

UNIVERSITÀ DEGLI STUDI DI MILANO

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Giacomo Artoni

CURRICULUM VITAE

INFORMAZIONI PERSONALI (NON INSERIRE INDIRIZZO PRIVATO E TELEFONO FISSO O CELLULARE)

COGNOME	ARTONI
NOME	GIACOMO
DATA DI NASCITA	19, 10, 1985

Employment

- Postdoctoral Researcher at Oxford University, Sept. 2015 - Present
- Postdoctoral Researcher at Brandeis University, Mar. 2013 - Aug. 2015

Education

- Ph.D. in Physics at Sapienza Università di Roma, Nov. 2009 - Feb. 2013
- MS in Physics at Sapienza Università di Roma (110/110 cum Laude), Sept. 2007 - July 2009
- BS in Physics at Sapienza Università di Roma (110/110 cum Laude), Sept. 2004 - Dec. 2007

Research Activity and Key Achievements

- **Muon Reconstruction, Oct. 2013 - Present** I participated in the study and improvement of the muon reconstruction performance in ATLAS. My work consisted of a precise measurement of the muon momentum scale and resolution using $Z \rightarrow \mu\mu$ decays. This measurement represents a crucial input for the Higgs boson mass measurement with the $H \rightarrow ZZ \rightarrow 4l$ analysis (*Phys. Rev. D*, 90:052004). The work is summarised in the ATLAS Run 1 muon reconstruction performance paper, to which I contributed as co-editor (*Eur. Phys. J. C*, 74:3130). In September 2014 I was appointed "Muon Momentum Calibration" sub-group convener, within the Muon Combined Performance group. As such, I have been the person responsible until April 2016 for the calibration of muon momentum in ATLAS. The calibrations produced, which have been documented in a paper (*Eur. Phys. J. C*, 76:292), are of particular importance as they are provided to all analyses in ATLAS using muons. In view of the increasing interest in analyses searching for high mass objects with the Run 2 dataset, I have focused on the development of the so-called *High- p_T* muon selection. This set of criteria allows the usage of muons with good momentum resolution beyond 500 GeV. As a result of all these activities and of my expertise in the area, I was selected as liaison between the MCP working group and two physics groups, namely the Higgs group (from June 2014 to March 2017) and the Exotics group (from November 2015 to March 2017). Since October 2019 I act as the Muon Combined Performance group convener, coordinating all activities related to muon performance in ATLAS.

- **H \rightarrow $\mu\mu$ coordinator, Oct. 2018 - present** Starting from October 2018 I have been chosen to coordinate the H \rightarrow $\mu\mu$ analysis team, which is composed by 40 people. The group's focus is currently to perform the analysis of the entire Run 2 ATLAS dataset. A preliminary result (ATLAS-CONF-2019-028) has already been obtained, with an improvement with respect to the previous ATLAS result of more than 30% in the expected sensitivity, thanks to improvements introduced under my coordination.
- **H \rightarrow ZZ convener, Apr. 2017 - Mar. 2018** Starting from April 2017 I have been appointed as convener for the H \rightarrow ZZ group, which consists of about 100 people and covers many interesting analysis, all of them using either the 4l or the ll + $\nu\nu$ final state. During my first months as a convener the group has been highly productive as we presented results from five different analyses at international conferences, ranging from the measurement of differential cross sections (*JHEP*, 10:132), couplings (ATLAS-CONF-2017-043) and mass (ATLAS-CONF-2017-046) of the Higgs boson with the H \rightarrow ZZ \rightarrow 4l channel, to a combined search for high-mass scalars with the 4l or the ll + $\nu\nu$ final states (ATLAS-CONF-2017-058), as well as a search for an invisibly decaying Higgs in association with a Z boson (*Phys. Lett. B*, 776:318).
- **Search for a heavy Higgs boson with the ll + $\nu\nu$ final state, Sept. 2015 - Mar. 2017** In September 2015 I joined the ATLAS Oxford group and started to work on the search for an additional Higgs boson in the H \rightarrow Z Z \rightarrow 2l 2 ν channel. In particular, I focused my activities on the improvement of the event selection as well of the understanding of the missing transverse energy calculation with high-energy photons, electrons and muons in the final state. The work done in the context of this analysis resulted in two public results, one with the 2015 dataset only (ATLAS-CONF-2016-012) and one containing also the first data collected in 2016 (ATLAS-CONF-2016-056). In view of a publication with the full dataset recorded in 2015 and 2016, I worked on several improvements for the final analysis: the first one is the introduction of event categorisation to allow us to set limits on the VBF production cross section, while the second one is the usage of γ + jets events to estimate the reducible background coming from Z + jets events, which is one of the most difficult to model with simulation. As a recognition of the work done for the group and of its quality, in February 2017 I have been nominated as "analysis contact". As such, I am responsible for the different analyses performed with the ll + $\nu\nu$ final state, which are all expected to be published soon.
- **Exotic dilepton search, June 2014 - June 2016** The first analysis I performed with the 2015 dataset collected by ATLAS is the search for a heavy, narrow resonance decaying into a pair of opposite charged leptons. This type of resonance, usually denoted as Z', is predicted by many extensions of the SM (including Technicolor and extra-dimensions models), and represents one of the most promising searches at the LHC. I contributed to these results with both my electron and muon expertise, as well as by deriving limits on the observed cross section. Thanks to these contribution I was appointed as editor of the preliminary results presented at the end of 2015 (ATLAS-CONF-2015-070) as well as of the final results included in a paper (*Phys. Lett. B*, 761:372).
- **Dark Matter search: mono-b, May 2013 - Oct. 2014** In parallel to the work in the Higgs group, I performed a Dark Matter search at the LHC which requires pair production of weakly interacting massive particles (WIMPs) in association with a b-tagged jet. Such an analysis, usually referred to as mono-b, is expected to give better limits than the standard mono-jet analysis for scalar operators representing the interaction of WIMPs with SM particles. This work was published as a white paper as part of the U.S. Particle Physics Community Study Snowmass 2013. The paper includes the prospects for the mono-b search both at the HL-LHC and at future hadron colliders. The analysis was also performed on the \sqrt{s} = 8 TeV ATLAS dataset and lead to a publication in 2014 (*Eur. Phys. J. C*, 75:92).

- **Couplings measurement in the $H \rightarrow ZZ \rightarrow 4l$ channel, Mar. 2013 - Aug. 2014** My first commitment at Brandeis as a postdoctoral researcher was to join the group's effort on the measurement of the Higgs couplings in the $H \rightarrow ZZ \rightarrow 4l$ decay channel. I developed a multivariate discriminant to enhance the separation between the vector boson fusion (VBF) and the gluon fusion (ggF) production mechanisms by exploiting their different jet kinematics. The usage of this discriminant allowed us to reduce by a factor of two the uncertainty on the VBF cross section scaling factor, μ_{VBF} , as measured with the $H \rightarrow ZZ \rightarrow 4l$ channel. As a result of this achievement, I was asked to coordinate the coupling measurement in the $H \rightarrow ZZ \rightarrow 4l$ channel. This effort culminated in the Run 1 legacy publication (*Phys. Rev. D*, 91:012006).
- **Search for a Standard Model Higgs boson with the $H \rightarrow ZZ \rightarrow 4l$ channel, Nov. 2009 - Feb. 2013** My PhD project focused on the search for the Higgs boson in the decay channel $H \rightarrow ZZ \rightarrow 4l$. First of all, I worked on the extension of the analysis to Higgs boson masses below 140 GeV, both by optimising the kinematic selections and by improving the performance of electron reconstruction at low energies (< 15 GeV). In particular, I developed a set of identification criteria (called *MultiLepton*) for GSF electrons that has been used by the $H \rightarrow ZZ \rightarrow 4l$ analysis in the discovery paper (*Phys. Lett. B*, 716:1) and has improved by $\sim 10\%$ the sensitivity in the electron channels (*Eur. Phys. J. C*, 77:195). I performed the estimation of the reducible background for the electron channels by developing a new methodology, usually referred to as $3l + X$. This technique was used in the final Run 1 publications () and since then has been used as the baseline background estimation method by analyses using the $H \rightarrow ZZ \rightarrow 4l$ channel. As a consequence of all this work done in the context of the $H \rightarrow ZZ \rightarrow 4l$ analysis, I was selected to present its results at the Rencontres du Vietnam conference in 2012.
- **Electron reconstruction, Sept. 2011 - Apr. 2012** During 2011 a new electron reconstruction algorithm based on a Gaussian Sum Filter (GSF) has been introduced in ATLAS, to account for energy losses due to *bremsstrahlung*. I performed a complete validation of this new reconstruction approach in order to ensure good performance of GSF electrons (ATLAS-CONF-2012-047). Thanks to this work, GSF electrons have been used in the $H \rightarrow ZZ \rightarrow 4l$ channel for the analysis of the data recorded in 2011 and have become the baseline electrons in ATLAS since 2012.
- **Inclusive Z cross section measurement, Nov. 2010 - Sept. 2011** At the beginning of my PhD I participated in the measurement of the inclusive cross section of the Z boson (ATLAS-CONF-2011-041). In particular, I developed a method to estimate the QCD background in the $Z \rightarrow \mu\mu$ channel. The same methodology has been used in the Z boson production cross section measurement associated with jets, that has resulted in a publication (*Phys. Rev. D*, 85:032009).
- **Level-2 muon trigger, Nov. 2010 - Sept. 2011** For my MS thesis and for the first part of my PhD I worked on the ATLAS level-2 muon trigger algorithms called μComb and μIso , which provide the first measurement of p_T , η and ϕ of the muon as well as the first isolation selection. I have been re-tuning the algorithms for the Run 1 data-taking and I have also participated in their commissioning. This work has been documented in a conference note [20] and I also reported on the performance of the whole second level muon trigger chain at the 96th SIF Congress in 2010 (*Nuovo Cim.*, C034N5:19-27). This work has been awarded the prize for 2nd best communication in the Nuclear and Subnuclear section.

Roles within the ATLAS Collaboration

- **Convener:** Muon Combined Performance (MCP) group, Oct. 2019 - present
- **Convener:** $H \rightarrow ZZ$ group, Apr. 2017 - Mar. 2018
- **Convener:** Muon momentum calibration group, Aug. 2014 - Apr. 2016
- **Analysis Coordinator:** $H \rightarrow \mu\mu$ group, Oct. 2018 - present
- **Analysis Coordinator:** $H \rightarrow ZZ \rightarrow 2l2\nu$ group, Feb. 2017 - Mar. 2017
- **Main Organiser:** $H \rightarrow ZZ$ workshop at the University of Oxford, April 2018
- **Performance Group Liaison:** MCP liaison with the Higgs group, June 2014 - Mar. 2017
- **Performance Group Liaison:** MCP liaison with the Exotics group, Nov. 2015 - Mar. 2017
- **Reviewer for Physics Letters B:** *Evidence for the Higgs boson decay to a bottom quark-antiquark pair*, in publication [arXiv:1709.07497[hep-ex]]
- **Internal Reviewer:** *Search for the Standard Model Higgs boson decay to $\mu+\mu-$ at $\sqrt{s} = 13$ TeV with the ATLAS detector*, ATLAS-CONF-2016-041
- **Internal Reviewer:** *Search for the Standard Model Higgs boson decay to $\mu+\mu-$ at $\sqrt{s} = 13$ TeV with the ATLAS detector*, Phys. Rev. Lett. **119** (2017) 051802 [arXiv:1705.04582[hep-ex]]
- **Contact Editor:** *Search for heavy ZZ resonances in the $4l$ and $2l2\nu$ final states using proton-proton collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, Eur. Phys. J. C **78** (2018) 293 [arXiv:1712.06386 [hep-ex]]
- **Contact Editor:** *Search for new phenomena in the dilepton final state using proton-proton collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, ATLAS-CONF-2015-070
- **Contact Editor:** *Search for high-mass new phenomena in the dilepton final state using proton-proton collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, Phys. Lett. B **761** (2016) 372-392 [arXiv:1607.03669 [hep-ex]]
- **Contact Editor:** *Measurement of the muon reconstruction performance of the ATLAS detector using 2011 and 2012 LHC proton-proton collision data*, Eur. Phys. J. C **74** (2014) 11 [arXiv:1407.3935 [hep-ex]]
- **Analysis Responsible:** *Measurements of Higgs boson production and couplings in the four-lepton channel in pp collisions at center-of-mass energies of 7 and 8 TeV with the ATLAS detector*, Phys. Rev. D **91** (2015) 012006 [arXiv:1408.5191 [hep-ex]]
- **Analysis Responsible:** *Measurement of inclusive and differential cross sections in the $H \rightarrow ZZ^* \rightarrow 4l$ decay channel in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, JHEP **10** (2017) 132 [arXiv:1708.02810 [hep-ex]]
- **Analysis Responsible:** *Search for an invisibly decaying Higgs boson or dark matter candidates produced in association with a Z boson in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, Phys. Lett. B **776** (2018) 318 [arXiv:1708.09624 [hep-ex]]
- **Analysis Responsible:** *Measurement of the Higgs boson coupling properties in the $H \rightarrow ZZ^* \rightarrow 4l$ decay channel at $\sqrt{s} = 13$ TeV with the ATLAS detector*, JHEP **03** (2018) 095 [arXiv:1712.02304 [hep-ex]]
- **Analysis Responsible:** *Measurement of the Higgs boson mass in the $H \rightarrow ZZ^* \rightarrow 4l$ and $H \rightarrow \gamma\gamma$ channels with $\sqrt{s} = 13$ TeV pp collisions using the ATLAS detector*, Phys. Lett. B **784** (2018) 345 [arXiv:1806.00242 [hep-ex]]
- **Analysis Responsible:** *Constraints on off-shell Higgs boson production and the Higgs boson total width in $ZZ \rightarrow 4l$ and $ZZ \rightarrow 2l2\nu$ final states with the ATLAS detector*, Phys. Lett. B **786** (2018) 223 [arXiv:1808.01191 [hep-ex]]
- **ATLAS Trigger Shifter** (Run 1)
- **Muon-BPhys Trigger Expert** (Run 1)

Teaching and Student Supervision

- **Computational Methods in Particle Physics (since 2018/2019):** lectures for first-year DPhil students at the University of Oxford
- **DPhil students supervised at the University of Oxford:** Siyuan Yan (2019-), Yingjie Wei (2018-), Miha Zgubic (2016-), Luigi Vigani (2016-2018), Luigi Marchese (2015-2018), Mariyan Bozhidarov Petrov (2015-2018)
- **PhD students supervised at Brandeis University:** Hannah Herde (2015-2016), Stefano Zambito (2013- 2014)
- **MS students supervised at Sapienza Università di Roma:** Vieri Candelise (2010), Eleonora Benhar Noccioli (2010)

Conference Talks, Seminars, Posters, Workshops and Schools

- **Combined Higgs boson measurements at the ATLAS experiment** talk given at Pheno 2019, Pittsburgh 2019
- **Searches for new phenomena in leptonic final states using the ATLAS detector** talk given at EPSHEP conference, Venice 2017
- **Muons in $H \rightarrow Z Z$ analyses: present and future** talk given at $H \rightarrow ZZ$ Workshop, Munich 2016
- **Differential distributions: ATLAS + CMS** talk given at Higgs Couplings, Torino 2014
- **Muon momentum scale and resolution in pp collisions at $\sqrt{s} = 8$ TeV in ATLAS** poster presented at ICHEP Conference, Valencia 2014
- **The Higgs golden channel in ATLAS: Run 1 results of the $H \rightarrow Z Z \rightarrow 4l$ channel** LPPC Seminar, Harvard University, 2013 Lunchtime Seminar, Massachusetts Institute of Technology, 2013
- **Higgs $\rightarrow ZZ$ searches in ATLAS and CMS** talk given at VI LHCpp Workshop, Genoa 2013
- **Categorized analysis: potential improvements on discriminating variables for VBF** talk given at $H \rightarrow ZZ$ Workshop, Rome 2013
- **Search for a SM Higgs in the $H \rightarrow Z Z \rightarrow 4l$ channel with the ATLAS Experiment** seminar given at Brandeis University, 2013
- **Standard Model Higgs searches in 4 leptons at ATLAS** talk given at Rencontres du Vietnam, 2012
- **Study of the Performance of the 2nd Level Muon Trigger of the ATLAS Experiment** talk given at XVI Congresso Nazionale della Società Italiana di Fisica, 2010
- **European School of High-Energy Physics 2010** June 20th - July 3rd 2010, Raseborg, Finland
- **Commissioning of the ATLAS Muon Trigger System With Early Data** poster presented at Incontri di Fisica delle Alte Energie, 2010

Publications Summary (source Inspirehep)

- **Papers:** 885, from 2010 to 2020
- **Total Citations:** 99308
- **Average Citations per Product:** 112.2
- **Hirsch (H) index:** 150

Academic Honors and Fundings

- **Italian National Scientific Qualification 2016-2018**, valid from 5/10/2018 to 5/10/2024, sector 02/A1
- **INFN associate**, from October 2008 to January 2013
- **CERN associate**, position held from August 2011 to July 2012 This highly selective position

provided the funding necessary to live in Geneva to conduct my PhD research at CERN. In particular I worked on the detector performance by optimising the reconstruction of electrons at low energies. I then used these developments in the $H \rightarrow ZZ \rightarrow 4l$ analysis, improving the background estimation techniques as well as the selection criteria for a low mass Higgs.

- **XCVI Congresso Nazionale della Società Italiana di Fisica**, 2nd best communication, Nuclear and Sub- nuclear Physics section
- **Summer Student at Fermilab**, worked at Fermilab National Accelerator Laboratory in Batavia, Illinois in the Collider Detector at Fermilab experiment, August and September 2008 This is a highly selective research experience programme. The funding I received enabled me to live in Chicago and participate in research with the CDF collaboration where I optimized the selection criteria for a study of the process $B_s \rightarrow \varphi\varphi$. This process is a sensitive probe of physics beyond the Standard Model.

Languages

- **Italian**, native speaker
- **English**, near native (C2)
- **French**, proficient (B2)

Family status

Relation	Surname and Name	Place of Birth	Date of Birth
Spouse	Benhar Noccioli Eleonora	Roma	November 28th, 1986
Child	Artoni Elisa	Meyrin (CH)	September 2nd, 2016
Child	Artoni Livia	Genève (CH)	October 11th, 2019

Data

07/04/2020

Luogo

St Genis Pouilly