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I am a **leader in scientific computing** with over 15 years of experience and have developed deep expertise in scientific software and computing infrastructure. At heart, I am a particle physicist and have both conducted and enabled breakthrough scientific discoveries in High Energy Physics (HEP). My goal is to continuously broaden my horizons and leverage my expertise to support an expanding range of scientific disciplines through software and computing.

I am intimately familiar with scientific grid sites, academic and commercial cloud platforms, and the largest supercomputers in the U.S. I am also an expert in object-oriented software development, statistical data analysis methods, Monte Carlo simulation techniques, and various optimization and machine learning approaches.

Since August 2024, I have served as the Deputy Associate Lab Director (interim) for the Computational Science and AI Directorate (CSAID) at the U.S. Department of Energy's Fermi National Accelerator Laboratory (FNAL). I lead strategic and tactical initiatives to support Fermilab's scientific program through software and computing solutions.

From March 2019 to December 2024, I served as the U.S. CMS Software and Computing Operations Program Manager, overseeing the U.S. CMS Tier-1 and Tier-2 facilities, as well as software maintenance and development efforts for core software, computing infrastructure, and analysis systems. To guide R&D planning for the High-Luminosity LHC (HL-LHC), I co-authored a strategic plan outlining four grand challenges. At Fermilab, I created the Computing Resources Evolution STrategy (CREST) process, which defines a ten-year strategy for the evolution of the lab's computing resources based on current experimental needs and anticipated future requirements for DUNE and HL-LHC.

I am actively involved in a global community effort to prepare the software and computing infrastructure for the High-Luminosity LHC (HL-LHC), expected to begin in 2029. This phase will require several times the computing capacity currently available. In 2020, I was invited to co-lead the Computational Frontier of the Particle Physics Snowmass 2021 process, a community-driven planning initiative to define a scientific vision for the future of particle physics in the U.S. and its international partners.

My original motivation came from conducting **cutting-edge research** in the search for new physics beyond the Standard Model, as well as performing precision measurements within the Standard Model. I have many years of experience analyzing high-energy collisions at various particle colliders using a wide range of techniques. At the LHC, I have led searches for signs of physics beyond the Standard Model using top quarks and contributed to searches for Supersymmetry and Dark Matter. One of my most notable publications is the Observation of the Higgs Boson in 2012.

1 Managerial Experience

Over more than 15 years in scientific computing, I have gained extensive managerial experience across large organizational structures, including line management at CSAID, international collaborations such as CMS, and major U.S. operations programs.

Since August 2024, I have served as the Deputy Associate Lab Director (interim) for CSAID at Fermilab. In addition, since November 2024, I have held the roles of Acting Deputy Division Director for the Scientific Computing Systems and Services Division and Department Head for the Facility Evolution Department.

From March 2019 to December 2024, I was appointed U.S. CMS Software and Computing Operations Program

Manager. This program, jointly funded by the National Science Foundation (NSF) and the Department of Energy (DOE), provides the software and computing infrastructure that enables U.S. CMS researchers to maintain leadership in CMS physics. Under my leadership, the program's annual budget grew from 15M U.S. Dollars in 2019 to nearly 20M U.S. Dollars in 2024, supporting more than 60 FTEs, including scientists, technical staff, and computing hardware across Fermilab and seven U.S. university sites.

I am actively engaged in recruiting and sustaining a vibrant, high-performing workforce. I support this goal by building career pipelines through internship programs and by mentoring junior technical staff, early-career scientists, and postdoctoral researchers.

2 Leadership Experience

Leveraging my extensive expertise in scientific software and computing infrastructure, I contribute to global community efforts to shape the future of software and computing for science, with a particular focus on the High-Luminosity LHC (HL-LHC). My leadership centers on providing the strategic vision needed to enable groundbreaking scientific discoveries.

For HL-LHC, I co-authored a strategic plan for the U.S. CMS Software & Computing Operations Program (arXiv:2312.00772) that outlines four grand challenges that must be addressed:

1. Modernizing Physics Software and Improving Algorithms
2. Building Infrastructure for Exabyte-Scale Datasets
3. Transforming the Scientific Data Analysis Process
4. Transitioning from R&D to Operations

To implement this plan, I established a Research Initiative within the U.S. CMS Software & Computing Operations Program. This initiative provides partial funding for postdoctoral researchers to explore novel and forward-looking solutions to these four grand challenges. The strategic plan also builds on prior contributions to broader community planning exercises, such as the Roadmap for HEP Software and Computing R&D for the 2020s.

In 2024, I was appointed co-lead of the CMS Collaboration Board Sub-Group for Offline & Computing for HL-LHC. I proposed the creation of this sub-group to introduce structured coordination and effort planning within the Offline & Computing area—an innovation for CMS, where such formal coordination had previously only existed in detector projects through institutional boards.

At Fermilab, I created the Computing Resources Evolution STrategy (CREST) process, which defines a ten-year strategic plan for evolving the lab's computing resources. This plan considers both current experimental needs and anticipated demands from DUNE and HL-LHC.

As part of the Department of Energy's Center for Computational Excellence (HEP-CCE), I co-authored a proposal in 2020 to lead four sub-projects addressing key challenges in adapting HEP computing for heterogeneous architectures:

1. **Parallel Portability Solutions (PPS):** Develop algorithms that can be written once and compiled for CPUs and accelerators alike.
2. **Fine-Grained I/O and Storage (IOS):** Optimize data structures and access patterns for large shared storage systems on HPC platforms.
3. **Event Generators (EG):** Adapt HEP theory code for efficient execution on HPC systems.
4. **Complex Workflows (CW):** Enable orchestration of multi-step workflows across heterogeneous hardware.

I was appointed technical lead of the PPS sub-project, which has since completed its funding cycle.

I am nationally and internationally recognized for my leadership. I was selected to co-lead the Computational Frontier for the Snowmass 2021 process, the U.S. particle physics community planning exercise. I also serve on the editorial boards of the journal "Computing and Software for Big Science" and the European Physical Journal (EPJ C).

3 Technical Experience

I possess deep expertise in planning, developing, maintaining, and operating distributed computing infrastructures that provide access to several hundred thousand computing cores and hundreds of petabytes of disk storage. I am proficient in efficiently storing and retrieving data from permanent tape storage. I am intimately familiar with both High-Throughput Computing (HTC) and High-Performance Computing (HPC), including scientific grid sites, academic and commercial clouds, as well as the largest supercomputers at HPC centers in the U.S. and worldwide. This infrastructure supports scientific software composed of millions of lines of C++ and Python code, essential for extracting physics results. I am an expert in object-oriented software development, statistical data analysis methods, Monte Carlo simulation techniques, and various optimization and machine learning approaches.

The technical components of my work are tightly linked to scientific research, enabling the analysis of particle physics detector data and simulations as the foundation for producing physics results. My active engagement in High Energy Physics (HEP) research allows me to guide the scientific community in leveraging the latest computing innovations, effectively bridging the domains of science and scientific computing.

My current R&D projects include:

- Revolutionizing wide-area network utilization by managing data transfers through dynamic Software-Defined Networking (SDN) channels within the DOE ASCR's ESnet SENSE/Rucio project.
- Characterizing and distinguishing traffic flow types at site borders using AI-based packet header analysis in collaboration with ESnet AI researchers.
- Enabling CMS to harness the latest GPU-based DOE leadership-class supercomputers.
- Transforming the end-user analysis paradigm by integrating industry-standard Python analysis ecosystems and adopting columnar analysis techniques.

4 Research Experience

I am a particle physicist at heart, originally motivated by conducting **leading-edge research** into New Physics Beyond the Standard Model, as well as precision measurements within the Standard Model.

I have many years of experience analyzing high-energy collisions from various particle colliders using a wide range of techniques. I have published numerous papers in leading journals and am currently a member of the CMS collaboration operating one of the four detectors at the Large Hadron Collider (LHC) at CERN in Geneva, Switzerland. The CMS collaboration is a global endeavor, comprising more than 3000 physicists from over 50 countries, including over 1000 students.

In my past LHC research, I have led searches for evidence of physics beyond the Standard Model using top quarks and contributed to investigations of Supersymmetry and Dark Matter. Among my most notable publications is the Observation of the Higgs Boson in 2012, where my work in scientific computing played a significant role.

5 Selected Recent Publications in Physics and Computing

A.M. Sirunyan et al., **Search for dark matter produced in association with a Higgs boson decaying to a pair of bottom quarks in protonproton collisions at** $\sqrt{s} = 13TeV$, *Eur. Phys. J. C.* 79 (2019) 280, doi:10.1140/epjc/s10052-019-6730-7, arXiv:1811.06562 [hep-ex]

V. Khachatryan et al., **Measurements of** $t\bar{t}$ **charge asymmetry using dilepton final states in pp collisions at** $\sqrt{s} = 8$ **TeV**, *Phys. Lett. B.* 760 (2016) 365–386, doi:10.1016/j.physletb.2016.07.006, arXiv:1603.06221 [hep-ex]

A. Apresyan et al., **Detector R&D needs for the next generation** e^+e^- **collider**, (2023). http://arxiv.org/abs/2306.13567, arXiv:2306.13567 [hep-ex]

M. Atif et al., **Evaluating Portable Parallelization Strategies for Heterogeneous Architectures in High Energy Physics**, (2023). http://arxiv.org/abs/2306.15869, arXiv:2306.15869 [hep-ex]

B. Bockelman et al., **IRIS-HEP Strategic Plan for the Next Phase of Software Upgrades for HL-LHC Physics**, (2023). http://arxiv.org/abs/2302.01317, arXiv:2302.01317 [hep-ex]

V.D. Elvira et al., **The Future of High Energy Physics Software and Computing**, in: **Snowmass 2021**, 2022, doi:10.2172/1898754, arXiv:2210.05822 [hep-ex]

M. Bhattacharya et al., **Portability: A Necessary Approach for Future Scientific Software**, in: **Snowmass 2021**, 2022. http://arxiv.org/abs/2203.09945, arXiv:2203.09945 [physics.comp-ph]

J. Balcas et al., **Automated Network Services for Exascale Data Movement**, *EPJ Web Conf.* 295 (2024) 01009, doi:10.1051/epjconf/202429501009

O. Gutsche et al., **The U.S. CMS HL-LHC R&D Strategic Plan**, *EPJ Web Conf.* 295 (2024) 04050, doi:10.1051/epjconf/202429504050, arXiv:2312.00772 [hep-ex]

K.H.M. Kwok et al., **Application of performance portability solutions for GPUs and many-core CPUs to track reconstruction kernels**, *EPJ Web Conf.* 295 (2024) 11003, doi:10.1051/epjconf/202429511003, arXiv:2401.14221 [physics.acc-ph]

N. Smith et al., **A Ceph S3 Object Data Store for HEP**, *EPJ Web Conf.* 295 (2024) 01003, doi:10.1051/epjconf/202429501003, arXiv:2311.16321 [physics.data-an]

N. Smith et al., **Coffea: Columnar Object Framework For Effective Analysis**, *EPJ Web Conf.* 245 (2020) 06012, doi:10.1051/epjconf/202024506012, arXiv:2008.12712 [cs.DC]

J. Albrecht et al., **A Roadmap for HEP Software and Computing R&D for the 2020s**, *Comput. Softw. Big Sci.* 3 (2019) 7, doi:10.1007/s41781-018-0018-8, arXiv:1712.06982 [physics.comp-ph]

- Full List of Physics Publications with Major Personal Contributions can be found here.
- Full List of Computing Publications with Major Personal Contributions can be found here.
- Full List of Presentations and Talks can be found here.
- Full CV can be found here.