

## Curriculum Vitae

## Andrea LONGHIN



Born December 09, 1976 in Noale (VE), Italy.

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### Education

- 2003 **Ph.D. in Physics** *Measurement of beauty production in ep collisions in the  $\mu D^*$  channel*, supervisor R. Brugnera at Università degli Studi di Padova.
- 2000 **Degree in Physics** *Measurement of the beauty photoproduction cross section with muon + dijets in ep collisions at HERA*, supervisor R. Brugnera at Università degli Studi di Padova obtaining full marks: 110/110 *cum laude*.

### Present position

- 2018- **Associate Professor at University of Padova**
- 2016-2018 **Permanent researcher at INFN-Padova**
- 2011-2016 **Permanent researcher at INFN-Frascati National Laboratories**

### Previous positions

- 2009-2011 **Post-doctoral fellowship** at IRFU, CEA-Saclay, (FR)
- 2004-2008 **Research associate at Physics Dep. / INFN of Bologna, Padova, Bari and Napoli (IT)**

### Scientific leadership

- 2020-2023 **Coordinator of “INFN-PD Gruppo 2”** (astroparticle and neutrinos) in Padova
- 2021- **Coordinatore gruppo fondi DOR** (Dotazione Ordinaria Ricerca) con DFA-UNIPD.
- 2021- **Membro del Gruppo per l’accreditamento e la valutazione (GAV)** per il DFA-UNIPD.
- 2016-2022 **Principal Investigator** of ENUBET (Enhanced NeUtrino BEams from kaon Tagging) **Consolidator Grant 2015 (2 M€ budget)** from the European Research Council
- 2017-2022 **P. I. of NUTECH** (NeUtrino Time-tagged bEams with Cherenkov detectors) **Decreto del fare 2017 (220 k€)** from MIUR
- 2016-present **Responsible** at INFN-PD of ENUBET\_2 (INFN-CSN2)
- 2014- **Deputy Physics Coordinator** of the OPERA Coll. In the OPERA executive board
- 2015- **Scientific Secretary** of the **Scientific Committee** of INFN-Frascati National labs (LNF).
- 2015- **OPERA Publication and Talks board** member (1/4)
- 2016- **Responsible** at INFN-LNF for the SCENTT project
- 2015- **Responsible** at INFN-LNF for the T2K project
- 2011- **Responsible** of the INFN-LNF OPERA **Emulsion Scanning Station**
- 2016- **Convener** of the T2K Inclusive Cross section Physics group
- 2013- **Committee of reviewers** for the T2K cross section group and OPERA papers
- 2012-2015 **Responsible** at INFN-LNF for the NESSiE project
- 2014 **Convener** at *Neutrino Oscillation International Workshop NOW 2014*, Sept. 2014 Otranto (IT)
- 2013 **Convener** of *Incontri sulla Fisica Alte Energie. IFAE 2013*, Cagliari (IT)
- 2006-2008 **Responsible** of the OPERA Emulsion Scanning Station at INFN-LNL (Legnaro)
- 2012-2015 (2000-2004) **Detector expert** for the T2K time-projection chamber (ZEUS  $\mu$  chambers)
- 2003-2004 **Installation team** of the OPERA magnetic spectrometer

### Research performances

#### Funding:

2 M€ through the European Research Council ENUBET Consolidator Grant.

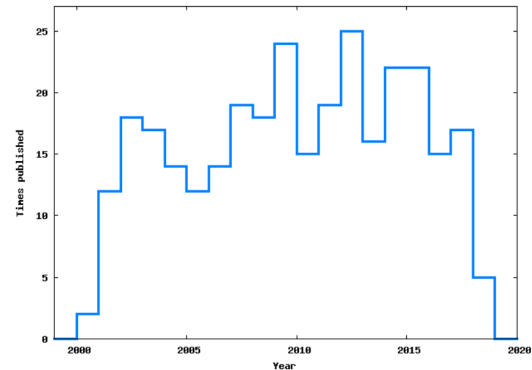
**220 k€ Decreto del Fare for NUTECH** from MIUR (2017).

**75 k€** through the 2<sup>nd</sup> / 5<sup>th</sup> INFN Commissione Scientifica Nazionale for the NESSiE, T2K and SCENTT activities.

**Publications:**

**236** in international journals with more than **15000** citations (details below).

	Citable	Published
Tot. papers	<b>297</b>	247
Tot. citations (per paper)	<b>18971 (63.9)</b>	18359(74.3)
Renowned (> 500 citations)	5	5
Famous (250-499)	8	8
Very well-known (100-249)	33	32
Well known (50-99)	51	50
Known (10-49)	136	122
Less known (1-9)	52	28
Unknown	12	2



Publications by year (2000-2019).

<http://inspirehep.net>, 14/11/2019.

**h-index = 75** (from the Google Scholar).

**Career supervision:**

- **Studenti triennali:** F. Turato (OPERA), M. Zoccoletti, N. Manara, E. Baci (ENUBET)
- **Studenti laurea magistrale:** M. Pari (ENUBET)
- **PhD:** M. Pari (ENUBET), C. Delogu (ENUBET)
- **Post-doc:** N. Mauri (OPERA), F. Pupilli (OPERA/ENUBET), A. Ajmi (T2K), G. Brunetti (ENUBET), M. Pozzato (ENUBET), A. Falcone (NUTECH), A. Branca (NUTECH).

**Visiting at international research laboratories**

- 1999-2004 **Deutsches Elektronen-Synchrotron (DESY)**, Hamburg (DE) working within the *ZEUS Coll.* as a Summer Student, diploma and Ph. D student.
- 2003-2006 **Gran Sasso INFN national underground laboratories (LNGS)**, Assergi (IT) as a post-doc for the construction and commissioning of the **OPERA** experiment.
- 2005 **Fermilab US national labs (FNAL)**, Aurora (IL) **PEANUT** experiment
- 2010-2016 **Japan Proton Accelerator Research Complex (J-PARC)**, Tokai (JP), **T2K** experiment
- 2015-2017 **CERN**, 2-4 weeks/year for test beams at the PS-T9 beamline for ENUBET

**Organisation of scientific meetings and schools**

Program definition, speakers/sponsors contacts, chairing, proceedings reviewing for:

- 02/2012: *RPC2012 XI Resistive Plate Chambers and related detectors*, LNF (IT). ~ 100 participants
- 04/2013: *Incontri sulla Fisica Alte Energie. IFAE 2013*, Cagliari (IT). ~ 130 participants
- 09/2014: *Neutrino Oscillation International Workshop NOW 2014*, Otranto (IT). ~ 150 participants
- 05/2014-2016: *XVII LNF Spring School Bruno Touschek*, LNF Frascati (IT). ~ 40 students
- 02/2017: *XVII Neutrino Telescopes 2017*, Venezia (IT) ~ 110 participants

**Editorial activity (referee)**

- Nuclear Instruments and Methods in Physics Research Section A (N.I.M. A)
- Journal of Instrumentation (JINST)

## Major Collaborations, EU programs and roles

- **2000-2006 ZEUS Coll. (450 people)** at DESY, Hamburg. *High Energy electron-proton collider.*
  - Expert of the muon chambers and of the micro-vertex radiation monitor system.
  - Responsibility in the Muon trigger upgrade.
  - Development of the real-time control software of micro-vertex radiation monitor detectors.
- **2003-present OPERA Coll. (150 people).** *Direct detection of  $\nu_\mu \rightarrow \nu_\tau$  with emulsion detectors.*
  - 2014-present deputy Analysis Coordinator.
  - 2003/2004 responsibility in the quality testing of Resistive Plate Chambers detectors and installation of the OPERA muon spectrometers at LNGS.
  - Responsible of the scanning laboratories at LNL (2006-2008) and LNF (2011-present).
  - Corresponding author/reviewer of milestone publications.
- **2006 International Scoping Study of a future Neutrino Factory and Super-Beam facility**
  - Coll. with the Detector Group: magnetized emulsion detectors proposal.
- **2009-2011 EUROnu FP7 program (WP2, 20 people).** *R&D for future neutrino facilities in Europe.*
  - Responsible for the simulation and optimization of the SPL-Fréjus neutrino Super Beam.
- **2009-2011 LAGUNA FP7 program.** *A study for long-baseline neutrino experiments in Europe.*
  - Simulation of fluxes and assessment of the best performing long-baselines configurations.
- **2010-present T2K Coll. (500 people).** *Determination of the  $\theta_{13}$  mixing parameters through  $\nu_\mu \rightarrow \nu_e$* 
  - Installation and expert of the Time Projection Chambers.
  - Reviewer in the cross section analysis group.
  - Convener in the inclusive cross-section group.
- **2012-2014 NESSiE Coll. (50 people).** *A proposal experiment for the search for sterile neutrinos.*
  - INFN responsible at LNF for the NESSiE proposal. Design of muon spectrometers.
  - Responsible of the neutrino flux simulations, editor of the experimental proposal(s).
- **2012-2015 Phenomenological studies / development of new ideas (1-5 people)**
  - INFN task force investigating CP violation perspectives with a CERN to Gran Sasso long baseline neutrino experiment (presenter of outcomes at the  $\nu$ Turn conference at Gran Sasso).
  - **Proposer of a program for positron tagged neutrino beams for the “What Next” INFN initiative.**
- **2016-2022 ENUBET** ERC Consolidator Grant program 2015. 2 MEUR budget in 60 months (3 post-docs, > 10 people).
- **2017-2022 NUTECH** P.I. Decreto del fare (MIUR). 220 kEUR in 4 years.

## Prizes

- **Breakthrough prize in Fundamental Physics 2015** (awarded by the Milner foundation) with K. Nishikawa and the T2K Coll. **Citation:** *For the fundamental discovery and exploration of neutrino oscillations, revealing a new frontier beyond, and possibly far beyond, the standard model of particle physics.*

## Invited talks at international conferences and workshops

- 06/2020 **Neutrino2020** virtual conference (Chicago, US) [Novel neutrino beams video](#)
- 02/2020 **CNNP2020** (Kogelberg Biosphere, South Africa, ZA) [ENUBET](#)
- 08/2019 **3 Neutrinos and Beyond**, (Quy Nhon, VN), *ENUBET*
- 06/2019 **WIN 2019** (Bari, IT), *ENUBET*
- 01/2019 **SPSC open session** (CERN, CH), *ENUBET*
- 11/2018 **GDR Neutrino** (Strasbourg, FR), *ENUBET*
- 10/2018 **European Neutrino Town meeting & ESPP2019 discussion** (CERN, CH), *ENUBET*
- 10/2018 **Neutrino Interactions workshop NUINT 2018**, (L'Aquila, IT), *ENUBET*.
- 06/2017 **Neutrino Interactions workshop NUINT 2017**, (Toronto, CA), *ENUBET*.
- 03/2017 **Neutrino Telescopes**, (Venice, IT). *ENUBET*.
- 09/2016 **Neutrino Oscillation Workshop** (NOW2016), (Otranto, IT). *ENUBET*.

- 02/2016 **Lake Louise Winter Institute**, (Lake Louise, CA), *Recent results from OPERA*
- 12/2014 **DISCRETE**, (London, GB) *Recent Results from the OPERA experiment at the CNGS beam*
- 07/2014 **Beauty 2014**, (Edinburgh, GB) *Beauty contribution to the  $p$  structure function and charm results in  $ep$  collisions at HERA.*
- 05/2012 **vTurn**, (LNGS, IT). *Opportunities for leptonic CP violation and mass hierarchy at LNGS.*
- 03/2012 **Moriond Electro-Weak**, (La Thuile, IT). *Recent results from OPERA.*
- 07/2009 **NuFact 09**, (Chicago, US). *EUROnu Super Beam Studies.*
- 06/2008 **Physics in Collisions**, (Perugia, IT). *OPERA: waiting for the  $\tau$ .*
- 10/2005 **RPC05**, (Seoul, SK) *OPERA Spectrometers RPC system installation and underground tests.*
- 04/2005 **DIS 2005** (Madison, US): *Measurement of beauty production with  $\mu\mu$  correlations.*
- 07/2003 **QCD 03**, (Montpellier, FR) *Heavy Flavour Production in  $ep$  collisions.*
- 03/2002 **Moriond QCD**, (Les Arcs, FR) *Heavy Flavours at HERA.*

## Teaching and Outreach

Teaching experience of about **270 hours** at the Physics Department of Padova University in **general physics, laboratory courses and scientific computing**.

In 2018 I have been responsible for the **General Physics course for Mechanical engineers** (odd id numbers) with 56 hours of classes to about 200 students.

Since 2019 I am responsible of the course of “**Esperimentazioni di Fisica 2**” (laboratory course of optics and electromagnetism) for the students in **Physics** (2<sup>nd</sup> year annual course with about 180 students).

Outreach for external visitors and students at INFN Frascati on a regular basis and at The Notte dei Ricercatori in Padova (2017 and 2018).

## Descriptive track-record of the scientific achievements

I have developed my scientific activity in the field of **high-energy physics**. In the first part of my career I have been formed in the environment of a large experimental Coll. at a **collider experiment** (ZEUS) while in the second part I have been working on **neutrino physics with accelerator produced beams** (OPERA, T2K Coll.s). I have balanced my engagement between detectors construction/commissioning, data analysis and simulation of new approaches.

*During my PhD* (2000-03) I decided to study experimentally the **production of beauty quarks in electron-proton interactions**, a process being at those times not well constrained and of significant interest as a test of perturbative Quantum Chromo Dynamics ( Eur. Phys. Journal C). I engaged myself in the life of the experiment being at **DESY** as a responsible of the operation of the **muon chambers** of the ZEUS detector (the largest apparatus of this kind at those times). I also developed the readout of a newly designed **radiation monitoring** system designed to protect the inner vertexing silicon tracker from possible particle beams losses. This hardware was finally successfully in operation during the last year of run (2006).

*After my PhD* neutrino physics was undergoing one its most exciting periods (i.e. the solar neutrino puzzle was finally solved by SNO) so I became interested in it and joined the OPERA experiment. I was responsible for a large scale data quality assurance program for **Resistive Plate Chambers detectors** (active surface > 1000 m<sup>2</sup>) and actively coordinated in situ (at the Gran Sasso underground laboratory) the **installation of the OPERA magnetic spectrometers** (mass of about 2 kt)[1]. In 2006-2008 I successfully **initiated the activity of nuclear emulsions scanning in Padova** by setting up a new dedicated laboratory (the first charm 3-prong decay of OPERA was observed). I have been actively involved in the  **$\nu_\tau$  appearance analysis**.

In parallel, since 2006, I have always been interested in the **future ideas/proposals** in neutrino physics (for example within the *International Scoping Study of a future Neutrino Factory and Super-Beam facility*). In 2009 I moved to France at IRFU **CEA-Saclay as a post-doc** and started working in the **FP7** projects **EUROnu** [2] and **LAGUNA** [3]. With a team of physicists and engineers (EUROnu-WP2) from UK, France and Poland I developed a technical design report for a future **neutrino Superbeam** with a completely new design and a deep optimisation ( Phys. Rev. ST Accel. Beams). Moreover I published my horn-optimisation

and sensitivity studies as **single author** in [2]. The optimized neutrino fluxes which I simulated have been used in more than ten neutrino phenomenology papers in later years. I continued being involved in experimental programs by joining the **T2K** international Coll. based in Japan. In 2010 I was in **Japan** for the installation of the **Time Projection Chambers** of the T2K experiment near detector and I was directly involved in the **analysis of the early neutrino data** (T2K technical notes 14, 15).

In February **2011** after undergoing a national-level selection I was selected for a **permanent researcher position at INFN Frascati National laboratories (LNF)** where I started my activity as an independent researcher. Since **2012** I became the proposer for a new activity (**NESSiE**) for the study of possible new states (**sterile neutrinos**). I was a leading player in the experiment simulations and design (see, for example, [6]). I have also had the opportunity to develop a research network by having frequent contacts with other parties being involved in this new proposal both in EU and US (the experiment was proposed at CERN Geneva and FERMILAB, Illinois).

At LNF I also continued my commitment within the *T2K Coll.* Thanks to the successful operation of the detector in 2012 the **first measurement of  $\nu_\mu \rightarrow \nu_e$  oscillations and of the neutrino mixing angle  $\theta_{13}$**  at a long baseline experiment [4, 5] became possible ([4] was awarded by the French review “La Recherche”). For these achievements I was awarded the **Breakthrough Prize in Fundamental Physics** with K. Nishikawa collaborators in 2015 (Milner foundation).

In 2012 I have worked for the INFN task force investigating the **perspectives of a CERN to LNGS experiment for the measurement of CP violation in the leptonic sector** (responsible of the simulation). I presented the results at the  $\nu$ Turn2012 workshop [7].

In 2012 I met the criteria required, at a national level, to access 2<sup>nd</sup> level academic professorship in Italian Universities (*Abilitazione Scientifica Nazionale*).

In **2012-13** I have been **editor** and corresponding author of two milestone publications of the *OPERA Coll.* dealing with the discovery of  $\nu_\mu \rightarrow \nu_\tau$  transitions (the main scientific goal of the experiment) [8, 9]. I am currently the **Deputy Physics Coordinator**.

In **2014**, beside continuing my commitments in OPERA, T2K and NESSiE, I started working out a precise layout for a **new-concept neutrino beam based on Kaon tagging** and proposed an experimental program in the context of the INFN initiative called **What Next** trying to foster fresh ideas for future experiments. I have presented the outcomes in the INFN What Next meeting (Padova, 2/12/2014). The paper is published by European Physical Journal C [10].

In **2015** I have proposed, in the role of principal investigator, a research project based on this idea, **ENUBET (Enhanced NeUtrino BEams from kaon Tagging)** which has been financed by the European Research Council within Consolidator Grant 2015 call with a **total budget of 2M EUR**. The project will start on **1 June 2016 for a duration of five years**. The team of interested people is presently composed of about 35 physicists from INFN and other foreign institutes (CERN, Protvino, IN2P3). Three new post-doctoral fellow positions are foreseen. The activity will also be represented in the Commissione Scientifica Nazionale 2. An Expression of Interest to CERN SPSC is going to be submitted.

In **2016 the activities of the five ENUBET Work-Packages<sup>1</sup>** started. The activity is also represented in the Commissione Scientifica Nazionale 2 INFN as ENUBET<sub>2</sub>. I have submitted an **Expression of Interest at the CERN SPSC<sup>2</sup>** committee to support the ENUBET program connected with CERN (beam tests, development of the hadronic beamline and of new proton extraction schemes) with 41 signatures allowing an official recognition and a continuous review of the scientific program. ENUBET has also been recognised as an R&D program within the **Neutrino Platform**. I have lead two **test beam sessions at CERN-PS-T9 in July and November** to check the response of a shashlik calorimeter prototype with full hadronic containment with pions, electrons and muons from 1 to 5 GeV at grazing incidence. I have hired **two collaborators with a senior post-doc profile** (Bologna e Padova), and tutored two **students** for their thesis on ENUBET (“triennale” and “magistrale”).

1 <https://agenda.infn.it/signIn.py?returnURL=https%3A%2F%2Fagenda.infn.it%2FcategoryDisplay.py%3FcategId%3D875>

2 ENUBET EOI at CERN SPSC: <https://cds.cern.ch/record/2221984/files/SPSC-EOI-014.3.pdf>

In **2017** I have proposed, within the so-called “Decreto del fare” funding scheme, the **NUTECH** (*NeUtrino Time-tagged bEams with CHerenkov detectors*) project which has been approved with a budget of **220 k€**. NUTECH extends the idea of ENUBET in the direction of a neutrino beam allowing time-coincidences between neutrinos at decay and interaction (time-tagged neutrino beam) by employing Micro-Channel-Plate detectors with Cherenkov radiators. We have continued an intense experimental **program at the PS-T9 beamline** totalling 5 weeks in May, August and October (the beam time allocation is subject to the scientific scrutiny of the CERN-SPSC committee). In particular, I have developed and successfully tested in collaboration with INFN-LNL, the first prototypes of **shashlik calorimeters based on Polysiloxane scintillators**. I have hired a **new collaborator with a senior post-doc** profile for the simulation of the hadronic beamline of ENUBET. I am tutoring a new **PhD** student (M. Pari) working on novel proton extraction schemes at the CERN-SPS being of interest for ENUBET. This position has been recognised in the context of the CERN doctoral student program.

I have disseminated the program and the scientific results of **ENUBET at these conferences**<sup>3</sup>: NOW2016, NEUTEL2017, NUINT2017, NUINT2018, WIN2019, Rencontres du Vietnam 2019.

In parallel I have continued my activity in **T2K** and **JENNIFER WP3** through the anti-neutrino cross section analysis in the FGD1 in collaboration with A. Ajmi (post-doc at Padova University) and the convenership of the subgroup on inclusive and single pion cross sections. I am actively participating to the experiment common duties: DAQ, shift leader and TPC expert shifts, revision of technical notes/papers and participation to general meetings in Japan.

Since March 1<sup>st</sup> 2018 I am working as **associate professor at the University of Padova**. In spring 2018 I have been responsible of the course in General Physics (Fisica 1) for mechanical engineers (56 h for about 200 students). I am currently responsible of the course of “Sperimentazioni di Fisica 2” for students in Physics (76 h ~150 students).

I have had a leading role for important Coll. papers both for ZEUS (450 members), OPERA (150) and T2K (500). I have papers written as single author reflecting directly my personal work (for example in the redesign of the SPL-Fréjus Superbeam) or in small groups (studies on CP violation, tagged neutrino beams). Here below I report, among the most recent ones, those ten which I judge as being scientifically more relevant and at the same time reflecting my direct contribution. I am corresponding author of [8, 9] and single author of [2]:

1. *First events from the CNGS neutrino beam detected in the OPERA experiment.* R. Acquafredda *et al.*, [New J. Phys. 8 \(2006\) 303](#).
2. *A new design for the CERN-Fréjus neutrino Super Beam* A. Longhin. [Eur. Phys. J. C71 \(2011\) 1745](#).
3. *Optimization of neutrino fluxes for future long baseline neutrino oscillation experiment* S. Di Luise, A. Longhin, A. Rubbia. [PoS ICHEP2012 \(2013\) 386](#).
4. *Indication of Electron Neutrino Appearance from an Accelerator-produced Off-axis Muon Neutrino Beam* T2K Coll. (K. Abe *et al.*). [Phys. Rev. Lett. 107 \(2011\) 041801](#).
5. *Observation of Electron Neutrino Appearance in a Muon Neutrino Beam.* K. Abe *et al.* [Phys. Rev. Lett. 112 \(2014\) 061802](#).
6. *An Appraisal of Muon Neutrino Disappearance at Short Baseline* L. Stanco, S. Dusini, A. Longhin, A. Bertolin, M. Laveder. [Adv. High Energy Phys. 2013 \(2013\) 948626](#).
7. *CP violation and mass hierarchy at medium baselines in the large  $\theta_{13}$  era* S. Dusini, A. Longhin, M. Mezzetto, L. Patrizii, M. Sioli, G. Sirri, F. Terranova. [Eur. Phys. J. C73 \(2013\) 2392](#).
8. *New results on  $\nu_{\mu} \rightarrow \nu_{\tau}$  appearance with the OPERA experiment in the CNGS neutrino beam.* OPERA Coll., 30 pages, [JHEP 1311 \(2013\) 036](#).
9. *Evidence for  $\nu_{\mu} \rightarrow \nu_{\tau}$  appearance in the CNGS neutrino beam with the OPERA experiment.* OPERA Coll., [Phys. Rev. D 89 051102\(R\) \(2014\)](#).
10. *A novel technique for the measurement of the electron neutrino cross section.* A. Longhin, L. Ludovici, F. Terranova, [arXiv:1412.5987](#). [Eur. Phys. J. C, April 2015, 75:155](#)

<sup>3</sup> <http://enubet.pd.infn.it/pub.html>

## **Other skills**

- English, French (fluent), Italian (mother), Mandarin, German, Japanese (basic).
- Fortran77, c, C++, LATEX, paw, GNUPLOT, ROOT, GEANT4, FLUKA, GloBES

Padova, 19/04/2021

*I authorise the use of my personal data in compliance with art.13 of the Legislative Decree 196/2003 and art.13 of GDPR 679/2016*