino Facility (LBNF) and Deep Underground Neutrino Experiment (DUNE) Conceptual Design Report
Volume 1: The LBNF and DUNE Projects, FERMILAB-DESIGN-2016-01, arXiv:1601.05471.
Volume 2: The Physics Program for DUNE at LBNF, FERMILAB-DESIGN-2016-02, arXiv:1512.06148.
Volume 4: The DUNE Detectors at LBNF, FERMILAB-DESIGN-2016-04, arXiv:1601.02984

Peer Reviewer & Editor Actvities

- **Symmetry**, ISSN: 2073-8994, Special Issue "Experimental Tests of Fundamental Symmetries in Particle Physics" Editor, https://www.mdpi.com/journal/symmetry/special_issues/JFR5P2420P
- **Physical Sciences Forum**, Proceeding Papers, Reviewer https://www.mdpi.com/journal/psf

---

Commitees

2023 Member of the Degree in Physics and Master Degree in Physics Commitee, II SESSIONE A.A. 2022/2023, September 2023

2020 Member of Selection Commitee cod. 20B228, Rep n. 7112/2020, prot. 0087031/20, for the scholarship: "Sviluppo di elettronica criogenica per rivelatori di particelle ad argon liquido", Milano Bicocca University, Physics Department G. Occhialini

---

Awards & Fellowships

2015-2017 Principal Investigator of the project "R&D on giant double-phase liquid argon time projection chamber detectors for future neutrino experiments" FACCTS (France and Chicago Collaborating in the Science) - Chicago University in collaboration with IPN Lyon, funding granted $15000

2009 Vinci Program of the Università Italo Francese/Université Franco Italienne for contribution and support to the international joint supervision of PhD programs, funding granted €5100

2009 Marco Polo Scholarship, Bologna University: program for the education of young researchers abroad, funding granted €1887

2006 Scholarships for research periods abroad of Bologna University – Mathematics, Physics and Natural Sciences Faculty, funding granted €2500

Other Qualifications & Competences

- Advanced training in tutoring students with Special Educational Needs/Specific Learning Disorders or Disabilities (*BES/DSA*), Save the Children Italia

---

Scientific Competences and Technical Skills

Neutrino Physics
Beam Instrumentation
Particle detectors
Neutrino beam facilities
Analysis, Simulations and Programming: C++, C, Java, Fluka, Geant, Transport, G4Beamline, ROOT, Fortran, shell scripting
Office Applications: Microsoft Office, Latex, LibreOffice
Detector testing, characterization and commissioning

Database monitoring and troubleshooting
Timing hardware and timing data processing
Time Transfer Measurements

LANGUAGES

Italian - mother tongue
English, French - fluent
German – basic

RESEARCH ACTIVITY

2020 → ON GOING ACTIVITIES: Researcher at Milano-Bicocca University

DUNE experiment[1] (Deep Underground Neutrino Experiment)
https://www.dunescience.org/, https://lbnf.fnal.gov/,
https://www.fnal.gov/pub/science/lbnf-dune/index.html

Double calorimetry analysis in the DUNE Far Detectors: I am developing a novel analysis focused on events simulated in the DUNE Far Detectors **aiming at the first calorimetric measurement using both the charge and the light collected in the detector.**

- **MC events generation, simulation and reconstruction:** full chain event simulation in the DUNE Far Detector for particles at different energies in order to study ionization electrons and scintillation photon emission. Data samples production for:
  - Mono-energetic single electrons and muons at different energies ranging from 0.1 GeV to 5 GeV. Comparison of reconstructed charge and light hits in the wires and in the optical detectors with true number of ionization electrons and scintillation photons. Study of the anticorrelation between light and charge at the simulation and reconstruction level and comparison of the two. Study of the energy resolution as a function of the energy.
  - Beam ν_e events: first energy estimation using both charge and light in DUNE FD **reaching a energy resolution around 6% significantly improving the resolution obtained using only the charge information for EM showers (~13%)**

Given the good results obtained the charge+light energy estimation will be part of the standard analysis tools provided to the DUNE collaborators.

ENUBET Project (Enhanced NeUtrino BEams from kaon Tagging)
http://enubet.pd.infn.it/

The goal of the project is to measure for the first time the positrons produced in conventional neutrino beams by the $K^+ \rightarrow \nu_e e^+\pi^0$ (K_{e3}) decays in an instrumented decay tunnel. The ENUBET project is a 2 M€ grant funded by the European Union (ERC Consolidator Grant 2015). It is aimed at demonstrating the concept of monitored neutrino beams to achieve an unprecedented precision in the measurement of the flux and, in turn, neutrino cross sections. The measurement will substantially reduce the systematic budget of the next generation long baseline experiments (DUNE and Hyper-Kamiokande) and it will allow a solid measurement of CP violation in neutrinos. In 2019 ENUBET has become a CERN experiment (NP06/ENUBET) in the framework of the CERN Neutrino Platform.

- **Coordinator of WP1 (Beamline)**.
- **Optimization of the optics and design of the ENUBET transfer line from a Graphite Target to the hadron and proton dump** (WP1):
  - New optics optimization with TRANSPORT to a 5% momentum bite for a central value of 8.5 GeV/c aiming at increasing the number of ν_e-CC interactions in the far detector. Full simulation with G4Beamline for particle transport and interaction. The new design involved also:

1 B. Abi et al (DUNE Collaboration), **JINST 15 (2020) P12004 .**
B. Abi et al (DUNE Collaboration), **Phys. Rev. D 102, 092003**
B. Abi et al (DUNE Collaboration), **Eur. Phys. J. C 80, 978 (2020)**

- A new target, selected among different candidates after an optimization study.
- An optimized hadron dump to minimize the backscattering background reaching the decay tunnel
- An optimized proton dump

· **Previous results on the flux at the decay tunnel entrance were improved by a factor two allowing to reach 10^4 νe-CC interactions in the far detector in 2.3 years** of data taking assuming nominal SPS 4.5 10^{19} POT/year.

- **Studies on the optimization of the hadron dump**: The hadron dump is placed dowstream the ENUBET decay tunnel (the tagger). The design was optimized to reduce as much as possible the background induced in the tagger by the backscattering sorrounding a graphite core (50cm diameter) with a layer of iron (1m diameter) and an external layer of borated concrete (4m diameter). In front of the dump there is an additional meter of borated concrete leaving the opening for the beam.
- **Studies on the optimization on the proton dump material composition and position** to minimize the contribution to the ν_e spectrum in the far detector due to interactions in the proton dump.

The ENUBET beamline and its performance is described in a dedicated article to be submitted to The European Physical Journal C

I'm also participating in the on-going activities of construction and assembly of the ENUBET prototype detector.

Teaching
A.A.: 2020-2021, 2021-2022, 2022-2023 and 2023-2024: Laboratory I for the Bachelor Degree in Physics at the Department of Physics "Giuseppe Occhialini" – Milano Bicocca University
Starting the academic year 2021-2022 I was given the responsibility of the course ETA (Thursday)

2017→2020: Researcher at INFN-Padova & Padova University

ENUBET project[2]

- **Coordinator of WP1 (Beamline)**.
- **Optimization of the optics and design of the ENUBET transfer line from a Be/Graphite Target to the hadron and proton dump** (WP1):
  · Optics optimized with TRANSPORT to a 5%-10% momentum bite for a central value of 8.5 GeV/c
  · Particle transport and interaction: full simulation with G4Beamline
  · All normal-conducting quadrupoles and bending dipole (with numerical aperture <40 cm)
- **Investigation of two options for the focusing**:
  · Horn-based (2 ms pulse, 180 kA, 10 Hz during the flat top)
  · Static focusing system: a quadrupole triplet is placed directly downstream the target
- **Full simulation and studies**:

2 M. Torti et al, **International Journal of Modern Physics A 35(34-35) (2020) 2044017**
F. Acerbi et al., **JINST 15 (2020) P08001**
F. Acerbi et al., **Nucl. Instrum. Methods Phys. Res. A, 956 (2020), 163379**
G. Brunetti at al., **Nuovo Cim. C42 (2019) no.4, 179**
F. Acerbi at al., **JINST 14 (2019) P02029**
G. Ballerini at al., **JINST 13 (2018) P01028**

· The F.O.M. used is the flux of π^+ and K^+ at the tagger entrance and the number of tagged ν_e events expected at a Far Detector.
· The design of collimators and absorbers is driven by the amount of background (mainly e^+) at the tagger entrance and by the minimization of the ratio (background e^+)/(total K^+)

The results obtained show a substantial increase w.r.t. ENUBET proposal in the rates of π^+ and K^+. While at first a transferline with a focusing horn was considered the main option, the static focusing design has become the preferred solution by the ENUBET collaboration since the performance turned out to be significantly better than early estimates. It offers several advantages in terms of cost, simplification of technical implementation and performance of particle identification. Moreover a static transferline would pave the way to the so-called tagged-beams (where the neutrino is uniquely associated with the other particles of the parent kaon). In the ENUBET static option the time between two K_{e3} decays could allow the neutrino interaction in the detector to be time linked with the observation of its associated lepton in the decay tunnel: this has never been performed in any neutrino experiment and would represent a major breakthrough in experimental neutrino physics.

DUNE experiment[3]

Test of ARAPUCA devices: The light read-out system of the Single-Phase DUNE detector is based on Silicon Photomultipliers (SiPM), for compactness and cryogenic requirements, associated with ARAPUCA devices that act as a light-trap capturing wavelength-shifted light inside highly reflective boxes further improving detection efficiency. I participated to the activities related to the testing of the photosensors and ARAPUCA devices to be used for the Single-Phase DUNE detectors photo-detection system in collaboration with the DUNE group of Milano-Bicocca.

Teaching
A.A.: 2017-2018, 2018-2019 and 2019-2020: Laboratory of Physics 1 - School of Engineering, Padova University (*Ing. Chimica e dei Materiali, Ing. dell'Energia, Ing. Informatica, Ing. Aerospaziale, Ing.dell'Informazione, Ing. Meccanica, Ing. Biomedica, Ing. Civile, Edile e Ambientale*)

2014→2017: Fermilab Research Associate

2014-2017
NOvA experiment[4] (NuMI Off-axis ν_e Appearance)
https://novaexperiment.fnal.gov/

- **Convener of the *NOvA Beam simulation and data working group*.**
- **NOvA Near detector**:
  Neutral Current (NC) inclusive π^0 cross-section measurement with the NOvA Near Detector data. π^0 production from ν_μ NC interactions is NOvA main background because the 2 photons produced by the π^0 decay can fake the ν_e appearance signal. Studying NC interactions with a π^0 in the final state will improve understanding of neutrino induced NC π^0 production and reduce

3 B. Abi et al (DUNE Collaboration), **JINST 15 (2020) T08008, JINST 15 (2020) T08009, JINST 15 (2020) T08010**

4 NOvA Coll., **Phys.Rev. D96 (2017),072006**
NOvA Coll., **Phys.Rev.Lett 118 (2017),231801**
NOvA Coll., **Phys.Rev.Lett 118 (2017),151802**
NOvA Coll., **Phys.Rev.Lett 116 (2016),151806**
NOvA Coll., **Phys.Rev. D93 (2016),051104**

background uncertainties for current and future neutrino oscillation experiments. **The analysis is the subject of a NOvA Phd thesis**.
The signal to background discrimination analysis performed was based on a multivariate technique (TMVA), with particular focus on 2-prong and 3-prong events.
Event information used:

- Reconstructed muon identification PID algorithm based on muon tracks,
- Convolutional Visual Network (CVN) algorithm to classify events according to their likely neutrino flavor and interaction type,
- Slice and Shower variables (energy, number of hits, missing planes, contiguous planes, dE/dx *etc…*).

I also participated on the completion and on the starting of operation of the Near Detector located at Fermilab by participating to the liquid scintillator filling operations

- **NuMI beam optimization studies**: simulations studies on the NuMI target and focusing system to **optimize the neutrino yield at the NOvA near and far detectors**. Several target-horn configurations and different target materials were simulated and compared to the standard NuMI beam. **Two NOvA technical notes summarize the results**[5].
  - The first studies explore NOvA target and horn optimization where existing target and existing horns are used without major modification.
    The target can have some additional graphite fins, some gaps between fins, or fewer fins, or fins of different material, but cannot change position closer to Horn 1 due to the target design. Horn 2 can change position relative to Horn 1, but only from the Medium Energy configuration to the Low Energy configuration. Both Horn currents can be changed together but not independently. The incoming beam energy from the Main Injector can be changed.
  - The second part of studies cover modifications to the NOvA target requiring new engineering effort and prototype work.
    Additional target fins can be added downstream of the fins in the existing target inside of Horn 1 aperture. An additional target can be added between the horns. Changes can be made to the Horns themselves: optimization of the Horn 2 position w.r.t. any position relative to Horn 1 with a new strip line, possible additional horns, different currents where the currents are not identical in all horns.

  The event yield gains are small in the first studies but larger in the second ones.
  The studies on the NuMI target were then used for target simulations in view of PIP-I+ plan where the beam power would go from 700kW up to 1.2 MW.
- **NuMI beam simulations**:
  - Estimate of the **effect of the NuMI horn tilt measured at the end of 2016 on NOvA** Near and Far detector neutrino energy spectra and on the Far/Near ratio and implementation of the tilt in the simulation.
  - Implementation of the terrestrial magnetic field measured inside the decay tunnel in the NOvA beam simulation.
- **Advisor for the "*NuMI Target Monitoring Advisory Group*" at Fermilab to advise on requirements and options for NuMI target monitoring in the post-MINOS running period.**
  I estimated and presented NOvA requirements and I also provided results on the benefit of using muon monitors on the NuMI beamline and the respective data analysis.
- **Supervisor of NOvA PhD and master degree students and Fermilab summer students**.
- **Thesis Supervisor**[6]: "Neutrino Beam Simulations and Data Checks for the NOvA Experiment", master degree thesis in Physics at Rome University "Sapienza".

NuMI (Neutrinos at the Main Injector)

5 http://nova-docdb.fnal.gov/cgi-bin/ShowDocument?docid=16233

6 **DOI:10.2172/1230042** (http://inspirehep.net/record/1404343/files/fermilab-masters-2015-06.pdf)

Member of the *NuMI Operations* group devoted to the NuMI neutrino beamline at Fermilab and link between the Fermilab Accelerator Division and the NuMI experiments MINOS, MINERvA and NOvA. **Beam monitoring**: analysis of various beamline detectors data (position and intensity monitors, horn currents, muon monitors *etc…*) during 2 years of data taking in order to monitor the neutrino beam stability in time and to understand the correlations between different components of the beamline.

I also presented and discussed NuMI and NOvA beam studies, analyses, simulations and results at several **NuMI-X** meetings (consortium comprising Fermilab neutrino experiments collaborating on the modeling of the NuMI beam, to develop and maintain the best knowledge about NuMI neutrino fluxes relevant to all NuMI experiments, MINOS+, MINERvA, NOvA, MicroBooNe, ArgoNeuT).

2015-2017
DUNE experiment[7] (Deep Underground Neutrino Experiment)

- **Test of LAPPD devices** (large-area picosecond photodetector) to be installed on the ProtoDUNE beamline at CERN for the TOF system. The devices were tested at Fermilab on the LArIAT beamline, further data were taken with cosmic rays.
- **Collaboration in the framework of the granted FACCTs funding (*Principal Investigator*) with the IPNL (Institut de Physique Nucléaire de Lyon, France)**. Project Title: *"R&D on giant double-phase liquid argon time projection chamber detectors for future neutrino experiments".*
  Installation and data taking of the dual-phase ProtoDUNE demonstrator at CERN (3x1x1 m^3 active volume dual-phase liquid argon detector): The TPC was pre-assembled in a custom built clean room and then inserted in the cryostat. I participated in all the detector assembly and testing activities at CERN[8], and I was able to have a look at the first cosmic ray raw events collected when the detector operations started and to test the first data/simulation comparisons.

2011→2014: Post-Doc at LHEP (Laboratory for High Energy Physics), Bern University

2013-2014
LAGUNA-LBNO (Large Apparatus studying Grand Unification and Neutrino Astrophysics for Long Baseline Neutrino Oscillations)
http://project-lagunalbno.web.cern.ch/project-lagunalbno/

Visiting Scientist at CERN working on the FP7/EU LAGUNA-LBNO
LAGUNA-LBNO was a EU funded design study aimed at a neutrino long-baseline experiment in Europe based on a large mass liquid argon TPC. This project was later merged in DUNE and inspired the design of the DUNE second module ("Vertical Drift"). I worked on the **first designs of a charged particle beam line for the dual-phase liquid argon LAGUNA prototype detector** to be tested at CERN.

2012

7 DUNE Coll., **FERMILAB-DESIGN-2016-01, FERMILAB-DESIGN-2016-02, FERMILAB-DESIGN-2016-04**

8 B. Aimard et al, **JINST 16 P03007B**.
B. Aimard et al., **JINST 13 (2018) P11003**

OPERA experiment[9](Oscillation Project with Emulsion-tRacking Apparatus)
http://operaweb.lngs.infn.it/

In 2012 OPERA has profited of a period of data taking with a short-bunch narrow-spacing proton beam. The beam structure was composed of 4 batches per extraction and 16 bunches per batch[10]. The timing system of the experiment was also improved on purpose.

- **Coordinator of the statistical analysis of the data collected with the special run to perform a more precise measurement of the neutrino velocity and member of the OPERA task force on timing measurements**
  Steps of the analysis:
  · New calibration of the timing chain at CERN,
  · Analysis of the bunched-beam events and quality cuts to select the final data sample,
  · Evaluation of the time link corrections to be applied to the selected data,
  · Correction related the position of the neutrino interaction in the detector to refer it to the reference point used for the baseline determination,
  · Other corrections that improved significantly the RMS of the event distribution (e.g. the corrections to get rid of jitter effects and of a small drift of the new OPERA master clock),
  · Comparison between internal and external events and study of possible energy dependencies for internal charged current events.

2011
OPERA experiment

Data analyses related to the measurement of the neutrino velocity[11]:
· Coherence among CNGS extractions/data taking periods,
· Possible day/night or seasonal effects,
· Consistency of the result using internal events only,
· Test of possible dependence on the beam intensity or on the energy,
· Biases related to the data statistical treatment and to the response of the beam line components to long lasting pulses using the data taken with a short-bunch wide-spacing neutrino beam. Using this beam it was possible to reduce the statistical uncertainty with only a few days of data by associating the events to their bunches within the proton spill,

Diamond detectors were installed at the end of the beam line at CERN to monitor muons created together with neutrinos by meson decays. These detectors were coupled to the two muon detectors for the monitoring of the muon, ionization chambers with no time resolution:
· Comparison of diamond detectors distributions with the measured proton distributions: confirmation of the hypothesis made, that the neutrino event time distribution is directly related and described by the one of the protons.

2008→2011: PhD conducted in joint supervision between the Bologna University and the Université Claude Bernard Lyon 1

9 OPERA Coll., **Phys.Rev.D89 (2014), 051102**
OPERA Coll., **JHEP 1311 (2013) 036**, Erratum: JHEP 1404 (2014) 014
OPERA Coll., **JHEP 1307 (2013) 004**, Addendum: JHEP 1307 (2013) 085
OPERA Coll., **New J.Phys. 14 (2012) 033017**
OPERA Coll., **New J.Phys. 14 (2012) 013026**
10 OPERA Coll., **JHEP 1301 (2013) 153**
T. Feldman et al., **44th Annual Precise Time and Time Interval Systems and Application Meeting, Proc.**
11 OPERA Coll., **JHEP 1210 (2012) 093**

In 2009 I was awarded the **Vinci Program funds (Università Italo Francese/Université Franco Italienne for international joint supervision of PhD programs)** for the complementary and interdisciplinary scientific project presented**.** I also had a **scholarship for education of young researchers abroad within the Marco Polo Program of the Bologna University**.
Thesis "Neutrino velocity measurement with the OPERA experiment in the CNGS beam"[12]

OPERA experiment[13]
I have been working in OPERA at the LNGS from 2008 to 2011 giving significant contributions to the detector running, the analysis of the electron neutrino sample and the measurement of the neutrino velocity.

- **Data analyses for the measurement of the neutrino velocity**:
  - Analysis of the OPERA neutrino events over 3 years of data taking (2009-2011). These events are precisely correlated with the proton pulses impinging in the CNGS target at CERN. The shape of the time distribution of the OPERA events is compared to that of the proton pulses (10.5 μs) in order to measure the neutrino time of flight (TOFν). A model of the cumulative time distribution of the OPERA events is obtained by summing up all the waveforms measured and corresponding to the selected neutrino events. The time distribution of the OPERA events is compared to the PDF distribution obtained. The parameter studied is the time shift δt representing a possible deviation of TOFν with respect to the time of flight assuming speed of light (TOFc). The most probable value of δt is extracted by maximizing a likelihood function built from the PDF functions. The analysis is performed with a blind technique.
  - OPERA-CNGS synchronization at the ns level. It is accomplished by two twin systems made of Cs atomic clocks coupled to GPS receivers working in "common view mode".
  - Study and link of the CERN and LNGS timing systems
  - Timing response simulation of the OPERA electronic sub-detectors
  - Simulation of effects due to the ignorance on the decay point along the CNGS beam line of the secondary particles producing neutrinos
  - Simulation of the effect on time resolution due to the ignorance on the interaction point in the rock surrounding the detector for neutrinos producing a muon crossing it
  - Optimization of the event selection criteria and final data sample selection
  - Evaluation of time link corrections between the two timing systems calculated at the single event level.
- **Geodesy campaign to precisely measure the neutrino baseline:** Collaboration with the geodesy group of Rome University "Sapienza" for the dedicated geodesy campaign to precisely measure the baseline between CERN and LNGS, **we achieved 20 cm accuracy over the 730km length**.
- **First studies on the sub-dominant oscillation $\nu_\mu \rightarrow \nu_e$:**
  - Signal over background kinematical separation, based on the simulated spectra of visible energy, missing transverse momentum and primary vertex electron energy distributions, taking into account the actual performance of the OPERA experiment.

12 G. Brunetti, (2012), **LAP Lambert Academic Publishing, ISBN-13 978-3-659-22444-7**

13 OPERA Coll., **New J.Phys. 13 (2011) 053051**
OPERA Coll., **Phys.Lett. B 691 (2010) 138-145**
OPERA Coll., **Eur.Phys.J. C67 (2010) 25-37**
OPERA Coll., **JINST 4 (2009) P04018**
OPERA Coll., **JINST 4 (2009) P06020**
OPERA Coll., **JINST 3 (2008) P07002**
OPERA Coll., **JINST 3 (2008) P07005**
OPERA Coll., **JHEP 1307 (2013) 004**

- Simulated background samples: νe contamination component of the beam, τ→e decays from the dominant $\nu_\mu \rightarrow \nu_\tau$ oscillation, NC events with a pion misidentified as electron or with electrons coming from gamma conversion and CC $\nu_{\square}$ events wrongly identified as NC.

2006→2007: Master degree thesis at Bologna University

In the framework of **Scholarships for research periods abroad** awarded by the Bologna University I spent a research period at CERN collaborating with the CNGS group and at the IPNL (France).
Thesis: "Study of the neutrino beam for the OPERA experiment"

CNGS (Cern Neutrino to Gran Sasso)
https://home.cern/science/accelerators/cern-neutrinos-gran-sasso

Beam studies during the commissioning phase in 2006. Tests to achieve accurate knowledge of the response of the various components of the beam line: the graphite target, a secondary emission monitor downstream of the target, the focusing system, the decay tube and two muon monitors at the end of the beam line.

- **Commissioning of the beam**:
  - study of possible misalignment effects of the beam with respect to the collimator, the target and the focusing system,
  - analysis of muon detectors data in different focusing conditions or with different alignments of the beam line components,
  - analysis of possible correlations between different beamline components,
  - analysis and troubleshooting of database malfunctioning,
  - definition and implementation of a quality variable based on the centroid of the muon monitors to control the beam focusing.
- **Data/simulations comparison**.

These studies allowed working in stable conditions during the LNGS experimental runs and Monte Carlo tuning with real data.