Riccardo **Ridolfi**

PhD in Physics
Via Irnerio 46, 40126 Bologna (BO), ITALY
Riccardo.Ridolfi@bo.infn.it • www.unibo.it/sitoweb/r.ridolfi/en • 0000-0001-7309-3461 • riccardo-ridolfi2

Education and training

Postdoctoral researcher in Physics — *Bologna, Italy*
University of Bologna and INFN (Italian National Institute for Nuclear Physics) — *February 2022–present*
- DAQ coordinator and member of the analysis team in the FOOT experiment
- Working on the development of detector and electronics in the RIPTIDE project

PhD in Physics — *Bologna, Italy*
University of Bologna and INFN (Italian National Institute for Nuclear Physics) — *June 2022*
- Funded with INFN scolarship for Nuclear and Subnuclear Physics curriculum

Visiting PhD — *Darmstadt, Hessen, Germany*
GSI Helmholtzzentrum für Schwerionenforschung — *September–November 2020*
- Gained Marco Polo fellowship from University of Bologna
- Worked in Biophysics department on the project *Measurements of neutron production in shielding materials and assessment of the radiobiological effect of secondary radiation via the induction of chromosome aberrations* funded by ESA
- Performed data analysis of ΔE-E telescopes for charged and neutral particles detection

Master of Science in Nuclear and Particle Physics — *Bologna, Italy*
University of Bologna — *2018*
- Thesis title: *Study of the track reconstruction in the FOOT experiment for Hadrontherapy*
- Final score 110/110 *cum laude*

Bachelor of Science in Physics — *Bologna, Italy*
University of Bologna — *2015*
- Thesis title: *Adroterapia: principi e applicazioni*
- Final score 110/110

Skills

Programming	C/C++, Python, ROOT, R, bash, LaTeX
Version control	git
OS	Linux, MacOS, Windows, Android
General software	European Computer Driving Licence (ECDL)
Languages	Italian (mother tongue), English (good speaking, writing and reading, FCE Cambridge)
	French (elementary speaking and reading)
Other	Driving licence B

Experience

Co-supervisor of a Bachelor thesis in Physics degree — *Bologna, Italy*
University of Bologna — *20 October 2023*
Caratterizzazione di trigger per un tracciatore di neutroni

Teaching tutor (12 hours) for 5^{th} Physical Sensing and Processing DIFA summer school — *Bologna, Italy*
University of Bologna — *July 2023*

Teaching tutor (30 hours) for *Fisica Generale T-2* course in Electrical Energy and Automation Engineering Degree — *Bologna, Italy*
University of Bologna — *March 2023–September 2023*

Co-supervisor of a Bachelor thesis in Physics degree — *Bologna, Italy*
University of Bologna — *16 September 2022*
Studio delle interazioni in aria nelle misure di sezione d'urto nell'esperimento FOOT

Co-supervisor of a Bachelor thesis in Physics degree — *Bologna, Italy*

University of Bologna — *16 September 2022*

Studio delle interazioni nel rivelatore e selezione degli eventi nelle misure di sezione d'urto nell'esperimento FOOT

Co-supervisor of a Master thesis in Physics degree — *Bologna, Italy*

University of Bologna — *28 October 2022*

Analysis of fragmentation cross sections of GSI 2021 data for the FOOT experiment

Teaching tutor (30 hours) for *Fisica Generale T-2* course in Electrical Energy and Automation Engineering Degree — *Bologna, Italy*

University of Bologna — *March 2022–September 2022*

Teaching tutor (30 hours) for *Fisica Generale T-2* course in Electrical Energy and Automation Engineering Degree — *Bologna, Italy*

University of Bologna — *March 2021–September 2021*

Teaching tutor (20 hours) for *Fisica Generale T-2* course in Electrical Energy and Automation Engineering Degree — *Bologna, Italy*

University of Bologna — *March 2020–July 2020*

Co-supervisor of a Bachelor thesis in Physics degree — *Bologna, Italy*

University of Bologna — *6 December 2019*

Esperimento FOOT: calibrazione dello scintillatore con fasci di protoni e ioni carbonio

Co-supervisor of a Bachelor thesis in Physics Degree — *Bologna, Italy*

University of Bologna — *6 December 2019*

Misure di tempo di volo di muoni con l'elettronica dell'esperimento FOOT

Tour Guide at the exhibition "Enrico Fermi: a dual genius between theory and experiments" — *Bologna, Italy*

SIF (Italian Physics Association) — *February 2016–May 2016*

- Worked with both general public and schools
- Exhibition now permanently moved to *Centro Ricerche Enrico Fermi* in Rome

Outreach Activities

Participation in 20^{th} Particle Therapy MasterClass for high-school students — *Bologna, Italy*

INFN (Italian National Institute for Nuclear Physics) - IPPOG — *15 March 2024*

- Local organizer and lecturer

Participation in 19^{th} Particle Therapy MasterClass for high-school students — *Bologna, Italy*

INFN (Italian National Institute for Nuclear Physics) - IPPOG — *14 March 2023*

- Local organizer and lecturer

Participation in European Researcher's Night — *Bologna, Italy*

INFN (Italian National Institute for Nuclear Physics) — *30 September 2022*

- Hadrontherapy principles shown to the general public

Tutor of the *Percorsi per le Competenze Trasversali e l'Orientamento* for high-school students — *Bologna, Italy*

INFN (Italian National Institute for Nuclear Physics) — *June 2021*

- Support for LHCb Monte Carlo and data analysis

Organising member of three editions of *Pint of Science* — *Bologna, Italy*

Pint Of Science — *2017-2019*

- Interesting and relevant talks (9 in total) on the latest science research in an accessible format to the public mainly across bars, pubs, cafes and other public spaces
- Organised by grassroot communities in 28 countries worldwide in more than 400 cities

Speaker at *Settimana culturale* for high-school student — *Recanati, Italy*

Liceo Scientifico "Giacomo Leopardi" — *March 2016*

- Title of the talk *Enrico Fermi: due fisici in uno*

Other Activities

Research fellows representative in Department Council — *Bologna, Italy*
DEPARTMENT OF PHYSICS AND ASTRONOMY, UNIVERSITY OF BOLOGNA — *May 2022–April 2024*

PhD students representative in Department Council — *Bologna, Italy*
DEPARTMENT OF PHYSICS AND ASTRONOMY, UNIVERSITY OF BOLOGNA — *May 2019–May 2022*

Member of ADI National Secretariat — *Italy*
ADI (ASSOCIATION OF DOCTORAL CANDIDATES AND JUNIOR RESEARCHERS IN ITALY) — *October 2020–October 2022*

- Member of organizational department
- Affiliated with Eurodoc (European Council of Doctoral Candidates and Junior Researchers)

Coordinator of ADI Bologna — *Bologna, Italy*
ADI (ASSOCIATION OF DOCTORAL CANDIDATES AND JUNIOR RESEARCHERS IN ITALY) — *June 2019–October 2020*

Conferences & Workshops with personal contribution

16th Pisa Meeting on Advanced Detectors — *La Biodola, Italy*
ACCEPTED POSTER CONTRIBUTION "RIPTIDE: A PROTON-RECOIL TRACK IMAGING DETECTOR FOR FAST NEUTRONS" — *26 May-1 June 2024*
https://www.pi.infn.it/pm/

European Nuclear Physics Conference 2022 (EuNPC 2022) — *Santiago de Compostela, Spain*
NUCLEAR FRAGMENTATION CROSS SECTION MEASUREMENTS WITH THE FOOT EXPERIMENT — *24-28 October 2022*
https://indico.cern.ch/event/1104299/

9^{th} *Beam Telescopes and Test Beams Workshop* — *online*
THE ΔE-TOF DETECTOR OF THE FOOT EXPERIMENT: CHARACTERIZATION AND FIRST RESULTS — *8-11 February 2021*
https://indico.cern.ch/event/945675/

106^{th} National Conference of *Società Italiana di Fisica* (SIF) — *online*
THE MAGNETIC SPECTROMETER OF THE FOOT EXPERIMENT — *14-18 September 2020*

- Selected for publication as one of best talks by the Scientific Committee
- https://www.sif.it/attivita/congresso/106

FAIR next generation scientists - 6th Edition Workshop — *Genova, Italy*
THE FOOT EXPERIMENT — *20-24 May 2019*
https://indico.gsi.de/event/7684/

104^{th} National Conference of *Società Italiana di Fisica* (SIF) — *Cosenza, Italy*
STUDY OF THE TRACK RECONSTRUCTION AND OF FRAGMENT IDENTIFCATION IN THE FOOT EXPERIMENT FOR HADRONTHERAPY — *20 September 2018*
https://www.sif.it/attivita/congresso/104

2^{nd} BCD International School on High Energy Physics — *Cargèse, France*
ION BEAM THERAPY: PRINCIPLES AND APPLICATIONS — *11-15 April 2016*

- Awarded for best student presentation

Particle and Astroparticle Physics Autumn Program — *GSSI-LNGS, Italy*
HADRONTHERAPY AGAINST CANCER: AN OVERVIEW — *3-6 October 2016*

- Awarded for best student presentation
- http://papap.ai-sf.it/

Schools & Workshops attendance

Seventh National Seminar on Innovative detectors (SNRI-VII) — *Turin, Italy*
INFN — *9-13 October 2023*
https://agenda.infn.it/event/35788/

Introduction to Deep Learning and Tensorflow — *online*
CINECA — *3-4 April 2023*

School on *IA applicata alla Fisica Medica* — *online*
ASSOCIAZIONE ITALIANA DI FISICA MEDICA E SANITARIA & INFN — *2,26 February, 15,24 March 2021*
https://l.infn.it/aifmai

School on *Modelling radiation effects from initial physical events* — *Pavia, Italy*
EUROPEAN JOINT PROGRAMME FOR THE INTEGRATION OF RADIATION PROTECTION RESEARCH - CONCERT — *28 May-8 June 2018*
https://www.concert-h2020.eu/

Workshop on *What next in Radiobiology at INFN* — *Trento, Italy*
INFN (ITALIAN NATIONAL INSTITUTE FOR NUCLEAR PHYSICS) — *12-13 May 2016*

PSI Winterschool for Protons 2016 — *Bad Zurzach, Switzerland*
PAUL SCHERRER INSTITUT — *24-28 Janaury 2016*

School on *Basi fisiche, tecnologiche e radiobiologiche dell'adroterapia* — *Trento, Italy*
SCUOLA SUPERIORE DI FISICA IN MEDICINA PIERO CALDIROLA - ASSOCIAZIONE ITALIANA DI FISICA MEDICA E SANITARIA — *11-12 May 2015*

Research Activity

Activity in the FOOT experiment

The electronic setup of the FOOT experiment is a flexible hierarchical distributed system based on Linux PCs, VME crates and boards, detector integrated readout systems and standard communication links such as Ethernet, USB and optical fibers. The system which is in charge of collecting all data and of the management of the whole data acquisition is the *Trigger and Data Acquisition (TDAQ) System.* The process of Data Acquisition takes care of all the steps from the generation of signals in the detector until their processing and storage on a disk. Moreover, TDAQ manages the distribution of trigger and busy signals and assures the synchronization among the detectors.

During my PhD I worked on the design of the TDAQ system and on the integration of different subdetectors, from VME to custom boards. Firstly, I developed VME readout of trigger board and beam monitor, using block transfer which can result in a 10-fold read/write speedup. Then, I worked on the integration of remote detectors together with detector experts. In particular, I joined the development of C++ custom classes for data transfer designed on consumer-producer model with *Transimission Control Protocol* (TCP), a widely-used reliable protocol for network communications. In this context, I had the opportunity to study, write and debug concurrent programming.

Eventually, I developed the online monitoring of the experiment: a lot of parameters have to be monitored during data acquisition such as hardware and software system status, buffer occupancies and sensor temperature. Moreover, checking correlation and synchronization among detectors is an important part of real-time data quality while online plot of physical quantities can provide useful information even for detector alignment as several experimental facilities lack low-intensity monitoring. In this context, I extended the online monitoring tools to all available detectors in the existing setup thus monitoring trigger information, beam position and synchronization. These tools were particularly useful during 2021-2023 FOOT data takings at GSI (Darmstadt, Germany), HIT (Heidelberg, Germany) and CNAO (Pavia, Italy) which I joined as one of the TDAQ experts. I am also the TDAQ responsible for the FOOT experiment since June 2021.

In these years I worked also both on the data quality for all the FOOT detectors (microstrip detectors, pixel detectors, fast scintillators) following all the chain from raw data to reconstructed quantities and on their representation in the software. Moreover, since I am involved also in the track reconstruction and analysis team, I dealt with event reconstruction both with Monte Carlo simulations and real data studying detector responses to different ion beams and energies to get a proper description of the setup needed for the analysis.

Activity in GSI project

The health risks of space radiation are one of the most difficult challenges in space exploration, especially in future missions beyond Low Earth Orbit (LEO). These hazards could be so important to prevent space missions due to huge costs and unacceptable risks for the astronauts. Radiation in space is a complex mixture of high-energy particles of solar and galactic origin as well as secondary particles produced by spacecraft shielding or planet surfaces. While galactic cosmic rays (GCR) spectrum is well known, there are no precise measurements of their nuclear fragmentation cross sections. For all these reasons it is mandatory to deepen our knowledge about the interaction of GCR with matter in order to assess their biological effects. In particular, neutrons and light ions produced by nuclear fragmentation seem to be the most dangerous hazard for astronauts in deep space and nowadays there is a lack of experimental data regarding their production in thick shielding. During my research stay at GSI I worked on the ESA-funded project *Measurements of neutron production in shielding materials and assessment of the radiobiological effect of secondary radiation via the induction of chromosome aberrations*, in particular I carried out the Time of Flight (ToF) analysis of ΔE-E telescopes from the very beginning. In particular, I analysed data from two ΔE-E detectors in a phoswich configuration, i.e. a thin plastic scintillator directly coupled with a thick barium flouride crystal read by a single PMT. The two telescopes were placed at 15 and 40 degrees with respect to the direction of the beam, 3 metres away from the 20 cm thick aluminum target. The main goal of my analysis was to characterise the charged spectrum behind the target, in particular the proton contribution. Indeed, since the neutron measurement is carried out using offline detectors such as thermoluminescent dosimeters, it is crucial to evaluate charged particle spectra in order to correct the measurements. Without this analysis the secondary proton correction had to be assessed using Monte Carlo simulation as presented in Boscolo, D. and Horst, F. *et al.*, Characterization of the Secondary Neutron Field Produced in a Thick Aluminum Shield by 1 GeV/u ^{56}Fe Ions Using TLD-Based Ambient Dosimeters, *Frontiers in Physics*, **8** (2020) 365. I started my activity from the very beginning, i.e. from waveforms acquired with a electronic setup during a beam time in March 2020 in which a 1 GeV/u ^{56}Fe beam was shot on a thick aluminum target. The iron beam was chosen as a representative of GCR. I extracted the most useful information from waveforms in order to perform both a ToF and a Pulse Shape Analysis (PSA). Before starting the real analysis, I used several calibration runs to calibrate the detectors. I also joined one of them at MIT (Marburger Ionenstrahltherapie-Zentrum), a particle therapy centre in Marburg. Thanks to the PSA, I was able to identify fragments produced in the collision, namely photons, neutrons and hydrogen isotopes. Then, I developed an analysis strategy to combine this information with the Time of Flight: in this way it was possible to get information about the energy spectra of such fragments. I assessed the suitability of these phoswich detectors to detect and to identify particles in a mixed field. Moreover, my analysis showed that after the punch-through energy, i.e. when particles have enough energy to escape the detector, the isotope identification capabilities are spoiled and it is hard to separate hydrogen isotopes. This was a good indication in order to design phoswich detectors for future experiments in this field. My results showed a good agreement between Monte Carlo simulation and data except for proton data at 15 degrees, in which simulation predicted a harder spectrum with respect to data.

Summary of PhD thesis

My PhD thesis was carried out in the framework of the FOOT (FragmentatiOn Of Target) experiment, an INFN-funded experiment related to the Nuclear Physics Scientific Committee (CSN3) activities. The FOOT experiment was designed to address a huge gap present in fragmentation cross section data for MISSING. Indeed, different fields can profit by nuclear fragmentation cross sections measurements: among them hadrontherapy and space radioprotection are of particular interest.

Hadrontherapy is an external radiation therapy technique in which protons and heavier ions are used to treat deep-seated solid tumours. The main advantage to use charged particles to treat tumours is their favourable depth-dose profile which is very different from that of photons used in conventional radiation therapy. Indeed, while a photon beam reduces its intensity exponentially as it enters into a material, charged particles are characterised by a low energy release in the beginning followed by a sharp rise after which the particle stops (Bragg peak). This peculiar behaviour makes charged particles particularly suitable to treat tumours near critical organs that must be spared by the radiation, especially in younger patients. Moreover, the electric charge of hadrons allows to actively move the beam to cover all the tumour volume. Furthermore, heavier ions such as Carbon and Oxygen can play an important role in treating radioresistant tumours thanks to their enhanced biological effectiveness. However, nuclear interactions have to be accounted for: beam particles can fragment in the human body producing low charge nuclei and these fragments are able to release a non-zero dose beyond the Bragg peak. This contribution has to be properly described. On the other hand, nuclear interactions providing the fragmentation of nuclei of the human body give rise to target fragments with low energy. These nuclear fragments can modify the dose released in healthy tissues and their effects are still in question given the lack of accurate cross sections data.

The study of such nuclear interactions is of strong interest also in the space radioprotection field. Indeed, the interest in long-term manned space missions beyond the Low Earth Orbit is growing in these years, both in national space agencies and in public-private sector. However, the health risks linked to space radiation are a major hazard which can potentially prevent any mission due to huge costs and unacceptable risks for the astronauts. For this reason, several mitigation strategies are employed, such as an intense development of risk models which strongly depend on the knowledge of underlying physical and radiobiological models. However, there are huge gaps in fragmentation cross sections data which are needed to benchmark both deterministic and Monte Carlo models currently in use.

To address all these questions, the FOOT experiment was proposed. It is composed by two independent and complementary setups, an Emulsion Cloud Chamber and an electronic setup composed by several subdetectors providing redundant measurements of kinematic properties of fragments produced in nuclear interactions between a beam and a target. FOOT was designed to detect, track and identify nuclear fragments and aims to measure double differential cross section both in angle and kinetic energy. Indeed, this would be the most significant contribution of experimental nuclear physics to the field providing the most complete information to develop a new generation of treatment planning system for patients, of transport codes and of risk models for space radioprotection. Thanks to its table top setup, the FOOT experiment can be mounted in several experimental rooms both in research centres and in clinical facilities to harness the available variety of beams and energies. Indeed, the core program of the experiment foresees the use of 250 MeV/u ^{4}He beams and $200-400$ MeV/u ^{12}C, ^{16}O beams with C, C_2H_4 and PMMA targets to measure fragmentation cross sections for hadrontherapy while $700-800$ MeV/u ^{4}He, ^{12}C and ^{16}O beams with C, C_2H_4 and PMMA targets for space radioprotection. Thanks to its flexibility, the experiment will be able to extend its physics program to other beam-target settings to possibly cover other data gaps.

My Ph.D thesis unfolded in the electronic setup activity which implements a magnetic spectrometer, coupled with detectors for tracking and detectors optimized for the identification of fragments heavier than ^{4}He. Such setup covers an angular acceptance up to a polar angle of about 10° with respect to the beam axis. Since my PhD covered the very first years of the experiment, I was able to work on several topics having the opportunity to join the development of important parts of the setup. Indeed, the aim of my Ph.D. project was twofold, i.e. the development of the Trigger and Data Acquisition (TDAQ) system for the FOOT electronic setup and a first analysis of 400 MeV/u ^{16}O beam on Carbon target data acquired in July 2021 at GSI (Darmstadt, Germany).

The TDAQ system designed for the whole apparatus is a flexible hierarchical distributed system based on Linux PCs, VME crates and boards, detector integrated readout systems and standard communication links like Ethernet, USB and optical fibers. Given the large number of different subdetectors, its architecture is similar to that of bigger particle physics experiments. Thus, it is crucial to assure the synchronization among all the detectors and to design a safe dataflow from frontend electronics to data storage. In this context, my PhD thesis aimed to develop the Beam Monitor readout with Time to Digital Converter (TDC) and the remote detectors consisting in custom electronics. In the former case the TDC is hosted in a VME crate read via USB or optical fiber while in the latter detectors are connected via Ethernet. Moreover, an online data monitoring framework was developed to check both beam and detector status to promptly cope with issues and misalignments during data takings. the Trigger and Data Acquisition (TDAQ) system for the electronic setup was developed. Namely, the VME boards for Beam Monitor readout and the remote detectors were included in the TDAQ. In this context, block transfer on VME boards was implemented in the system allowing a 10-fold speed up on the single read operations together with a processing of events completely decoupled from events themselves. The whole system was designed to work at a rate ≈ 2 kHz but tests performed with VME boards and a DE10nano board simulating a FOOT tracking station reached a maximum of 3.6 kHz with a periodic trigger. If block transfer on VME boards was switched off the rate fell to 900 Hz, showing the relevance of this work to meet FOOT requirements. Using a beam simulator providing a trigger pattern similar to a real synchrotron beam, the system showed an efficiency of 40% with a mean trigger rate of 5 kHz. The code developed for remote detectors allows an acquisition rate as high as 20 kHz when slower detectors are not present. Moreover, the online monitoring framework was enhanced to include several information for all the detectors, i.e. time synchronization among different detectors, beam shape in the whole tracking system to properly deal with misalignments and other tools to tune trigger settings. The DAQ system was extensively tested in different scenarios and it was able to take more than 40 million events at GSI in July 2021 using 200 and 400 MeV/u ^{16}O beams on Carbon (C) and Polyethylene (C_2H_4) targets. Data were acquired both with minimum bias and fragmentation trigger with an acquisition rate ranging from 200 Hz to 2 kHz depending on the beam time structure. In that context, the online monitoring framework was able to provide a very quick feedback of the overall status of the apparatus: this was particularly useful since the beam was delivered in a non-stop run of 48 hours leaving no time for an offline data analysis.

Furthermore, using a part of the latter data sample, a first fragmentation cross section analysis, both total and differential in angle, is presented. To evaluate detection efficiency an analysis of Monte Carlo samples was carried out before analyzing acquired data together with a careful check on the alignment of interesting detectors. The charge of fragments was evaluated using the Tof Wall detector as well as the production angle. To this end, both minimum bias and fragmentation runs were used together with a run without target to estimate the uninteresting fragmentation events.

Furthermore, a first analysis on a subset of GSI data (400 MeV/u ^{16}O $+$ C) of the elemental fragmentation cross sections for different produced charges have been obtained together with the first evaluations of the differential cross sections as a function of the fragment direction angle in the range $0 \leq \theta \leq 4.85°$. In the analysis the Time of Flight system (Start Counter and ToF Wall) was included together with the drift chamber (Beam Monitor) placed before the target which has the task to provide a precise measurement of the direction of the entering beam particle while rejecting fragmentations before the target.

The analysis showed that the current fragmentation trigger was able to enhance the share of interesting events without spoiling the cross section evaluation. Indeed, total cross section calculated either with minimum bias and fragmentation runs gave the same results within statistical errors. To remove background due to out-of-target fragmentation, a run without target was employed. When possible, a comparison with other available measurements was performed: obtained cross sections for Boron, Carbon and Nitrogen fragments were in agreement with current data within 2σ. In particular, for Boron a value of 62 ± 5 mb for total production cross section was found, while for Carbon 146 ± 8 mb and for Nitrogen 116 ± 9 mb.

This work proved the capability of the FOOT experiment to properly address cross section measurements.

Publications

Journal Articles and Conference Proceedings

Charge identification of fragments produced in 16O beam interactions at 200 MeV/n and 400 MeV/n on C and C2H4 targets
Galati G. Et al.
Frontiers in Physics **11** . 2024. DOI: 10.3389/fphy.2023.1327202

Riptide: a proton-recoil track imaging detector for fast neutrons
Pisanti C. Et al.
Journal of Instrumentation **19** p. C02074, 2024. DOI: 10.1088/1748-0221/19/02/C02074

The fragmentation trigger of the FOOT experiment
Galli L et al.
Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment **1046** p. 167757, 2023. DOI: https://doi.org/10.1016/j.nima.2022.167757

Nuclear fragmentation cross section measurements with the FOOT experiment
R Ridolfi
EPJ Web of Conf. **290** p. 08006, 2023. DOI: 10.1051/epjconf/202329008006

A multi-detector experimental setup for the study of space radiation shielding materials: Measurement of secondary radiation behind thick shielding and assessment of its radiobiological effect
Horst F et al.
EPJ Web Conf. **261** p. 03002, 2022. DOI: 10.1051/epjconf/202226103002

The Microstrip Silicon Detector (MSD) data acquisition system architecture for the FOOT experiment
Kanxheri K. Et al.
Journal of Instrumentation **17** p. C03035, 2022. DOI: 10.1088/1748-0221/17/03/c03035

Characterization of 150 µm thick silicon microstrip prototype for the FOOT experiment
Silvestre G et al.
Journal of Instrumentation **17** P12012, 2022. DOI: 10.1088/1748-0221/17/12/P12012

Elemental fragmentation cross sections for a 16O beam of 400 MeV/u kinetic energy interacting with a graphite target using the FOOT ΔE-TOF detectors
Toppi M et al.
Frontiers in Physics **10** . 2022. DOI: 10.3389/fphy.2022.979229

Architecture and First Characterization of the Microstrip Silicon Detector Data Acquisition of the FOOT experiment
Barbanera M et al.
2021 IEEE Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC), 2021. DOI: 10.1109/NSS/MIC44867.2021.9875514

Measuring the Impact of Nuclear Interaction in Particle Therapy and in Radio Protection in Space: the FOOT Experiment
Battistoni G et al.
Frontiers in Physics **8** p. 555, 2021. DOI: 10.3389/fphy.2020.568242

The Drift Chamber detector of the FOOT experiment: Performance analysis and external calibration
Dong Y et al.
Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment **986** p. 164756, 2021. DOI: 10.1016/j.nima.2020.164756

Charge identification of fragments with the emulsion spectrometer of the FOOT experiment
Galati G et al.
Open Physics **19** pp. 383–394, 2021. DOI: 10.1515/phys-2021-0032

Charge identification of nuclear fragments with the FOOT Time-Of-Flight system
Kraan A C et al.
Nuclear Instruments and Methods in Physics Research Section A **1001** p. 165206, 2021. DOI: 10.1016/j.nima.2021.165206

The magnetic spectrometer of the FOOT experiment
Ridolfi R
Il Nuovo Cimento C **2-3** . 2021. DOI: 10.1393/ncc/i2021-21073-x

Measurement of ^{12}C Fragmentation Cross Sections on C, O and H in the Energy Range of interest for Particle Therapy Applications
Mattei I et al.
IEEE Transactions on Radiation and Plasma Medical Sciences **4** . 2020. DOI: 10.1109/trpms.2020.2972197

The FOOT experiment
Ridolfi R
Journal of Physics: Conference Series **1667** p. 012035, 2020. DOI: 10.1088/1742-6596/1667/1/012035

Performance of the ToF detectors in the FOOT experiment
Traini G et al.
Il Nuovo Cimento C **1** . 2020. DOI: 10.1393/ncc/i2020-20016-5

The FOOT experiment: fragmentation measurements in particle therapy
Alexandrov A et al.
RAD Association Journal **3** . 2019. DOI: 10.21175/radj.2018.03.032

Track reconstruction in the FOOT experiment

Franchini M et al.
Il Nuovo Cimento C **2-3** . 2019. DOI: 10.1393/ncc/i2019-19141-7

Ion charge separation with new generation of nuclear emulsion films
Montesi M C et al.
Open Physics **17** . 2019. DOI: 10.1515/phys-2019-0024

Development and characterization of a ΔE-TOF detector prototype for the FOOT experiment
Morrocchi M et al.
Nuclear Instruments and Methods in Physics Research Section A **916** . 2019. DOI: 10.1016/j.nima.2018.09.086

The FOOT (FragmentatiOn Of Target) experiment
Valle S M et al.
Il Nuovo Cimento C **5** . 2019. DOI: 10.1393/ncc/i2018-18169-5

Bologna, 09/04/2024