Camilla Vittori

Personal Information

Italy - 24 October 1990
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Education

Nov 2014 - Apr 2018 **Ph.D. in Physics at University of Bologna**
- Thesis title: *Inclusive Z boson production and in association with b-jets in proton-proton collisions at $\sqrt{s}$ = 13 TeV with the ATLAS experiment.*
- Supervisors: Dott. B. Giacobbe, Prof. L. Fabbri
- Final grade: Excellent
- Winner of INFN Premio Conversi 2019

Dic 2012 - Oct 2014 **Master Degree in Physics, University of Bologna**
- Thesis title: *A new method for high energy top tagging at the ATLAS experiment.*
- Supervisors: Dott. R. Spighi, Prof. N. Semprini Cesari
- Final grade: 110/110 cum laude

Sep 2009 - Dic 2012 **BSc in Physics, University of Bologna**
- Thesis title: *Study of systematics of Monte Carlo generators in the top pair production with the ATLAS experiment.*
- Supervisors: Dott. R. Spighi, Prof. N. Semprini Cesari
- Final grade: 110/110 cum laude

Professional Career

Aug 20212 - Now **CERN Research Fellow**
- Based at CERN (European Organization for Nuclear Research).
- Topic: *Analysis research on Standard Model processes in ATLAS. Development of the Inner Detector alignment software..*

Jul 2021 - Jun 2022 **INFN-CERN Associate Programme**
- Based at CERN (European Organization for Nuclear Research).
- Topic: *Installation and commissioning of LUCID for Run-3. Measurement of Z boson in association with heavy flavours with full Run-2 statistics.*

Nov 2017 - Jul 2022 **Postdoctoral Researcher, University of Bologna**
- Based in Bologna (Italy) and at CERN.
- Topic: *Analysis research and data acquisition development in the ATLAS experiment.*

Jul 2018 - Jun 2019 **INFN-CERN Associate Programme**
- Based at CERN.
- Topic: *Measurement of the Standard Model Higgs boson produced in association with a Z boson and decaying into a pair of b-quarks in Run-2 data*

with ATLAS.

Honours and Awards

- **INFN Premio Conversi 2019**
  Prize for the best italian Ph.D. thesis in high energy physics.
  https://web.infn.it/atlas/a-due-tesi-di-atlas-il-premio-conversi-2019/

Scientific Qualification

- **Teaching Qualification** (Abilitazione Scientifica Nazionale)
  Italian national licence as II level university professor in *Particle physics and fundamental interactions* at University of Bologna. Valid from 2020 to 2029.

Leadership Positions

Apr 2021 - Now **Convener of the ATLAS Standard Model W/Z group**
- Head of a group of 150 physicists divided in 30 analyses
- Interaction on a daily basis with the analysis teams
- Link between analyses and Standard Model conveners
- Review of ATLAS Internal Notes and talks for conferences
- During my leadership: formation of 6 new analysis teams, initiation of ATLAS internal review process for 5 analyses and publication of 1 conference note.

Jan 2020 - Now **Contact person of Monte Carlo production for the Standard Model group**
- Manage the ATLAS requests for new Monte Carlo samples of Standard Model processes
- Contact for the preparation of the inputs for sample production
- Validation of the inputs for sample production
- Link between requesters and Monte Carlo production team
- Report to Standard Model group information about the Monte Carlo production campaigns

Nov - Dec 2015
Oct - Dec 2016
Mar - Apr 2018 **ATLAS Forward Detector (FWD) Run Coordinator**
- Manage FWD daily operations
- Coordinate FWD activities with other ATLAS detectors following the LHC schedule
- Responsible for LUCID detector performance during data-taking
- On-call contact for problems related to FWD

Research Experience

Physics Analysis

I currently work on the ATLAS experiment, and I am involved in analyses of the QCD Z boson production in association with (heavy flavour) jets. My research has been focused on measurements of the Standard Model W and Z vector bosons and on the Higgs boson coupling with the b-quark.

Summary of on-going analyses

- Measurement of the Z boson mass at $\sqrt{s} = 13$ TeV with 139 fb^{-1} dataset in ATLAS
  - Measurement of a fundamental parameter of the Standard Model, first time measured at a

hadron collider. The measurement from LEP with a precision of 2 MeV represents one of the largest tension in the electroweak fit. Extremely challenging to reach the precision of LEP, possible in Run-2 due to improvements in the alignment, which brought the muon momentum scale uniform as a function of the muon transverse momentum.
- MAIN ANALYSER: responsible for the muon calibrations, which based on quantities not correlated to the Z-boson mass.

- Measurement of the Z+b-jets and Z+c-jets at $\sqrt{s} = 13$ TeV with 139 fb^{-1} in ATLAS
  - Measurement of primary importance for perturbative QCD studies and PDF understanding. Sensitive to gluon splitting and b/c-quark production. First measurement of Z+c-jets with the ATLAS detector.
  - MAIN ANALYSER: software development, signal optimisation, estimation of background with Monte Carlo and data-driven methods, design of a data-driven method to identify jet flavour composition, responsible for the unfolding and associated uncertainties, student supervision.
  - EDITOR of the Internal Note.

Summary of published analyses

- Cross-section measurements for the production of a Z boson in association with high-transverse-momentum jets in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector
  - Precision measurement sensitive to the collinear emission of a real Z boson from a quark and to the recoil of a boosted Z boson against a very high-energy jet. These processes suffer from poor description by Monte Carlo (MC) generators.
  - MAIN ANALYSER: development of the data-driven multijet background estimation, top and diboson modelling uncertainties, selection optimisation for an additional topology of events characterised by high jet multiplicity in the final state, student advisor.
  - EDITOR of the Internal Note.
  - Accepted by JHEP, arXiv:2205.02597

- Measurement of the Z+b-jets at $\sqrt{s} = 13$ TeV with 36 fb^{-1} in ATLAS
  - Measurement of primary importance for perturbative QCD studies and PDF understanding. Sensitive to gluon splitting and b-quark production.
  - MAIN ANALYSER: software development, signal optimisation, $t\bar{t}$ background validation, estimation of multijet background with a likelihood fit on data, contribution to the statistical analysis, responsible for the unfolding and associated uncertainties.
  - EDITOR of the Internal Note.
  - Subject of my Ph.D. thesis (DOI:10.6092/unibo/amsdottorato/8604 (2018)) which won the INFN Premio Conversi 2019.
  - JHEP 07 (2020) 044

- Measurement of WH and ZH production in the $H \to b\bar{b}$ decay channel at $\sqrt{s} = 13$ TeV with 139 fb^{-1} in ATLAS
  - Challenging measurement of the most probable decay channel of the Higgs boson, dominated by high multijet background at LHC.
  - ANALYSER: focus on the ZH associated production, where the Z boson decays in two charged leptons, responsible for the modelling uncertainties of the Z+heavy flavour jets background, lepton selection optimisation, multijet background determination with a data-driven method.
  - Supervision of a Ph.D. student, which focused on the signal category optimisation within the Simplified Template Cross Section (STXS) framework and on the development of the multivariate analysis.
  - EDITOR of the Internal Note.
  - Eur. Phys. J. C 81 (2021) 178

- Observation of the Higgs boson coupling to b-quarks at $\sqrt{s} = 13$ TeV with the ATLAS detector
  - Challenging measurement of the most probable decay channel of the Higgs boson, dominated by high multijet background at LHC.
  - ANALYSER: focus on the ZH associated production, where the Z boson decays in two charged leptons, responsible for the modelling uncertainties of the Z+heavy flavour jets background and multijet background determination with a data-driven method.
  - Phys. Lett. B 786, 59 (2018).

- Measurement of the $VH(\to b\bar{b})$ production in the STXS framework (resolved) at $\sqrt{s} = 13$ TeV with the ATLAS detector
  - Interpretation of the $VH(\to b\bar{b})$ observation data within the STXS: the measurements benefit form the cancellation of the theoretical uncertainties.
  - CONTRIBUTION to the measurement of ZH,$H \to b\bar{b}$ differential cross sections as a function of the Z boson transverse momentum.
  - JHEP 1905 (2019) 141.

- Measurement of W and Z cross sections at $\sqrt{s} = 13$ TeV with the ATLAS detector
  - Benchmark for the understanding of QCD and EW processes and PDF sets, the measurements have been performed with early Run-2 data and therefore have primary importance for detector calibration.
  - MAIN ANALYSER of the Z boson cross section analysis, with focus on the muon channel: developer and maintainer of the analysis framework, responsible for signal optimisation and background estimation, evaluation of efficiency and acceptance factors and determination of the cross sections.
  - Phys. Lett. B759 (2016) 601-621.

- Measurement of Z+jets cross section at $\sqrt{s} = 13$ TeV with the ATLAS detector
  - Measurement of primary importance for perturbative QCD tests and for tuning of Monte Carlo generators.
  - ANALYSER: study of the modelling of Z+jets signal from different Monte Carlo generators
  - Eur. Phys. J. C77 (2017) no.6, 361.

- Muon reconstruction performance of the ATLAS detector in pp collision data at $\sqrt{s}$ =13 TeV with the ATLAS detector
  - Muons are key objects to many measurements in the high physics sector. Detailed studies on the performance of the muon reconstruction, identification and isolation are needed to correct Monte Carlo generators for the real detector resolutions.
  - ANALYSER: responsible for the determination of the reconstruction efficiency for muons with low transverse momentum, evaluation of the main uncertainties on the reconstruction efficiencies.
  - Eur. Phys. J. C76 (2016) no.5, 292.

- Top tagging techniques for boosted top identification at $\sqrt{s} = 8$ TeV with the ATLAS detector
  - CONTRIBUTION on performance studies of the Template Overlap Method in the reconstruction of high energy top quarks ("boosted") in semileptonic $t\bar{t}$ events. Subject of my Master Degree Thesis.

Physics Performance and Detector Activities

I participated to the LUCID detector activities, the ATLAS system responsible for the luminosity measurement.

- Inner Detector Alignment in Run-2 and Run-3
  - Determination of the radiation damage on the pixels of the Inner Detector of ATLAS.
  - Development of a new method to evaluate the sagitta bias with the calculation of the pseudo-mass.

- LUCID for Run-3 and HL-LHC
  - Performed measurements in ATLAS P1 of the optimal working point for every photomultiplier
  - Installation of photomultipliers on LUCID for Run-3
  - Qualified shifter of the Forward-Calo desk

- The new LUCID-2 detector for luminosity in ATLAS
  - Developer and maintainer of the framework for the offline analysis of the calibration data
  - Studies on the reproducibility of the calibration results and the associated uncertainties
  - Responsible for the planning and realisation of measurements in CERN laboratories in order to understand the cause of ageing after Run-2 of LHC
  - Forward Detectors Run Coordinator for various period during LHC data-taking
  - JINST 13 (2018) P07017.

- Choice and characterization of photomultipliers for LUCID detector
  - Subject of my qualification task in ATLAS and my Summer School at CERN
  - Designer of calibration system of LUCID photomultipliers with a ^{207}Bi radioactive source
  - Studies on the geometry optimisation of the radioactive source
  - Performed measurements in CERN laboratories of the optimal working point for every photomultiplier
  - JINST 11 (2016) no.05, P05014.

Student Supervision

Advisor of five Ph.D. students within the analysis teams of my research work. Thesis supervisor of one Ph.D. and two under-graduated students, on the following topics:

2022 **Thesis supervision of an under-graduated student (University of Bologna)**
Martina Turchini, *on the Measurement of the Z+c-jets cross section with data collected by ATLAS at LHC.*

2020 **Thesis supervision of a Ph.D. student (University of Bologna)**
Grazia Cabras, *on the Measurement of the $ZH(H \to b\bar{b})$ associated production with $Z \to ll$ in pp collisions at $\sqrt{s}$ = 13 TeV with the ATLAS experiment* (now postdoctoral researcher at the University of Bologna).
DOI:doi:10.6092/unibo/amsdottorato/9459.

2019 **Thesis supervision of an under-graduated student (University of Bologna)**
Luigi Zallio, on *Study of the Z+jets modelling uncertainty in the $ZH(H \to b\bar{b})$ analysis with data collected by ATLAS at $\sqrt{s}$ = 13 TeV.*

Teaching Activities

2022 **Advanced Topics in Standard Model Measurements**
Course (24 hours) for Ph.D. students of the Bologna University

2021 **Higgs and Standard Model Physics at LHC**
Course (12 hours) for Ph.D. students of the Bologna University

2020 **Higgs and Standard Model Physics at LHC**
Course (12 hours) for Ph.D. students of the Bologna University

2019 - 2020 **Electromagnetism**
Tutor (24 hours) for the course of Prof. A. Zoccoli, School of Physics, University of Bologna

2019 - 2020 **Electromagnetism**
Tutor (30 hours) for the course of Prof. M. Villa, School of Electronic Engineering, University of Bologna

2017 - 2018 **General Physics**
Tutor (24 hours) for the course of Prof. L. Fabbri, School of Civil Engineering, University of Bologna

2016 - 2017 **Electromagnetism**
Tutor (30 hours) for the course of Prof. M. Villa, School of Electronic Engineering, University of Bologna

Scholarships

Oct 2015 - Apr 2016 **Marco Polo Scholarship**
- 6 months scholarship based at CERN provided by University of Bologna.

Jun 2014 - Aug 2014 **CERN Summer School Program**
- 3 month scholarship based at CERN and provided by CERN.
- Topic: *Equalisation of the PMT response to charge particles for the LUCID detector of the ATLAS experiment.*

Schools

Jul 2016 **Hadron Physics Summer School** (Julich, Germany).

May 2015 **School of High Energy Physics** (Cargese, France).

Jan 2015 **ATLAS offline analysis software tutorial** (CERN).

Jul 2013 **HASCO Summer School** (Goettingen, Germany).

Conferences

Talks and Posters at International Conferences

Oct 2021 ATLAS talk on *Hard QCD at ATLAS* at Blois 2021 (Blois, France).
http://blois.in2p3.fr/2021/index.html

Jul 2020 ATLAS talk on *Measurements of W/Z boson production in association with jets at ATLAS* at ICHEP 2020 (Prague, Czech Republic).
http://ichep2020.org

Apr 2019 Plenary ATLAS talk on *Observation of the $VH(H \to b\bar{b})$ associated production in pp collisions with the ATLAS detector* at IFAE2019 (Napoli, Italy).
https://agenda.infn.it/event/17945/

Dec 2018 Plenary ATLAS and CMS talk on *Observation of Higgs in $b\bar{b}$ channel from ATLAS and CMS* at Kruger2018 (South Africa).
https://indico.tlabs.ac.za/event/75/overview

Jun 2018 ATLAS poster on *Measurements of the production of W/Z boson in association with (heavy flavour) jets with the ATLAS detector* at LHCp (Bologna, Italy).
https://indico.cern.ch/event/681549/

Aug 2017 ATLAS talk on *Precision measurements of electroweak observables with the ATLAS Detector* at QCD@LHC (Debrecen, Hungary).
https://indico.cern.ch/event/615220/

Jul 2017 ATLAS poster on *W/Z+jets and W/Z+HF-jets production at ATLAS* at EPS (Venezia, Italy).
https://indico.cern.ch/event/466934/

Apr 2017 Plenary ATLAS talk on *Measurements of the W mass, the W/Z and Z+jets production cross section and ratios with the ATLAS detector* at IFAE2017 (Trieste, Italy).
https://agenda.infn.it/event/12289/

Feb 2017 ATLAS poster on *The forward Detectors of the ATLAS experiment* at LHCC (CERN).
https://indico.cern.ch/event/609813/

Jul 2016 Plenary ATLAS talk on *W and Z production cross-sections with the ATLAS detector* at QCD16 (Montpellier, France).
https://www.lupm.univ-montp2.fr/users/qcd/qcd16/Welcome.html

Talks at Workshops

Mar 2020 Invited plenary talk on *V+HF-jets production in ATLAS* at LHC-EW.
https://indico.cern.ch/event/896630/

Feb 2020 Invited plenary talk on *SM measurements: Z+HF jets and Z+jets collinear* at VHbb Italia.
https://agenda.infn.it/event/21448/

May 2019 Invited plenary talk on *SM Z+b-jets measurements* at ATLAS $H \to b\bar{b}$ Workshop (Genova, Italy).

Oct 2015 ATLAS poster on *W and Z production cross-sections at $\sqrt{s} = 13$ TeV with the ATLAS detector* at ATLAS week (Lecce, Italy).
https://web.le.infn.it/atlasweek15/

Nov 2015 Invited plenary talk on *W and Z analyses with the ATLAS detector* at ATLAS Italia (Cosenza, Italy).
https://agenda.infn.it/event/10076/

Talks at National Conferences

Jun 2022	Invited plenary ATLAS talk on at ATLAS Italia (Pisa, Italy). https://agenda.infn.it/event/29726/
Sep 2021	Invited plenary ATLAS+CMS talk on *SM measurents at LHC: results from ATLAS e CMS* at Italian Physics Society (SIF) (Milano, Italy). https://www.sif.it/attivita/congresso/107
Sep 2016	Talk on *W and Z boson cross section measurements with ATLAS* at Italian Physics Society (SIF) (Padova, Italy). https://www.sif.it/attivita/congresso/102
Sep 2015	Talk on *W and Z production cross-sections at* $\sqrt{s} = 13$ *TeV with the ATLAS detector* at talian Physics Society (SIF) (Roma, Italia). https://www.sif.it/attivita/congresso/101

Other Conferences Attended

2016	LHCpp2016 (Pisa, Italy).
2016	Standard Model Workshop (Madrid, Spain).
2015	Standard Model Workshop (Annecy, France).

Publications as primary author

I authored 490 articles in high-impact scientific journals on particle physics (from INSPIRE-HEP on 21/02/2022). The total number of citation exceeds 13,700 and 55 H-index (from Web Of Science on 21/02/2022). The publications with significant contributions are listed in the following.

Publication with the ATLAS Collaboration

- ***Measurements of the production cross section of a*** Z ***boson in association with high transverse momentum jets in*** pp ***collisions at*** $\sqrt{s} = 13$ ***TeV with the ATLAS detector***
  [ATLAS Collaboration].
  Accepted by JHEP, arXiv:2205.02597.

- ***Measurements of*** WH ***and*** ZH ***production in the*** $H \to b\bar{b}$ ***decay channel in*** pp ***collisions at 13 TeV with the ATLAS detector***
  G. Aad *et al.* [ATLAS Collaboration].
  Eur. Phys. J. C 81, no.2, 178 (2021)

- ***Measurements of the production cross-section for a*** Z ***boson in association with*** b***-jets in proton-proton collisions at*** $\sqrt{s} = 13$ ***TeV with the ATLAS detector***
  G. Aad *et al.* [ATLAS Collaboration].
  JHEP 07 (2020) 044

- ***Measurement of*** VH***,*** $H \to b\bar{b}$ ***production as a function of the vector-boson transverse momentum in 13 TeV*** pp ***collisions with the ATLAS detector***
  M. Aaboud *et al.* [ATLAS Collaboration].
  JHEP 1905 (2019) 141

- ***Observation of*** $H \to b\bar{b}$ ***decays and*** VH ***production with the ATLAS detector***
  M. Aaboud *et al.* [ATLAS Collaboration].
  Phys. Lett. B **786**, 59 (2018)

- ***Measurement of $W^{\pm}$ and Z boson production cross sections in pp collisions at $\sqrt{s}$=13 TeV with the ATLAS detector***
  G. Aad *et al.* [ATLAS Collaboration].
  Phys.Lett. B759 (2016) 601-621

- ***Measurements of top-quark pair to Z boson cross-section ratios at $\sqrt{s}$=13,8,7 TeV with the ATLAS detector***
  M. Aaboud *et al.* [ATLAS Collaboration].
  JHEP 1702 (2017) 117

- ***Measurements of the production cross section of a Z boson in association with jets in pp collisions at $\sqrt{s}$=13 TeV with the ATLAS detector***
  M. Aaboud *et al.* [ATLAS Collaboration].
  Eur.Phys.J. C77 (2017) no.6, 361

- ***Muon reconstruction performance of the ATLAS detector in proton-proton collision data at $\sqrt{s}$=13 TeV***
  G. Aad *et al.* [ATLAS Collaboration].
  Eur.Phys.J. C76 (2016) no.5, 292

ATLAS Public Notes

- ***Kinematic Distributions of W→lν and Z→ ll production from pp collisions at $\sqrt{s}$=13 TeV with the ATLAS detector***
  ATLAS Collaboration
  ATL-PHYS-PUB-2015-021

Publication outside the ATLAS Collaboration

- ***The new LUCID-2 detector for luminosity measurement and monitoring in ATLAS***
  G. Avoni *et al.*.
  JINST 13 (2018) P07017

- ***Choice and characterization of photomultipliers for the new ATLAS LUCID detector***
  G.L. Alberghi *et al.*
  JINST 11 (2016) 05, P05014

Ph.D. Thesis

- ***Inclusive Z boson production and in association with b-jets in proton-proton collisions at 13 TeV with the ATLAS experiment***
  C. Vittori.
  DOI: 10.6092/unibo/amsdottorato/8604

Conference Proceedings

- ***Measurements of W/Z boson production in association with jets at ATLAS***
  C. Vittori
  PoS **ICHEP2020**, 517 (2021)

- ***Observation of Higgs in $b\bar{b}$ channel from ATLAS and CMS***
  C. Vittori

In press on the Open Access Journal of Physics: Conference Series (JPCS), part of the IOP Conference Series.

- ***Observation of $H \to b\bar{b}$ in ATLAS***
  C. Vittori
  Nuovo Cim. C **43**, no. 2-3, 40 (2020)

- ***W and Z boson precision measurements at ATLAS***
  C. Vittori
  Nuovo Cim. C **41**, no. 1-2, 29 (2018)

- ***Measurements of the production of W/Z boson in association with (heavy flavour) jets with the ATLAS detector***
  C. Vittori
  PoS LHCP **2018**, 021 (2018)

- ***W/Z+jets and W/Z+HF-jets production at ATLAS***
  C. Vittori
  PoS EPS **-HEP2017**, 748 (2017)

- ***ATLAS measurement of Electroweak Vector Boson production***
  C. Vittori
  Nucl. Part. Phys. Proc. **282-284**, 5 (2017)

Outreach Activities

2021	**Officina Laboratorio**, an Italian project addressed to high school students with hands-on sessions on ATLAS data analysis
2019	**Alternanza Scuola Lavoro**, an Italian project addressed to high school students with hands-on sessions on ATLAS data analysis
2019	**Night of Researchers**, participation at the speed date event.
2018	**Alternanza Scuola Lavoro**, an Italian project addressed to high school students with hands-on sessions on ATLAS data analysis
2017	**Night of Researchers**, participation at the speed date event.
2017	Presentation of the film "The sense of beauty" in the cinemas in Bologna (Italy).

Additional Information

Jul 2020 - Nov 2020	Maternity leave
2015 - Now	Member of the "Italian Physics Society (SIF)"

Languages

Italian	mother tongue
English	Advanced
French	Medium
Greek	Basic

Personal Skills and Competences

- Operating Systems: Linux (Ubuntu), masOS and MS Windows
- Word Processing: Latex, MS Word and Open Office.org Writer
- Programming Languages: BASH, C, C++, Python and HTML
- Data Analysis and Fitting Framework: ROOT, RooFit, RooStats, HistFitter and xFitter
- Unfolding tool: RooUnfold
- Multivariate Analyses: TMVA

References

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Position: Associated Professor
Institution: University of Cosenza
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Federico Sforza
Position: Associated Professor
Institution: University of Genova
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Ulrike Blumenschein
Position: Senior Lecturer
Institution: Queen Mary University of London
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