Miguel Reis Orcinha — Physicist

CONTACT INFORMATION

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CURRENT POSITION

Researcher at **Università degli Studi di Perugia - UniPG** &
Istituto Nazionale di Fisica Nucleare - INFN, Perugia, Italy.

EDUCATION

Instituto Superior Técnico, Universidade de Lisboa, Lisbon, Portugal

Ph.D. in **Physics**   **Feb 2023**

Thesis title: *Study of solar modulation effects on cosmic ray fluxes measured by the AMS experiment*
Supervisor: Fernando José de Carvalho Barão
Classification: Pass with Distinction

M.Sc. in **Engineering Physics**   **Nov 2014**

Specialization: Physics
Thesis title: *Solar modulation studies and proton-electron separation with the AMS/RICH detector*
Supervisor: Fernando José de Carvalho Barão
Co-Supervisor: Maria Luísa Ferreira da Gama Velho Arruda

B.Sc. in **Engineering Physics**   **Sep 2011**

TEACHING EXPERIENCE

Instituto Superior Técnico, Universidade de Lisboa, Lisbon, Portugal

Computational Physics

Laboratory classes for *B.Sc. in Physics Engineering*:
Feb 2022 - Jul 2022 as a Teaching Assistant
Sep 2021 - Feb 2022 as a Teaching Assistant
Sep 2020 - Mar 2021 as a Teaching Assistant
Sep 2018 - Feb 2019 as a Teaching Collaborator
Sep 2016 - Feb 2017 as a Teaching Collaborator
Sep 2015 - Feb 2016 as a Teaching Collaborator

Electromagnetism and Optics

Problem classes for *B.Sc. in Industrial Management and Engineering & B.Sc. in Telecommunications and Informatics Engineering*:
Sep 2020 - Mar 2021 as a Teaching Assistant

Laboratory classes for *Bologna B.Sc. Biomedics Engineering & Bologna B.Sc. Applied Mathematics to Computers*:
Sep 2020 - Mar 2021 as a Teaching Collaborator

Laboratory of Radiation and Atomic Physics - LFRA

Laboratory classes for *B.Sc. Physics Engineering*:
Sep 2017 - Feb 2018 as a Teaching Collaborator

Laboratory of Advanced Experimental Physics - LFEA

Laboratory classes for *B.Sc. Physics Engineering*:
May 2021 preparation and guidance of "Cosmic Ray Lab - LIP" set of experiments
May 2019 preparation and guidance of "Cosmic Ray Lab - LIP" set of experiments
May 2018 preparation and guidance of "Cosmic Ray Lab - LIP" set of experiments
May 2017 preparation and guidance of "Cosmic Ray Lab - LIP" set of experiments
May 2016 preparation and guidance of "Cosmic Ray Lab - LIP" set of experiments

Faculdade de Ciências, Universidade de Lisboa, Lisbon, Portugal

Advanced Formation of Teachers

"VI Encontro Internacional da Casa Das Ciências - VI International Meeting of the House of Sciences":

12 Jul 2019 Preparation of activities and guidance of attendees for the "VI Encontro Internacional da Casa Das Ciências - VI International Meeting of the House of Sciences" on the topic of "Experimentação com sensores, Raspberry Pis e programação Python - Experimenting with sensors, Raspberry Pi's and Python programming" for basic (7th-9th year) and high school teachers.

SUPERVISION EXPERIENCE

Instituto Superior Técnico, Universidade de Lisboa, Lisbon, Portugal

Feb 2023 - Jul 2023 - "Time Variability of Cosmic Ray Fluxes", Rafael Parente, 1st Cycle Integrated Project in Engineering Physics - Bologna B.Sc. in Engineering Physics
Role: Co-Supervisor

LIP Internship Program

Jul 2022 - Oct 2022 - "Temporal variability of the cosmic-ray flux"
Jul 2019 - Sep 2019 - "Selection of Helium nuclei using multivariate data analysis in AMS"
Jul 2018 - Sep 2018 - "Solar modulation of cosmic rays - 1D Stochastic resolution"
Jul 2017 - Sep 2017 - "Solar modulation of cosmic rays - 1D Finite Difference"
Jul 2016 - Sep 2016 - "Selection of positrons in AMS and measurement of its differential rate (dN/dt.dRig)"

FELLOWSHIPS, SCHOLARSHIPS & AWARDS

Assegno di Ricerca (Research Grant)   **Apr 2023 - Apr 2024**

Title: "Studio fenomenologico della modulazione solare dei raggi cosmici galattici"
Institution: Dipartimento di Fisica e Geologia, Università degli Studi di Perugia, Perugia, Italy
Project: CAESAR
Reference: D.R. 3437 del 13.12.2022

Ph.D. Grant   **Mar 2015 - Mar 2019**

Institution: FCT - Fundação para a Ciência e Tecnologia
Reference: SFRH/BD/104462/2014.

Diploma for Teaching Excellence

2021/2022 Computational Physics
2020/2021 Computational Physics
2018/2019 Computational Physics
2016/2017 Computational Physics
2015/2016 Computational Physics

REFEREED JOURNAL PUBLICATIONS

The following papers were published in the following international peer-reviewed journals: **Physical Review Letters**, **Advances in Space Research** and **The Astrophysical Journal Letters**, with article [8] featured as a highlight on the AAS NOVA editor's choice. A complete reference list of the publications can be found on the INSPIRE database **here**.

27. M. Aguilar et al. (AMS Collaboration), "Properties of Cosmic-Ray Sulfur and Determination of the Composition of Primary Cosmic-Ray Carbon, Neon, Magnesium, and Sulfur: Ten-Year Results from the Alpha Magnetic Spectrometer ", Phys. Rev. Lett. 130 (2023) 211002, doi: 10.1103/PhysRevLett.130.211002

26. M. Aguilar et al. (AMS Collaboration), "Temporal Structures in Electron Spectra and Charge Sign Effects in Galactic Cosmic Rays", Phys. Rev. Lett. 130 (2023) 161001, doi: 10.1103/PhysRevLett.130.161001

25. M. Aguilar et al. (AMS Collaboration), "Properties of Daily Helium Fluxes", Phys. Rev. Lett. 128 (2022) 231102, doi: 10.1103/PhysRevLett.128.231102

24. M. Aguilar et al. (AMS Collaboration), "Periodicities in the Daily Proton Fluxes from 2011 to 2019 Measured by the Alpha Magnetic Spectrometer on the International Space Station from 1 to 100 GV", Phys. Rev. Lett. 127 (2021) 271102, doi: 10.1103/PhysRevLett.127.271102

23. M. Aguilar et al. (AMS Collaboration), "Properties of a New Group of Cosmic Nuclei: Results from the Alpha Magnetic Spectrometer on Sodium, Aluminum, and Nitrogen", Phys. Rev. Lett. 127 (2021) 021101, doi: 10.1103/PhysRevLett.127.021101

22. M. Aguilar et al. (AMS Collaboration), "Properties of Heavy Secondary Fluorine Cosmic Rays: Results from the Alpha Magnetic Spectrometer", Phys. Rev. Lett. 126 (2021) 081102, doi: 10.1103/PhysRevLett.126.081102

21. M. Aguilar et al. (AMS Collaboration), "Properties of Iron Primary Cosmic Rays: Results from the Alpha Magnetic Spectrometer", Phys. Rev. Lett. 126 (2021) 041104, doi: 10.1103/PhysRevLett.126.041104

20. M. Aguilar et al. (AMS Collaboration), "The Alpha Magnetic Spectrometer (AMS) on the international space station: Part II – Results from the first seven years", Phys. Rept. 894 (2020) 1-116, doi: 10.1016/j.physrep.2020.09.003

19. M. Aguilar et. al. (AMS Collaboration), "Properties of Neon, Magnesium, and Silicon Primary Cosmic Rays Results from the Alpha Magnetic Spectrometer", Phys. Rev. Lett. 124 (2020) 211102, doi: 10.1103/PhysRevLett.124.211102

18. M. Aguilar et. al. (AMS Collaboration), "Properties of Cosmic Helium Isotopes Measured by the Alpha Magnetic Spectrometer", Phys. Rev. Lett. 123 (2019) 181102, doi: 10.1103/PhysRevLett.123.181102

17. N. Tomassetti, F. Barao, B. Bertucci, E. Fiandrini, M. Orcinha, "Numerical modeling of cosmic-ray transport in the heliopshere and interpretation of proton and helium fluxes in Solar Cycle 24", Advances in Space Research 64 (2019) 2477-2489, doi: 10.1016/j.asr.2019.06.025

16. M. Aguilar et. al. (AMS Collaboration), "Towards Understanding the Origin of Cosmic-Ray Electrons", Phys. Rev. Lett. 122 (2019) 101101, doi: 10.1103/PhysRevLett.122.101101

15. M. Aguilar et. al. (AMS Collaboration), "Towards Understanding the Origin of Cosmic-Ray Positrons", Phys. Rev. Lett. 122 (2019) 041102, doi: 10.1103/PhysRevLett.122.041102

14. N. Tomassetti, F. Barao, B. Bertucci, E. Fiandrini, J. L. Figueiredo, J. B. Lousada, M. Orcinha, "Testing Diffusion of Cosmic Rays in the Heliosphere with Proton and Helium Data from AMS", Phys. Rev. Lett. 121 (2018) 251104, doi: 10.1103/PhysRevLett.121.251104

13. M. Aguilar et. al. (AMS Collaboration), "Precision Measurement of Cosmic-Ray Nitrogen and its Primary and Secondary Components with the Alpha Magnetic Spectrometer on the International Space Station", Phys. Rev. Lett. 121 (2018) 051103, doi: 10.1103/PhysRevLett.121.051103

12. M. Aguilar et. al. (AMS Collaboration), "Observation of Complex Time Structures in the Cosmic-Ray Electron and Positron Fluxes with the Alpha Magnetic Spectrometer on the International Space Station", Phys. Rev. Lett. 121 (2018) 051102, doi: 10.1103/PhysRevLett.121.051102

11. M. Aguilar et. al. (AMS Collaboration), "Observation of Fine Time Structures in the Cosmic Proton and Helium Fluxes with the Alpha Magnetic Spectrometer on the International Space Station", Phys. Rev. Lett. 121 (2018) 051101, doi: 10.1103/PhysRevLett.121.051101

10. M. Aguilar et. al. (AMS Collaboration), "Observation of New Properties of Secondary Cosmic Rays Lithium, Beryllium, and Boron by the Alpha Magnetic Spectrometer on the International Space Station", Phys. Rev. Lett. 120 (2018) 021101, doi: 10.1103/PhysRevLett.120.021101

9. M. Aguilar et. al. (AMS Collaboration), "Observation of the Identical Rigidity Dependence of He, C, and O Cosmic Rays at High Rigidities by the Alpha Magnetic Spectrometer on the International Space Station", Phys. Rev. Lett. 120 (2017) 021101, doi: 10.1103/PhysRevLett.119.251101

8. N. Tomassetti, M. Orcinha, F. Barao, B. Bertucci, "Evidence for a Time Lag in Solar modulation of galactic cosmic rays", ApJL, 849 (2017) L32, doi: 10.3847/2041-8213/aa9373

7. M. Aguilar et. al. (AMS Collaboration), "Precision Measurement of the Boron to Carbon Flux Ratio in Cosmic Rays from 1.9 GV to 2.6 TV with the Alpha Magnetic Spectrometer on the International Space Station", Phys. Rev. Lett. 117 (2016) 231102, doi: 10.1103/PhysRevLett.117.231102

6. M. Aguilar et al. (AMS Collaboration), "Antiproton Flux, Antiproton-to-Proton Flux Ratio, and Properties of Elementary Particle Fluxes in Primary Cosmic Rays Measured with the Alpha Magnetic Spectrometer on the International Space Station", Phys. Rev. Lett. 117 (2016) 091103, doi: 10.1103/PhysRevLett.117.091103

5. M. Aguilar et al. (AMS Collaboration), "Precision Measurement of the Helium Flux in Primary Cosmic Rays of Rigidities 1.9 GV to 3 TV with the Alpha Magnetic Spectrometer on the International Space Station", Phys. Rev. Lett. 115 (2015) 211101, doi: 10.1103/PhysRevLett.115.211101

4. M. Aguilar et al. (AMS Collaboration), "Precision Measurement of the Proton Flux in Primary Cosmic Rays from Rigidity 1 GV to 1.8 TV with the Alpha Magnetic Spectrometer on the International Space Station", Phys. Rev. Lett. 114 (2015) 171103, doi: 10.1103/PhysRevLett.114.171103

3. L. Accardo et al. (AMS Collaboration), "High Statistics Measurement of the Positron Fraction in Primary Cosmic Rays of 0.5-500 GeV with the Alpha Magnetic Spectrometer on the International Space Station", Phys. Rev. Lett. 113 (2014) 121101, doi: 10.1103/PhysRevLett.113.121101

2. M. Aguilar et al. (AMS Collaboration), "Electron and Positron Fluxes in Primary Cosmic Rays Measured with the Alpha Magnetic Spectrometer on the International Space Station", Phys. Rev. Lett., 113 (2014) 121102, doi: 10.1103/PhysRevLett.113.121102

1. M. Aguilar et al. (AMS Collaboration), "Precision Measurement of the (e++e-) Flux in Primary Cosmic Rays from 0.5 GeV to 1 TeV with the Alpha Magnetic Spectrometer on the International Space Station", Phys.Rev.Lett. 113 (2014) 221102, doi: 10.1103/PhysRevLett.113.221102

CONFERENCE PROCEEDINGS

1. M. Orcinha, N. Tomassetti, F. Barão and B. Bertucci, "Observation of a time lag in solar modulation of cosmic rays in the heliosphere", J. Phys.: Conf. Ser. 1181 (2019) 1, 012013, doi: 10.1088/1742-6596/1181/1/012013
26th Extended European Cosmic Ray Symposium and 35th Russian Cosmic Ray Conference, Barnaul - Belokurikha - Altai Mountains, Russia, July 6 - 10, (2018)

CONFERENCE & WORKSHOP PRESENTATIONS

Contributed talks at international conferences and workshops

7 July 2018 "Observation of a time lag in solar modulation of cosmic rays in the heliosphere", 26th Extended European Cosmic Ray Symposium and 35th Russian Cosmic Ray Conference, Altai State University, Barnaul & Belokurikha, Russia

Contributed talks at national conferences and workshops

2 Jul 2019 "Study of solar modulation effects on cosmic ray fluxes measured by the AMS experiment", 5th IDPASC/LIP Students Workshop, University of Minho, Braga, Portugal
17 Feb 2018 "AMS - Solar modulation in the AMS era", "Jornadas do LIP" - LIP National Workshop, Évora, Portugal
24 Mar 2017 "Solar modulation of the galactic cosmic-ray flux", LIP PhD Student's workshop, University of Coimbra, Coimbra, Portugal
20 Oct 2015 "Short-term structures in the AMS-02 proton flux", IDPASC Workshop on "Space Particles and Earth", University of Évora, Évora, Portugal

AMS Collaboration Meeting Talks

1 Mar 2018 "Solar Modulation Studies with Protons", M. Orcinha, F. Barão, L. Derome, N. Tomassetti, for AMS General Analysis Meeting - Low Energy, Geneva, Switzerland

Poster sessions

6 July 2018 "Precision Measurement of the Monthly Cosmic Ray Fluxes with the Alpha Magnetic Spectrometer on the ISS", 26th Extended European Cosmic Ray Symposium and 35th Russian Cosmic Ray Conference, Altai State University, Barnaul & Belokurikha, Russia
12 October 2017 "Solar Modulation of Galactic Cosmic-Rays", Técnico Lisboa Research Activity during the Top Industrial Managers Europe General Assembly, Instituto Superior Técnico, Lisboa, Portugal
5-6 April 2017 "Solar Modulation of Galactic Cosmic-Rays", IST PhD OpenDays, Instituto Superior Técnico, Lisboa, Portugal

ADVANCED EDUCATION

Participation in international schools

Sep 2015 "3rd International Summer School on INtelligent Signal Processing for FrontIEr Research and Industry - INFIERI", University of Hamburg and Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany

KNOWLEDGE TRANSFER

Invited talks at academic institutions

20 Dec 2018 "Parallelization of Code in Physics - An introduction to Parallelization & MPI", Seminar for the course of "Computational Physics", taught by Fernando Barão, for the MSc in Physics Engineering of Instituto Superior Técnico, Instituto Superior Técnico, Lisboa, Portugal
14 Dec 2018 "Parallel Selection of Protons in AMS - Optimizing data selection with Open MPI", Seminar for the course of "Programming for Cluster and Multicore", taught by Alcides Fonseca, for the MSc in Computer Science of the Faculty of Sciences of the University of Lisbon, Faculdade de Ciências da Universidade de Lisboa, Lisboa Portugal
12 Jul 2017 "A experiência AMS - Efeito do vento Solar", IDPASC Workshop "Hands on Particles and Light", Instituto Superior Técnico, Lisboa, Portugal
14 Jul 2016 "Introdução a ROOT", IDPASC Workshop "Hands on Particles and Light", Instituto Superior Técnico, Lisboa, Portugal
15 Jul 2016 "A experiência AMS - Efeito do vento Solar", IDPASC Workshop "Hands on Particles and Light", Instituto Superior Técnico, Lisboa, Portugal
29 Mar 2016 "Overview of the Solar Modulation Phenomenon", Laboratoire de Physique Subatomique et de Cosmologie - CNRS, Grenoble, France

Outreach talks

13 May 2022 Presented the lecture entitled "Alpha Magnetic Spectrometer - A cosmic-ray observatory in space" for the *Seventh Lisbon mini-school on Particle and Astroparticle Physics*, Oeiras, Portugal
9 Mar 2022 Presented the lecture entitled "Alpha Magnetic Spectrometer - A cosmic-ray observatory in space" for the *Jornadas da Engenharia Física do Técnico - Inside Views*, LIP - Lisboa, Portugal
7 Feb 2020 Presented the lecture entitled "Alpha Magnetic Spectrometer - A cosmic-ray observatory in space" for the *Fifth Lisbon mini-school on Particle and Astroparticle Physics*, Costa da Caparica, Portugal
9 May 2018 Presented the lecture entitled "LIP - Das profundezas da terra ao espaço (The AMS Experiment)" for the *32° aniversário do LIP*, Laboratório de Instrumentação e Física Experimental de Partículas, Lisboa, Portugal
22 Nov 2017 Presented the lecture entitled "A Escuridão do Espaço - Matéria Escura e AMS" for the *A Semana da Ciência e Tecnologia no LIP*, Laboratório de Instrumentação e Física Experimental de Partículas, Lisboa, Portugal

SCIENTIFIC ACTIVITIES

Current Scientific positions & Memberships

2023 - present - **Member** of the Istituto Nazionale di Fisica Nucleare - INFN, Perugia, Italy

2023 - present - **Assegnista** of the Università degli Studi di Perugia, Perugia, Italy
2013 - present - **Researcher** at Laboratório de Instrumentação e Física Experimental de Partículas - LIP, Lisboa, Portugal
2013 - present - **Member** of the international scientific collaboration Alpha Magnetic Spectrometer - AMS
2013 - present - **Member** of the European Organization for Nuclear Research - CERN, User

Past Scientific positions & Memberships

2015 - 2023 - **Ph.D. student** at Instituto Superior Técnico/ Laboratório de Instrumentação e Física Experimental de Partículas, Lisbon, Portugal

Teaching positions

2020 - 2022 - **Teaching Assistant** at Instituto Superior Técnico, Lisbon, Portugal
2015 - 2019 - **Teaching Collaborator** at Instituto Superior Técnico, Lisbon, Portugal

Visits

March - June 2016 Laboratoire de Physique Subatomique et de Cosmologie - LPSC, Grenoble, France
Visiting researcher under colaboration with Professor Laurent Derome.
2013 - Present regular yearly short-term visits to CERN, Geneve, Switzerland

Service

2013 - 2019 AMS Collaboration - shifter for the PM sub-detector group (ECAL, TOF, RICH). RICH expert on-call from CERN area during shifts.

PROJECTS

Electronics

P4 September 2019 Design and development of the "ADC Stereo - Analog-to-Digital Converted Stereo", a wireless playback device (WiFi and Bluetooth) from an old Denon audio amplifier and radio receiver. It is a RaspberryPi-based system which can receive audio from AirPlay or Bluetooth and can be controlled manually through the original analog interface. The interface is digitized using an Arduino Uno which communicates with the RaspberryPi through a USB serial connection. The user can also interact with the device through the LCD display.

P2 June 2016 Design and development of an Arduino-based control system for a graduation project of students of the Universidade de Belas Artes de Lisboa. The object consisted of an acrylic cube which would glow and change colours as people in the exhibit room got closer or farther away from it. The control system used ultrasound sensors and an Arduino to control the RGB LED strips.

P1 May 2015 - 2019 Participated on the design of a front end circuit board for a silicon photomultiplier for the AMU ("A Observar Muões" - "Observing Muons") project at LIP. Design and layout of a 4 layer board with signal amplification and pre-amplification, analog output, variable threshold and a digital output in the TTL and NIM norms.

Software design

P5 Jan 2021 Design and development of a web scrapping platform for publicly available documents from Torre do Tombo's archive website for research purposes. Main focus of the research is the Portuguese Inquisition. A database of all inquisition processes has been created which includes partial treatment of bad inputs, linking of split partial entries and some statistical analysis of data.

P3 Jan 2017 Design and development of a parallelization algorithm with natural workload balancing for the optimization of Proton event selection from AMS cosmic ray data. It was coded in C++ using Open MPI for the parallelization scheme and used AMS libraries, custom LIP libraries (file management and XRootD access) and a selection scheme designed by me.

HARDWARE &
SOFTWARE
SKILLS

Programming & Scripting Languages

> C, C++
> PHP, HTML, CSS
> Python
> UNIX shell scripting (bash, dash, tcsh, zsh)
> GNU Make
> Markdown (GitHub and Emacs Muse flavours), Obsidian

Parallelization and Communication Technologies

> Message Passing Interface (OpenMPI implementation in C/C++ and mpi4py in Python)
> Threads
> Forks
> Inter-Process Communication (Signal, Message Queue, Socket, Shared Memory, Semaphores, Mutex, Conditions, MPI, Pipe)

Signal Processing

> Empirical Mode Decomposition
> Wavelet Transform
> Fourier Transform

Data Analysis

> Wolfram Mathematica
> ROOT - Data Analysis Framework, CERN
> TMVA - Toolkit for Multivariate Data Analysis with ROOT (Boosted Decision Trees, Perceptrons, ...)
> statsmodels
> Numpy
> Pandas

Data Structures

> ROOT files (C++ Object Oriented Storage)
> XML
> JSON
> CSV (and similar)
> SQL (MySQL)

Access, Extraction & Management of Data

> RAID
> XRootD, EOS
> CVMFS - CERN VM File System
> NFS
> Web Scrapping (GET & POST requests, HTML & JSON parsing)

Web, Serial & IoT Communication Protocols

> I^2C, SPI
> TCP, UDP, FTP, HTTP requests

Package Management Software

> Homebrew
> Apt (apt-get) - Advanced Packaging Tool

Project Management Software

> Trello

Virtualization Software

> VMWare
> VirtualBox

Version Control Software

> DVCS (Git)
> VCS (CVS, SVN)
> Bitbucket, GitHub, GitLab

Text Editing and Productivity Software

> Vim, Emacs
> Sublime Text 4
> Visual Studio Code
> Atom text editor
> TeX (TeX, LaTeX 2_ε, BibTeX, TikZ, $\mathcal{AMS}$-LaTeX, MiKTeX, pdfLaTeX),
> Microsoft Office, OpenOffice.org, LibreOffice, Google Docs

Computer-Aided Design (CAD) Software

> Autodesk Eagle - PCB Design Software
> Fritzing
> Autodesk AutoCAD

Graphic Design Tools

> Boxy SVG
> Sip
> Inkscape
> Gimp

Operating Systems

> Microsoft Windows family
> Apple OSX
> Linux

Micro-Computers

> Arduino
> Raspberry Pi (2 Model A, B and B+, 3 Model B and B+)
> BeagleBoard (BeagleBone Black)

3D printing

> Creality Ender 3 V2