Ruggero Turra

Curriculum Vitæ

Education

2013 **PhD in Physics**, *Univ. degli Studi di Milano*, Italy.
Thesis title: Energy calibration and observation of the Higgs boson in the diphoton decay with the ATLAS experiment
Supervisors: Dr. Chiara Meroni, Dr. Marcello Fanti
Courses: Computational Physics (D. Galli), Collider Physics (F. Ragusa), calorimeters (L. Carminati), SUSY (T. Lari), Jet reconstruction (M. Cacciari)

2009 **Master's degree "Laurea Specialistica"**, *Univ. degli Studi di Milano-Bicocca*, Italy.
Thesis title: Study of the decay $B_s^0 \to D_s^+ D_s^-$
Supervisor: Dr. Marta Calvi
110/110 cum laude

2006 **Bachelor's degree "Laurea Triennale"**, *Univ. degli Studi di Milano-Bicocca*, Italy.
Thesis title: Simulazioni Monte Carlo per l'esperimento CUORE
Supervisors: Dr. Chiara Brofferio and Dr. Maura Pavan
110/110 cum laude

2003 **Diploma**, *Liceo Scientifico Tecnologico G. Galiei*, Crema (CR), Italy.
Maturità scientifica: 100/100

Schools and courses

2021 **Docker and container orchestration**, *INFN*.

2015 **Finite state machine course**, *CERN*.

2013 **WinCC-OA/PVSS course**, *CERN*.

2012 **Proof and PoD tutorial**, *Laboratori Nazionali di Frascati*, Frascati.

2011 **19th European Schools of High-Energy Physics (ESHEP)**, Romania.

Programming skills

Languages (advanced): C++, python[1]

Languages (intermediate): C, LATEX, JavaScript, HTML4/5, Mathematica, MatLab, bash, SQL, Pascal, QBASIC

Tools and frameworks: git, docker, HTCondor, ROOT (RooFit, RooStats, TMVA), numpy[2], matplotlib, pandas, boost, WinCC-OA (PVSS) SCADA system

---

Present position

2017-today **Researcher**, *INFN*.

Past positions

2013-2017 **Postdoc**, *Università degli Studi di Milano*, "Assegno di Ricerca".

2015 **Simil-fellow**, *INFN – CERN*.

2012 **Simil-fellow**, *INFN – CERN*.

---

[1] top 5% on stackoverflow answers
[2] top 5% on stackoverflow answers

Responsibilities within the ATLAS Collaboration

2021-today **Convener e/gamma group**.
2019-2021 **Convener e/gamma reconstruction subgroup**.
2017-2019 **Convener HGam subgroup**.
2014-2017 **Convener e/gamma calibration subgroup**.

Short summary of the research activities

I joined the ATLAS Collaboration in 2010 as a PhD student, and I am an ATLAS qualified author since 2011. My activity is focused on the performance of the electromagnetic calorimeter and on the photon physics, both within the Standard Model analyses, precision measurements of the Higgs boson and BSM searches. I also work on an upgrade project about the High Granularity Timing Detector.

Concerning the performances of the ATLAS detector I have mostly worked for the energy calibration of electrons and photons and I have been responsible for the relative ground inside e/gamma. In 2012 I proposed a new calibration, based on machine learning techniques, which has been adopted by the collaboration.

I have contributed to many physics analyses with photons, including measurements: prompt photon cross section, diphoton cross section, Higgs mass, Higgs couplings and STXS cross sections, Higgs differential cross sections, and searches: Higgs boson in the diphoton channel (including the discovery in 2012), photon-jet resonances and search for resonances in the diphoton channel. I have been responsible for the HGam group inside the Higgs group.

I have been involved in the data-taking operation as hardware on-call for the high-voltage (HV) of the liquid-argon system and I am a maintainer of the Detector Control System (DCS).

I have been responsible for the reconstruction software of e/gamma, focusing on tuning the reconstruction to Run3 conditions and the migration of the e/gamma algorithms to be multi-thread safe.

I am coordinating the e/gamma group, which is resposibile of electrons and photons in ATLAS.

Detailed summary of the research activities

2019–2021 **E/Gamma reconstruction sub-group coordinator**.
During my convenership I focused on the migration to AthenaMT and a new electron/photon ambiguity resolution and other tunings of the e/gamma reconstruction.

2019–2021 **Higgs differential cross sections in the diphoton channel**.
Differential cross sections are an important tool to investigate the properties of the Higgs boson. I have developed an analysis using a single fit to unfold the data, instead of the two-steps approach used in the past. I am editor of the paper.

2018–2021 **Characterization of LGAD sensors for HGTD**.
Thanks to a grant from INFN I started a new hardware activity to characterize novel LGAD sensors that will be used in the High Granulary Timing Detector during HL-LHC. By now several quantities have been measured, the main ones are the interpad gap of the sensor matrix and the time resolution as a function of various parameters as the bias voltage and the radiation damage.

2018–2020 **Higgs coupling and STXS in the diphoton channel**.
With more data Higgs analyses have evolved, measuring more granular cross sections with more advanced techniques. In this analysis measuring simultaneously many cross sections, with a PhD student, we have implemented an optimization based on a new approach using a global loss based on the determinant of the covariance matrix.

2017–2019 **HGam sub-group coordinator**.
During my convenership I have followed many analyses using the full Run2 data including: $ttH(\gamma\gamma)$ observation [65], $HH \to \gamma\gamma bb$ [66], Higgs mass [67, 37], Higgs properties [34, 35, 68, 36], BSM searches [69].

2015–2016 **Search in the diphoton channel**.

In the first data of Run2 a significant excess around $m_{\gamma\gamma} \simeq 750\,\mathrm{GeV}$ in the invariant mass spectrum has been found. I have contributed to the statistical analysis and I have been the editor of the internal note [49] about "cross checks", trying to find an experimental explanation for the excess. I have been contact editor for the paper [70]. I contributed to the update of this analysis with new data [69].

2015 **Seach in the photon-jet channel**.

Excess in the photon-jet invariant mass spectrum can be the signature of New Physics, as quantum black holes or excited quarks. I have worked on all the steps of the analysis, from the selection of the events, parametrization of the signal and the background, study of the systematics and the statistical analysis. I have been the editor of the internal note [50] and contact editor for the paper [71]. Thanks to the new collisions at $\sqrt{s} = 13\,\mathrm{TeV}$ this analysis has significantly improved the previous result.

2014-2016 **Calibration sub-group coordinator**.

Inside the e/gamma group, this sub-group has the responsibility to provide prescriptions and tools to calibrate electrons and photons for all the analyses in ATLAS. This includes: simulation-based calibration to compute the energy of the particles from the energy deposits in the calorimeter, several data-driven corrections (intercalibration of the calorimetric layers studied with muons and electrons, geometric deformations, high-voltage corrections, temperature corrections and a global scale of the calorimeter computed from the $Z \to ee$ and $J/\psi \to ee$ peak), cross checks with radiative decays of the Z, correction to the resolution from the Z experimental width. To every correction a systematic variation is associated. Presently the most detailed model of the systematics on the energy scale has more than 60 independent effects.

The energy calibration systematics are the dominant systematics for example for analyses that measure the mass or width of new resonances decaying in electrons or photons and they are also important for the measurement of the cross section of processes with photons.

During my mandate we have released the prescriptions for Run2 and have migrated the software to the new analysis model. I have been editor of the paper [64].

2012–2014 **Mass measurement with $H \to \gamma\gamma$**.

I have been involved in the Higgs mass analysis in the $H \to \gamma\gamma$ channel [73]. I have implemented all the steps of the analysis, from the cutflow, the propagation of the systematics and the final fit and cross checks. I have been the editor of the internal note in 2014 [51]. Thanks to the new decomposition of the calibration uncertainties the systematics error has been reduced by a factor two.

2012–today **MVA energy calibration**.

I have developed a new calibration based on boosted decision trees. For this study I have created a small group including a summer student. The improvement on the $H \to \gamma\gamma$ invariant mass resolution is 4% [72, 52]. This is now the official calibration for electrons and photons for all the analyses in ATLAS.

2011-2012 **Higgs decay in the diphoton channel**.

I have been working in the $H \to \gamma\gamma$ group since 2011 on different analyses. My first contributions have been the improvement of the photon pointing to improve the direction measurement of the two photons and the background decomposition [54]. I have worked on the discovery of the Higgs boson in the diphoton channel [78].

2011 **Improvement of the energy resolution of converted photons**.

I have developed a correction for the energy of converted photons using the radius of conversion. For example it is possible to reduce the RMS of the $H \to \gamma\gamma$ mass by a factor of 7%, considering only pairs of converted photons.

2010–2013 **Proof optimization and PoD**.

Proof is a tool to easily parallelize ROOT analyses. I was involved in the installation, the configuration and the testing of a medium proof farm in Milan. I have also tested PROOF on Demand, a tool to run PROOF on any resource management system as batch systems.

2010–2011 **Isolated diphoton at the ATLAS detector**.

The measurement of the diphoton cross section [61] is a test of pQCD and in addition diphoton events are the irreducible background for the Higgs decay into two photons. I have contributed to the full analysis [77], in particular I focused on the purity, the jet background decomposition using the 4×4 matrix method, the electron background and the unfolding of the cross section spectra.

2010	**Inclusive prompt photon at the ATLAS detector**.
	I worked on the estimation of the photon purity [59] using the two dimensional sideband data driven method [62] for the first published physics result on photon, the measurement of the inclusive isolated prompt photon cross section [58][9] and its update [81][57][45, 46].
2010	**Passive material effects on the ATLAS electromagnetic calorimeter**.
	Using simulations with distorted geometry I have studied the effect of additional dead materials on the energy and on the reconstruction and identification performance of electrons and photons.
2010–2013	**Electromagnetic calibration using the Calibration Hits method**.
	The Calibration Hits method [55] is based on Monte Carlo simulations that describe the energy deposition in the active but also in the passive parts of the detector. Using these simulations it is possible to parametrize the non-reconstructed energy versus measurable quantities. For the 2011 and 2012 data taking I have optimized and tested such a calibration, which has been used by ATLAS Run1.
2010	**Photon shower shape variables with early data**.
	My first work in ATLAS was the commissioning of the shower shapes with 900 GeV data [63].

Operational activities

I am involved in the operational activities of the experiment, in particular for the liquid argon high-voltage system. This consists in the electromagnetic calorimeter, part of the hadronic calorimeter and the forward calorimeter. This is a fundamental activity to check that the detector is able to collect good data.

2011–2016	**Hardware on-call expert for liquid argon high-voltage system**, *CERN*.
	ATLAS takes data continuously for several months every year. This means that during shifts I need to be able to promptly fix potential problems to the system to avoid any data loss. I have also improved the interface of some web tools used by the shifters.
2014–2018	**High voltage detector control system (DCS)**.
	I am a developer of the DCS for the monitoring and control of the HV for the ATLAS LAr calorimeter. The electrodes of the calorimeter are connected to hundreds of HV-lines. The DCS is the main control interface to the HV-modules. In addition a Finite State Machine helps to visualize the state of the whole system. This is a tree structure of abstract layers, each one with a state which is defined by the state of the lower layers. In addition commands can be sent to the element of the FSM which propagate according to its structure.

Supervisor

2021	**Supervisor (correlatore)**, *Università degli Studi di Milano*.
	Elena Mazzeo, Master thesis: "Search for Higgs boson pair production in the two photon plus two bottom quark final state using Run2 pp collision data with the ATLAS detector".
2020	**Supervisor (correlatore)**, *Università degli Studi di Milano*.
	Valentino Rossi, Master thesis: "Characterization of LGAD sensors for the High Granularity Timing Detector in the ATLAS Phase-II upgrade project".
2020	**Supervisor (correlatore)**, *Università degli Studi di Milano*.
	Alessandro Demela, Master thesis: "Optimization of the Higgs boson mass measurement in the diphoton channel with the ATLAS detector".
2020	**Supervisor (correlatore)**, *Università degli Studi di Milano*.
	Martino Pulici, Bachelor Thesis: "Improving suppression of the jets from pileup at high luminosity LHC using timing information from the High Granularity Timing Detector for ATLAS".
2020	**Supervisor (correlatore)**, *Università degli Studi di Milano*.
	Pietro Daniele, Bachelor Thesis: "A machine learning approach to the electron and photon classification with the ATLAS detector at the LHC".
2020	**Supervisor (correlatore)**, *Università degli Studi di Milano*.
	Edoardo Tronconi, Bachelor thesis: "Electrons and Photons classification using machine learning techniques with the ATLAS detector at the LHC".
2020	**Supervisor (correlatore)**, *Università degli Studi di Milano*.
	Mario Lamberti, Master thesis: "Measurement of differential cross-sections for Higgs boson production in the decay channel at 13 TeV with the ATLAS experiment".

2019	**Supervisor (correlatore)**, *Università degli Studi di Milano*.
	Eleonora Foschino, Bachelor thesis: "Photon Identification optimisation using machine learning techniques with the ATLAS detector at the LHC".
2019	**Supervisor (correlatore)**, *Università degli Studi di Milano*.
	Andrea Visibile, Bachelor thesis: "Determination of the primary vertex in di-photon events with the ATLAS detector at the LHC".
2019	**Supervisor (correlatore)**, *Università degli Studi di Milano*.
	Davide Mungo, Master thesis: "Measurement of Higgs boson production cross sections in the diphoton decay channel with $80\,\text{fb}^{-1}$ of pp collision data collected by the ATLAS detector".
2019	**Supervisor (correlatore)**, *Università degli Studi di Milano*.
	Chiara Vitali, Master thesis: "Measurements of diphoton differential cross sections in proton–proton collision at 13 TeV with the ATLAS detector at LHC".
2018	**Supervisor (correlatore)**, *Università degli Studi di Milano*.
	Luigi Favaro, Bachelor thesis: "Optimization of the energy calibration of electrons and photons at the ATLAS experiment with machine learning techniques".
2015	**Supervisor (correlatore)**, *Università degli Studi di Milano*.
	Edoardo Lamperti, Master thesis "Misure di sezioni d'urto di stati finali con due fotoni e jets adronici in collisioni protone-protone all'esperimento ATLAS".
2014	**Supervisor (correlatore)**, *Università degli Studi di Milano*.
	Marco Rimoldi, Master thesis: "Higgs mass measurement in the di-photon decay channel with the ATLAS experiment"
2014	**Supervisor (correlatore)**, *Università degli Studi di Milano*.
	Silvia Comotti, Master thesis: "Measurement of the isolated photon plus jet cross section in pp collisions at a center-of-mass energy of 8 TeV with the ATLAS detector".
2014	**Supervisor (correlatore)**, *Università degli Studi di Milano*.
	Andrea Poli, Bachelor thesis: "Tecniche di identificazione dei fotoni per il Run 2 all'esperimento ATLAS ad LHC".
2012	**Summer student supervisor**, *CERN*.
	I have been the supervisor of a CERN summer student, Ladislav Chytka, working in the MVA energy calibration.

Teaching activities

2015-today	**Teaching**, *Università degli Studi di Milano*, PhD school.
	I taught during the PhD course "Computational techniques in particle physics". Lectures about inferential statistics are available online: `https://github.com/wiso/StatisticsLectures`.
2016/17	**Assistant**, *Università degli Studi di Milano*, Laurea Magistrale.
	Assistant of prof. Attilio Andreazza, "Istituzioni di fisica nucleare e subnucleare".
2014	**Teaching**, *Università degli Studi di Milano*.
	I taught during the course "Methodologies of Data Analysis" with lectures about multivariate algorithms applied to the discrimination about signal and background in physics analyses.
2011/12	**Assistant**, *Università degli Studi di Milano*.
	Assistant of dott. Leonardo Carminati, "Laboratorio di Trattamento Numerico dei Dati Sperimentali" (Laboratory of Numerical Treatment of Experimental Data).
2010/11	**Assistant**, *Università degli Studi di Milano*.
	Assistant of prof. Fernando Palombo, "Laboratorio di Trattamento Numerico dei Dati Sperimentali" (Laboratory of Numerical Treatment of Experimental Data).

Outreach

2014 – today	**MasterClass**, *Università degli Studi di Milano*.
	For several editions I have helped students from high-schools during the MasterClass events (`http://www.physicsmasterclasses.org`), organized by the Physics Department. During the whole day students are invited to interact with true collisions detected by the ATLAS detector and try to classify them, looking at event displays. At the end of their work the results are combined and discussed with other institutes around the world.

2020   **Seminar**, *IIS Enzo Ferrari*, Monza.

2019   **Seminar**, *Liceo Artistico Giovanni XXIII*, Milano.

2017, 2018   **Notte dei ricercatori**, *Univ. degli Studi di Milano & INFN*.
I have participated to a couple of editions of "Notte dei ricercatori" at Museo della Scienza where I have illustrated the "Extreme" exibition about detectors in high-energy physics.

2016   **Seminar**, *Liceo Tecnologico Galilei*, Crema.

2013, 2014   **MeetmeTonight, European Researchers' Night**, *Univ. degli Studi di Milano & INFN*.
I have participated to the 2013 and 2014 editions of MeetmeTonight at Museo della Scienza (2014) and at Giardini Montanelli in Milan (2013), where with other researchers I have illustrated our work to the general public. In 2014 we also organized a special session with kids.

Talks at conferences

[1] R. Turra. "$H \rightarrow \gamma\gamma$". Frascati: Workshop on Photon Physics and Simulation at Hadron Colliders 2019, May 2019.

[2] R. Turra. "Measurement of cross sections and properties of the Higgs boson in decays to bosons with the ATLAS experiment". Lake Louise Winter Institute, Feb. 2019.

[3] R. Turra. "Measurement of photon production cross sections with the ATLAS detector". Venezia: EPS, July 2017.

[4] R. Turra. "Searches for exotics at ATLAS". Blois: 28th Rencontres de Blois, June 2016.

[5] R. Turra. "QCD at the LHC: status and prospects". Trento: LFC15, 2015.

[6] R. Turra. "Measurement of the Higgs boson mass by ATLAS and CMS". Torino: Higgs Couplings, 2014.

[7] R Turra. "Search for the Standard Model Higgs Boson in the Decay Mode $H \rightarrow \gamma\gamma$ with ATLAS". Quy Nhon (Vietnam): Beyond the standard model in particle physics, 2012.

[8] R. Turra. "Search for the Standard Model Higgs Boson in the Decay Mode $H \rightarrow \gamma\gamma$ with ATLAS". Napoli: Società Italiana di Fisica (SIF), 2012.

[9] R. Turra. "Misura della sezione d'urto di produzione di fotoni diretti con il rivelatore ATLAS all'LHC". Bologna: Società Italiana di Fisica (SIF), Sept. 2010.

Posters

[10] R. Turra. "Ricerca di SM Higgs nel canale di decadimento H→gamma gamma in ATLAS". Presented at IFAE, Ferrara 2012. Apr. 2012.

[11] R. Turra. "Measurements of isolated prompt photons in pp collisions with the ATLAS detector". ATL-PHYS-SLIDE-2011-379. Presented at PLHC, Perugia 2011. July 2011.

Proceedings

[12] R. Turra. "Measurement of photon production cross sections with the ATLAS detector". The European Physical Society Conference on High Energy Physics. Ed. by PoS. 2018.

[13] P. Meridiani and R. Turra. "Higgs boson search and properties measurement in the $H \rightarrow \gamma\gamma$ decay channel". VI Workshop Italiano sulla Fisica p-p a LHC. Ed. by PoS. Vol. LHCPP2013. 2013, p. 002.

[14] R. Turra. "Search for the SM Higgs boson in the diphoton decay channel with ATLAS". Incontri di Fisica delle Alte Energie - IFAE 2012. Ed. by Il Nuovo Cimento. Vol. 36. Feb. 2013. DOI: 10.1393/ncc/i2013-11470-1.

[15] R. Turra. "Search for the standard model higgs boson in the decay mode $H \rightarrow \gamma\gamma$ with ATLAS". Rencontres du Vietnam. ATL-PHYS-PROC-2012-289. Geneva, Nov. 2012.

[16] R. Turra. "Measurements of isolated prompt photons in pp collisions with the ATLAS detector". Physics at LHC 2011. Ed. by SLAC eConf C1106061. ATL-PHYS-PROC-2011-159. Geneva, Oct. 2011.

Talks at workshops

I gave several talks at workshops connected to the various group I work on: Higgs, e/gamma or in the Atlas-Italia meetings. I have been chair of some sessions [23–25]. I have been also invited to the ROOT-workshop as an expert user [29].

[17] R. Turra. "E/gamma energy calibration for Higgs mass measurement". Berlin, Germany: ATLAS Overview week, 2019.

[18] R. Turra. "Higgs to bosons". Genova: ATLAS Italia, May 2019.

[19] R. Turra. "$H \rightarrow \gamma\gamma$ & $H \rightarrow 4\ell$ with 36.1 fb^{-1} at 13 TeV". Pavia, Italy: ATLAS Italia, Oct. 2017.

[20] R. Turra. "Ricerca di risonanze a due corpi". Pisa, Italy: VII Workshop italiano sulla fisica pp a LHC, May 2016.

[21] R. Turra. "Egamma performance". Cosenza: ATLAS Italia, 2015.

[22] R. Turra. "Photon calibration". Saint Genis Pouilly, France: ATLAS HGamma workshop, 2015.

[23] R. Turra. "Systematics and decorrelation". Annecy, France: ATLAS e/gamma workshop, 2015.

[24] R. Turra. "Introduction and discussion to the calibration session". Paris, France: ATLAS e/gamma workshop, 2014.

[25] R. Turra. "Introduction of the Higgs session". Roma: ATLAS-Italy Workshop on physics and upgrade for HL-LHC program, 2014.

[26] R. Turra. "Calibration Cross-Checks". Annecy, France: HSG1 workshop, 2013.

[27] R. Turra. "Electron performance". Roma, Italy: HSG2 workshop, 2013.

[28] R. Turra. "$H \to \gamma\gamma$ in ATLAS and CMS". Genova, Italy: VI Workshop Italiano sulla Fisica p-p a LHC, 2013.

[0] R. Turra. "MVA calibration". Mainz, Germany: ATLAS e/gamma workshop, 2013.

[29] R. Turra. "ROOT experience from a user at ATLAS". Saas Fee, Switzerland: ROOT Users Workshop, 2013.

[30] R. Turra. "Search for the Standard Model Higgs Boson in the Decay Mode $H \to \gamma\gamma$". Lecce: ATLAS Italia, 2012.

[31] R. Turra. "Status of MVA calibration". Desy, Germany: HSG1 workshop, 2012.

[32] R. Turra. "Activities in egamma WG". Napoli: ATLAS Italia, 2011.

[0] R. Turra. "Energy correction for converted photons". Belgirate, Italy: ATLAS e/gamma workshop, 2011.

[0] R. Turra. "Distorted geometry effects". Carry Le Rouet, France: ATLAS e/gamma workshop, 2010.

[33] R. Turra. "Studio del decadimento $B_s^0 \to D_s^+ D_s^-$". Bologna: LHCb Italia, Jan. 2009.

━━━━━ Selected conference notes

Conference notes are public documents which illustrate preliminary results which are shown at conferences. I have been editor of [37–40].

[34] *Measurement of the properties of Higgs boson production at $\sqrt{s}$=13 TeV in the $H \to \gamma\gamma$ channel using 139 fb^{-1} of pp collision data with the ATLAS experiment*. Tech. rep. ATLAS-CONF-2020-026. Geneva: CERN, 2020. URL: http://cds.cern.ch/record/2725727.

[35] *Measurements and interpretations of Higgs-boson fiducial cross sections in the diphoton decay channel using 139 fb^{-}1 of pp collision data at $\sqrt{s} = 13$ TeV with the ATLAS detector*. Tech. rep. ATLAS-CONF-2019-029. Geneva: CERN, 2019. URL: http://cds.cern.ch/record/2682800.

[36] *Measurements of Higgs boson properties in the diphoton decay channel using 80 fb^{-1} of pp collision data at $\sqrt{s} = 13$ TeV with the ATLAS detector*. Tech. rep. ATLAS-CONF-2018-028. Geneva: CERN, 2018. URL: http://cds.cern.ch/record/2628771.

[37] *Measurement of the Higgs boson mass in the $H \to ZZ^* \to 4\ell$ and $H \to \gamma\gamma$ channels with $\sqrt{s}$=13TeV pp collisions using the ATLAS detector*. Tech. rep. ATLAS-CONF-2017-046. Geneva: CERN, 2017. URL: http://cds.cern.ch/record/2273853.

[38] *Search for resonances in diphoton events with the ATLAS detector at $\sqrt{s} = 13$ TeV*. Tech. rep. ATLAS-CONF-2016-018. Geneva: CERN, 2016. URL: https://cds.cern.ch/record/2141568.

[39] *Measurement of the Higgs boson production cross section at 7, 8 and 13 TeV center-of-mass energies in the $H \to \gamma\gamma$ channel with the ATLAS detector*. Tech. rep. ATLAS-CONF-2015-060. Geneva: CERN, 2015. URL: https://cds.cern.ch/record/2114826.

[40] *Search for resonances decaying to photon pairs in 3.2 fb⁻¹ of pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*. Tech. rep. ATLAS-CONF-2015-081. Geneva: CERN, 2015. URL: https://cds.cern.ch/record/2114853.

[41] *Measurements of the properties of the Higgs-like boson in the two photon decay channel with the ATLAS detector using 25 fb⁻¹ of proton-proton collision data*. Tech. rep. ATLAS-CONF-2013-012. Geneva: CERN, 2013.

[42] *Observation and study of the Higgs boson candidate in the two photon decay channel with the ATLAS detector at the LHC*. Tech. rep. ATLAS-CONF-2012-168. Geneva: CERN, 2012.

[43] *Observation of an excess of events in the search for the Standard Model Higgs boson in the gamma-gamma channel with the ATLAS detector*. Tech. rep. ATLAS-CONF-2012-091. Geneva: CERN, July 2012.

[44] *Observation of an Excess of Events in the Search for the Standard Model Higgs boson with the ATLAS detector at the LHC*. Tech. rep. ATLAS-CONF-2012-093. Geneva: CERN, July 2012.

[45] *Expected photon performance in the ATLAS experiment*. Tech. rep. ATL-PHYS-PUB-2011-007. Geneva: CERN, Apr. 2011.

[46] *Measurement of the inclusive isolated prompt photon cross section in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector using 35 pb⁻¹*. Tech. rep. ATLAS-CONF-2011-058. Geneva: CERN, Apr. 2011.

[47] *Search for the Standard Model Higgs boson in the diphoton decay channel with 4.9 fb⁻¹ of ATLAS data at $\sqrt{s} = 7$ TeV*. Tech. rep. ATLAS-CONF-2011-161. Geneva: CERN, Dec. 2011.

Selected internal notes

Internal notes are internal documents which support publications detailing the various aspects of the analyses. I have been editor of [48–53].

[48] J. Beacham et al. *Cross-checks and diphoton event activity studies: Search for new phenomena in diphoton events with the ATLAS detector at $\sqrt{s} = 13$ TeV*. Tech. rep. ATL-COM-PHYS-2016-759. Geneva: CERN, 2016. URL: https://cds.cern.ch/record/2162756.

[49] R. Turra et al. *Cross-checks and diphoton event activity studies: Search for resonances decaying to photon pairs in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*. Tech. rep. ATL-COM-PHYS-2016-192. Geneva: CERN, 2016. URL: https://cds.cern.ch/record/2134944.

[50] R. Turra et al. *Search for new physics in photon+jet final states at 13 TeV*. Tech. rep. ATL-COM-PHYS-2015-606. Geneva: CERN, 2015. URL: https://cds.cern.ch/record/2030268.

[51] N. Lorenzo Martinez and R. Turra. *Mass measurement in the $H \to \gamma\gamma$ channel: Supporting documentation for the Mass Paper*. Tech. rep. ATL-COM-PHYS-2014-018. Geneva: CERN, 2014.

[52] R. Turra and B. Lenzi. *Monte Carlo calibration update for electrons and photons using multivariate techniques*. Tech. rep. ATL-COM-PHYS-2013-1426. Geneva: CERN, 2013.

[53] R. Turra et al. *Selection for $H \to \gamma\gamma$ analysis supporting note, for Moriond 2013*. Tech. rep. ATL-COM-PHYS-2013-093. Geneva: CERN, 2013. URL: https://cds.cern.ch/record/1510141.

[54] R. Turra et al. *Background Studies for the Search of Higgs Boson Decaying to Two Photons with 8TeV data*. Tech. rep. ATL-COM-PHYS-2012-754. Geneva: CERN, June 2012.

[55] R. Turra et al. *Electromagnetic energy scale in-situ calibration and performance: Supporting document for the egamma performance paper*. Tech. rep. ATL-COM-PHYS-2011-263. Geneva: CERN, Mar. 2011.

[56] R. Turra et al. *Measurement of isolated di-photon cross section in pp collision at $\sqrt{s} = 7$ TeV with the ATLAS detector*. Tech. rep. ATL-PHYS-INT-2011-071. Supporting document for CERN-PH-EP-2011-088. Geneva: CERN, Sept. 2011.

[57] R. Turra et al. *Measurement of the inclusive isolated prompt photon cross section in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector using 35 pb⁻¹*. Tech. rep. ATL-PHYS-INT-2011-037. Supporting document for CERN-PH-EP-2011-115. Geneva: CERN, Apr. 2011.

[58] R. Turra et al. *Measurement of the inclusive isolated prompt photon cross section in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector*. Tech. rep. ATL-PHYS-INT-2011-013. Geneva: CERN, Mar. 2011.

[59] R. Turra et al. *Purity Estimates for the Inclusive Isolated Photons*. Tech. rep. ATL-PHYS-INT-2011-015. Geneva: CERN, Mar. 2011.

[60] R. Turra et al. *Search for the Higgs boson in the diphoton final state with 38 pb^{-1} of data recorded by the ATLAS detector at $\sqrt{s}$=7 TeV*. Tech. rep. ATL-PHYS-INT-2011-024. Geneva: CERN, Mar. 2011.

[61] R. Turra et al. *Study of the Di-Photon Backgrounds to the $H \rightarrow \gamma\gamma$ Search with the ATLAS detector at $\sqrt{s}$= 7 TeV*. Tech. rep. ATL-PHYS-INT-2011-011. Supporting document for CERN-PH-EP-2011-088. Geneva: CERN, Feb. 2011.

[62] R. Turra et al. *Calculating The Purity of Direct Photon Candidates in ATLAS: Proposed Methods and Plans for Early Data*. Tech. rep. ATL-COM-PHYS-2010-233. Geneva: CERN, May 2010.

[63] R. Turra et al. *Electron and photon reconstruction and identification results from ATLAS at 900 GeV*. Tech. rep. ATL-COM-PHYS-2010-172. Supporting document for ATLAS-CONF-2010-005. Geneva: CERN, Apr. 2010.

Publications

More than 900 publications as ATLAS author, I've been mainly involved in the following. I have been contanct editor of [64, 70, 71].

[64] M. Aaboud et al. "Electron and photon energy calibration with the ATLAS detector using 2015–2016 LHC proton-proton collision data". *JINST* 14.03 (2019), P03017. DOI: 10.1088/1748-0221/14/03/P03017. arXiv: 1812.03848 [hep-ex].

[65] M. Aaboud et al. "Observation of Higgs boson production in association with a top quark pair at the LHC with the ATLAS detector". *Phys. Lett. B* 784 (2018), pp. 173–191. DOI: 10.1016/j.physletb.2018.07.035. arXiv: 1806.00425 [hep-ex].

[66] M. Aaboud et al. "Search for Higgs boson pair production in the $\gamma\gamma b\bar{b}$ final state with 13 TeV pp collision data collected by the ATLAS experiment". *JHEP* 11 (2018), p. 040. DOI: 10.1007/JHEP11(2018)040. arXiv: 1807.04873 [hep-ex].

[67] M. Aaboud et al. "Measurement of the Higgs boson mass in the $H \to ZZ^* \to 4\ell$ and $H \to \gamma\gamma$ channels with $\sqrt{s} = 13$ TeV pp collisions using the ATLAS detector". *Phys. Lett. B* 784 (2018), pp. 345–366. DOI: 10.1016/j.physletb.2018.07.050. arXiv: 1806.00242 [hep-ex].

[68] M. Aaboud et al. "Measurements of Higgs boson properties in the diphoton decay channel with 36 fb^{-1} of pp collision data at $\sqrt{s} = 13$ TeV with the ATLAS detector". *Phys. Rev. D* 98 (2018), p. 052005. DOI: 10.1103/PhysRevD.98.052005. arXiv: 1802.04146 [hep-ex].

[69] M. Aaboud et al. "Search for new phenomena in high-mass diphoton final states using 37 fb^{-1} of proton–proton collisions collected at $\sqrt{s} = 13$ TeV with the ATLAS detector". *Phys. Lett. B* 775 (2017), pp. 105–125. DOI: 10.1016/j.physletb.2017.10.039. arXiv: 1707.04147 [hep-ex].

[70] M. Aaboud et al. "Search for resonances in diphoton events at $\sqrt{s}$=13 TeV with the ATLAS detector". *JHEP* 09 (2016), p. 001. DOI: 10.1007/JHEP09(2016)001. arXiv: 1606.03833 [hep-ex].

[71] G. Aad et al. "Search for new phenomena with photon+jet events in proton-proton collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector". *JHEP* 03 (2016), p. 041. DOI: 10.1007/JHEP03(2016)041. arXiv: 1512.05910 [hep-ex].

[72] G. Aad et al. "Electron and photon energy calibration with the ATLAS detector using LHC Run 1 data". *Eur. Phys. J.* C74.10 (2014), p. 3071. DOI: 10.1140/epjc/s10052-014-3071-4. arXiv: 1407.5063 [hep-ex].

[73] G. Aad et al. "Measurement of the Higgs boson mass from the $H \to \gamma\gamma$ and $H \to ZZ^* \to 4\ell$ channels with the ATLAS detector using 25 fb^{-1} of pp collision data". *Phys. Rev.* D90.5 (2014), p. 052004. DOI: 10.1103/PhysRevD.90.052004. arXiv: 1406.3827 [hep-ex].

[74] G. Aad et al. "Evidence for the spin-0 nature of the Higgs boson using ATLAS data". *Phys. Lett.* B726 (2013), pp. 120–144. DOI: 10.1016/j.physletb.2013.08.026. arXiv: 1307.1432 [hep-ex].

[75] G. Aad et al. "Measurements of Higgs boson production and couplings in diboson final states with the ATLAS detector at the LHC". *Phys. Lett.* B726 (2013). [Erratum: Phys. Lett.B734,406(2014)], pp. 88–119. DOI: 10.1016/j.physletb.2014.05.011,10.1016/j.physletb.2013.08.010. arXiv: 1307.1427 [hep-ex].

[76] G. Aad et al. "Electron performance measurements with the ATLAS detector using the 2010 LHC proton-proton collision data". *Eur. Phys. J.* C72 (2012), p. 1909. DOI: 10.1140/epjc/s10052-012-1909-1. arXiv: 1110.3174 [hep-ex].

[77] G. Aad et al. "Measurement of the isolated di-photon cross-section in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector". *Phys. Rev.* D85 (2012), p. 012003. DOI: 10.1103/PhysRevD.85.012003. arXiv: 1107.0581 [hep-ex].

[78] G. Aad et al. "Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC". *Phys. Lett.* B716 (2012), pp. 1–29. DOI: 10.1016/j.physletb.2012.08.020. arXiv: 1207.7214 [hep-ex].

[79] G. Aad et al. "Search for a fermiophobic Higgs boson in the diphoton decay channel with the ATLAS detector". *Eur. Phys. J.* C72 (2012), p. 2157. DOI: 10.1140/epjc/s10052-012-2157-0. arXiv: 1205.0701 [hep-ex].

[80] G. Aad et al. "Search for the Standard Model Higgs boson in the diphoton decay channel with 4.9 fb^{-1} of pp collisions at $\sqrt{s} = 7$ TeV with ATLAS". *Phys. Rev. Lett.* 108 (2012), p. 111803. DOI: 10.1103/PhysRevLett.108.111803. arXiv: 1202.1414 [hep-ex].

[81] G. Aad et al. "Measurement of the inclusive isolated prompt photon cross-section in pp collisions at $\sqrt{s} = 7$ TeV using 35 pb^{-1} of ATLAS data". *Phys. Lett.* B706 (2011), pp. 150–167. DOI: 10.1016/j.physletb.2011.11.010. arXiv: 1108.0253 [hep-ex].

[82] G. Aad et al. "Search for the Standard Model Higgs boson in the two photon decay channel with the ATLAS detector at the LHC". *Phys. Lett.* B705 (2011), pp. 452–470. DOI: 10.1016/j.physletb.2011.10.051. arXiv: 1108.5895 [hep-ex].