

VINCENZO PATERA
Curriculum Vitae per la pubblicazione

General Information

Full Name	Vincenzo Patera
Citizenship	Italian
E-mail	Vincenzo.patera@uniroma1.it
Spoken Languages	Italian, English

Education – Academic Achievements

- 2014 Appointed with the Italian ASN National scientific qualification for FIS/01- 01/A2 scientific sector (“Sessione di abilitazione” 2012)
- 2002-now Confirmed Associate Professor at S.B.A.I. Department of Rome University “La Sapienza”
- 1999-2002 Associate Professor at Energetics Department of Rome University “La Sapienza”
- 1992-1999 Permanent Researcher at Energetics Department of Rome University "La Sapienza"
- 1992 Visiting Researcher at California Institute of Technology.
- 1990-1992 Permanent Researcher at Istituto Nazionale di Fisica Nucleare (INFN) at Frascati National Laboratory (LNF)
- 1988-1989 Research grant of INFN at Frascati National Laboratory
- 1987 Degree in Physics (Elementary Particle Physics): 110/110 cum laude at Rome University "La Sapienza"

Scientific Responsibilities

- 2016-now Spokesperson of the FOOT (FragmentatiOn Of Target) international collaboration (France, Germany, Italy, Japan)
- 2016-now Coordinator of the Working Package 5 “Charged detector for Imaging in Particle Therapy” of the European Nuclear Science and Applications Research (ENSAR-2) - MediNet project.
- 2014-2016 Principal Investigator (PI) of the NCS@HIT experiment at Heidelberg Ion-Beam Therapy Center (HIT) funded by the Union of Light Ion Centers in Europe (ULICE) Program for the study of the beam fragmentation in Particle Therapy
- 2012-2015 PI of the Flagship Project (Progetto Premiale) of the MIUR (Italian Ministry of Education, University and Research) for the Centro Fermi Research Institute: “Multiple source, real-time Imaging for Hadrontherapy”
- 2012-2015 PI at “La Sapienza” University of Rome of the PRIN project (Research Project of National Relevance) INSIDE: “Innovative Solution of Imaging and Dosimetry in Hadrontherapy”

- 2012-2016 PI of the INFN experiment RDH (R&D in Hadrontherapy) at Roma1 section
- 2012-now PI of the project of the Centro Fermi Research Institute: “Innovative non invasive imaging of dose release in hadrontherapy”
- 2010-2015 Spokesperson of the FIRST-S361 (Fragmentation of Ions Relevant for Space and Therapy) international collaboration at GSI laboratory (Darmstadt, Germany)
- 2009-2012 PI of the INFN project TPS (Treatment Planning System for hadrontherapy) at Frascati National Laboratory of INFN
- 2006-2009 PI at “La Sapienza” University of Rome of the PRIN project on “Read-out optimization and DAQ electronics development of a scintillating fiber tracking calorimeter”

Memberships and Associations

- 2017 Member of the selection Committee for the assignment of the INFN post-doc fellowships for foreigners
- 2016-now Member of the selection Committee for the assignment of the INFN post-doc fellowships of the Roma 1 section.
- 2016-now Member of the FOOT international Collaboration
- 2013-now Member of the Ph.D. School in Accelerator Physics at Rome University “La Sapienza”
- 2015-now Member of the post graduate Specialization School in Medical Physics at Rome University “La Sapienza”
- 2014-now Associate to Museo Storico della Fisica e Centro Studi e Ricerche Enrico Fermi
- 2012-2014 Member of the Laboratori Nazionali del Sud (LNS) Users Committee
- 2010-2015 Member of the FIRST international Collaboration
- 2010-2014 Member of the FLUKA international collaboration Scientific Committee
- 2008-now Member of the Policy Board of KLOE-2 (K Long Experiment) experiment at LNF
- 2006-2009 Member of the Panel for TARI (Transnational Access to Research Infrastructure) funds assignment of the European Network of Underground Laboratories: Boulby (EN) – Canfranc (ES) – Modane (FR) – Laboratori Nazionali del Gran Sasso (IT)
- 2004-now Member of the FLUKA international Collaboration
- 2003-now Member of the KLOE-2 international Collaboration
- 2003-2009 Member of the Panel for the TARI funds assignment of Laboratori Nazionali del Gran Sasso (LNGS) of INFN
- 2002-2005 Member of the Executive Committee of the Energetics Department of Rome University “La Sapienza”.
- 2001-2007 Member of the Scientific Committee coordinating the activity of LNGS of INFN
- 1992-2002 Member of the KLOE international Collaboration
- 1987-2005 Member of the MACRO (Monopole And Cosmic Ray Observatory) international Collaboration
- 1987-now Associate to Istituto Nazionale di Fisica Nucleare

Referee/Reviewer activities

- 2016-now Referee for DFG (German Research Foundation) for Nuclear and Medical physics project funding
- 2016-now Referee for FARE (Framework per l’Attrazione e il Rafforzamento della Ricerca) research projects of MIUR.

- 2010-now Reviewer of International Scientific Journals (Physics in Medicine and Biology, Physica Medica, Medical Physics, Journal of Radiation Research, Nuclear Instruments and Methods, Translational Cancer Research, Frontiers in Oncology, Advances in Physics, Transaction of Nuclear Science, IEEE Transactions on Radiation and Plasma Medical Sciences)
- 2015-2017 MIUR (Italian Ministry of Education, University and Research) referee for the research evaluation: VQR-2011-2014
- 2011-2014 MIUR referee for the research evaluation: VQR-2004-2010
- 2008-2016 Referee for PRIN and FIRB (Futuro In Ricerca) research project of MIUR
- 2007-2011 Referee of Padova University for the assignment of research grants in physics
- 2005-2006 Reviewer of CIVR (Comitato di Indirizzo per la Valutazione della Ricerca) of MIUR
- 2004-2018 Member of thesis jury for PhD examination at University of Rome “La Sapienza”, University of Rome “Tor Vergata”, University of Rome “Tre”, University of Milano, University of Napoli and University of Torino
- 2004-2007 Member of evaluation committee for the assignment of permanent researcher positions in experimental physics (FIS/01) at Perugia and Lecce Universities

Funding Information: grants obtained as principal investigator

Year	Program/Funding Agency	Grant value €
2016-now	FOOT (FragmentatiOn Of Target)/INFN	1.727.000
2012-now	“Innovative non invasive imaging of dose release in hadrontherapy” project / Centro Fermi	286.000
2013-2016	RDH (Research & Development in Hadrontherapy) project/ INFN	29.500
2014	Development of a TPS for hadrontherapy on GPU/Sapienza	7.000
2012-2014	Flagship Project “Multiple source, real-time Imaging for Hadrontherapy/MIUR-Centro Fermi	103.000
2013-2015	PRIN project “INSIDE” (Soluzioni Innovative per la Dosimetria "in-beam" in adroterapia oncologica)/MIUR	148.600
2009-2012	TPS (Treatment Planning System for hadrontherapy) project/INFN	113500
2003-2005	PRIN project “Read-out optimization and DAQ electronics development of a scintillating fiber tracking calorimeter/ MIUR	80.000
2005-2006	Engineering Faculty of University of Rome “La Sapienza” project: “Development of accelerator physics for medical applications”	2.500
2004-2005	Engineering Faculty of University of Rome “La Sapienza” project: “Development of Compton detectors for PET”	3.000

Other Achievements

- 2015 Inventor of the international patent “INTRAOPERATIVE DETECTION OF TUMOR RESIDUES USING BETA-RADIATION AND CORRESPONDING PROBES”, N.PCT/IT2014/000025

Teaching activity

The following teaching activity took place at University of Rome “La Sapienza”:

Academic Year	Faculty/Degree	Lecture/Course - CFU
2014-2018	Ingegneria Biomedica	Fisica delle Radiazioni applicata alla Medicina – 6 CFU
2012-2018	Ingegneria Meccanica	Fisica Generale II – 9 CFU
2009-2013	Ingegneria Biomedica	Radioprotezione e Complementi di Fisica – 6 CFU
2010-2012	Ingegneria Chimica	Fisica Generale II – 9 CFU
2008-2010	Ingegneria Elettrica	Fisica Generale II – 9 CFU
2005-2008	Ingegneria Clinica	Fisica Generale I – 6 CFU
2005-2008	Scienze per l’Ingegneria/Ingegneria Elettronica	Fisica Moderna – 3 CFU
2005-2008	Scienze per l’Ingegneria/Ingegneria Elettronica	Fisica Moderna – 3 CFU
2005-2006	Ingegneria Elettrica	Laboratorio di Fisica - 6 CFU
1999-2004	Ingegneria Elettronica	Fisica Generale II – 12 CFU
1997-1998	Ingegneria Ambiente e Territorio	Fisica Generale II – annual course
1996-1997	Ingegneria Meccanica	Fisica Generale I – annual course
1995-1996	Ingegneria Civile	Fisica Generale II – annual course
1992-1995	Ingegneria Elettronica	Fisica Generale II – (Exercises)

Other teaching experiences: V.P. has given lectures at

- 2017 University of Rome, PhD school in Mathematical models for Engineering, Electromagnetism and NanoScience, lecture “Science for Particle Therapy”
- 2017 University of Pisa, School “Rewriting nuclear physics textbooks”, lecture “Nuclear interaction for medicine”
- 2016 BEST (Board of European Students of Technology) School “House of Stars” at “La Sapienza” University, lecture “Radioprotection in Space”
- 2015 INFN National school on Rivelatori ed Elettronica per Fisica delle Alte Energie, Astrofisica, Applicazioni Spaziali e Fisica Medica, lecture “Particles fragmentation detectors: applications for particle therapy and radioprotection in space”
- 2013 INFN KM3NeT courses, lectures about “Interaction of Radiation with Matter”
- 2012 German Helmholtz PhD School, lectures about “Interaction of radiations with matter”
- 2009-10 “Master in Basi Fisiche e Tecnologiche dell’Adroterapia e della Radioterapia di Precisione” of Tor Vergata University in Rome, lectures about “MonteCarlo methods and Treatment Planning System for Particle Therapy”

Academic training and advancement of young scientists

- Supervisor of **34 master thesis** (“tesi specialistiche”) of the faculty of Engineering and of the faculty of Mathematics, Physics and Natural Science of the Rome University "La Sapienza".
- Supervisor of **9 Ph.D. thesis** of the Doctorate Schools of University of Rome "La Sapienza", of University of Rome "Tor Vergata" and University "Roma Tre".
- Supervisor of **1 thesis** of the specialization School of Medical Physics of Rome University “La Sapienza”.
- Tutor of several post-doc contracts funded by Università "La Sapienza", by INFN and by Centro Fermi Research Institute.

Outreach and dissemination activities

Year	Activity
2017	Educational seminar at “AccendiScienza”, Frascati: “Ospedale Nucleare: Cosa ci fa la fisica Nucleare in un ospedale? “
2012	Educational seminar at “Caffe’ & Scienza”, Rome: “Visione a Particelle Elementari”
2012	Interview on RAI-1 TV show “Uno Mattina”: “Curare tumori con il carbonio”
2003	Author of the educational book “L’Istituto Nazionale di Fisica Nucleare, la ricerca italiana in fisica subatomica”, Laterza Editori

Summary of the Scientific Production (source Scopus)

period	International papers	Citations	Citations / papers	H Index	Normalized H Index: H/time
Total production (until December 31 st 2017)	296	6188	20.9	41	1.46
Ten years production (January 1 st 2008 - December 31 st 2017)	136	1672	12.3	20	2.00

Total Scopus products with Impact Factor¹ = 225. Total Impact Factor = 644,43, with normalized Impact Factor per published paper = 2.18.

For publications relative to years when the Impact Factor was not yet available, the Impact Factor of the first available year has been assumed.

Summary of Research Activities

a) 2008-2018: Physics applied to particle therapy and to medical imaging

¹ Thomson Reuters Impact Factor obtained from <https://jcr.incites.thomsonreuters.com/>

In 2009 V.P. promoted the birth of the Applied Radiation Physics Group (ARPG) at “La Sapienza” University of Rome, acting since then as coordinator (<http://arpg-serv.ing2.uniroma1.it/arpg-site/>). ARPG aims at developing cutting-edge applications of nuclear and particle physics in the field of medical diagnostics and therapy.

The ARPG group members are from the Dipartimento di Scienze di Base e Applicate per l'Ingegneria and from Dipartimento di Fisica of "La Sapienza" University of Rome, but includes also members from Laboratori Nazionali di Frascati of INFN, from Milano section of INFN and from Centro Fermi Research Institute. The group is presently collaborating with research and therapy centers as the GSI Laboratory (Darmstadt, Germany), the HIT Ion-Beam Therapy Center (Heidelberg, Germany), the CNAO Centro Nazionale Oncologico di Adroterapia (Pavia, Italy), the IFJ PAN Proton Therapy Center (Krakow, Poland) and with the APSS Proton Therapy Center (Trento, Italy). The group has also close collaborations with several sections of Istituto Nazionale di Fisica Nucleare (Bologna, Cagliari, Catania, Frascati, Napoli, Pisa, Roma 2, TIFPA, Torino).

Notably, the group has focused its activity on nuclear techniques related with the use of hadron beams – mainly proton and carbon – for tumor treatment. This general activity is divided in several research streams:

- Evaluation of the effects of the ion beam fragmentation in the patient, both in carbon treatment (projectile fragmentation) and proton treatment (target fragmentation). During this ten years effort, V.P. has been the spokesperson of two international collaborations, aiming at hadron beam fragmentation studies: S371-FIRST (Fragmentation of Ions Relevant for Space and Therapy; Germany, France and Italy), which took data at GSI in 2011-2012, and the FOOT (FragmentatiON Of Target; Germany, France, Japan and Italy), which at present is in the design and construction phase of an apparatus that plans to take data on beam facilities at GSI, HIT and CNAO, starting in 2019. The FOOT experiment has been included in the Nuclear Physics European Collaboration Committee roadmap of 2017 and has been endorsed by the European Space Agency for its research program for radioprotection on space (**pub 6, 14, 15, 17**)
- V.P. along with the above experimental activity, coordinated an R&D effort of ARPG towards the optimization of the imaging of the dose release during the particle therapy treatment. The monitor of the beam range during the treatment is one of the major improvement of the quality assurance of the treatment and can be achieved exploiting the neutral and charged secondary flux produced by the interaction of the beam with the patient tissue. Due the absence of data about the secondary production, in particular at large angle with respect to the beam, V.P. has coordinated in the role of PI the design, construction, data taking, data analysis, and simulation of several measurement campaigns at the beams of LNS (Catania), GSI (Darmstadt), HIT (Heidelberg), CNAO (Pavia) and TIFPA (Trento). (**pub 4, 5, 8, 11**)
- The study of the mentioned secondary emission provided the V.P. group with the knowledge necessary for the design of an on-line monitor device, to be used at CNAO during therapeutic sessions for the beam range monitoring. This device is made of a compact tracker to detect on-line the charged secondary emission (Dose Profiler), allowing the monitoring of the carbon beam range during the treatment. The group led by V.P. designed and built the detector, the front-end electronics, the data acquisition and an innovative on-line reconstruction technique. A special joined effort with the CNAO technical personnel has been necessary to integrate the Profiler front-end electronics and the data acquisition with the dose delivery system of the treatment room. All this activity has been carried out initially within the INSIDE PRIN project and then within the Centro

Fermi Project dedicated to the Particle Therapy technology development, in both cases with V.P. as PI. (**pub 2, 3, 9**)

- In parallel with the above experimental activity, V.P. has been deeply involved in Monte Carlo software development applied to medical physics and radioprotection, notably to its use in developing the Treatment Planning System in particle therapy. Such an activity has been carried out within large collaborations such as the INFN-CERN FLUKA one (V.P. is one of the contributing author of the FLUKA code) and the INFN-TPS collaboration, which produced a Treatment Planning system for carbon and proton treatment in collaboration with the Ion Beam Application (IBA) company. As a further step in this field V.P. is at present coordinating the development of the FRED (Fast particle thErapy Dose evaluator) code: a Monte Carlo based software that can compute in a GPU environment the dose to be released to the patient by a proton beam reducing the CPU time of two orders of magnitude with respect to commercial TPS codes. That software is now on the way of the clinical testing in the CNAO Particle therapy center of Pavia and in the IFJ PAN proton therapy center of Krakow. (**pub 1, 7, 13, 16**)
- Finally, a parallel research stream has been focused on the development of an innovative intraoperative probe for brain surgery in oncology. Such an intraoperative tool, which effectively detects tumor margins in real time, could be a useful surgical adjunct for brain tumor resection. (**pub. 10, 12**). That work also provided V.P. of a patent about “Intraoperative detection of tumor residues using β - radiation and corresponding probes, N.PCT/IT2014/000025

b) 1993-today. Study of fundamental discrete symmetries of sub-nuclear interaction and of the quark mixing matrix unitarity.

This research took place in the framework of the international KLOE collaboration, that designed and built an apparatus optimized for the study of discrete symmetries (parity inversion, time inversion and charge conjugation) in the quantum system of charged and neutral kaon pairs generated in the decay at rest of phi mesons, and of the unitarity test of the quark mixing matrix (CKM). The KLOE data taking at the DAPHNE electron-positron collider of the Frascati National Laboratory of INFN ended in april 2006.

The contribution of the candidate to the detector was first focused in the design of the charged particle trigger system and in the development of the simulation and reconstruction software of the drift chamber.

V.P. was the coordinator of the analysis group that studied the charged kaon physics. This work updated all the charged kaon branching ration in literature and gave also an important contribution to the determination of the V_{us} element of the Cabibbo-Kobayashi-Maskawa (CKM) quark mixing matrix (**pub 18,19,20**).

In 2002 V.P. has become a member of the KLOE2 collaboration with the goal of improving the KLOE physics program at a renewed DAPHNE machine with an upgraded detector. The first data taking run of KLOE2 started in 2011. V.P. is member of the Policy Board of the KLOE2 collaboration since 2008.

c) 1987-2004 Study of high energy penetrating cosmic rays

The main effort in this field was carried out within the MACRO experiment, hosted in Hall B of the underground laboratories of Gran Sasso (INFN) and conducted by an Italy-US collaboration.

The aims of this experiment were the study of the penetrating cosmic radiation, the search for neutrinos from stellar collapses inside our galaxy, and the possible detection of magnetic monopoles of cosmological origin.

V.P. took part to the MACRO connection group with the EAS-TOP experiment, designed to detect Extended Atmospheric Cascades (EAS). The EAS-TOP apparatus was placed in Campo Imperatore at 1.3 km above the underground laboratories of Gran Sasso.

The candidate played an important role in the joint analysis effort that provided an accurate measurement of the cosmic ray flux, both in energy and composition.

The MACRO detector was optimized for the detection of magnetic monopoles. V.P. carried out the computation of the interaction probability (and the tracking efficiency) of the slow monopoles in the MACRO tracking system, providing an important contribution to the monopole flux limit determination.

Seminars and Conference Talks in the last five years

- Invited talk: “FOOT FragmentatiOn Of Target experiment” at PRESS: PRoton thErapy research SeminarS, Krakow, 2017
- Talk: “Foot, an experiment for the measurement of the nuclear fragmentation in Particle Therapy”, International Nuclear Physics Conference Adelaide, 2016
- Invited talk: “Novel developments in imaging and dosimetry for Hadrontherapy”, 54th Int. Winter Meeting on Nuclear Physics Bormio, 2016
- Seminar: “Nuclear aspects in hadrontherapy” at Universisty of Tor Vergata, Rome, 2015
- Invited talk: “What are the new challenges in Particle Therapy?”, IFD2015 workshop, Torino, 2015
- Invited talk: “Nuclear Fragmentation and Particle therapy”, 101 Congress of Italian Physics Society, Rome, 2015
- GSI Kolloquium: “Nuclear aspects in hadrontherapy” at GSI, Darmstadt, 2015
- Invited talk “Novel techniques for dose monitoring in particle therapy”, MEDAMI, Alghero, 2014
- Seminar at Ludwig-Maximilians-Universität Colloquium: “Nuclear aspects in hadrontherapy”, Munich, 2014
- Invited talk: “INFN Research and Development in Hadrontherapy” at international workshop: “HADRONTHERAPY: a new frontier for cancer treatment”, CNAO, Pavia, 2014
- Talk: “The INSIDE project: an integrated monitoring system for the on-line assessment of particle therapy treatment accuracy”, ICTR-PHE Geneva, 2014
- Invited talk: “The FIRST experiment: Fragmentation of Ions Relevant for Space and Therapy”, NUFRA, Kemer, Turkey, 2013
- Invited talk: “Nuclear fragmentation measurements for hadrontherapy”, INPC, Firenze, 2013

Roma 13/2/2018

Vincenzo Patera