

Francesco Arneodo



Education

- July 1997: Ph.D. degree in Physics awarded by the University of Rome - La Sapienza. The subject of the thesis was the study of the high energy gamma ray spectrum of the Crab Nebula.
- November 1993 - November 1996: Graduate student of the University of L'Aquila, working on the gamma ray telescopes of the EAS-TOP experiment at the Laboratori Nazionali Gran Sasso (LNGS) in Italy¹.
- July 1991 - July 1993: Postgraduate fellow of Istituto Nazionale di Fisica Nucleare, (INFN), Italy.
- October 1983 - October 1990: Master in Physics, University of Torino. Final grade: 110/110 *cum laude*. Subject of the thesis: study of high energy cosmic rays with the EAS-TOP experiment at LNGS².
- June 2011: Master of Business Administration, Warwick Business School, UK. Title of the final dissertation: "A case study of the internal evaluation system of a basic research organization".

Employment

- From September 2019: Professor of Physics with tenure at New York University Abu Dhabi.
- September 2015 - August 2019: Associate Professor of Physics with tenure at New York University Abu Dhabi.
- September 2016 - present: Associate Dean of Science at New York University Abu Dhabi (NYUAD).
- September 2016 - present: *ad interim* Program Head of Chemistry at NYUAD.
- September 2014 - August 2016: head of the physics program at New York University Abu Dhabi.
- September 2013 - August 2015: on leave of absence from INFN as visiting professor of Physics at NYUAD.
- 2005 - 2013 senior researcher ("primo ricercatore") at LNGS.
- 1997 - 2005: researcher at LNGS, tenured in 2002.

Other roles and qualifications

- Co-director for Scientific Research of Dhakira (NYUAD Center for Heritage Studies in the UAE) since September 2018.
- Member of the Board and of the Faculty Council of the Gran Sasso Science Institute, a doctoral school in L'Aquila, Italy (that I have contributed to establish - see further below).
- In 2012, I was ranked as full professor by the 'national academic qualification' exercise (<https://abilitazione.cineca.it/ministero.php/public/esitoAbilitati/settore/02%252FA1/fascia/1>), meaning that I can be called as full professor by any Italian university without further selection.

¹as 1994 was the first year of operation of the Physics graduate school of L'Aquila University, the degree was awarded by the already established graduate school of Rome - La Sapienza

²LNGS is an infrastructure owned and managed by INFN

Research

Activities at NYUAD

My goal at NYUAD is to establish in the Gulf area an experimental astroparticle physics group (the first to my knowledge), capable of international visibility, but with a strong local presence for the benefit of NYUAD students and of the wider community. Below I describe my group and our main activities.

Group Construction

My first hire has been [REDACTED], who has joined the group as Research Associate in October 2013, and is now Research Scientist giving an invaluable contribution to all group's activities. From 2015 to 2017 I have hired [REDACTED], a very talented young technician, who is now pursuing electronics engineering studies in Italy. Valerio has been instrumental in setting up our laboratory and in designing and building mechanical and electronics equipment. He has also helped the teaching activity building in-class demos. From 2015 to 2017 I worked with [REDACTED], Research Associate, especially skilled in software and analysis, who was coming from the AUGER cosmic rays experiment, and that left for a tenure position at the Université Libre de Bruxelles. In August 2017 I hired for 14 months only [REDACTED], as a co-technical coordinator of XENONnT (the evolution of XENON1T) and responsible for the design and commissioning of our laboratory's cryogenic facility (CRYSTALX). In November 2018, [REDACTED] joined us from LNGS, after a long experience in experimental astroparticle physics, both in the hardware and software sides. In July 2018 I have hired [REDACTED], recent graduate from University College, London, as young post-doctoral associate. [REDACTED] was previously employed at University College London as associate researcher. Affiliated to my research group are also [REDACTED], lecturer, and [REDACTED], physics instructor. Finally, [REDACTED], an NYUAD student who graduated in 2018, is continuing his collaboration with us as Graduate Research Assistant until October 2020 in the framework of the Dhakira Center For Cultural Heritage Studies.

XENON Dark Matter search

My NYUAD group joined officially the XENON collaboration as a new institution in 2014. Presently (August 2018), XENON1T is the most sensitive detector for WIMP (Weak Interacting Massive Particles) Dark Matter. We have recently published [1] one tonne-year of data, pushing the limit for WIMP Dark Matter down $4 \times 10^{-47} \text{ cm}^2$ for masses of $30 \text{ GeV}/c^2$. We are about to start the operations to upgrade the experiment to the more sensitive XENONnT, with about 8 tonnes of total xenon mass.

All the XENON detectors are Time Projection Chambers filled with liquid xenon (Liquid Xenon TPC - LXeTPC), XENON1T being the first one at the ton scale. See [2] for a detailed description of the technology and of the XENON1T detector. Below the list of our main contributions.

- We have designed, tested and installed (in Fall 2015) the resistor chain that guarantees the continuity and the uniformity of the electric field inside the TPC. We have also provided the system to measure the current flowing in the resistor chain, as a way to monitor the continuity of the field.
- We are in charge of the purification system of the water that fills the active shield surrounding the detector that features an inverse osmosis purifier (Osmoplanet DEMRO 2M 840), delivering up to $2.2 \text{ m}^3/h$ of water with a residual conductivity of $0.07 \mu\text{S}/\text{cm}$.
- We are involved in the data taking management. As a participating group in the experiment, we do (more than) our share of on-site shifts, and [REDACTED] has been Run Coordinator on several occasions. We provided the main server that manages the data handling of XENON1T. Several virtual machines (VM) run on this server, and one of them is dedicated to the Offline Monitoring (see below).
- Offline Monitoring: the idea of this system is that members of the collaboration can login to the web interface and check the evolution of some of the detector's parameters, like light yield, charge yield, over a

user selected time range. Because of the unexpected resignation of one member of the group (██████████), we could not complete this system on time for its use on XENON1T, but it is now ready in September 2018, being beta-tested on XENON1T data and will then be deployed on XENONnT.

- Data Analysis: we are involved in aspects of the data analysis in particular regarding the Muon Veto system (trigger and the synchronization of the Muon Veto and TPC clocks), and the 'electron recoil' (ER) region using radon calibration data. 2) Checked behaviour for SR2 of the area fraction top variable (NG, radon, kripton), checked acceptance too 3) ER band for Rn in v0bb analysis (high energy)
- Outreach: we have contributed to the scientific outreach aspects of the entire XENON1T project, mostly by starting and coordinating a professional video documentation of the project, whose outcome is a series of short movies on each of the sub-systems of the detector, and a longer movie on the entire project [3]. We have also provided a touch screen, placed in the Hall B of the LNGS, in front of XENON1T, to make those movies, and other outreach material, available to the public.

We are also contributing to the next phase of the program, XENONnT. In 2017/18, we have led the technical coordination of the project (through ██████████), in particular taking care of the following aspects:

- Editing of the Technical Design Report.
- Project managing.
- Quantitative Risk Analysis and definition of the general framework of the safety and environmental impact of the project.

We have also participated in the actual construction phase of XENONnT, which is currently (Summer 2019) being assembled at LNGS, Italy. Specifically, we have participated in the xenon distillation operations and in the cleaning of the parts of the detector (wires and electrodes) and in the wiring of the TPC.

Finally, we are members of DARWIN, a wider collaboration for the construction of the 'ultimate dark matter detector' [4], a multi-ton liquid xenon device capable of pushing the sensitivity to WIMP-like Dark Matter down to the the irreducible background of solar neutrino interactions. Our group, through ██████████, is leading one of the project's Work Packages: 'WP5, Light and Charge readout'.

Development of novel photodetectors and of front-end electronics for cryogenic environment

This is one of the first activities that we started at NYUAD. The need of improving the sensitivity of Dark Matter detectors, and specifically those employing liquid xenon or argon, calls for better ways of detecting UV scintillation photons. Standard photomultipliers represent a mature technology whose improvement is probably difficult; especially their bulkiness represents a problem in detectors that need to minimize the mass of their components, lest they introduce unwanted radioactive contamination. Our group, in 2013, started investing on the relatively new devices called 'Silicon Phomultipliers' (SiPMs, also known as Multi Pixel Photon Counters - MPPCs), that couple an extremely low mass (few grams), with the capability of resolving very well single photons with high quantum efficiency. One of the challenges of SiPMs is to build large surfaces without increasing the capacity and associated noise. We started working on SiPMs, gradually increasing our expertise and the capability of characterizing the new devices on the market in terms of their suitability to our intended applications. Our work culminated in 2018, with the realization of a 'tile' of 16 SiPMs, expandable to 64, that showed excellent S/N ratio, thanks to a clever and original electronics layout. This work (published) has been highly appreciated and included in the highlights at the ICASiPM 2018 conference, held in Schwetzingen, Germany, in June 2018. Our main achievements on this line of research are listed below.

- Construction of a first SiPM cosmic muons characterization device [5] (2014/15).
- Design and construction of an amplifier for cryogenic applications. [6] (2015/16).

- Characterization of several samples of SiPMs from various manufacturers (2015-2017).
- Design and construction of a system to group up to 64 SiPMs in a single tile [7] (2017/18).
- Design and construction of CRYSTALX, a facility for testing photosensors in vacuum and in noble liquids, in collaboration with CRIOTEC (<https://www.criotec.com/en>) (2017/18).
- Participation in conferences to present our results (see dedicated section).

Cultural Heritage

The application of nuclear and particle physics techniques to cultural heritage is a fun and useful application of our group's skills and capabilities. The occasion to start this activity was triggered by our link to INFN and specifically to their LABEC laboratory in Florence, one of the world's centers of excellence in applying physics to cultural heritage and the environment. In summer 2015, Capstone student ██████████ spent six weeks at LABEC, learning the basics of several techniques, and in particular X-Ray Fluorescence (XRF), that he subsequently applied to his Capstone research. Since then we collaborate with INFN-LABEC, exchanging visits focused on the development and improvement of a portable XRF scanner-spectrometer. The main achievements on this line of research have been:

- The construction of a fully functional, multi-detector XRF scanner-spectrometer that is now part of the Core Technology Platform at NYUAD. A paper on the instrument has been published [8].
- The formalization of a collaboration with INFN-LABEC and the connection to CH-Net, a wider cultural heritage network.
- A NYUAD Research Center proposal that encompasses Arts&Humanities, Science and Engineering, aimed at establishing a regional center of excellence for studies on cultural heritage and the use of tools from physics, chemistry and engineering to answer questions related to provenance, dating, restoration, etc, of art objects or archaeological findings.
- Two interdisciplinary Capstone projects, of ██████████ (2015) and ██████████ (2018).
- The organization of an international workshop, "Scientific Research for Cultural Heritage" [9], with another edition in 2019 (if funded).
- We started a collaboration with Louvre Abu Dhabi, soon to be formalized by an MoU, about the in situ analyses with our portable instrumentation. The first measurements at Louvre Abu Dhabi are going to take place in September 2019.

Cosmic Rays, outreach and muon tomography

This activity dates back to 2007, when ██████████ and I were working at LNGS, and very much involved in science outreach. Together with other LNGS colleagues we decided to build a cosmic ray detector with the capability of visualizing in real time the passage of charged particles, to catch the interest of students and the general public. We designed and built a couple of prototypes [10] which were shown in several occasions, including the G8 meeting held in L'Aquila in July 2009. The first prototype made use of Glass Resistive Plate Chambers, that required a continuous flow of gas, subtracting to the portability of the device. The last generation of these detectors utilizes instead plastic scintillators with SiPMs, enormously simplifying the operations and making them easily movable [11]. Two of them were built at NYUAD, with the help of students, and have been shown in Abu Dhabi and Dubai in several public occasions, offering an entertaining and instructive display of the passage of cosmic rays. They are a regular fixture in my sample classes during Candidate Weekends. Because of their excellent performance, we decided to characterize them fully and to carry out measurements of the local cosmic ray flux, and tests of muon transmission imaging capabilities. A full description of the detector has been recently

published [12], and a preliminary measurement of the cosmic ray flux and angular distribution (possibly the first in the Gulf area) has been presented at a conference in 2018 [13]. Muon tomography and muon transmission imaging tests are ongoing, indicating that a better angular resolution should be desirable, and GEANT4 simulations are underway to decide a better geometry.

Gamma-Ray Spectroscopy and Environmental Radiation

Gamma-ray spectroscopy is an excellent investment for an astroparticle physics laboratory. On one hand, it allows to assess the radioactivity of any material or component that has to be employed in a high sensitive experiment, like XENON. On the other hand, it has the practical and educational aspect of measuring the radioactivity of any sample (rock, food, water etc) or of the environment, which can be especially interesting in a country that is starting to develop nuclear power. Those were the reasons why I proposed this activity in the portfolio that I presented for my tenure application in 2013. On this front, we have worked with students, adding environmental radiation measurements in the Advanced Physics Laboratory portfolio and building a water Cherenkov detector. We have presently a 3-inch shielded NaI detector, a few 2-inch ones (one of them taking data continuously outdoors) and we are discussing with the head of the Core Technology Platform, [REDACTED], the purchase of a high purity germanium detector. We have two ongoing collaborations, with Dr. Viktor Alekseenko of the Russian Academy of Science, and with [REDACTED] of BAUER Emirates Environment Technologies & Services LLC on the study of NORMs (Naturally Occurring Radioactive Materials) to be found in oil drilling operations.

Gamma-Rays in Space

Since 2014, the UAE have started to boost their space program, first by announcing an ambitious mission to send an orbiter around Mars in 2021, to be managed by the Mohammed Bin Rashid Space Center (formerly EIAST), and soon after by founding a Space Agency. We have been in touch with both institutions. In 2014, we have been contacted (together with other UAE universities), and prompted to submit proposals for instruments to be flown on the Mars orbiter. Although we had been given an extremely short time (3 weeks) we managed to submit a proposal [14] together with colleagues from NASA.

In summer 2015 I worked with the President of the Italian Space Agency (ASI), [REDACTED], and with the Director of the ASI Data Center ([REDACTED]) to organize an internship of two Emirati students, Ahlam Al Qasim and Fatema Alkhouri at the ASI Data Center in Rome. There, they worked with an ASI staff scientist on the data analysis of the AGILE gamma ray mission. Back in the UAE, they enjoyed a significant media coverage [15]. From that experience, the students developed the idea of proposing a Cubesat mission to study Terrestrial Gamma Ray Flashes (TGFs), and my group worked with them, with [REDACTED] and [REDACTED] to put together a proposal that was submitted to the UAE Space Agency in occasion of a call issued in 2016. The proposal was eventually approved for funding of USD 350,000 that never arrived (as of summer 2019). We nonetheless continued to study and characterize the chosen detector (the scintillating crystal CeBr_3), and started a collaboration with the Masdar Institute and Yahsat (<http://www.yahsat.com/>) to fly a single one-inch crystal on a Cubesat, and submitted another, student-led proposal to the 2018 'UAE Mini Sat Challenge' [16] that was accepted in August 2018.

I summarize the main achievements below:

- In 2014 we submitted a proposal to EIAST (now MBRSC) for a Gamma Ray Burst detector on board of the UAE Mars orbiter.
- In 2015 I organized the first Emirati student internship with the Italian Space Agency.
- In 2016 we submitted a proposal to the UAE Space Agency, for a gamma-ray detector suitable to study Terrestrial Gamma Ray Flashes from a 3U Cubesat, eventually approved for USD 350,000 but (as of August 2018) not funded. The detector has been named "RAAD" (Rapid Acquisition Atmospheric Detector).
- RAAD was presented at the 3rd COSPAR symposium in Seoul [17], and at the 42nd COSPAR Scientific Assembly in Pasadena by Emirati student Aisha AlMannaiei.

- Three Capstone theses have been done on RAAD.
- A student-led proposal on RAAD was sent to the 'UAE Mini Sat Challenge' and has been approved for USD 100,000 in August 2018.
- A paper on the characterization of the detector has been submitted and accepted by the Journal of Instrumentation [18].

Activities pre-NYUAD

- **XENON**: I have been the first XENON member of INFN (since 2004), and I have strongly promoted the choice of LNGS as the site of the experiment. From 2005 to 2013, I was member of the XENON Collaboration Board as head of the local group at LNGS; I managed the contacts between the collaboration and the Laboratory. I coordinated the Infrastructures Working Group of XENON1T and I was responsible of the Common Fund of the experiment (about 70,000 €/year). Between 2011 and 2012 I have been granted by INFN a total of € 350,000 that have been used for the purchase of xenon gas, the construction of an underground building for XENON1T and the purchase of the electronics for the active cosmic-ray veto. I have been head of the Speakers' Bureau from 2011 to 2013. I have been advisor of two PhD thesis [19, 20].
- **ICARUS experiment** [21] (1996 to 2010). In this project (a 600 t liquid argon detector for neutrino physics) I was involved in the measurements of the neutron background in the LNGS underground laboratory [22, 23]; I was responsible of the measurement of the electron lifetime in the Liquid Argon [24, 25]; I participated in the commissioning and run coordination of a 10 m³ liquid argon prototype [26], and in the commissioning and run coordination of the "T600" ICARUS module [21, 27]. I reported such activities at international conferences [28, 29], and coordinated the work of graduate and undergraduate students.
- I led the knowledge transfer of the liquid argon technology for particle detectors from Europe to US groups, namely Fermilab and Yale University. This contributed to the birth of a group interested in the further development of the technique, the Argoneut collaboration, that has operated a liquid Argon detector on the Fermilab neutrino beam [30] and evolved into the larger Microboone project [31].
- From 2003 to 2008 I participated in the **AUGER cosmic rays experiment**, a very large project for the detection of extremely energetic cosmic rays particles: 3000 km² of Argentinian *pampa* equipped with 1,600 water Cherenkov detectors and four air fluorescence telescopes. I worked on the calibration of the surface Cherenkov detectors. [32, 33] I have been several times at the Malargue site (province of Mendoza) to coordinate the local staff during technical shifts.
- From 1990 to 2000 I worked in the **EAS-TOP cosmic rays experiment** at Gran Sasso [34, 35, 36], working first on the correlations between that experiment and the underground detector MACRO, and later on the telescopes for the detection of atmospheric Cherenkov light [37, 38], designing and implementing the data acquisition system and coordinating the data taking shifts.

Teaching Activity

Courses taught at NYUAD

- Fall 2013 Advanced Physics Laboratory
- Spring 2014: Mechanics.
- Fall 2014: Foundations of Science 2 Laboratory; Mechanics; Capstone Seminar.
- Spring 2015: Advanced Physics Laboratory. For this edition of the course I organized a field trip to SESAME, in Jordan, the first and only particle accelerator in the Middle East.
- Fall 2015: Foundations of Science 2 Laboratory; Advanced Physics Laboratory; Mechanics, Detectors for Particle Physics (Directed Study).
- Spring 2016: Advanced Physics Laboratory; Particle Physics (Directed Study).
- Fall 2016: Foundations of Science 2 Laboratory; Advanced Physics Laboratory.
- Spring 2017: Foundations of Science 5-6;
- Fall 2017: Advanced Physics Laboratory; Mechanics.
- Spring 2018: Advanced Physics Laboratory; Atom and Energy (Core Colloquium).
- Fall 2018: Advanced Physics Laboratory; Mechanics.
- Spring 2019: Particle Physics.

Capstone projects at NYUAD (see also dedicated document)

- ██████████, AY 2014-15
- ██████████, AY 2015-16
- ██████████, AY 2015-16
- ██████████ (co-supervised with L. Benabderrahmane), AY 2015-16
- ██████████ (co-supervised with L. Benabderrahmane), AY 2015-16
- ██████████ (co-supervised with M. Roberts), AY 2016-17
- ██████████ (co-supervised with M. Roberts), AY 2017-18
- ██████████, AY 2017-18

Summer Research for NYUAD students

- 2014: ██████████, ██████████ at Gran Sasso Laboratory. Sumit and Luis took part in the operations of the XENON100 experiment, worked on gamma ray spectroscopy and on silicon photomultipliers.
- 2015: ██████████ did an internship at CAEN, a leading company in electronics for high energy physics in Viareggio, Italy.

- 2015: [REDACTED] (as postgraduate assistant), [REDACTED] at Gran Sasso Laboratory. [REDACTED] was 'responsible shifter' on the XENON100 experiment, [REDACTED] worked on silicon photomultipliers. [REDACTED] led the cryogenic testing for resistors to be used in the XENON1T detector. [REDACTED] started her Capstone project on LXeTPC calibration.
- 2015: Organized summer research at Italian Space Agency for [REDACTED]. [REDACTED] worked on data from the space mission AGILE.
- 2015: Organized summer research at LABEC for [REDACTED]. [REDACTED] worked on several of the techniques used in nuclear physics for cultural heritage: Carbon-14 dating, X-ray fluorescence and others.
- 2015: Placed [REDACTED] in a GEANT4 (high energy particle physics simulation software) course at the Gran Sasso Science Institute.
- 2016: [REDACTED] at Gran Sasso Laboratory. [REDACTED] worked on the characterization of scintillating crystals. [REDACTED] on the preliminary analysis of XENON1T data, [REDACTED] worked with the LUNA experiment.
- 2017: Organized summer research at LABEC for [REDACTED]. [REDACTED] worked mainly on the improvement of the X-ray fluorescence spectrometer that became the subject of his Capstone project.

Academic Mentoring

I have been academic mentor of the following students: [REDACTED]

Other teaching-related activities while at NYUAD

- August 2014: I attended a one-week training on the teaching of physics experiments in Buffalo, NY, organized by TeachSpin, the company that provided most of the equipment that I use for the Advanced Physics Laboratory course.
- In 2014, 2016, and 2017, my group and I have supervised the summer research of [REDACTED], physics student at Oxford since 2016. He joined our group at the Gran Sasso Laboratory during the summer.
- 2017 Reviewer of the Ph.D. thesis of [REDACTED] (Gran Sasso Science Institute).
- 2013: External Reader of the PhD thesis of [REDACTED] (Yale University).
- 2011-2014: Member of the jury for the evaluation of the Ph.D. project of [REDACTED] (University of Coimbra, Portugal)
- I have given many guest lectures on cosmic rays, particle detectors, radioactivity, and cultural heritage in several colleagues' courses: Space ([REDACTED]), Conserving Cultural Heritage Through Science ([REDACTED]), The Seven Wonders ([REDACTED]), Quantum Theory and Relativity ([REDACTED]), Instrumentation Sensors and Actuators ([REDACTED]).

pre-NYUAD

- 2009: PhD supervisor of [REDACTED], University of L'Aquila [20]. Serena worked afterwards at the University of Mainz, coordinating the Muon Veto working group of XENON1T.
- 2003/2004: Supervisor of the Master's thesis of [REDACTED], University of L'Aquila (later a member of the WArP and DarkSide experiment).

- Supervisor of the Master's (2002) and PhD (2006) thesis of ██████████ [19] ██████████ has become a key member of the XENON collaboration, he has been, among other roles, analysis coordinator, and he is now Senior Research Scientist at the University of Stockholm.
- 1999/2000: teaching for the laboratory course of the 4th year Physics students (University of L'Aquila, main teacher: ██████████).
- 1999/2000: Supervisor of the PhD thesis of ██████████, University of L'Aquila.
- 1993/94 member of the teaching staff of General Physics I, (Faculty of Chemistry, University of Torino) (main teacher: ██████████).

Proposals

Proposals submitted while at NYUAD

- "A X-gamma ray detector for UAE Mars mission: preliminary conceptual design", proposal that answered a call from EIAST (now MBRSC) for an instrument to be placed on the UAE Mars Mission. Not funded.
- NYUAD Research Enhancement Fund proposal "Proposal For The Participation Of Nyuad To The XENON1T Dark Matter Project", 2015, funded with USD 305,000.
- " X-ray Fluorescence for Cultural Heritage and Environment", proposal submitted to the Abu Dhabi Education Council (not approved).
- NYUAD Research Enhancement Fund proposal, "XENON1T and XENONnT at NYUAD", requested amount USD 250,000, not funded.
- Proposal to the Space Agency "Develop a Space Qualified Detector for Measuring Gamma Ray Burst in Earth's Atmosphere", 2015, approved for USD 350,000 but not funded (as of July 2018).
- Proposal in answer to the UAE Mini Sat Challenge' [16], July 2018, "Gamma-Ray Detector for the Study of Terrestrial Gamma Ray Flashes", submitted in July 2018 (requested sum USD 100,000).
- Co-PI of the proposal for the development of the Center for Astrophysics Particle and Planetary Physics (CAP³) February 2019, approved and to be funded in Fall 2019.
- Research Enhancement Fund proposal "Near Infrared Emission in Liquid Xenon", submitted in Spring 2018, USD 40,000 asked, not funded.
- Research Enhancement Fund proposal "Multi-Channel Station For Radiation And Environmental Parameters Monitoring", submitted by ██████████ USD 40,000 asked, not funded.
- "Gamma-Ray Detector for the Study of Terrestrial Gamma Ray Flashes", proposal submitted in 2018 to the 'UAE MiniSat Challenge', that was won in August 2018 (USD 100,000).
- co-PI of the Research Enhancement Fund proposal for a Center Planning Grant, to develop the "Dhakira Center for Heritage Studies in the UAE", submitted in June 2018, funded with USD 30,000.
- co-PI of the full proposal to develop the "Dhakira Center for Heritage Studies in the UAE", submitted in February 2019, sent back for further review.

Service Activity at NYUAD

Institutional positions

- Associate Dean of Science (since 09/2016). Duties: work with NYU Global (see below); to deal with issues of various kinds related with the Science Division and concerning students, faculty, space management etc.
- co-Director for Scientific Research of the Dhakira Center for Heritage Studies, since Fall 2018.
- *ad interim* Program Head of Chemistry (since 09/2016). Duties: organizing the teaching schedule, holding regular faculty meetings, participating in the searches of new faculty or staff, managing the instructors.
- Program Head of Physics (09/2014 - 08/2016). Duties: beyond what listed above for Chemistry, I have been working on a joint doctoral program with NYU-NY (see below).
- Member of the Faculty Council of the Gran Sasso Science Institute, Italy (since June 2018).

Committee memberships

- I have been member of several committees for faculty and instructors search, promotion and tenure, in Chemistry and Physics.
- Admissions committee for Ph.D. candidates to the Gran Sasso Science Institute (June 2017).
- Selection committee for post-doctoral candidates to the Gran Sasso Science Institute (July 2017).
- NYU Florence site Advisory Committee.
- NYUAD Grant for Publication Support Committee.
- Campus Life - Faculty Liaison Committee (10/2013 - 09/2014)

Work with NYU Global

- In the capacity of Program Head of Physics at first, and then of Associate Dean, I have dealt (and I am dealing) with the enhancement of the Science courses offering in the NYU study abroad sites. In particular, we have started physics courses at NYU Florence. In Spring 2017 we have offered Statistical Mechanics, Electricity and Magnetism, Quantum Mechanics (as Directed Study), and Nuclear Techniques for the Cultural Heritage. We also organized a field trip to CERN where I accompanied our students. In Fall 2018 we offer Electricity and Magnetism, Quantum Mechanics, and Nuclear Techniques for the Cultural Heritage. The latter course is especially popular because of its cross-disciplinarity.
- In Spring 2017, I have placed [REDACTED], who was doing his semester abroad at NYU Florence (see above) in the research group of [REDACTED], who works on the CMS experiment at LHC. Thanks to this experience [REDACTED] was subsequently admitted to the CERN summer student program (the first student of NYUAD).

Work with Graduate and Postdoctoral Programs Office

NYUAD does not have a doctoral school yet. In order to enable Ph.D. students to come and do research at NYUAD, several Programs have signed agreements with their corresponding graduate school at NYU-NY. These agreements allow a student to enrol in a Ph.D. program at NYU, complete the coursework there, and then come to NYUAD for research. In 2014 and 2015, in the capacity of Program Head of Physics, I have worked with the Graduate and Postdoctoral Programs Office, with the NYUAD Dean of Science and with the Physics Director of Graduate Studies at NYU to establish such agreement for Physics, that became effective in 2016.

Work with Admissions

- I have participated in most NYUAD Candidate Weekends with interviews, sample classes, lab tours, and participating in the Academic Fairs.
- I have participated in several Counsellor weekends.
- Because of the extremely low numbers of Italian students applying to NYUAD, I have triggered the 'scouting' by Admissions of some Italian high schools, and I have been invited by one (Liceo Nobel of Torre del Greco) to give an talk on NYUAD, in March 2018 [39].

Conferences and Events Organized

- Scientific Research for Cultural Heritage, February 2017, NYUAD
- Science Photography Workshop, for NYUAD students, with award winning science photographer Enrico Sacchetti, October 2017, NYUAD.
- NYUAD preview of the movie 'The Sense of Beauty, Art and Science at CERN', April 2018.

SESAME

SESAME is the first and only synchrotron light machine in the Middle East, namely in Jordan. Synchrotron light has many applications in materials science, medicine, cultural heritage, detector testing etc. SESAME is a international consortium in which several countries of the Middle East participate. I think that joining SESAME would be a great opportunity for the UAE, and I have been working toward this goal with [REDACTED] Scientific Director of SESAME. I have accompanied NYUAD students at SESAME in 2015. I have invited [REDACTED] twice to the UAE (in 2015 and 2016), to give seminars at NYUAD and in other UAE universities (University of Sharjah, Masdar Institute, Khalifa University) to present SESAME to UAE researchers that already make use of synchrotron light. I have also invited Prof. [REDACTED], former CERN Director General and current President of the SESAME consortium, to give a public NYUAD Institute talk in November 2017. Unfortunately, despite our efforts, the UAE remains outside the SESAME consortium.

Invited Seminar Speakers for the NYUAD Physics Program

- [REDACTED] (GSSI, Italy)
- [REDACTED] (GSSI, Italy)
- [REDACTED] (CERN)
- [REDACTED] (university of Bern, Switzerland)
- [REDACTED], Scientific Director of SESAME (Jordan)
- [REDACTED] (University of Milano Bicocca and LNGS)
- [REDACTED] (Columbia University)
- [REDACTED] (Columbia University)
- [REDACTED] (Carleton University, Canada)
- [REDACTED] (University of Granada, Spain)
- [REDACTED] (INFN-LABEC, Italy)

- ██████████ (Italian Space Agency)
- ██████████ (Italian Space Agency)
- ██████████ (INFN, Italy)
- ██████████ (University of Naples and INFN, Italy)
- ██████████ (Fermilab, USA)

Invited NYUAD Institute Speakers

- ██████████, Director of the Egyptian Museum in Torino (2019).
- ██████████, Director of the United Nations Office for Outer Affairs (UNOOSA) (2017).
- ██████████, President of the SESAME Council, and former Director General of CERN (2017).
- ██████████, President of Istituto Nazionale di Fisica Nucleare, Italy (2015).

Service outside NYUAD

- October 2014: member (for the second time) of the expert committee review panel of the Canada Foundation of Innovation that reviewed major astroparticle physics experiment proposals in Ottawa.
- February 2014: evaluator for the University of Padova PISCOPIA Fellowship Programme.

Service pre-NYUAD

- From October 2012 to August 2013: head of the Industrial Liaison Office and member of the Board of the Gran Sasso Science Institute: a new doctoral school created by INFN at L'Aquila (see below).
- Member of the project team for the design of the **Gran Sasso Science Institute (GSSI)**, a new doctoral school at L'Aquila. This project has been started under the auspices of OECD [40] and the Ministry of Territory Cohesion, in the framework of a program to relaunch the regional economy after the earthquake that hit the region on April 6th, 2009. The GSSI has been launched and is now fully operative.
- From January 2012 to August 2013: head of the Experiments Support Service at LNGS. The service acts as an interface between the Technical and Research Divisions of LNGS.
- From 2004 to July 2013: member of the INFN GLV (working groups on evaluation), a top management structure responsible for collecting and handling the data concerning the performance evaluation of INFN as a research organization. Here, I have played a key role in the framework of the "VQR 2004-2010", the evaluation of the whole Italian research system launched by the Ministry of University and Research in 2011. I have written the software used to select the about 6,000 publications to be submitted to the VQR and directed an operative working group aimed to manage the input data and the results of that software. **Thanks to this effort, INFN scored first among large Italian research organizations [41].** Until August 2013, I have chaired a working group aimed to implement the mechanism successfully used for the VQR on a permanent basis to monitor the scientific performance of the INFN.
- 2012: Scientific expert evaluator for the European project RBUCE-UP (<http://www.rbuce-up.eu>).
- July 2012: member of the expert review panel n. 442 of the Canada Foundation of Innovation.
- August 2012 - January 2013: member of the WG4 of the CERN European Strategy Group (technology transfer).

- From July 2003 to September 2009: member of the **INFN "Commissione Scientifica Nazionale II" (CSN2) scientific committee**. This committee manages the funds for non-accelerator and astroparticle physics, which are about 16M€/year. The CSN2 meets four times a year, and evaluates new proposals and ongoing projects. As a representative of LNGS inside this committee I had to directly manage about 50,000 € yearly for capital and travel expenses of the Laboratory researchers.
- From 2004 to 2009: scientific referee of ANTARES [42] experiment and of NEMO-KM3 [43]: two projects for the deployment of neutrino telescopes in the depths of the Mediterranean sea. Concerning ANTARES, I have represented the INFN in several occasions at the meetings of the Financial Review Committee, which manages the Common Fund (about 600 M€/year).
- Member of the LNGS Laboratory Council from 2003 to 2009.
- Member of the project design team and of the technical coordination committee for the management of EU-ESF (European Social Fund) grants together with the Regione Abruzzo [44, 45]. In this framework, we have designed a successful collaboration program with the Regione Abruzzo focused on the advanced training of young people and knowledge transfer to local SMEs. We have signed three successive MoUs for a total allocation of about 5M€.
- From 2008 to July 2013: head of the committee for the space management at LNGS.
- Member of **conference organizing committees**, as **TAUP 2009** [46] and the **ASPERA Underground Synergies Workshop** (Durham, UK, December 2012).
- I represented many times the Gran Sasso Laboratory in formal occasions such as interviews with journalists, public debates, and meetings with authorities.
- Immediately after the earthquake that hit the area of L'Aquila on April 6th, 2009, I helped the Director of LNGS, Prof. ██████████, handling the subsequent crisis and acted on his behalf on several occasions.
- Referee of international peer reviewed journals.
- Outreach
 - I was always involved in the scientific outreach programs at the Gran Sasso Laboratory and at INFN (Open Days, public conferences, exhibitions). I have provided several photographic images used officially in publications and presentations concerning the activities of LNGS and INFN.
 - I have often collaborated in the writing of texts used for outreach purposes. One example is my article published on the CERN Courier in 2010 [47].
 - From 1995 to 1998: regular guide for visits of external guests to the Gran Sasso Laboratory (mostly high school students).

Conferences, seminars and events (for all the members of my group).

- [REDACTED] presented the talk 'Purity Monitors in protoDUNE Dual-Phase' at the LIDINE 2019 conference, in Manchester, UK, August 2019. (<https://indico.hep.manchester.ac.uk/conferenceDisplay.py?confId=5456>)
- [REDACTED] participated in the DARWIN Collaboration Meeting in Zurich, December 2018.
- [REDACTED] presented our work on cryogenic SiPM readout in the ICASiPM 2018 conference (Schwetzingen, Germany, <https://indico.gsi.de/event/6990/>), [48].
- [REDACTED] and [REDACTED] participated in the conference "Frontier Detectors for Frontier Physics – 14th Edition", at La Biodola, Italy, presenting, respectively, our work on the cryogenics readout for SiPMs [49] and PMTs, and the first measurement of the cosmic rays flux in Abu Dhabi, [13].
- [REDACTED] presented an invited talk at VULCANO Workshop 2018, Frontier Objects in Astrophysics and Particle Physics, Vulcano, Italy, 20 May, 2018, presenting the talk *The PTOLEMY project: from an idea to a real experiment for detecting Cosmological Relic Neutrinos*.
- [REDACTED] presented an invited talk at Seventh Workshop on Theory, Phenomenology and Experiments in Flavour Physics, Capri, Italy, 8 June, 2018, *Latest results of 1 tonne x year Dark Matter Search with XENON1T*
- [REDACTED] presented an invited talk at 2nd World Summit on Dark Side of the Universe, Guadeloupe, France, 23 June, 2018, *Latest results of 1 tonne x year Dark Matter Search with XENON1T*
- Our group organized the XENON Collaboration Meeting at NYU Florence, January 2-18.
- [REDACTED] was invited to give a talk at the Canadian University in Dubai (12/2017).
- [REDACTED] participated in the first meeting of the Mohammed Bin Rashid Academy of Scientists, in Dubai, (December 2017)
- [REDACTED] was invited to speak at the United Nations-Italy Workshop on the Open Universe Initiative [50] and he gave a talk on "Open data and Space Science in the UAE" (11/2017)
- [REDACTED] participated in LIDINE 2017 [51] presenting our work on SiPM cryogenic readout [52].
- [REDACTED] participated in the "Neutrino and Nuclear Physics Conference" [53] Catania, Italy presenting the talk 'A Multi-Pixel Photon Counter detector prototype for direct detection of scintillation light in liquid xenon' (October 2017), [52].
- [REDACTED] gave a talk at the European Physics Conference in Venice, on 'DARWIN: towards the ultimate dark matter detector'. (July 2017).
- [REDACTED] gave an invited talk at IFAE2017, Incontri di Fisica delle Alte Energie, Trieste, Italy, 20 April, 2017, *Status of WIMP Dark Matter searches*.
- [REDACTED] gave an Invited talk at COSMO-17, 21st International Cosmology Conference, Paris, France, 28 August, 2017, *The first XENON1T results*.
- [REDACTED] participated in June 2017 in the PASCOS conference in Madrid, presenting 'Latest results from XENON100 electronic recoil modulation' [54].
- [REDACTED] presented a talk in the 'IV Arabian Tunneling Conference' with the title 'Underground Physics Laboratories'. The talk was presented in the section 'Innovative use of underground spaces'.

- [REDACTED] gave an invited talk at the 'The international conference Frontiers in Theoretical and Applied Physics (FTAPS 2017)', at the American University of Sharjah. Title of the talk was 'Recent results of Dark Matter direct detection experiments' (02/23/2017).
- [REDACTED] gave an invited talk in the 25th edition of the European Cosmic Ray Symposium in Turin, Italy [55], September 2016.
- [REDACTED] gave an invited talk at Rencontres de Moriond: Cosmology 2016, La Thuile, Italy, 21 March, 2016, *The XENON1T Dark Matter experiment* [56].
- [REDACTED] participated in the workshop on Xenon1T data handling, MPI Heidelberg (February 2016).
- [REDACTED] participated in the XXVII International Conference on Neutrino Physics, London, with a poster on Neutrino Physics in Darwin [57].
- [REDACTED] presented a poster with the title 'An amplifier for VUV photomultiplier operating in cryogenic environment', at the conference "Frontier Detectors for Frontier Physics – 13th Edition", at La Biodola, Italy, May 2015 [6].
- [REDACTED] presented a poster with the title 'A compact muon tracking system for didactic and outreach activities', at the conference "Frontier Detectors for Frontier Physics – 13th Edition", at La Biodola, Italy, May 2015 [11].

XENON Meetings

- LNGS, November 2014 ([REDACTED])
- LNGS, March 2015 ([REDACTED])
- LNGS, April 2015 ([REDACTED])
- LNGS, November 2015 ([REDACTED])
- Heidelberg, workshop on XENON software ([REDACTED]).
- LNGS, April 2016 ([REDACTED])
- Freiburg, September 2017 ([REDACTED])
- NYU-Florence, January 2018 ([REDACTED])
- LNGS, March 2018 ([REDACTED])
- LNGS, Technical Meeting, January 2019 ([REDACTED]).

pre-NYUAD Conferences and Talks

- **Les Rencontres de Physique de la Valle d'Aoste, La Thuile**, Italy, February 2014, 'Status of XENON', invited talk.
- **IFAE 2013, "Incontri di Fisica delle Alte Energie"**, Cagliari, IT, April 2013, Invited talk on non-accelerator physics.
- **Physics in Collision 2012**, Strbské Pleso (Slovakia), invited talk on "Dark Matter Searches", September 2012 (<http://www.saske.sk/PIC2012/>).
- "La Fisica della Vela", lessons on the physics of sailing to high school students of Vasto (Abruzzo, Italy) September 2012 (http://vastoscienza.it/wp/?page_id=345).

- Colloquium at the University of Pavia in the framework of "Doctoral colloquia", with the presentation of the seminar "Direct Dark Matter Searches" (June 2012).
- Colloquium at the University of Bern - Albert Einstein Institute, with the presentation of the seminar "Astroparticle physics and the management of science" (May 2012).
- **12th Pisa Meeting on Advanced Detectors, talk: "The XENON100 experiment and the evolution to the ton scale"** (<http://www.pi.infn.it/pm/2012/>)
- SIF2011: Invited talk at the Italian Society of Physics on recent results of XENON100 at the Gran Sasso Laboratory.
- SATEXPO 2009 Public fair of space applications and technologies: "The CNGS project: the neutrino run towards Gran Sasso", invited presentation, Rome New Fair, March 2009.
- "Abruzzo made in Italy", public debate on the Abruzzo territorial marketing, Pescara, February 2008.
- "The XENON experiment at the Gran Sasso Laboratory", invited seminar, Lecce University, May 2008.
- "Physics on the boat", outreach initiative for high school students, Ancona, November 2007.
- **Rencontres de MORIOND 2005: "Status and Performances of the AUGER Surface Detector Array"**, Les Arcs, France, 2005
- **TAUP 2003 Conference: "MINOS, OPERA, ICARUS" (invited talk), Seattle, 2003.**
- **Imaging 2003 Conference: "The ICARUS T600 Liquid Argon Time Projection Chamber"**, Stockholm, 2003.
- **Frontier objects in Astrophysics, Vulcano Workshop: "Atmospheric and Solar Neutrino Detection with the ICARUS T600 Module"**, Vulcano, Italy, 2002
- "Cherenkov light measurements with the EAS-TOP telescopes", colloquium at Max-Planck Institute, Heidelberg, October 25th, 2000
- "The ICARUS liquid Argon TPC and the T600 detector", invited seminar at Institute of Nuclear Physics, Warsaw, April 2002.
- "Icarus: a status report", seminar, LNGS, 2000.
- **Frontier Objects for Frontier Physics: VIII Pisa meeting, "Operation of a 10 m³ ICARUS module"**, Isola d'Elba, May 2000.
- "Gamma ray astronomy with the Cherenkov telescopes of EAS-TOP", invited lecture at the International Baksan School "Particles and Cosmology", 1997.
- **TAUP 1997 Conference : "Solar neutrino detection with the ICARUS experiment and the neutron background measurement"**, LNGS, 1997.
- **XXIV International Cosmic Ray Conference, Rome: "VHE observations of the Crab Nebula from the Cherenkov array of EAS-TOP"**, 1995.
- Congress of the European Physical Society: Gamma-Ray Astronomy with the Cherenkov detector of EAS-TOP, CERN, 1992.

