

UNIVERSITÀ DEGLI STUDI DI MILANO

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# Giulio Settanta

## Curriculum Vitae

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### Personal informations

first name Giulio  
last name Settanta  
date of birth 13.01.1992  
nationality Italian

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### Employment

2019 - present **Postdoctoral Research Associate at Institut für Kernphysik, Forschungszentrum Jülich.**

*Research topics:*

- analysis of data from the Borexino detector, in the framework of the search for neutrinos from the solar CNO cycle. The Borexino detector is located at the Laboratori Nazionali del Gran Sasso and is in stable operation since 2007. Thanks to the impressive level of radiopurity achieved, the full set of measurement of neutrino fluxes from the dominant solar *pp chain* have become accessible throughout the years. The conclusive target for the Borexino collaboration is nowadays the detection of the neutrino flux from the CNO cycle fusion process, so far predicted but not yet observed. Current work includes the management of Monte Carlo simulations, detector stability and the spectral fit in the low energy sector.

*Specific responsibilities:* responsibility of the filter algorithm for solar neutrino events, which includes the processing of both Monte Carlo simulations and data for the final multi-variate fit of the energy spectrum; responsibility of the results stability under different fit conditions; responsibility of the evaluation of systematic contributions to the final measurement;

- atmospheric neutrino physics with the JUNO experiment. Monte Carlo simulations production and validation, spectral analysis of the atmospheric neutrino flux and study of oscillation effects.

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### Education and training

2020 **PhD in Physics at Roma Tre University.**

*Thesis title:* Atmospheric neutrino spectrum reconstruction with the JUNO experiment.

*Advisor:* Prof. Stefano Maria Mari (Roma Tre University and INFN Roma Tre)

*Summary of activities:* The main activity of the PhD program consisted of the development of an analysis to reconstruct the atmospheric neutrino energy spectrum with the future JUNO detector.

The atmospheric neutrino flux represents a continuous source that can be exploited to infer properties about Cosmic Rays and neutrino oscillation physics. Within the PhD project, the JUNO performances in reconstructing the atmospheric neutrino spectrum have been evaluated. The different time evolution of scintillation light on the PMTs has been exploited in building an algorithm to discriminate the flavor of the primary neutrinos.

A probabilistic unfolding method has been used, in order to infer the primary neutrino energy spectrum by looking at the detector output. The simulated spectrum has been reconstructed between 100 MeV and 10 GeV, showing a great potential of the detector in the atmospheric low energy region. The uncertainties on the final flux, including both statistic and systematic contributions, have been estimated to be between 10% and 25%, with the best performances obtained at the GeV.

The analysis activity has been carried out within the JUNO collaboration. The progresses of the work have been reported periodically in the form of presentations at collaboration meetings or phone calls. The results reported in the thesis have been also presented at several international conferences, in the form of posters or talks. Two related proceedings have been submitted and a paper for a peer-reviewed journal is in preparation.

Side activities included the management of the JUNO software at the INFN-CNAF computing center and the participation to shifts at the JUNO PMT test facility at Zhongshan (China).

**2016 Master degree in Physics, Nuclear and Subnuclear Physics curriculum, at Roma Tre University (joint thesis program with DESY - Zeuthen).**

Thesis title: A single- $\mu$  real time alert system with the IceCube detector.

*Advisor:* Prof. Elisa Bernardini (Berlin Humboldt University and DESY Zeuthen)

*Int. Advisor:* Prof. Stefano Maria Mari (Roma Tre University and INFN Roma Tre)

*Dissertation abstract:* Recent developments in Astronomy include multi-messenger approaches. The combined observation of astronomical sources with different "messengers" enhances the accessible knowledge of the physical processes at the source. Neutrinos, in particular, are expected to be produced in interactions of high-energy cosmic rays with ambient matter or photons close to their acceleration sites. With their unique properties, neutrinos may help to identify these sites, and probe the acceleration processes. The IceCube Neutrino Observatory, a  $km^3$ -sized neutrino telescope located at the geographical South Pole, was built with the intent of detecting high-energy cosmic neutrinos. The Gamma-ray Follow-Up (GFU) program was recently set in order to obtain a real-time selection of events of potential astrophysical interest. Selected events are immediately sent to Cherenkov telescopes, with the final goal of a correlated neutrino-gamma observation. Due to the limited computing power at the South Pole site, the criteria used in real-time selection must rely on light and fast algorithms. Currently, the GFU program includes a Point Source analysis that looks at clustered events. Using the IceCube Neutrino Observatory as a trigger for gamma-ray telescopes, a real-time alert system based on just single- $\mu$  events has been developed, in order to enhance the detector sensitivity to events induced by astrophysical neutrinos. A single- $\mu$ -based alert system does not rely on events correlation and must be therefore implemented with additional selections, to get rid of the background. Several criteria were evaluated to separate the cosmic signal from the atmospheric background, using the available reconstructed variables. Particular care was devoted to the selection of well reconstructed events, in order to provide Cherenkov telescopes of a set of alerts with small angular uncertainty.

*Grade:* 110/110 cum laude.

**2014 Bachelor degree in Physics at Roma Tre University.**

Thesis title: The Cosmic Ray Spectrum in the energy range (1-100) TeV measured by the ARGO-YBJ detector. Analysis of the final data sample. (*translated title*)

*Advisor:* Prof. Stefano Maria Mari (Roma Tre University and INFN Roma Tre)

*Dissertation abstract:* The Cosmic Ray light component (p + He) energy spectrum has been measured in the energy range 4 - 200 TeV, with the full data sample of the ARGO-YBJ experiment. The results are not consistent with the extrapolations made at lower energies, opening new scenarios about the interpretation of the Cosmic Ray spectrum. The results presented in the thesis have been published in Phys. Rev. D 91, 112017.

*Grade:* 110/110 cum laude.

**2011 Scientific high school diploma at Liceo Scientifico Talete (Rome, Italy).**

*Grade:* 100/100 cum laude.

## Training activities

- 2016 **Erasmus+ Traineeship grant.**  
Scholarship granted by an Italian consortium, led by Roma Tor Vergata University. Devoted to student mobility for traineeship.  
The traineeship was focused on the development of a reliable, real-time alert system for high energy astrophysical events, using the data stream from the IceCube observatory.  
Duration: 3 months | Destination: DESY Zeuthen (Germany)
- 2015 **Summer Student Program.**  
The work was carried out within the MAGIC collaboration. In the activity several simulations have been made to evaluate performances of the future Cherenkov Telescope Array. The work was focused on the study of *partial arrays*.  
*Supervisors: Prof. Elisa Bernardini and Dr. Giovanna Pedalletti (DESY - Zeuthen).*  
Duration: 2 months | Destination: DESY - Zeuthen (Germany)
- 2014 **Summer Student Program.**  
During the activity our group analyzed crystal detectors performances for the future Belle-II electromagnetic calorimeter. The work included the analysis of runs using cosmic rays, gamma rays and an electron test beam.  
*Supervisor: Dr. Riccardo De Sangro (INFN - LNF).*  
Duration: 2 months | Destination: INFN - LNF, Frascati (Italy)

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## Teaching

- 2018 - 2019 **Teacher assistant at Roma Tre University.**  
Teacher assistant for the course "General Physics 2" within the bachelor in Mathematics, about classical electromagnetism and optics. Hold theoretical and exercises lectures, along with preparation and evaluation of both written and oral examinations.

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## Journal Publications

- 2019 **Atmospheric neutrino spectrum reconstruction with JUNO**, G. Settanta et al., submitted to Proceedings of Science for the EPS-HEP 2019 conference.  
preprint: arXiv:1910.11172
- 2019  **$e-\mu$  discrimination at high energy in the JUNO detector**, G. Settanta et al., EPJ Web of Conferences 209, 01011.  
<https://doi.org/10.1051/epjconf/201920901011>
- 2019 **Nanoseconds Timing System Based on IEEE 1588FPGA Implementation**, D. Pedretti et al., IEEE Transactions on Nuclear Science 66, 1151 - 1158.  
<https://doi.org/10.1109/TNS.2019.2906045>
- 2019 **Towards a reconstruction of Supernova Neutrino Spectra in JUNO**, C. Martellini et al., EPJ Web of Conferences 209, 01012.  
<https://doi.org/10.1051/epjconf/201920901012>
- 2019 **Distillation and stripping pilot plants for the JUNO neutrino detector: Design, operations and reliability**, P. Lombardi et al., Nucl.Instrum.Meth. A925, 6-17.  
<https://doi.org/10.1016/j.nima.2019.01.071>
- 2019 **GIGJ: A Crustal Gravity Model of the Guangdong Province for Predicting the Geoneutrino Signal at the JUNO Experiment**, M. Reguzzoni et al., Journal of Geophysical Research: Solid Earth 124, 4231– 4249.  
<https://doi.org/10.1029/2018JB016681>
- 2018 **Charge reconstruction in large-area photomultipliers**, M. Grassi et al., Journal of Instrumentation 13, 02 P02008.  
<http://stacks.iop.org/1748-0221/13/i=02/a=P02008>
- 2015 **Cosmic ray proton plus helium energy spectrum measured by the ARGO-YBJ experiment in the energy range 3–300 TeV**, B. Bartoli et al. (ARGO-YBJ Collaboration), Phys. Rev. D 91, 112017.  
<http://dx.doi.org/10.1103/PhysRevD.91.112017>

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## Other Publications

- 2019 **Juno experiment at CNAF**, S. M. Mari, C. Martellini, P. Montini and G. Settanta, INFN-CNAF Annual Report 2018, ISSN 2283-5490.  
<https://www.cnaf.infn.it/wp-content/uploads/2020/01/cnaf-annual-report-2018.pdf>
- 2018 **Juno experiment at CNAF**, S. M. Mari, C. Martellini, P. Montini and G. Settanta, INFN-CNAF Annual Report 2017, ISSN 2283-5490.  
<https://www.cnaf.infn.it/wp-content/uploads/2018/09/cnaf-annual-report-2017.pdf>
- 2017 **Juno experiment at CNAF**, S. M. Mari, C. Martellini, G. Settanta, INFN-CNAF Annual Report 2016, ISSN 2283-5490.  
<https://www.cnaf.infn.it/Annual-Report/annual-report-2016.pdf>

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## Conferences contributions

### Speaker

- 2019 **Atmospheric neutrino spectrum reconstruction with JUNO**, 2019 European Physical Society Conference on High Energy Physics, Ghent.  
Parallel Talk
- 2019 **Atmospheric neutrino spectrum reconstruction with JUNO**, The 27<sup>th</sup> International Workshop on Weak Interactions and Neutrinos, Bari.  
Poster
- 2019 **Atmospheric neutrino spectrum reconstruction with JUNO**, XVIII International Workshop on Neutrino Telescopes, Venice.  
Poster - <http://doi.org/10.5281/zenodo.3333511>
- 2018  **$e-\mu$  discrimination at high energy in the JUNO detector**, 7<sup>th</sup> Rome International Conference on Astroparticle Physics, Rome.  
Poster
- 2017 **The JUNO computing model**, Workshop of the INFN Commissione Calcolo e Reti (INFN Computing and Network Committee), L.N.G.S (L'Aquila).  
Poster

### Co-author

- 2018 **Preliminary Studies on Supernova Neutrinos with the JUNO detector**, 7<sup>th</sup> Rome International Conference on Astroparticle Physics, Rome.  
Poster

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## Public seminars

- 2019 **I molti sguardi sul cosmo**, (*The many sights on cosmos*), public seminar devoted to students at the "Liceo Scientifico Taletè" high school, Rome.
- 2018 **Una pioggia di Raggi Cosmici**, (*a Cosmic Ray rain*), public seminar devoted to students at the "Liceo Scientifico Taletè" high school, Rome.
- 2017 **Cosmoclimatology: an influence of Cosmic Rays on Earth's climate**, Journal Club of the Department of Mathematics and Physics, Roma Tre University, Rome.

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## Awards

- 2020 **ARAP PhD Thesis award**, granted by ARAP - Associazione Romana Astro-Particelle, to best PhD Thesis in Astro-Particle Physics in Rome.
- 2016 **ARAP Elementary Particle Physics award**, granted by ARAP - Associazione Romana Astro-Particelle, to best Particle Physics students in Rome.

- 2011 – 2014 **Roma Tre University grant for bachelor's student (three years)**, granted by Italian Ministry of Education to best students enrolled in 2011/2012 season in Physics and Mathematics university courses.
- 2006 – 2011 **Liceo Scientifico Talete grant for its students (five years)**, granted by Liceo Scientifico Talete to its 10 best students at the end of each year..
- 2010 **Amici di Luigi award for scientific schools**, Award granted by “Amici di Luigi Onlus” association to best students attending secondary scientific schools in Rome.

## Outreach activities

- 2017 - 2019 **Collaboration to outreach events at Roma Tre University.**  
Participation in the organization of outreach events at the Mathematics and Physics Department of Roma Tre University, in the form of public entertainment, seminars and explanation of experimental setups.

## Languages

- Italian mother tongue
- English written and spoken, level C1

### Language experiences abroad:

- 2010 **Gorey Language Center, Gorey (Ireland).**  
Language: english | Duration: 1 (week) | Family hosted.
- 2010 **Participation to 2010 National High School Model of United Nations (NHSMUN) in New York (US).**  
Language: english | Duration: 10 (days).
- 2008 **St. Mary's Academy, Carlow (Ireland).**  
Language: english | Duration: 2 (weeks) | Family hosted.

## Computer skills

- Programming languages Bash, C, C++, Python
- Data analysis softwares ROOT Cern
- Monte Carlo softwares Genie Neutrino Monte Carlo Generator
- Document markup languages LaTeX
- Operative systems Linux, Windows
- Batch platforms PBS, LSF, Condor, Slurm