

Leonardo Toffolin

Address

Date of Birth

Nationality

Italian

Mobile Phone

Email

Institutional Email leonardo.toffolin@cern.ch

Education

November 2022 - Present

PhD in Physics

University of Trieste - INFN Scholarship

“Measurement of the b -quark forward-backward asymmetry at the LHC”.

Supervisor: Prof. Marina Cobal, Co-supervisor: Dr. Michele Pinamonti

Main topics of the courses attended: electroweak physics, flavor physics, Standard Model phenomenology, semiconductor detectors, machine learning, advanced Bayesian and frequentist methods.

2020-2022

Master Degree in Nuclear and Subnuclear Physics - Grade: 110/110 *cum laude*

University of Trieste

“Feasibility study for the measurement of the angular asymmetry in the production of a bottom quark-antiquark pair in electron-positron collisions with a center-of-mass energy of 91 GeV at the future accelerator FCC-ee at CERN”.

Supervisor: Prof. Marina Cobal, Co-supervisor: Dr. Michele Pinamonti

Study of the forward-backward asymmetry of the b -quark in the associated production of a $b\bar{b}$ pair at the Z -boson pole at the leptonic Future Circular Collider (FCC-ee), based on Monte Carlo simulation to extract expected sensitivity to the main sources of systematic uncertainties.

2017-2020

Bachelor Degree in Physics - Grade: 106/110

University of Trieste

“Spettroscopia ottica non lineare: sviluppo di uno strumento per l'analisi dei dati ottenuti mediante il processo di generazione di frequenza somma”.

Supervisor: Prof. Erik Vesselli, Co-supervisor: Dr. Francesco Armillotta

Study on non-linear vibronic SFG spectroscopy, development of tools for data analysis in Condensed Matter Physics.

2012-2017

High School Diploma (Scientific Studies) - Grade: 100/100 *cum laude*

Scientific High School “ISISS M. Casagrande”, Pieve di Soligo, Italy

Employments

November 2022 - Member of the ATLAS Collaboration at CERN

- Present** *At Università degli Studi di Udine, Udine, Italy*
- Working with the ATLAS Outreach & Open Data group (since March 2023)
 - Working with the ATLAS Combined Performance Flavour Tagging group (since December 2022)
 - Working with the ATLAS Standard Model group (since December 2022)
- January 2022 - Present** **Member of the RD-FCC Collaboration at CERN**
At Università degli Studi di Udine, Udine, Italy
- Working with the RD-FCC Physics, Experiments and Detectors groups
 - Working with the FCC software group
- January 2022 - Present** **Association with the National Institute for Nuclear Research (INFN)**
Association with the Trieste section, in Italy, formally in the "Gruppo Collegato di Udine".
- January 2022 - Present** **Association with the Abdus Salam International Centre for Theoretical Physics**
ICTP in Trieste, Italy, is the main place of my work.

Relevant courses

- October 9th 2023 - October 12th 2023** **PyHEP 2023 - "Python in HEP" Users Workshop**
CERN, online
- Participation in activities and tutorials.
- March 6th 2023 - March 10th 2023** **6th HEP C++ Course and Hands-on Training - The Essentials**
CERN, online
- Participation in activities and tutorials.
- July 25th 2022 - July 29th 2022** **CODATA-RDA Research Data Science Advanced Workshops**
At ICTP, Trieste, Italy
- Participation in activities and tutorials.

Schools

- June 18th 2023 - June 30th 2023** **ICTP Summer School on Particle Physics**
At ICTP, Trieste, Italy
- Organization by ICTP.
- April 11th 2023 - April 18th 2023** **Eight Machine Learning in High Energy Physics Summer School**
In Erice, Italy
- Organization by INFN and Practicum.

Outreach and other events

**2022 -
2023** **Trieste Next**
In Trieste, Italy
Organization of INFN activities and explanation to general public and middle and high-school students

**June 27th 2023 -
June 28th 2023** **Giornate di studio sul piano triennale INFN 2024-2026**
In Trieste, Italy
Participation at the various sessions and round tables.

**2023 -
Present** **International Masterclass on particle physics**
In Udine, Italy
Tutoring of the students during the hands-on sessions.

Teaching and didactics

**March 2023 -
September 2023** **Tutorship in “Fisica Generale” (General Physics) for the bachelor degree in Geology**
At University of Trieste, Trieste, Italy
Time amount of the tutorship program: 50 hours

**2017 -
Present** **Personal tutor for high school students**
Independent

Publications

L. Toffolin, “**Feasibility study for the measurement of the angular asymmetry in the production of a bottom quark-antiquark pair in electron-positron collisions with a center-of-mass energy of 91 GeV at the future accelerator FCC-ee at CERN**”, Master Thesis, University of Trieste, <https://doi.org/10.17181/dkyc0-vzd48> (2022)

M. Cobal, G. Guerrieri, H. Khanpour, G. Panizzo, M. Pinamonti, L. Toffolin, “**Bottom quark forward-backward asymmetry at the future electron-positron collider FCCee**”, FCC technical note, <https://doi.org/10.17181/g97j3-q0w73> (2023)

Contributions at conferences

Second ECFA Workshop on e^+e^- Higgs/EW/Top Factories, 11-13 October 2023, Paestum (Salerno), Italy
“Bottom quark forward-backward asymmetry at the future electron-positron collider FCC-ee”
Poster
11-13 October 2023

109th Italian Physical Society Congress, Salerno, Italy
“Prospects for measuring A_{FB}^b at the ATLAS Experiment at the LHC and at the FCC-ee”
Talk
11-15 September 2023

11th Large Hadron Collider Physics Conference (LHCP) in Belgrade, Serbia
“Engaging Universities and Beyond – Open Data for Education and Research”, on behalf of the ATLAS Collaboration

Poster
22-26 May 2023

108th Italian Physical Society Congress, Milano, Italy

“Misura di asimmetria di produzione angolare di quark-antiquark bottom al futuro acceleratore FCC-ee al CERN”

Talk

12-16 September 2022

Description of Scientific activity

PhD: My PhD research is being conducted in the realm of experimental particle physics, specifically within the ATLAS experiment at the LHC collider, and the RD-FCC Collaboration at CERN.

ATLAS (A Toroidal LHC Apparatus) is a multi-purpose detector. Its purpose is to utilize the unparalleled energy and luminosity available at the LHC to observe phenomena that involve the production of highly massive particles.

My thesis project is centered on measuring the forward-backward asymmetry of the bottom quark using either the full set of Run 2 of LHC, with pp collisions at a centre-of-mass energy of 13 TeV, and the early Run 3 data at a centre-of-mass energy of 13.6 TeV, considering the associated production of a Z -boson and a b -quark in the final state.

Connected to the PhD main topic, I am actively working on Combined Performance within the ATLAS Flavour Tagging group. My task is to perform calibration on the light jets and to provide light-flavoured scale factors for Run 2 and Run 3 data, using the Release 24 of Athena (the central ATLAS Experiment software framework). The light calibration is challenged by the high rejection factors that make it hard to find a sample pure enough in light jets following b -tagging selections. With the improvements provided by either the state-of-art algorithms (such as DL1r, DL1d) and the more recent graph neural network-based taggers, light-jet calibration still remains a challenge. I am taking part in all aspects of the analysis: from tuples production, analysis selections, and final fit for the extraction of the light-jet efficiency in data. In the near future, I will also investigate light-jet calibration methods for a tagger exploiting soft-muons information, which poses additional challenges related to the analysis methodology.

Simultaneously, I am strongly contributing to the ATLAS Open Data project. I am committed to maintaining and enhancing the computational tools and infrastructure that enable non-expert users to deploy complex analysis infrastructures, utilizing the cloud providers available on the market.

Aside from that, I am also contributing in the development of a Deep Neural Network, in the context of my local group (ATLAS Udine/ICTP Trieste), with the aim of searching for new massive particles decaying to $t\bar{t}$ resonances measured at the LHC.

Lastly, I am contributing to the measurement of Z boson couplings to bottom quarks at FCC-ee. The FCC-ee (Future electron-positron Circular Collider) is a novel, highest-luminosity energy frontier collider, designed to tackle the open questions of contemporary physics. It will serve as a precision instrument for ongoing in-depth exploration of nature at the smallest scales, optimized for studying the Z , W , Higgs, and top particles with high precision, and with samples of 5×10^{12} Z bosons, 10^8 W pairs, 10^6 Higgs bosons and 10^6 top quark pairs. The primary purpose of this analysis is to probe such interactions through a competitive determination of $A_{FB}^{0,b}$, not only improving the precision of the measurement, but also defining future detector requirements and recommendations.

In the FCC community, I am mainly active in the software and feasibility study working groups.

Software Engineering Skills

■ Programming Languages

- C, C++, ROOT
- Python
- Bash

■ Languages

- Italian- Native
- English- Proficient

- **HTML**
- **IDL**
- **Igor Pro**

- **French- Basic**
- **German- Basic**

Interests

- **Competitive tennis player**
- **Running, cycling, hiking, climbing**