

Ruggero Turra

Curriculum Vitæ

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Date of birth: May 31, 1984

Place of birth: Treviglio (BG), Italy

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 $B_s^0 \rightarrow D_s^+ D_s^-$
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

- 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++03, python2, L^AT_EX

Languages (intermediate): C, JavaScript, HTML4/5, C++11, python3, Mathematica, MatLab, bash, SQL, Pascal, QBASIC

Technologies: programming paradigms: OO, functional, concurrent, event-based; basic design pattern

Tools and frameworks: ROOT, RooFit, RooStats, TMVA, Proof, PoD, numpy, matplotlib, boost, WinCC OA (PVSS) SCADA system

Present position

- 2013 **Postdoc**.
Presently I have a postdoc position "Assegno di Ricerca" from the University of Milan.

Past position

- 2012 **Simil-fellow**.
I have won an Italian "simil-fellow" position to work at CERN during 2012 as CERN associate.

Past research activities

- 2006 **Simulazioni Monte Carlo per l'esperimento CUORE (Bachelor's Degree Thesis).**
CUORE is an array made with TeO₂ bolometers designed for the search of neutrinoless double beta decay (DBD0ν) of ¹³⁰Te. The purpose of my thesis had been the optimization of the calibration configuration using MC simulations. I have analyzed how the calibration time, the pile-up and the linearity change when modifying the disposition and the number of calibration wires.
- 2009 **Madame Wu experiment with cryogenic bolometers.**
During the laboratory of the final year in my University I've been involved in an experiment to reproduce the Madame Wu results with cryogenic bolometers. I've followed the full experiment from the design and optimization, the bonding and testing of the detectors, the assembly inside the cryostat, the cryostat operation and the data analysis.
- 2009 **Study of the decay $B_s^0 \rightarrow D_s^+ D_s^-$ (Master's degree Thesis).**
The goal of my thesis was the study of the $B_s^0 \rightarrow D_s^+ D_s^-$ in which the D_s^\pm mesons are detected by their $KK\pi$ decay [1]. The products of the B_s^0 decays of this channel build up an even CP eigenstate, so it will be possible to study the proper time of this component separately. I have optimized different signal selections, extracted the decay proper time, and made an estimation of its statistical error. From this information I have extracted the parameter $\Delta\Gamma_s/\Gamma_s$ and its error by comparing the proper time of the studied decay and the proper time of the semileptonic decay.
- 2009 **LHCb Cherenkov detectors.**
The LHCb detector has two RICH subdetectors to identify particles. I studied trackless pattern recognition algorithms. In addition I have studied the online measurement of the refraction index of the areogel using high momentum particles.

Present research activities

I currently work in the ATLAS Collaboration since January 1st, 2010, and I am an ATLAS qualified author since February 1st, 2011. My activity is focused on the performance of the electromagnetic calorimeter and on the photon physics, both within the Standard Model analyses and the search for the Higgs Boson.

- 2010 **Shower shape variables with early data.**
My first work in ATLAS was the study of the shower shape variables comparing data with $\sqrt{s} = 900$ GeV and Monte Carlo simulations [21].
- 2010–today **Electromagnetic calibration using Calibration Hits method.**
The Calibration Hits method [22] 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 is used by ATLAS.
- 2010 **Dead material effect on the ATLAS electromagnetic calorimeter.**
Using Monte Carlo simulations with distorted geometry I have studied the effect of additional dead materials on the energy calibration and on the reconstruction and identification performance of electrons and photons.
- 2010 **Inclusive prompt photon at the ATLAS detector.**
I worked on the estimation of the photon purity [23] using the two dimensional sideband data driven method [24] for the first published physics result on photon, the measurement of the inclusive isolated prompt photon cross section [25][2] and its update [33][26][14, 15].
- 2010–2011 **Isolated diphoton at the ATLAS detector.**
The measurement of the diphoton production cross section [27] is of great interest as a probe to the QCD, in addition diphoton events are the irreducible background for the Higgs decay into two photons. I have followed the full analysis [34], in particular I focused on the purity, the jet background decomposition using the 4×4 matrix method, the background removal from electrons misidentified as photons and the unfolding of the cross section spectra.
- 2010–today **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. I have also tested PROOF on Demand, a tool to run PROOF on any resource management system.

2011–today **Vertexing for the $H \rightarrow \gamma\gamma$ at the ATLAS detector.**

To improve the measurement of the direction of the two photon from the Higgs decay one can constrain the direction of the photons to pass through the primary vertex. The goal of this work is to select the most probable vertex from which the photon pair originates combining information from the calorimeter and the inner detector.

2011–today **Background estimation for the $H \rightarrow \gamma\gamma$ at the ATLAS detector.**

As in the di-photon study I have implemented the 4×4 matrix to decompose the background [28]. Thanks to the new statistics it is possible to take into account additional information, for example the dependency of the isolation on the number of primary vertexes.

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

I have developed a correction (used by ATLAS in $H \rightarrow \gamma\gamma$) for the energy for converted photons using the radius of conversion. For example it is possible to reduce the RMS of the $H \rightarrow \gamma\gamma$ mass by a factor of 7% considering only pair of converted photons.

2012 **Development of an online monitor of the space token usage.**

I have developed a tool to monitor the space used by each user. A working example can be found here: http://precision-turra.mi.infn.it/LOCALGROUPDISK_usage/

2012 **$H \rightarrow \gamma\gamma$ + MET.**

I was involved into some cross checks about the missing transverse energy for the $H \rightarrow \gamma\gamma$ analysis, in particular checking the consistency of the object definitions entering in the MET computation and the $H \rightarrow \gamma\gamma$ analysis.

2012–2013 **MVA energy calibration.**

I have developed a new calibration based on multivariate algorithms. For this study I have created a small group of people working together including a summer student. Using the most simple version of this calibration the improvement on the $H \rightarrow \gamma\gamma$ invariant mass resolution is 4%. The work has been documented in the supporting note [29] of the calibration paper [35].

2012–2014 **Mass measurement for $H \rightarrow \gamma\gamma$.**

I have been involved in the Higgs mass analysis in the $H \rightarrow \gamma\gamma$ channel. 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 [30].

Operational activities

2011–today **Hardware on-call expert, CERN.**

I am a hardware on-call expert for the liquid argon subsystem of the ATLAS detector. In particular the activity is focused on the operation of the high voltage modules. I have also improved the interface of some web tools used by the shifters.

2014–today **High voltage detector control system.**

I am a developer of the DCS monitoring the HV for the ATLAS LAr calorimeter.

Teaching activities

2010/11 **Assistant, Università degli Studi di Milano.**

I was assistant of prof. Fernando Palombo during the course “Laboratorio di Trattamento Numerico dei Dati Sperimentali” (Laboratory of Numerical Treatment of Experimental Data).

2011/12 **Assistant, Università degli Studi di Milano.**

I was assistant of dott. Leonardo Carminati during the course “Laboratorio di Trattamento Numerico dei Dati Sperimentali” (Laboratory of Numerical Treatment of Experimental Data).

2012 **Summer student supervisor, CERN.**

I have been the supervisor of a CERN summer student working in the MVA energy calibration.

2014 **Supervisor, Università degli Studi di Milano.**

I have been the supervisor of Marco Rimoldi for his Master Thesis.

2014 **Teaching, Università degli Studi di Milano.**

I taught during the course “Methodologies of Data Analysis”

2014 **Supervisor, Università degli Studi di Milano.**

I have been the supervisor of Silvia Comotti for her Master Thesis.

Conferences and talks

- [1] R. Turra. "Studio del decadimento $B_s^0 \rightarrow D_s^+ D_s^-$ ". Bologna: LHCb Italia, Jan. 2009.
- [2] 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.
- [3] R. Turra. "Activities in egamma WG". Napoli: ATLAS Italia, 2011.
- [4] R. Turra. "Search for the Standard Model Higgs Boson in the Decay Mode $H \rightarrow \gamma\gamma$ with ATLAS". ATL-PHYS-SLIDE-2012-485. Quy Nhon (Vietnam): Beyond the standard model in particle physics, 2012.
- [5] 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.
- [6] R. Turra. "Search for the Standard Model Higgs Boson in the Decay Mode $H \rightarrow \gamma\gamma$ ". Lecce: ATLAS Italia, 2012.
- [7] R. Turra. "Measurement of the Higgs boson mass by ATLAS and CMS". Torino, 2014.

Posters

- [8] 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.
- [9] R. Turra. "Ricerca di SM Higgs nel canale di decadimento $H \rightarrow \gamma\gamma$ in ATLAS". Presented at IFAE, Ferrara 2012. Apr. 2012.

Proceedings

- [10] 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.
- [11] 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.
- [12] 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.
- [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.

Selected conf notes

- [14] *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.
- [15] *Expected photon performance in the ATLAS experiment.* Tech. rep. ATL-PHYS-PUB-2011-007. Geneva: CERN, Apr. 2011.
- [16] *Search for the Standard Model Higgs boson in the diphoton decay channel with 4.9 fb^{-1} of ATLAS data at $\sqrt{s}=7\text{TeV}$.* Tech. rep. ATLAS-CONF-2011-161. Geneva: CERN, Dec. 2011.
- [17] *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.
- [18] *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.
- [19] *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.

- [20] *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.

Selected internal notes

- [21] R. Turra et al. *Electron and photon reconstruction and identification results from ATLAS at 900 GeV.* Tech. rep. ATL-COM-PHYS-2010-172. This COM note supports the CONF note on electron and photon particle identification and reconstruction at 900 GeV (ATLAS-CONF-2010-005). Geneva: CERN, Apr. 2010.
- [22] 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.
- [23] R. Turra et al. *Purity Estimates for the Inclusive Isolated Photons.* Tech. rep. ATL-PHYS-INT-2011-015. Geneva: CERN, Mar. 2011.
- [24] 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.
- [25] 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.
- [26] 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.
- [27] 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.
- [28] 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.
- [29] 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.
- [30] N. Lorenzo Martinez and R. Turra. *Mass measurement in the $H \rightarrow \gamma\gamma$ channel: Supporting documentation for the Mass Paper.* Tech. rep. ATL-COM-PHYS-2014-018. Geneva: CERN, 2014.
- [31] 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.
- [32] 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.

Publications

More than 300 publications as ATLAS author, I've been mainly involved in [33, 34, 36–42]

- [33] G. Aad et al. (ATLAS Collaboration). “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].
- [34] G. Aad et al. (ATLAS Collaboration). “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].

- [35] G. Aad et al. (ATLAS Collaboration). “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].
- [36] G. Aad et al. (ATLAS Collaboration). “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].
- [37] G. Aad et al. (ATLAS Collaboration). “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].
- [38] G. Aad et al. (ATLAS Collaboration). “Search for the Standard Model Higgs boson in the diphoton decay channel with 4.9 fb^{-1} of pp collisions at $\sqrt{s} = 7 \text{ TeV}$ with ATLAS”. *Phys.Rev.Lett.* 108 (2012), p. 111803. DOI: 10.1103/PhysRevLett.108.111803. arXiv: 1202.1414 [hep-ex].
- [39] G. Aad et al. (ATLAS Collaboration). “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].
- [40] G. Aad et al. (ATLAS Collaboration). “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].
- [41] G. Aad et al. (ATLAS Collaboration). “Measurements of Higgs boson production and couplings in diboson final states with the ATLAS detector at the LHC”. *Phys.Lett.* B726 (2013), pp. 88–119. DOI: 10.1016/j.physletb.2013.08.010. arXiv: 1307.1427 [hep-ex].
- [42] G. Aad et al. (ATLAS Collaboration). “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].