Irene Zoi

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In essence

- Curious physicist, quick and restless learner, adaptive communicator
- Passionate and highly qualified in instrumentation development with experience in silicon detectors and physics data analysis
- Collaborative and team player, brings leading contribution to common goals and student supervision

Professional Experience

11/2021 — now **Research associate** · Fermilab

- Leading contribution in testing and calibration development of **strip-strip and pixel-strip modules** for the **Outer Tracker Phase-2 upgrade**. The modules are made of **two closely spaced silicon sensors** and **multiple ASICs** to provide **tracking information to the L1 trigger** and **on module p_T discrimination** for the **first time at a hadron collider**.
  - Responsible for DAQ and p_T discrimination tools for an irradiated pixel-strip module testbeam at Fermilab to verify the p_T discrimination capability
  - Leading contribution in pixel-strip module task force solving outstanding issues before the start of the module production
  - Developer of pixel-strip and strip-strip modules calibrations and Q&A tools, for the production of thousands of modules
- Leading the **search for anomalous EW production of VBS WV (semi-leptonic) with dimension-8 EFT operators**
  - Supervision of a grad student to develop **polarization studies** in the same final state
- Active member of the **CMS** collaboration at **CERN**
- **Supervision and mentoring of students**, presenting results at international conferences, involved in **LPC events and committees**
- Supporting role in the R&D of Monolithic Active Pixels Sensor with prospects for future colliders

02/2017 — 10/21 **Research assistant** · Universität Hamburg (Germany)

- Active member of the **CMS** collaboration at **CERN**
- **Contact person and main data analyst** of a search for new particles covering a large variety of di-boson (W, Z, H) all-hadronic final states and **jet-tagging techniques**
- Took part in several **test beam** campaigns at the **DESY** and **Fermilab** facilities, **collecting and analysing the data**, to characterize and select **pixel silicon sensors** for the **Phase-2 upgrade**
- Supervision of students, presenting results at international conferences

11/2016 — 01/2017 **Research assistant** · Università degli studi di Firenze (Italy)
R&D of planar and 3D pixel sensors for the CMS Phase-2 Upgrade

04/2016 — 10/2016 **Visiting Scientist** · Fermilab (USA)
Characterization of non-irradiated and irradiated pixel sensor properties trough beam and laser tests, calibrations and analysis of the collected data.

07/2015 — 09/2015 **Summer Intern** · Fermilab (USA)
Analysis of test beam data of pixel sensor prototypes.

Education

02/2017 — 10/2021 **PhD student** • Universität Hamburg (Germany)
Thesis: Search for diboson resonances in the all jets final state with CMS at $\sqrt{s}$ = 13 TeV and pixel sensors development for HL-LHC - **magna cum laude**
Supervisors: A. Hinzmann, E. Garutti

- PhD student in the PIER Helmholtz Graduate School
- Working on the CMS experiment at CERN
- Data analysis on a search for new particles decaying to Higgs or Vector Bosons
- Extensive use of jet tagging techniques and jet substructure observables
- Measurement of the spatial resolution of pixel sensors for the Phase-2 Upgrade
- Study of the radiation damage for the current and future detector

09/2014 — 10/2016 **MSc in Physics and Astrophysics** • Università degli studi di Firenze (Italy)
Thesis: Silicon pixel detectors for the CMS Tracker upgrade at HL-LHC - **cum laude**
Supervisors: R. D'Alessandro, G. Bolla, L. Uplegger

- Thesis work carried out at Fermilab as a continuation of the study started during my stay as Summer Intern at Fermilab in 2015
- Contributed to test beam data taking and analysis on irradiated sensors

09/2010 — 04/2014 **BSc in Physics and Astrophysics** • Università degli studi di Firenze (Italy)
Thesis: Study of saturation effects in the new silicon detectors modules of the LHCf experiment - **cum laude**; Supervisor: M. Bongi

Awards

2025 **LHC Physics Center Distinguished Researcher** • Fermilab
Fellowship for 2025

2024 **SPOT award** • Fermilab
For guiding excellent VIP tours for the Italian Scientific Attache and the students

2024 **R&R** • Fermilab
Reward and recognition award for PS module testbeam in 2023

2023 **SPOT award** • Fermilab
Panelist in the fSWE Collegiate Pipeline Program

2018 **Travel grant** • PIER Helmholtz Graduate School
To participate in the CERN-Fermilab Hadron Collider Physics Summer School

2015 **Summer student scholarship** • INFN & Fermi National Accelerator Laboratory
Two months staying at Fermilab working on R&D on pixel silicon detector.
Supervisors: G. Bolla, L. Uplegger, C. Vernieri

Leadership roles

July 2024 — Now **Fermilab Society of Women Engineers (fSWE) Executive Board** • Fermilab
Outreach Subcommittee

June 2024 — Now **LPC Physics Forum chair** • Fermilab
Organization of seminars for CMS and non CMS members.

10/2023 — 04/2024 **Pixel-strip modules task force** • CMS Collaboration
Investigated and solved outstanding issues with pixel-strip modules before the start of production

2022 — 2023 **LPC Events Committee member** • Fermilab
Organization of events, workshops and tutorials.

2018 — 2020 **DESY Language Café** • DESY
Organized bi-weekly meeting to practice different languages with the support of DOIT (Doktoranden-Initiative in partnership of DESY, Universität Hamburg & PIER Helmholtz Graduate School), CSSB (Centre for Structural Systems Biology) and Fortbildung DESY.

Supervision, teaching and mentoring

Student supervision and mentoring

2022 - Now **Co-supervision of several students and interns** • Fermilab

- Several topics related to the Outer Tracker Phase-2 Upgrade, including testbeam datataking and analysis, software development and module testing.
  - Sweta Baradia, Graduate student at Saha Institute of Nuclear Physics (IN) and Fermilab G&V
  - Lacey Dishman, Undergraduate student at Tennessee University, Knoxville
  - Olivia Gzamouranis, High school student at Willowbrook High School, Villa Park
  - Elizabeth Hagen, Undergraduate student at Tennessee University, Knoxville
  - Johnny Lawless, Graduate student at Tennessee University, Knoxville
  - Jack Peltier, Undergraduate student at Tennessee University, Knoxville
  - Nicolò Salimbeni, Master student at University of Padova (IT)
  - Iqra Sohail, Graduate student at National Centre for Physics (PK) and LPC based
  - Colby Thompson, Graduate student at Tennessee University, Knoxville
- Polarization studies in VBS WV (semi-leptonic) channel
  - Hayden Hollenbeck, Graduate student at the University of Virginia

07/2023 — 09/2023 **Supervision of a summer student** • Fermilab
Raffaele Delli Gatti, Trieste University (IT), "New jet tagging techniques in Vector Boson Scattering WV analysis in the semi-leptonic channel with the CMS experiment"

06/2019 — 10/2019 **Supervision of a Bachelor student** • Universität Hamburg (Germany)
David Leppla-Weber, "Search for excited quark states decaying to qW/qZ with the CMS experiment"

10/2018 **Supervision of 3 Italian high school students for a European project of work-school exchange** • Universität Hamburg (Germany)
Project on pixel sensors

Other activities

09/2024 - Now **USCMS mentor** • US
Mentoring of a graduate student

06/2024 - Now **Mentoring@CERN mentor** • CERN
Women in Technology (WIT) and LHC Early Career Mentoring programme

2022, 2023, 2024, .. **LPC DAS Facilitator** • Fermilab
Facilitator for several short and long exercises, and social events

Outreach and DEI effort

Outreach talks

- **Women in STEM presentation** • Willowbrook High School, Villa Park, IL (USA), April 2024
  - My journey in particle physics (so far) **(invited talk)**
- **fSWE Collegiate Pipeline Program- Panel Discussion on Engineering Career Paths at Fermilab** •

Fermilab, March 2023
  - How I went from intern to postdoc at Fermilab
- **Physikerinnentagung 2019 (German conference for women physicists)** • TU Berlin, Germany, November 2019
  - Are you ready for the future? Here how the CMS pixel detector will evolve **(invited talk)**

Various activities

2024 — Now	**CU*iP Program Committee** • Fermilab Organization of the Conference for Undergraduate Women and Gender Minorities in Physics
2023 — Now	**Remote Operation Center Outreach** • Fermilab Presenting the Outer Tracker work to VIP visitors of the lab or the department.
2022 — Now	**ACT-SO Judge** • DuPage County Judge or mock judge for the Afro-Academic, Cultural, Technological, and Scientific Olympics (ACT-SO) in the Engineering category. The program targets African American High school students.
2022 — Now	**SiDet tour guide** • Fermilab Providing tours of the Silicon Detector facility at Fermilab for students, experts of the scientific community and other guests of the laboratory.
08/2019	**Supervision of 2 female high school students** • Physik-Projekt-Tage, Universität Hamburg (Germany) Initiative to involve more women in pursuing a career in science, project on Silicon Photo Multipliers (SiPM)

Skills

Programming	Python • Jupyter • C++ • LaTeX • ROOT • Git • Linux • Basic VHDL • Batch computing (Condor) • singularity
Languages	Italian (Mother tongue) • English (Fluent) • German (B1)

Publications

The CMS collaboration lists each member of the experiment as an author on all publications. Below are publications to which I contributed substantially. A full publication list can be found at http://inspirehep.net/author/profile/Irene.Zoi.1.

Selected peer-reviewed publications

CMS Collaboration, *"Model-agnostic search for dijet resonances with anomalous jet substructure in proton-proton collisions at* $\sqrt{s} = 13$ *TeV"*, CMS-PAS-EXO-22-026, To be submitted.

CMS Collaboration, *"Searches for Higgs boson production through decays of heavy resonances"*, CMS-B2G-23-002-003, Accepted by Physics Reports.

CMS Collaboration, *"Search for new heavy resonances decaying to WW, WZ, ZZ, WH, or ZH boson pairs in the all-jets final state in proton-proton collisions at* $\sqrt{s} = 13$ *TeV"* , CMS-B2G-20-009, arXiv:2210.00043, 10.1016/j.physletb.2023.137813.

I. Zoi et al., *"Position resolution with 25* μ*m pitch pixel sensors before and after irradiation"*, NIM A 1021 (2021) 165933

A. Ebrahimi et al., *"Position reconstruction for segmented detectors"*, NIM A 1014 (2021) 165744

M. Boscardin et al., *"Performance of new radiation-tolerant thin planar and 3D columnar n on p silicon pixel sensors up to a maximum fluence of* $\sim 5 \times 10^{15}$ n_{eq}/cm^2*"*, NIM A 953 (2020) 163222

CMS Collaboration, *"The Phase-2 Upgrade of the CMS Tracker"*, Technical Design Report, CERN-LHCC-2017-009, CMS-TDR-17-001

C. Vernieri et al., *"Pixel sensors with slim edges and small pitches for the CMS upgrades for HL-LHC"*, NIM A 845 (2017) 189

Selected technical and conference notes

Irene Zoi on behalf of the CMS Collaboration, *"Design and construction of the Outer Tracker for the Phase-2 Upgrade"*, CMS-CR-2023-298, PoS(VERTEX2023)021.

CMS Collaboration, *"Pixel Charge Profiles in Run-2 Data and Simulation"*, CMS-DP-2020-026

CMS Collaboration, *"Tracker Performance in 2017 Legacy processing"*, CMS-DP -2019-027

F. Feindt for the CMS Tracker Group, *"Beam test measurements on planar pixel sensors for the CMS phase 2 upgrade"*, CMS-CR-2019-298

I. Zoi et al., *"Beam Test Results of Thin n-in-p 3D and Planar Pixel Sensors for the High Luminosity LHC Tracker Upgrade at CMS"*, PoS(EPS-HEP2017)809

Conference contributions

International conferences and workshops

- **2024 Annual Review - Tracker** • CERN, 29 April 2024
  - OT: modules - kick off batch results
- **Vertex 2023 - 32nd International Workshop on Vertex detectors** • Sestri Levante (Italy), 16-20 October 2023
  - Design and construction of the CMS Outer Tracker for the Phase-2 Upgrade
- **PS module workshop** • Fermilab, 10-12 October 2023
  - PS testing
- **Deep Dive: QCD backgrounds** • CERN, 30 May 2023
  - Multidimensional fits
- **Deep Inelastic Scattering (DIS)** • Michigan State University (US), 27-31 March 2023
  - Vector Boson Scattering results in CMS
- **CMS Physics Days: Review of Run 2 interesting excesses** • CERN, 14-15 September 2022
  - B2G: Diboson and resonance searches
- **The Tenth Annual Large Hadron Collider Physics (LHCP2022) conference** • Taipei, Taiwan (online), 16-20 May 2022
  - ATLAS+CMS Searches for Di-/Tri-boson resonances
- **Phenomenology 2022 Symposium: From Virtual to Real** • University of Pittsburgh, USA, 9-11 May 2022
  - Searches for heavy resonances in diboson final states at CMS
  - Chair of Higgs II parallel session
- **CMS Week** • CERN (online), 24-28 January 2022
  - Multi-dimensional search for new heavy resonances decaying to boosted WW, WZ, ZZ, WH or ZH boson pairs in hadronic final states
- **10th LHC students poster session at 141st LHCC Meeting** • CERN, 19 February 2020
  - Precision single hit resolution measurements for the CMS Inner Tracker Phase-2 upgrade (poster)
- **Remote B2G Spring Workshop 2020** • 18-20 May 2020 (online)
  - Diboson all-hadronic resonance search using a 3D fit
- **2019 CMS B2G Spring Workshop** • Naples, Italy, April 2019
  - Search for VBF produced diboson resonances in the all-jets final state: overview & first look at 2018 data
- **CMS Physics and Upgrade Week** • Budapest, Hungary, October 2018
  - Search for VBF produced diboson resonances in the all-jets final state at $\sqrt{s}$ = 13 TeV (poster)
- **B2G Spring Workshop** • Hamburg, Germany, May 2018

  - Search for VBF produced diboson resonances in the all-jets final state at $\sqrt{s}$ = 13 TeV with the CMS experiment
- **European Physical Society Conference on High Energy Physics** • Venice (Italy), July 2017
  - Beam Test Results of Thin n-in-p 3D and Planar Pixel Sensors for the High Luminosity LHC Tracker Upgrade at CMS (poster)

National conferences and workshops

- **2022 US CMS Annual Collaboration Meeting** • Jun 8 – 10, 2022 UW-Madison, Madison, WI, USA
  - The Outer Tracker module testing at Fermilab
- **DPG Spring Meeting 2021** • March 15-19, 2021 (online)
  - A multi-dimensional search for new heavy resonances decaying to boosted WW, WZ, ZZ, WH or ZH boson pairs in the all jets final state at 13 TeV
  - Position resolution with 25 μm pitch pixel sensors
- **FSP CMS Workshop 2020** • September 23-25, 2020 (online)
  - Diboson all-hadronic resonance search using a 3D fit
  - Pixel status and radiation effects in the Phase-1 pixel detector
- **D-CMS Workshop 2019** • KIT, Karlsruhe, Germany, September 2019
  - Extension of VV all-hadronic with 3D fit to VH and VBF
- **DPG Spring Meeting 2019** • Aachen, Germany, March 2019
  - Spatial resolution measurements with planar pixel sensors for the CMS Phase-2 Upgrade
- **FSP CMS Workshop** • Hamburg, Germany, September 2018
  - Search for VBF produced diboson resonances in the all-jets final state at $\sqrt{s}$ = 13 TeV
- **DPG Spring Meeting 2018** • Würzburg, Germany, March 2018
  - Search for VBF produced diboson resonances in the all-jets final state at $\sqrt{s}$ = 13 TeV with CMS
- **FSP CMS Workshop** • RWTH Aachen University, Germany, October 2017
  - The Phase-II Tracker Upgrade and Jet Substructure Performance