Caleb James Smith

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Education

Ph.D.	–	Physics, Baylor University	–	2020
M.A.	–	Physics, Baylor University	–	2018
B.S.	–	Physics, Taylor University	–	2014
Minor	–	Mathematics, Taylor University	–	2014

Employment

Postdoctoral Researcher, University of Kansas, 2021–Present.

Research Assistant, Baylor University, 2016–2020.

Teaching Assistant, Baylor University, 2014–2016.

Baylor University CASPER Physics REU, Summer 2013.

Research

Postdoctoral

CMS Tracker Phase 2 upgrade (KU, 2021)

The CMS inner tracker will be replaced in the Phase 2 upgrade. Over two billion pixels will be installed, and custom RD53 chips will process and encode pixel data. High bandwidth electrical and optical links will be used to provide communication between the RD53 chips and off detector electronics. At the University of Kansas, I am implementing tests for the high speed electrical links in this readout chain. We use a variety of setups to test electrical links for continuity, measure bit error rates, produce eye diagrams, measure crosstalk between channels, and measure impedances. These measurements provide robust tests of electrical link quality.

CMS Tracker DPG (KU, 2021)

Tracking and alignment of the CMS detector depend on measuring a precise beam spot of the proton-proton collisions provided by the LHC near the center of CMS. Typically, the beam spot is measured using tracking information and reconstructed tracks. However, track reconstruction requires significant computing time. I am working on a novel fitting method to predict the beam spot location without using reconstructed particle tracks. Various methods have been developed and tested on simulation and data.

Graduate

CMS SUSY Analysis (Fermilab, 2018–2020)

There are many CMS analysis groups searching for different forms of new physics. I worked on a search for supersymmetry (SUSY) using the Run 2 dataset from CMS. We looked for top squarks that decay into all-hadronic (zero lepton) final states. We specifically targeted nine simplified SUSY models including T2tt and T1tttt. I focused on predicting the Z invisible background that accounts for events in which a Z decays to two neutrinos and results in missing transverse energy.

CMS HCAL Phase 1 upgrade installation and commissioning (CERN, 2016–2018)
In the fall of 2016, I went to CERN where I supported testing and commissioning of Hadron Calorimeter (HCAL) front-end electronics for the HCAL Endcap (HE) Phase 1 upgrade. Under the supervision of Jim Hirschauer from FNAL, I managed quality assurance tests for HE calibration units (CU) at CERN. The calibration units are used to send either LED or laser light to the primary light detectors, silicon photomultipliers (SiPM), and can be used to tune SiPM gains. I also participated in initial commissioning of the HCAL Barrel (HB) readout electronics at CERN, including testing new HB backplanes and new font-end communication software, measuring muon data with HB Readout Modules (RM) in testbeam, and performing HB RBX power and cooling tests.

CMS HCAL Online Software on-call expert and developer (CERN, 2017–2018)
I joined the HCAL Online Software (HCOS) group in 2017. This required being an on-call expert for CMS HCAL online software issues in week-long shifts. I helped solve software problems in the production CMS setting to ensure quality data-taking. Additionally, I developed software for the configuration and monitoring of the Phase 1 upgrade readout electronics.

CMS HCAL Phase 1 upgrade QIE card testing (Fermilab, 2016 and 2018)
The CMS HCAL Phase 1 upgrade involved installing silicon photomultipliers (SiPM) to measure light from scintillators in the detector. The SiPM signals are digitized by custom readout cards, called QIE cards, using the FNAL-designed Charge Integrator and Encoder version 11 (QIE11) chip. In 2016, I created software to test the hardware and firmware functionality of about 750 HE QIE cards and contributed to the development of a database to save the test results and calibration constants for all cards. In 2018, I helped with testing about 880 HB QIE cards by implementing an efficient method to automatically upload firmware to multiple QIE cards in series.

Undergraduate

Data encryption using coupled chaotic circuits with Dr. Ken Kiers (Taylor University, January 2014).

String theory model building with Dr. Gerald Cleaver (Baylor University, Summer 2013).

Teaching

Baylor Physics 1409 Lecture (Electricity and Magnetism, algebra based), 2015–2016
I taught an introductory electricity and magnetism physics course. I prepared lecture material, taught the lectures, assigned online homework problems, and prepared and graded exams. I enjoyed giving lectures, explaining physics concepts, and working through example problems with the class.

Baylor Physics 1409/1430 Lab (Electricity and Magnetism), Summer 2015
I taught introductory electricity and magnetism physics labs. This included explaining the physics theory and the lab procedure, helping students perform the experiment, and grading the lab reports. I enjoyed helping students understand and demonstrate physics concepts in the lab experiments.

Baylor Physics 1408/1420 Lab (Classical Mechanics), 2014–2015
I taught introductory classical mechanics physics labs. This included explaining the physics theory and the lab procedure, helping students perform the experiment, and grading the lab reports. I enjoyed helping students understand and demonstrate physics concepts in the lab experiments.

Fellowships

DOE Office of Science Graduate Student Research (SCGSR) Program at Fermilab – 2018 to 2019.

LHC Physics Center (LPC) Guests and Visitors Program at Fermilab – 2016, 2018 and 2019.

Baylor University Graduate School Fellowship – 2014 to 2019.

Honors

Texas Section of the American Physical Society (TSAPS) Graduate Student Presentation Award, 2020.

Outstanding Physics & Engineering Senior, Taylor University, 2014.

Louis Armstrong Award, Taylor University Jazz Ensemble, 2013 and 2014.

Advanced Placement (AP) Scholar with Honor Award, College Board, 2010.

Publications

Development of a high bandwidth readout chain for the CMS Phase-2 pixel upgrade
TWEPP 2021 Conference Proceedings, October 26, 2021
https://arxiv.org/abs/2110.14021

Search for top squark production in fully hadronic final states in proton-proton collisions at $\sqrt{s} = 13$ *TeV*
Phys. Rev. D 104, 052001, September 10, 2021
https://journals.aps.org/prd/abstract/10.1103/PhysRevD.104.052001

Search for supersymmetric top quarks in the CMS Run 2 data set
PhD Dissertation, October 21, 2020
https://baylor-ir.tdl.org/handle/2104/11191

The Phase-2 upgrade of the CMS barrel calorimeters
CMS Technical Design Report, September 12, 2017
https://cds.cern.ch/record/2283187

Presentations

Development of a high bandwidth readout chain for the CMS Phase-2 pixel upgrade
TWEPP 2021[1], September 21, 2021
https://indico.cern.ch/event/1019078/contributions/4444260

Searches for third generation squarks with the CMS detector
SUSY 2021[1], August 23, 2021
https://indico.cern.ch/event/875077/contributions/4485659

Search for Supersymmetric Top Quarks in the CMS Run 2 Data Set
Texas Section APS 2020[1], November 13, 2020
https://tsapsf20.uta.edu/agenda-nov-13

Search for Supersymmetric Top Quarks in the CMS Run 2 Data Set
Ph.D. Dissertation Oral Presentation[1], October 9, 2020
https://indico.cern.ch/event/956156/#1-search-for-supersymmetric-to

Search for Supersymmetric Top Squark Production at CMS with Heavy Object Taggers
APS April 2020[1], April 18, 2020
http://meetings.aps.org/Meeting/APR20/Session/B13.5

Phase 1 Upgrade for the CMS Hadron Endcap Calorimeter
2018 US LHC Users Association Meeting at Fermilab, October 26, 2018
https://indico.fnal.gov/event/17566/session/2/contribution/75/material/slides/0.pdf

HCAL Endcap Installation and Commissioning
LPC Physics Forum at Fermilab, August 30, 2018
https://indico.cern.ch/event/744809/#1-hcal-endcap-installation-and

[1] Virtual meeting due to COVID-19.

Completing the CMS HCAL Endcap Phase 1 Upgrade (Poster)
51st Annual Users Meeting at Fermilab, June 20, 2018
https://indico.fnal.gov/event/16332/session/10/contribution/114/material/poster/0.pdf

Online Software and Monitoring
HCAL meetings during CMS week: PM report and Operations session, April 16, 2018
https://indico.cern.ch/event/719790/#5-online-software-and-monitori

Phase 1 Frontend Monitoring, Plans for 2018
HCAL meetings during CMS week: PM report, HB Phase 1 summary, and Operations session
February 5, 2018
https://indico.cern.ch/event/701182/#4-phase-1-frontend-monitoring

HE Calibration Unit Validation
HCAL meetings during CMS week: HB and HE Phase1 session, December 3, 2017
https://indico.cern.ch/event/683888/#1-he-calibration-unit-validati

HE Calibration Unit Characterization
HCAL meetings during CMS week: HB and HE Phase1 session, April 2, 2017
https://indico.cern.ch/event/624907/#7-he-calibration-unit-characte

Computing Skills

MacOS, Linux, Windows, Python, C++, Bash, Git, ROOT, Jupyter Notebook, Mathematica, LaTeX, Vim, Keynote, Microsoft Office.

References

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