

CURRICULUM VITAE – VALENTINA SOLA

PERSONAL INFORMATION

Family name, First name: Sola, Valentina

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Date of birth: June 16, 1984

Nationality: Italian

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EDUCATION

09.02.2012 **Ph.D. in Physics**, Torino University (Italy). Thesis title: *Inclusive diffractive cross sections in deep inelastic scattering at HERA*, Supervisors: Prof. M. Arneodo, Prof. M. Ruspa

25.07.2008 **M.Sc. degree in Physics of Fundamental Interactions**, Torino University (Italy), 110/110 cum laude

26.10.2006 **B.Sc. degree in Physics**, Torino University (Italy), 110/110 cum laude

CURRENT POSITION

2022 – present **Fixed-term Researcher of Type A**, Torino University (Italy)

PREVIOUS POSITIONS

2019 – 2022 **Postdoctoral Research Fellowship**, INFN – Torino Unit (Italy)

2017 – 2019 **Postdoctoral Research Fellowship**, Torino University (Italy)

2015 – 2017 **Postdoctoral Research Fellowship**, INFN – Torino Unit (Italy)

2012 – 2015 **Postdoctoral Research Fellowship**, Hamburg University (Germany)

INSTITUTIONAL RESPONSIBILITIES

2022 – present **Principal Investigator of the *Thin Silicon Sensors for Extreme Fluences (eXFlu-Innova)* project**, AIDAinnova (EU)

2020 – present **Principal Investigator of the *Silicon Sensors for Extreme Fluences (eXFlu)* project**, INFN (Italy)

2018 – present **Responsible for the Irradiation Campaigns** for the Endcap Timing Layer of CMS

2016 – 2017 **Responsible for the Ultra-Fast Silicon Detector installation and operation** in the CMS-TOTEM Precision Proton Spectrometer

2012 – 2014 **Co-convener of the SUSY Searches Group at Hamburg University** (Germany), leading and supervising the activity of the undergraduate and graduate students within the group (~ 20 students)

AWARDS

2018 Winner of the ***CMS Achievement Award for the outstanding contribution to the MTD project in CMS***, CERN (Switzerland)

2007 Winner of one over 10 ***INFN grants for students with B.Sc. degree in Physics***, INFN (Italy)

MAJOR COLLABORATIONS

2015 - present **Member of the RD50 Collaboration**, CERN, Switzerland

2010 - present **Member of the CMS Collaboration**, CERN, Switzerland

2009 - 2014 **Member of the ZEUS Collaboration**, DESY Hamburg, Germany

MAIN RESEARCH ACTIVITIES

Detector development

2020 – present R&D on the development of silicon sensors able to track charged particles up to fluences of the order of 10^{17} particles/cm² (eXFlu project)

2015 – present R&D on next-generation tracking systems to build a 4D tracker able to measure with excellent precision (10 μ m, 10 ps) position and crossing time of charged particles (part of the activity within the CMS Experiment)

2013 – 2015 R&D of the silicon pixel detector for the tracker upgrade (CMS Experiment)

2010 – 2012 Calibration of the electromagnetic calorimeter (CMS Experiment)

Analysis of physics data

- 2012 – 2015 Search for supersymmetry in events with photons and missing transverse energy at the LHC (CMS Experiment)
 2008 – 2012 Study of the diffractive cross section at HERA (ZEUS Experiment)

RESEARCH PERFORMANCE

1123 publications in refereed international journals, **18** publications in conference proceedings, **31** presentations at international conferences, and **8** presentations at national conferences
 Times Cited = **56,405** (**46,820** without self-citations), h-index = **104** (Web of Science)

National Scientific Qualification as Associate Professor, obtained in 2018

REVIEWING ACTIVITIES

- 2018 – present **Member of the *MTD Editorial Board***, CMS Collaboration, CERN (Switzerland)
 2018 – present **Reviewer**, *Nuclear Instruments and Methods in Physics Research, Section A*
 2019 **Reviewer**, *Journal of Instrumentation*

ORGANISATION OF SCIENTIFIC MEETINGS

- 2018 **Member of the Local Organising Committee** of the *Workshop on Pico-Second Timing Detectors for Physics and Medical Applications*, Torino (Italy)

SUPERVISION OF STUDENTS AND POSTDOCTORAL FELLOWS

- 2020 – present Tommaso Croci, Postdoctoral Fellow, Perugia University (Italy), on the simulation and gain layer design optimisation of thin LGAD sensors
 2018 – present Luca Menzio, Federico Siviero, and Marta Tornago, Ph.D. students, Torino University (Italy) on the R&D studies towards the design and construction of the Endcap Timing Layer of the CMS experiment
 2017 – present G. Gioachin, L. Lantieri, M. Milanesio, and R. Mulargia, M.Sc. students, Torino University (Italy) on the R&D activity on LGAD silicon sensors optimised for precise timing measurements and extreme fluence environments
 2015 – 2021 S. Durando, F. Miserocchi, G. Petrini, and M. Pennisi, B.Sc. students, Torino University (Italy) on the characterisation of UFSD sensors produced by FBK and HPK
 2013 – 2014 M. Hoffmann, Ph.D. student, Hamburg University (Germany), on beam test data-taking and analysis for the Phase I Upgrade of the CMS Pixel Detector
 2013 S. Bohlen, B.Sc. student, Universität Hamburg (Germany), on b-tagging optimisation studies in SUSY events with photons and missing energy at CMS

TEACHING ACTIVITIES

- 2022 – present Physics Laboratory II, Physics, Torino University (Italy)
 2015 – 2022 Applied Physics – Problem Sessions, Nursing and Paramedic Sciences, Torino University (Italy)
 2017 – 2021 Physics, Preparation class for the Medical College Admission Test, University of Eastern Piedmont (Italy)
 2016 – 2018 Applied Physics – Problem Sessions, Pharmacological Sciences, University of Eastern Piedmont (Italy)
 2015 – 2016 Physics I – Problem Sessions, Forestry and Environmental Sciences, Torino University (Italy)
 2012 – 2013 Physics I – Problem Sessions, Physics, Hamburg University (Germany)
 2008 – 2010 Applied Physics – Problem Sessions, Nursing and Paramedic Sciences, University of Eastern Piedmont (Italy)

CAREER BREAK

- 30.05.2014 – 18.09.2015 Maternity leave (16 months)

SYNOPSIS OF ACTIVITIES

I am an experimental physicist working in the field of high-energy particle physics. My research activity focuses on data analysis from colliders, namely HERA and LHC, and on detector development, mainly concentrating on the R&D of silicon detectors for the CMS experiment and future high radiation environments.

Presently, I am the Principal Investigator of an R&D project to develop silicon sensors able to efficiently detect particles up to extreme fluences. I have been an active member of the ZEUS experiment, and I currently work within the CMS and RD50 Collaborations. In the following, I describe the key goals I achieved.

1. My undergraduate and Ph.D. activity focused on the study of diffractive events, $ep \rightarrow eXp$, with the ZEUS experiment at the HERA ep collider. My first contribution was **the measurement of the t distribution of the diffractively scattered proton**, based on the data collected in 2000 with the Leading Proton Spectrometer. The results were used to extract the diffractive parton density functions (dPDFs) of the proton. Afterwards, I analysed data collected by the ZEUS experiment during the last data-taking period, 2006/07: **I extended the measurement of the inclusive diffractive cross-section at two different centre-of-mass energies** ($\sqrt{s} = 318$ GeV and 225 GeV), **exploring new regions of the kinematic phase space**. After the HERA shutdown in 2007, the H1 and ZEUS Collaborations dedicated significant efforts in the combination of their results. As a member of the *HERA Diffraction Working Group*, **I performed the first combination of the inclusive diffractive cross sections measured by the H1 and ZEUS experiments**.

2. During my Ph.D. I participated in the commissioning of the Electromagnetic Calorimeter (ECAL) of the CMS detector. **I actively worked on the ECAL calibration** within the *CMS ECAL Detector Performance Group*. **My activity concentrated on the development of the in-situ calibration method based on the azimuthal symmetry of the energy flow through the ECAL crystals (phi-symmetry)**. I analysed minimum bias events with the first LHC data, providing a fast and precise calibration of the detector. This method was extensively used during the whole LHC Run 1 to calibrate ECAL and monitor its stability. **The precise calibration of the CMS electromagnetic calorimeter played a crucial role in the observation and discovery of the Higgs boson through its two-photon decay**.

3) During my Postdoctoral activity at Hamburg University, I joined the *Supersymmetry (SUSY) Physics Analysis Group* at CMS. I concentrated on searches for SUSY breaking mediated by gauge bosons. **I played a major role in the analysis of events with at least one photon, hadronic jet activity, and missing transverse energy**. The results, based on the full Run 1 CMS data samples at $\sqrt{s} = 7$ TeV and 8 TeV, are in agreement with the Standard Model predictions and significantly extended previously published limits. Meanwhile, **I was co-convener of the SUSY Searches group at Hamburg University, leading and supervising the activity of ~ 20 students within the group**. The importance of the group within the CMS SUSY scene is documented by the production of 5 papers during the time I was convener.

4) From 2013 to 2015, I worked within the *CMS Tracker Group* on the upgrade of the pixel detector, the innermost component of the CMS tracking system. The originally installed three-layer system has been replaced at the end of 2016 by a new detector equipped with an additional 4th layer and a new digital read-out chip. **I actively worked on the characterisation of single-chip module prototypes**. In particular, I was in charge of the beam test campaign at the DESY laboratory (Hamburg, Germany), studying single-chip modules before and after irradiation up to a dose of 130 kGy, which corresponds to the lifetime dose expected for the outermost layer of the pixel detector. **I supervised and actively participated in the beam test data-taking and analysis, as well as in the simulation of the beam test results**, proving that the performance of the prototype chip bump-bonded to the sensor remains unchanged after irradiation.

5) Within Torino University and INFN, I work on the R&D of the Ultra-Fast Silicon Detectors (UFSD), in the frame of the *ERC Advanced Grant UFSD*. The target is to reach the time resolution of ~ 10 ps by using 50 μm thick silicon sensors with controlled signal multiplication, exploiting the Low-Gain Avalanche Diode (LGAD) technology. **My activity concentrates on the characterisation and test of both the new UFSD sensors and the dedicated electronics and includes the undergraduate and graduate students' supervision. I have been responsible for the installation and operation of UFSD inside the CMS-TOTEM Precision Proton Spectrometer (CT-PPS)**, located at about 200 m from the CMS interaction point. During the 2017 data taking, a plane of UFSD together with three planes of diamond sensors measured the time-of-flight of the scattered protons to precisely determine the position of the primary vertex. I actively participated in the organisation, preparation, and installation of the UFSD in CT-PPS. I also followed the commissioning and operation during the data-taking period. **Such experience represents the first application of UFSD in a high-energy physics experiment**. At present, **I am involved in the sensor development and optimisation for the MIP Timing Detector (MTD)**, a new component for the CMS detector upgrade in view of the High-Luminosity LHC: UFSD are the proposed technology for the Endcaps. Alongside students' supervision, **I am responsible for the**

organisation and coordination of the irradiation campaigns, and I am actively engaged in sensor characterisation through laboratory and beam test activities.

6) As Principal Investigator of the *Silicon Sensor for Extreme Fluences* (eXFlu) project founded by INFN and of the *Thin Silicon Sensor for Extreme Fluences* (eXFlu-innova) project founded by AIDAinnova, **I am leading a group of researchers, postdoctoral fellows, and students from Torino University and INFN, Fondazione Bruno Kessler (FBK), Perugia University and CNR.** The projects aim at simulating, designing, and producing silicon sensors that can detect particles in the fluence regime of 10^{17} n_{eq}/cm². The idea behind the projects is to explore the silicon behaviour in the extreme fluence regime. **I coordinate the group activities, plan the irradiation campaigns, organise, and actively participate in the sensor testing.**

In my activity, I dedicate great care to the supervision of undergraduate and graduate students, as well as young Post-Doc. Since I was a Ph.D. student, I have been involved in teaching activities, as I consider it a great responsibility to share the understanding and the passion for physics with young students. With the aim of spreading the high-level research knowledge to the public, I participated in several outreach activities, such as the International Masterclasses and the European Researchers' Nights, I gave lectures on scientific communication to High School students, and I have been a CMS official guide. The active role I played in the convenorship of the SUSY Searches Group at the Hamburg University (Germany), brought to the finalisation and publication of the graduate and undergraduate students' results. As responsible for the installation and operation of the first fast silicon detector in a high-energy physics experiment, I had to harmonise and coordinate the teamwork of researchers from different experiments. As Principal Investigator of the eXFlu and eXFlu-innova projects, I lead a group of researchers from different institutes to pave the way for sensor development able to efficiently track particles in future high-energy and high-intensity particle collider experiments. The experience I have matured along with my research path strongly empowered my leadership and coordination capabilities.

SELECTED CONFERENCE PRESENTATIONS

- 2022 *Present and future development of thin silicon sensors for extreme fluences*, VCI2022 – The 16th Vienna Conference on Instrumentation, Wien (Austria), **plenary talk**
- 2021 *First results from thin silicon sensors irradiated to extreme fluence*, The 12th International Conference on Position Sensitive Detectors (PSD12), Birmingham (UK), **plenary talk**
- 2020 *First results from thin silicon sensors for extreme fluences*, Virtual 2020 IEEE Nuclear Science Symposium & Medical Imaging Conference, **parallel talk**
- 2020 *Precision Timing with the CMS MTD Endcap Timing Layer for HL-LHC*, Vertex 2020, Virtual, **invited talk**
- 2019 *Next-Generation Tracking System for Future Hadron Colliders*, Vertex 2019, Lopud Island (Croatia), **invited talk**
- 2018 *Fast Timing Detectors towards a 4-Dimensional Tracking*, ICHEP2018 - XXXIX International Conference on High Energy Physics, Seoul (South Korea), **parallel talk**
- 2017 *First production of 50 μ m thick Ultra-Fast Silicon Detectors at FBK*, 11th International "Hiroshima" Symposium – HSTD11, Okinawa (Japan), **plenary talk**
- 2013 *Searches for SUSY in final states with photons at CMS*, Lake Louise Winter Institute, Chateau Lake Louise, Alberta (Canada), **plenary talk**
- 2010 *Diffraction at HERA*, Rencontres de Moriond, La Thuile (Italy), **plenary talk**