CURRICULUM VITÆ
Enrico NARDI

Personal Records

- **Nationality:** Italian.
- **Date and place of birth:** 23 December 1955. Milano, Italy.
- **Codice Fiscale:** NRDNRC55T23F205B
- **Languages:** Italian, English, Spanish, French.
- **ORCID iD:** 0000-0001-7165-3808.
- **Mailing address:** INFN - Laboratori Nazionali di Frascati
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Synopsis and highlights of scientific activity

Five papers single authored already during Ph.D./first postdoc (1990-1993). No papers with Ph.D./M.Sc. supervisors. More than 50 co-authors, mostly younger and international. Original contributions in: LEP physics, GUT models $[SU(5), SO(10), E_6]$, B-physics, SUSY without R-parity, neutrino physics (mass models, form factors, non-standard ν interactions, ν's from supernova and pulsars), flavour symmetries, leptogenesis, dark matter, axion physics and dark sectors. More than 4,700 citations to refereed articles with five or less authors . Total of 74 refereed journal articles [average: 64 citations/article], h: 33. Supervision: 7 postdocs; 5 Ph.D., 4 M.Sc., 2 B.Sc. thesis. Chair of 18 international workshops/conferences/schools. Coordinator of the LNF Theory Group. Referee for CSN4 Linea 5 (Astroparticle physics). Evaluator for both calls (2018, 2019) of the FELLINI - Fellowship for Innovation at INFN, co-financed through the EC Marie Sklodowska-Curie COFUND Action. Local Responsible of CSN4 IS on Theoretical Astroparticle Physics (TAsP).

Academic Education and Working Experience

Academic Education

1987: Degree in Theoretical Physics, University of Trieste, (110/110 *cum laude*)
1989: Master in Elementary Particle Physics, SISSA-ISAS, Trieste (30/30 *cum laude*)
1990: *Research Associate* in the Program for Advanced Graduate Student, CERN (CH)
1991: Ph. D in Elementary Particle Physics, SISSA-ISAS, Trieste

Postgraduate and working experience

1991-1994: Post-doctoral fellow, University of Michigan – Ann Arbor, (USA).
1994-1997: Research fellow, Feinberg Graduate School, Weizmann Institute of Science (IL)
1997-2009: Professor of Physics, Postgraduate program, University of Antioquia (CO)
2001-2008: INFN Researcher (level 3) - Laboratori Nazionali di Frascati (RM)
2009-2019 INFN Primo Ricercatore (level 2) - Laboratori Nazionali di Frascati (RM)
2010-2011: Visiting professor in the Master Program, Madrid Autonoma University & Institute for Theoretical Physics, Madrid (ES)
2018-2024: Italian ASN: "Abilitazione a professore di prima fascia, settore 02/A2" (with all required indicators well above the reference thresholds).

Present position

Since 01/01/2019: INFN Research Director (level 1) - Laboratori Nazionali di Frascati (RM)

Scientific leadership, institutional assignments and development

1999-2008: Head of the particle physics group GFIF, U. Antioquia (CO)
2002-present: Local responsible INFN "Iniziativa Specifica" TAsP (previously FA51)
2009-2011: Member of the LNF Selection Committee for "Assegni di Ricerca"
2011: Member of the INFN selection committee for INFN Postdoctoral Fellowships for non Italian citizens for the CSN4 IS FA51
2014-2017: Local LNF responsible for PRIN-2012 in Theoretical Astroparticle Physics
2015-2019: Coordinator of the Theory Group of the Frascati National Laboratories (1st term)
2015-2019: Internal referee for Astroparticle Theory, Linea 5 INFN CSN4 (1st term)
2016: President of the INFN selection committee for INFN Postdoctoral Fellowships for non Italian citizens for the INFN IS: TAsP
2017: President of the selection committee for LNF Summer Students (call n. 18789/17)
2017-present: Associated member of the European Organization for Nuclear research (CERN)
2018: Responsible of the LNF selection committee for INFN Postdoctoral Fellowships for non Italian citizens for the INFN IS: TAsP
2019-2021: Responsible of the LNF postdoctoral position "Cabibbo Fellowship"
2015-present: Internal referee for Astroparticle Theory, Linea 5 INFN CSN4 (2nd term)
2019-2022: Coordinator of the Theory Group of the Frascati National Laboratories (2nd term)

Early experience gained abroad, in developing the first Ph. D. program in theoretical particle physics in the Antioquia Department (CO) at the University of Antioquia, teaching a different course each semester to make up for the initial lack of sufficiently trained professors, setting up a HEP group with funding from several governmental and University grants, organizing international HEP schools, conferences and workshops in that country.

Scientific output and metrics (inSPIRE Database)

- 86 articles in refereed international journals (80 with five or less authors)
- more than 6,300 citations
- average citations per paper: 73
- h-index: 39
- 114 citable papers (including proceedings and reports), with more than 7000 citations

Awards and recognictions

1989: *"Fondazione Della Riccia"* fellowship at the " Laboratoire de Physique Mathématique de l' Université de Languedoc ", Montpellier (FR)
2003-present: European member in the International Scientific Committee of the *"Latin American Symposium of High Energy Physics"*

2006: (U. Antioquia, Fac. Science) Parchment *"In recognition of the leadership of the HE group and for the contributions to the excellence and development of scientific research in the Faculty."*

2009: (U. Antioquia, Fac. Science) Plaque and commendation letter reporting: *Your commitment, responsibility, ethics, honesty, initiative, vocation and leadership, always accompanied by excellent human relations, which leave an indelible mark on our institution. Your contributions from different international fronts were essential to achieve the recognition that the Institute of Physics enjoys today as a leading academic dependency in the country. Receive our admiration and gratitude forever.*

2017: Highlight as a Physics Review Letters Editors' Suggestion for the article *"Redefining the axion window"* by L. Di Luzio, F. Mescia and E. Nardi [Phys. Rev. Lett. 118, 031801 (2017)]"Due to its particular importance, innovation, and broad appeal"

2018: Awarded a María de Maeztu grant for visiting scientists at the Institut de Ciències del Cosmo, Universitat de Barcelona during May 2018.

2018 Awarded a Simons Foundation grant for visiting scientist at the Aspen Center for Physics, CO (USA) as invited participant in the workshop "Understanding the Origin of the Baryon Asymmetry of the Universe?"

2019: Awarded a María de Maeztu grant for visiting scientists at the Institut de Ciències del Cosmo, Universitat de Barcelona during May 2019.

2019 Awarded a Simons Foundation grant for visiting scientist at the Aspen Center for Physics, CO (USA) as Leader of the Working Group "The landscape of QCD axion models".

2020: Highlight as a Physics Review Letters Editors' Suggestion for the article *"Solar axions cannot explain the XENON1T excess"* by L. Di Luzio, M. Fedele, M. Giannotti, F. Mescia and E. Nardi [Phys. Rev. Lett. 118, 031801 (2017)]"Due to its particular importance, innovation, and broad appeal"

2022: Awarded a María de Maeztu grant for visiting scientists at the Institut de Ciències del Cosmo, Universitat de Barcelona during May 2022.

2022: Awarded a five years *Team Grant* from the Estonian Research Council.

Grants & Research Projects

1998-2000: *"Study of rare B meson decays for testing the standard electroweak theory and constraining of new physics"*. Funding agency: Colciencias (CO) (50,000 eu. - 5 pers.)

1999-2001: *"Neutrino Oscillations in High Density Matter"*. Funding agency: Comité de Investigaciones, UdeA (CO) (10,000 eu. - 3 pers.)

2001-2002: *"Neutrino masses and mixings in supersymmetry without R-parity"*. Funding agency: : Comité de Investigaciones, UdeA (CO) (5,000 eu. - 3 pers.)

2004-2006: *"Computing Yukawa couplings in $SU(5) \times U(1)$"*. Funding agency: Comité de Investigaciones, UdeA (CO) (10,000 eu. - 3 pers.)

2004-2006: *"Searching for sub eV-scale neutrino masses using supernova neutrinos"*, Funding agency: Colciencias (CO) (30,000 eu. - 4 pers.)

2005-2006: *"Sostenibilidad"* - Project to strengthen and develop the *Grupo de Fenomenologia de las Interacciones Fundamentales (GFIF) - UdeA"*, Funding agency: Comité de Investigaciones, UdeA (CO) (30,000 eu. - 10 pers.)

2006-2007: *"Flavor Effects in Leptogenesis and Neutrino Physics"*. Funding agency: Colciencias (CO) (50,000 eu. - 10 pers.)

2002-present *INFN CSN4 Iniziativa Specifica on Astroparticle Physics:* TAsP. LNF local coordinator (non-competitive basis grant).

2010-2011: INFN-MICINN ACI2009-1038 grant for collaboration between LNF and the U. of Barcelona. Research Project: *"Low scale leptogenesis"* (8,000eu. - 4 pers.)

2014-2017: *PRIN-2012: Theoretical Astroparticle Physics*, local coordinator (for LNF and U. Rome 1 groups).

2018-2018: ICCUB-María de Maeztu Grant for for visiting scientists at ICCUB (2,500eu.)

2019-2019: ICCUB-María de Maeztu Grant for for visiting scientists at ICCUB (1,000eu.)

Recent talks and invitations

Recent invited talks/lectures at International Conferences/Workshops (last five years only)

2022 (Invited talk) *"The X17 boson anomaly: status and prospects."* Conference "7th ComHEP", Villa de Leyva (Boyacá), CO, November 28 - December 2, 2022

2022 (Parallel) *"14th Latin American Symposium on High Energy Physics"* Universidad San Francisco de Quito, Cumbayá, Quito, (EC), November 14-18, 2022

2022 (Invited talk) *"More on Axion Model Building."* Workshop "Invisibles' 22", Orsay, Paris-Saclay University, June 20-24, 2022

2022 (Invited talk) *"The physics case for axion searches in the mass range 0.5-2 μeV."* Online workshop "Physics Opportunities at 100-500 MHz Haloscopes", February 17-18, 2022

2021 (Invited talk) *"The axion: phenomenological implications and open theoretical problems."* Invited talk. Online conference "XII3/4 Latina American Symposium on High Energy Physics", November 8-12, 2021

2021 (Plenary) *"Axion quality from gauge flavour symmetries"* 16th PATRAS workshop on Axions, Wimps and Wisps, Online Workshop (*June 14-18, 2021)*

2019 (Plenary) *"QCD Axions off the beaten tracks"* 15th PATRAS workshop on Axions, Wimps and Wisps, Freiburg (D) (*June 3-7, 2019*)

2018 (Plenary) *"Understanding the origin of the Baryon asymmetry of the Universe"* Aspen Center for Physics, Aspen, CO (*August 26 - September 16, 2018)*

2017 (Plenary) *"New Directions in Dark Matter and Neutrino Physics"* Perimeter Institute for Theoretical Physics, Waterloo, ON (CA)

2017 (Plenary) *"New Physics at the Intensity Frontier"* CERN-EPFL-Korea Theory Institute CERN, Geneva (CH)

2017 (Plenary) *"2nd ComHEP: Colombian Meeting on High Energy Physics"* UNAL, Bogota

2016 (Plenary) 2016 MIAPP programme *"Why is there more Matter than Antimatter in the Universe?"* Munich, (D)

2016 (Plenary) ERC-Grant workshop *"Towards the Construction of the Fundamental Theory of Flavour"* MIAPP, Munich (D)

2016 (Plenary) *"6th International Workshop on High Energy Physics in the LHC era"* Universidad Técnica Federico Santa María, Valparaiso (CL)

2016 (Plenary) *"1st ComHEP: Colombian Meeting on High Energy Physics"* ITM, Medellin (CO)

2016 (Parallel) *"TeV Partilce Astrophysics"* (TeVPA), CERN (CH)

2016 (Parallel) *"11th Latin American Symposium on High Energy Physics"* Antigua, (GT)

Recent invitations (last five years only)

2022 Visiting scientist at the Institut de Ciències del Cosmo, Universitat de Barcelona
2021 NICPB, Tallinn, Estonia. Short-term visitor, 18-23 October 2021
2020 CERN-TH short-term visitor, (COVID-9 postponed)
2020 MIAPP Workshop *"Axion Cosmology"*, Munich, March 1-13
2019 Proposer and Working Group Leader *"The Landscape of Axion mModels":* Aspen Center for Physics, (USA)
2019 Visiting scientist at the Institut de Ciències del Cosmo, Universitat de Barcelona
2018 Aspen Center for Physics, CO (USA)
2018 Visiting scientist at the Institut de Ciències del Cosmo, Universitat de Barcelona
2017 Visiting researcher, CERN Theory Group, Geneva (CH)
2017 Visiting scientist, Perimeter Institute for Theoretical Physics, Waterloo, ON (CA)
2017 Invited participant, CERN-EPFL-Korea Theory Institute, CERN, Geneva (CH)
2016 Munich Institute for Astro- and Particle Physics, MIAPP, Munich (D)

Coordinator of International Cooperation Agreements:

2001-2002 *Cooperation Agreement:* Physics Institute, Antioquia U. (CO) & International Center for Relativistic Astrophysics (ICRA) (Rome - Italy)

2001-2002 *Cooperation Agreement:* Physics Institute, Antioquia U. (CO) & University of Valencia (Spain) (2001-02). Funding Agencies: COLCIENCIAS (Colombia) & CSIC (Spain).

2002-2007: *Federation Arrangement:* Abdus Salam International Centre for Theoretical Physics (Trieste - Italy) & Physics Institute, Antioquia U. (CO)

Organization of Scientific Events

– *Proposer/Chair of Conferences, Workshops and Schools*

2022 Proposer/Contact person: GGI Workshop *"Axions Beyond Boundaries between Particle Physics, Astrophysics, Cosmology and forefront Detection Technologies"*. Approved for the 2023 GGI workshop program, April 17 to June 2, 2023 GGI, Arcetri, Firenze.

2019 Deviser and co-chair of the *Rome Physics Encounters LNF*
`https://agenda.infn.it/category/1150/`

2019: Proposer/Co-Chair of the LNF Autumn Institute on *"Directional Sub-GeV Dark Matter Detection"*
`https://agenda.infn.it/conferenceDisplay.py?confId=19972`

2019: ACP Working Group Leader: *"The landscape of QCD axion models"*
Aspen Institute of Physics, Aspen (CO-USA) 14-28 July 2019.

2019: Chair: LNF Summer Institute on *"Flavour anomalies in B decays, light dark matter from hidden sectors and lepton dipole moments"*
`https://agenda.infn.it/conferenceDisplay.py?confId=19324`

2019: Chair: LNF Spring Institute on *" The importance of being light: Axions, Nambu-Goldstone Bosons, and Vector Bosons in the Dark"*
`https://agenda.infn.it/conferenceDisplay.py?confId=19200`

2019: Chair: LNF Winter Institute on *"Axions in Astrophysics and Cosmology"*
`https://agenda.infn.it/conferenceDisplay.py?confId=17880`

2018: Chair: LNF Summer Institute on *"Flavor Physics, axion phenomenology and dark sectors"*
`https://agenda.infn.it/conferenceDisplay.py?confId=15950`

2014-2017: Deviser & main organizer of the Rome Joint Workshops series

2017: Chair: 6th Rome Joint Workshop *"Weird Theoretical Ideas"*
`https://agenda.infn.it/conferenceDisplay.py?confId=14269`

2017: Chair: 5th Rome Joint Workshop *"Hot QCD Matters"*
`https://agenda.infn.it/conferenceDisplay.py?confId=13016`

2016: Chair: 4th Rome Joint Workshop *"Selected puzzles in Particle Physics"*
`https://agenda.infn.it/conferenceDisplay.py?confId=12099`

2016: Director: *XVIII Frascati Spring School "Bruno Touscheck"* & *5^{th} Young Researcher Workshop* `http://www.lnf.infn.it/conference/lnfss/16/index.php`

2015: Chair: 3rd Rome Joint Workshop *"Challenges in the Dark Sector: Alternatives to the WIMP paradigm"* `https://agenda.infn.it/conferenceDisplay.py?confId=10217`

2015: Chair: 2nd Rome Joint Workshop *"Top mass: challenges in definition and determination"*
`https://agenda.infn.it/conferenceDisplay.py?confId=9202`

2014: Chair: 1st Rome Joint Workshop *"Rethinking Naturalness"* ,
`https://agenda.infn.it/conferenceDisplay.py?confId=8527`

2014: Director: *XVII Frascati Spring School "Bruno Touscheck"* & *4^{th} Young Researcher Workshop,* `http://www.lnf.infn.it/conference/lnfss/14/index.php`

2012: Director: *XVI Frascati Spring School "Bruno Touscheck"* & *3^{rd} Young Researcher Workshop,* `http://www.lnf.infn.it/conference/lnfss/12/index.php`

2010: Director: *XV Frascati Spring School "Bruno Touscheck"* & *2^{nd} Young Researcher Workshop,* `http://www.lnf.infn.it/conference/lnfss/10/index.php`

2010: Organizer: Course on *Space-time metrics, Cosmology, Inflation and Dark Matter*, LNF

2009: Co-chair of the Local Organization Committee:
CERN School: 5th Latin American School of High-Energy Physics, Antioquia (CO)
`http://physicschool.web.cern.ch/PhysicSchool/LatAmSchool/2009/`

2009-2016: Deviser, Chair and Editor of the proceedings of 5 editions of the Frascati Young Researcher Workshop "Physics Challenges in the LHC Era"

2009-2016: Director of 5 editions of the : *Frascati Spring School "Bruno Touscheck"*

2009: Director: *XIV Frascati Spring School "Bruno Touscheck"* & *1^{st} Young Researcher Workshop,* `http://www.lnf.infn.it/conference/lnfss/09/index.php`

2007: Co-Chair: *International Meeting on Lepton Properties and the Cosmological Origin of Matter*, Antioquia, (CO) `http://csi.uan.edu.co/imlpcom07/index.htm`

2003: Chair of the session: *Neutrino Physics, Astrophysics and Cosmology*, 10th Marcel Grossmann Meeting on General Relativity, Rio de Janeiro (BR)

2000: Chair: *III Latin American Symposium on High Energy Physics*, (SILAFAE-III), Cartagena de Indias, (CO)

1997: Director: *XII Colombian School in Theoretical Physics*, San Andres Islas, (CO)

– Member of Organizing & Scientific Committees of Workshops, Conferences and Schools

2019: Convener of the *"Ultralight Dark Matter"* session at the *"Light Dark Matter at Accelerators (LDMA)"* conference, Venice, November 20-22, 2019

2018: Member of the Organizing Committee: *XIX Frascati Spring School "Bruno Touscheck" & 6^{th} Young Researcher Workshop*

2002-08: Member of the Organizing Committee:
LNF Spring School in Nuclear, Subnuclear and Astroparticle Physics "Bruno Touscheck", INFN - Laboratori Nazionali di Frascati. (Years 2002/03/04/05/06/07/08).

2006-09: Member of the Organizing Committee: *LNF Spring Institute* (Years 2006/07/08/09).

2002 - : Member of the Scientific Committee: *Latin American Symposium on High Energy Physics*, (SILAFAE) (2002 - present).

1994: Member of the Organizing Committee: *International Workshop on Supersymmetry and Unification of Fundamental Interactions SUSY-94*, U. of Michigan, Ann Arbor, (USA)

Scientific Reviewer:

Projects and proposals reviewer: FONDECYT (Chile); National Science Centre (Poland); Comité para el Desarrollo de la Investigación (Antioquia U., Colombia); Erwin Schrödinger International Institute for Mathematics and Physics (U. of Vienna, Austria); French National Research Agency (ANR) (France).

Editorial boards:
Member of the Editorial Board of the journal *Particles* (ISSN 2571-712X).

Referee of Scientific Journals:
Physical Review Letters, Physical Review D, Nuclear Physics B, Physics Letters B, JHEP (Journal of High Energy Physics), JCAP (Journal of Cosmology and Astroparticle Physics), Modern Physics Letters A, Journal of Physics G, New Journal of Physics, Europhysics Letters, European Physical Journal C.

Thesis Supervision and Teaching

Career supervision (abridged)

- 5 Ph. D. students (*all presently holding academic positions*)
- 1 ongoing Ph. D. supervision (Rome Tor Vergata U.)
- 5 M. Sc. students, 2 B. Sc. (*all presently holding academic positions*)
- 12 Postdoctoral fellows [D. Aristizabal (CO), E. Peinado (MX), C.S. Fong (MY), A. Meroni (IT), S. Boucenna (DZ), M. Krauss (DE), F. Björkeroth (SE), F. Giacchino (IT), L. Visinelli (IT), J.L. Darmé (FR), G. Grilli di Cortona (IT), A. Plascencia (MX)]

Ph. D., M. Sc. & B. Sc. thesis (detailed):

- **Ph. D.**: Dafne Guetta, (**presently:** Researcher, Osservatorio Astr. Roma), Topic: *B Physics in SUSY without R-parity.* Bologna U., (February 1999).
- **Ph. D.**: Jesus M. Mira (**presently:** Associate Professor, Antioquia U., CO), Topic: *B Physics in SUSY without R-parity.* Antioquia U. (December 2000).
- **M. Sc.**: Jorge I. Zuluaga (**presently:** Associate Professor, Antioquia U., CO), Topic: *Pulsar Kicks.* Antioquia U. (February 2001).
- **M. Sc.**: Diego Aristizabal (**presently:** Associate Professor, U. Técnica Federico Santa María, Valparaíso, CL), Topic: *Flavor Symmetries.* (January 2004).
- **Ph.D.**: Jorge I. Zuluaga (**presently:** Associate Professor, Antioquia U., CO), Topic: *Supernova neutrino signals.* Antioquia U. (January 2005).
- **B. Sc.**: Jorge Noreña (**presently:** Associate Professor, Pontificia U. Católica de ValparaíÄ±so, CL), Topic: *Leptogenesis.* Antioquia U. (June 2006).
- **M. Sc.**: Luis F. Duque (**presently:** Professor, ITM - Medellín), Topic: *Flavor Symmetries in GUT Models.* Antioquia U. (February 2007).
- **B. Sc.**: Carolina Arbelaez (**presently:** Postdoc, U. Técnica Federico Santa María, Valparaíso, CL), Topic: *Flavor Symmetries for ν masses.* (December 2010).
- **Ph. D.**: Luis A. Muñoz, (**presently:** Professor, ITM - Medellín), Topic: *Selected Issues in Leptogenesis.* Antioquia U. (April 2010).
- **M. Sc.** - César Arias, (**presently:** Assistant Professor, ITM - Medellín) Topic: *Flavour in Leptogenesis.* Antioquia U. (June 2011).
- **Ph. D.**: Cristian D. Ruiz Carvajal, (**presently:** Contract Professor, UdeA, Medellín), Topic: *Phenomenology of axion dark matter.* Antioquia U. (February 2019).
- **M. Sc.** - Clemente Smarra, (**presently:** Ph.D. Student, SISSA-ISAS - Trieste) Topic: *The Axion-Flavour connection.* U. Sapienza, (Rome - IT) (September 2021).
- **Ph. D.** (ongoing) - Francesco P. Di Meglio, (**presently:** Ph.D. Student, Univ. RM2) Topic: *Peccei-Quinn protection from flavour gauge symmetries.* Rome U. 'Tor Vergata' , Expected date of defense: September 2024).

Didactics and teaching (abridged)

- 3 graduate and 12 postgraduate courses: Subatomic Physics, Electromagnetism, Advanced topics in the Standard Model, Physics beyond the Standard Model, Quantum Field Theory, Supersymmetry, Astroparticle physics, Physics of the early universe, at U. Antioquia (CO) and U. Autonoma Madrid (ES).
- 4 invited short courses in Universities and Schools, on physics of the early Universe: U. of Southern Denmark (DK), U. Barcelona (ES), U. San Carlos (GT), Astro-scuola 2001, Otranto (I) .

Teaching: courses in Undergraduate, M. Sc., Ph. D. programs and Physics Schools (detailed)

- *Three lectures on the physics of the Early Universe*
  9th Odense Winter School on Theoretical Physics - CP3-Origins University of Southern Denmark - Odense (DK) - February 6-10, 2017.
- *Standard Model II.* (M. Sc.). 2^o semesters 2010 and 2011, Physics Department, Madrid Autonoma University Madrid, (Spain).
- *Four lectures on the Early Universe: 1. Boltzmann Equations, 2. Recombination, 3. Nucleosynthesis, 4. Freeze-out of WIMP Dark Matter.* (M. Sc. & Ph. D.)
  Barcelona University - June 14-18, 2010.
- *Introduction to Quantum Field Theory.* (M. Sc.)
  University San Carlos de Guatemala - February 5-9, 2007.
- *Neutrinos in Physics and Astrophysics* . (Graduate Level).
  1 semester, Ph. D. program, U. Antioquia (Medellín - CO)
- *Introduction to the Standard Model.* (Undergraduate Level).
  2 semesters, U. Antioquia (Medellín - CO)
- *Advanced topics in the Standard Model.* (Graduate Level).
  1 semester, Ph. D. program, U. Antioquia (Medellín - CO)
- *Supersymmetry.* (Graduate Level).
  3 semesters, Ph. D. program, U. Antioquia (Medellín - CO)
- *Introduction to Subatomic Physics.* (Undergraduate Level).
  2 semesters, U. Antioquia (Medellín - Colombia)
- *Selected topics in Physics of the Early Universe.* (Graduate & Undergraduate Level).
  1 semester, U. Antioquia (Medellín - Colombia)
- *Electromagnetism I.* (Undergraduate level).
  3 semesters, U. Antioquia (Medellín - CO)
- *Introduction to Quantum Field Theory* (Graduate Level).
  3 semesters, Ph. D. program, U. Antioquia (Medellín - CO)
- *Neutrinos and Supernovae.* Lectures at "AstroScuola 2001 - Prima Scuola Nazionale in Fisica delle Astroparticelle" Conca Specchiulla (Otranto, Lecce) 11 - 16 June 2001.
- *From Quarks to Cosmos.* Lectures at *Incontri di Fisica dell' INFN* Frascati (Roma) 5 -7 Settembre 2001.

Outreach ("Terza Missione"):

2022 Outreach Conference, Universidad Pedagógica y Tecnológica de Colombia, Tunja, "Nature' s fundamental constants and Modern Physics", November 30th, 2022.

Collaboration with the LNF *"Information and Scientific Dissemination Service"* for the Instagram Educational and Outreach blog "in other words".

2021 Collaboration with the LNF *"Information and Scientific Dissemination Service"* for the Instagram Educational and Outreach blog "in other words".

2017 Collaboration to "LNF Highlights 2016" publication with the divulgative article "Where should we search to find the Axion?"
http://library.lnf.infn.it/wp-content/uploads/2017/09/Highlights2016.pdf

2016 Outreach Conference, ITM, Medellín, Colombia,
"Las constantes fundamentales de la naturaleza y la física moderna".

2016 Two talks at the 12th IPPOG International Masterclass 2016 at LNF
"Le costanti fondamentali della natura e la fisica moderna",
"Introduzione al Modello Standard".

2015 Talk at the 11th IPPOG International Masterclass 2015 at LNF
"Le costanti fondamentali della natura e la fisica moderna".

2013 Outreach Conference, Parque Explora, Medellín, Colombia,
"Las constantes fundamentales de la naturaleza y la física moderna".

2012 Conference for Scientific High Schools, Liceo Scientifico G. Marinelli, Udine
"Le costanti fondamentali della natura e la fisica moderna".

2007 Outreach conference, *Instituto Italiano de Cultura*, Ambasciata d' Italia,
Ciudad de Guatemala: "De los quarks al Cosmo".

2006– Scientific Collaborator for the INFN outreach project "ScienzaPerTutti".

2002 Outreach conference, Instituto di Fisica, Univ. de Antioquia, Medellín, Colombia,
"From quarks to Cosmos". July 29th, 2002.

2001 Outreach conference: *Corso di fisica per insegnanti di scuola media superiore,*
Laboratori Nazionali di Frascati, "Dai quarks al Cosmo".

Resumed List of Research Topics

- LEP Physics. Radiative Corrections in $SU(2) \times U(1)$. Top-quark mass loop effects.
- Global fits to high precision measurements and limits on new physics parameters
- GUT models. Non-conventional E_6 models.
- B-physics. Study of rare decays. New physics effects in B-decays. Excess of b-quarks production at LEP: analysis and models.
- SUSY without R-parity. Neutrino masses from broken R-parity. Models for R-parity as an accidental symmetry.
- Flavor Symmetries: models for charged and neutral fermion masses.
- Neutrino physics: electromagnetic form factors. Neutrino propagation in matter.
- Physics of Supernovæ and Pulsars. Models to explain *Pulsar Kicks*. Limits on neutrino masses from precise measurements of a Galactic supernova neutrino signal.
- Leptogenesis: Spectator processes; Flavor effects; CP asymmetries in scatterings. Low scale leptogenesis.
- Non-Abelian and Abelian flavor symmetries for neutrino masses. Related effects in leptogenesis.
- Dark Matter. Non-conventional candidates. Asymmetric Dark Matter. Dark Matter decays and related signals (anomalies) in cosmic rays fluxes. Dark Matter from GUTs.
- Spontaneous breaking of the $SU(3)^5$ flavour symmetry. Effective potential and phenomenological models.

- Axion physics.
- Dark photons and dark sectors.

Specific skills in leadership

- Experience in starting and developing research groups.
- Experience in leading research projects.
- Experience in preparing/submitting research proposals.
- Experience in the organization of scientific events.

Publications

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Journal Publications

1. **"The (g-2)$_\mu$ window discrepancy: a GeV scale new physics explanation"**
   Luc Darmé, Giovanni Grilli di Cortona, Enrico Nardi,
   Submitted to JHEP [arXiv:2212.03877 [hep-ph]].
2. **"The axion flavour connection"**
   Luc Darmé, Enrico Nardi, Clemente Smarra,
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6. **Frascati National Laboratory, INFN-LNF. 2005 Annual Report.**
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Publications during the years 2020-2022

Journal Publications

1. **"The (g-2)$_\mu$ window discrepancy: a GeV scale new physics explanation"**
   Luc Darmé, Giovanni Grilli di Cortona, Enrico Nardi,
   Submitted to JHEP [arXiv:2212.03877 [hep-ph]].
2. **"The axion flavour connection"**
   Luc Darmé, Enrico Nardi, Clemente Smarra,
   Submitted to Nucl.Phys.B [arXiv:2211.05796 [hep-ph]].
3. **"Resonant search for the X17 boson at PADME"**
   Luc Darmé, Marco Mancini, Enrico Nardi, Mauro Raggi,
   Submitted to Phys.Rev.D [arXiv:2209.09261 [hep-ph]].
4. **"Renormalization group effects in astrophobic axion models"**
   L. Di Luzio, F. Mescia, E. Nardi and S. Okawa,
   Phys.Rev.D 106 (2022) 5, 055016
5. **"Probing light mediators at the MUonE experiment"**
   Giovanni Grilli di Cortona, Enrico Nardi,
   Phys.Rev.D 105 L111701 (2022)
6. **"The μ g-2 anomaly confronts new physics in $e^\pm$ and $\mu^\pm$ final states scattering"**
   Luc Darmé, Giovanni Grilli di Cortona, Enrico Nardi,
   JHEP 06 (2022) 122
7. **"Stellar evolution confronts axion models"**
   L. Di Luzio, M. Fedele, M. Giannotti, F. Mescia and E. Nardi,
   JCAP 02 (2022) 035
8. **"Light dark matter searches with positrons"**
   M. Battaglieri et al.,
   Eur.Phys.J.A 57 (2021) 8, 253
9. **"Exact accidental U(1) symmetries for the axion"**
   Luc Darmé, Enrico Nardi,
   Phys.Rev.D 104 (2021) 5, 055013
10. **"Invisible decays of axion-like particles: constraints and prospects"**
    Luc Darmé, Federica Giacchino, Enrico Nardi, Mauro Raggi,
    JHEP 06 (2021) 009
11. **"Selective enhancement of the QCD axion couplings"**
    Luc Darmé, Luca Di Luzio, Maurizio Giannotti, Enrico Nardi,
    Phys.Rev.D 103 (2021) 1, 015034
12. **"An experimental program with high duty-cycle polarized and unpolarized positron beams at Jefferson Lab"**
    A. Accardi et al.,
    Eur.Phys.J.A 57 (2021) 8, 261

13. **"Solar axions cannot explain the XENON1T excess"**
L. Di Luzio, M. Fedele, M. Giannotti, F. Mescia and E. Nardi,
Phys.Rev.Lett. 125 (2020) 13, 131804

14. **"New production channels for light dark matter in hadronic showers"**
A. Celentano, L. Darmé, L. Marsicano and E. Nardi,
Phys.Rev.D 102 (2020) 7, 075026

15. **"The landscape of QCD axion models"**
L. Di Luzio, M. Giannotti, E. Nardi and L. Visinelli,
Phys.Rept. 870 (2020) 1-117

16. **"Covert symmetries in the neutrino mass matrix"**
F. Björkeroth, L. Di Luzio, F. Mescia and E. Nardi,
JHEP **2002**, 066 (2020)

17. **"Axion-electron decoupling in nucleophobic axion models"**
F. Björkeroth, L. Di Luzio, F. Mescia, E. Nardi, P. Panci and R. Ziegler,
Phys. Rev. D **101**, no. 3, 035027 (2020)

Proceedings and Reports

1. **"The muon (g-2) Standard-Model prediction and GeV-scale new physics"**
Luc Darmé, Giovanni Grilli di Cortona, Enrico Nardi,
Published in: PoS ICHEP2022 (2022) 707 • Contribution to: ICHEP 2022, 707.

2. **" TF07 Snowmass Report: Theory of Collider Phenomena"**,
Maltoni, F. *et al.*,
arXiv:2210.02591 [hep-ph].

Planned activities for the year 2023

A major appointment for year 2023 will be the analysis of the data that the LNF experiment PADME is presently collecting, with the aim of validating or ruling out the hypothetical $X17$ boson, a new particle with mass $m_X \sim 17\,\mathrm{MeV}$ that was introduced in 2016 to account for a series of anomalies observed by the Atomki collaboration in Debrecen (Hungary), in the decays to the ground state of excited states of ^{8}Be, ^{4}He and ^{12}C nuclei. The anomalies consist in a bump in the angular correlation spectrum of e^+e^- pairs emitted in the corresponding transitions, all of which are kinematically and dynamically consistent with the process $\mathcal{N}^* \to X_{17} \to e^+e^-$ where $\mathcal{N}^*$ represent the excited state of one of the three nuclei listed above.

Already at the beginning of 2018, together with two Ph.D. students and two other senior collaborators, I had proposed that the X_{17} could be searched at PADME via the resonant inverse process $e^+e^- \to X_{17} \to e^+e^-$ (E. Nardi *et al.*, "Resonant production of dark photons in positron beam dump experiments", Phys.Rev.D 97 (2018) 9, 095004). While a number of nuclear physics experiments are presently under development to test the Atomki result, by using the same nuclei, PADME is presently the only experiment that can test the X_{17} hypothesis via a completely different physics approach, that is the resonant production of the X_{17} via a particle physics process.

Another activity, relevant for fundamental physics studies in Frascati, that I plan do develop in 2023, is understanding what could be the sensitivity of an axion helioscope, as the FLASH helioscope of the LNF proposal, to gravitational waves (GW) through GW-photon conversion. Studies in this direction are presently in their infancy, but preliminary results suggest that an effort to understand the reach of helioscopes for GW detection in specific frequency bands is well worthwhile the effort.

Besides the two research activities mentioned above, during the next year I will keep developing a theoretical idea that I have been pursuing during the last couple of years, that is the construction of models that can relate the origin of a global Peccei-Quinn symmetry (related to the solution of the strong CP problem and to the existence of the axion) to the presence of a local non-Abelian symmetry that could account for fermion family replication and explain the standard model flavour puzzle (see: "*The axion flavour connection*", L. Darmé, E. Nardi, C. Smarra, `[arXiv:2212.03877]`; "*Exact accidental U(1) symmetries for the axion*", L. Darmé, E. Nardi, Phys.Rev.D 104 (2021) 5, 055013.)

For year 2023 I am also involved in a series of commitments with the organization of scientifica events. I am principal organizer and contact person of the workshop *"Axions across boundaries between Particle Physics, Astrophysics, Cosmology and forefront Detection Technologies"* that will be held at the Gaileo Galilei Institute for Theoretical Physics from April 26 to June 09, 2023. I am also the local organizer of the conference *"Dark Energy from Fundamental Theories to Observations"* that will be held at LNF from 11 to 15 September 2023.