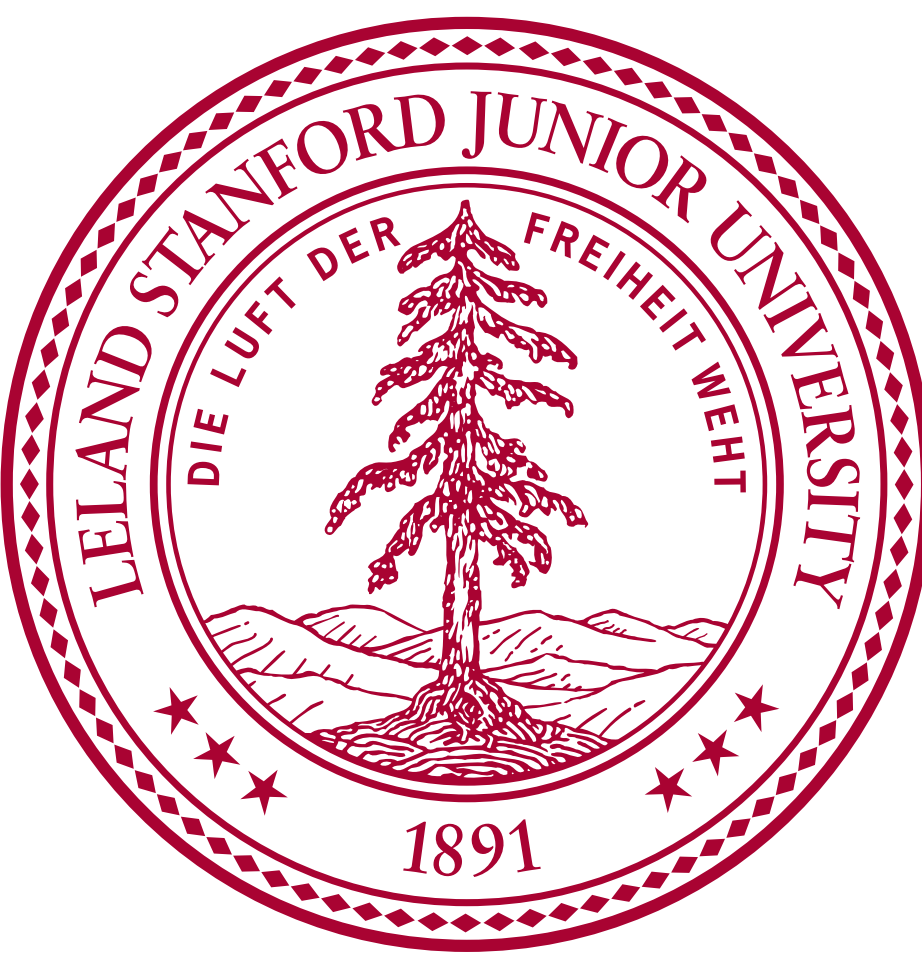





A New US-CERN Summer Program on ATLAS Experiment of LHC at CERN for California State University (CSU) System

Yongsheng Gao (CSU Fresno) and Lauren Tompkins (Stanford)



California State University

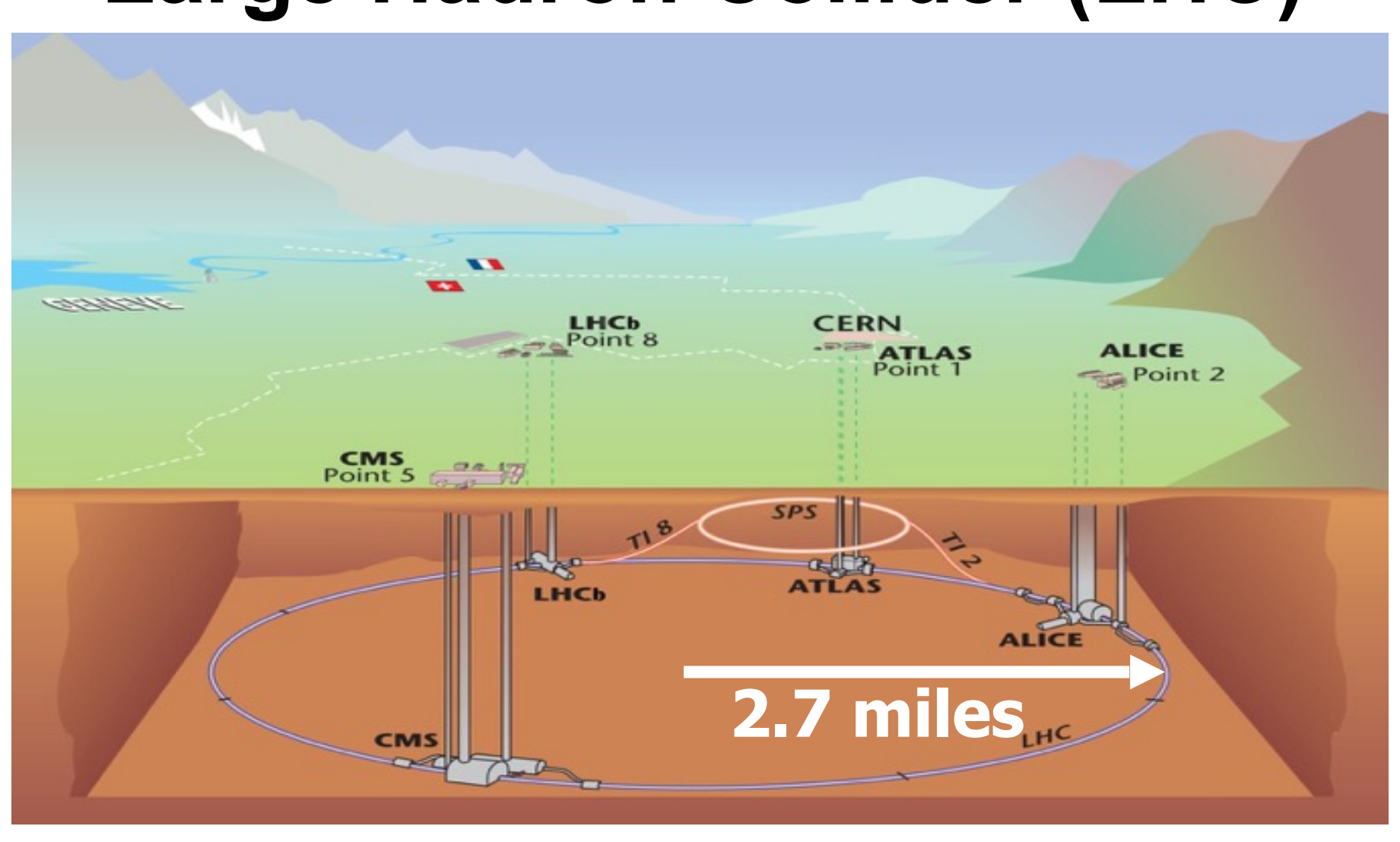
- Largest university system in the US
- 23 campuses with ~450,000 students
- Very large first-generation college student (~35%) and non-hispanic white (~70%) student populations.



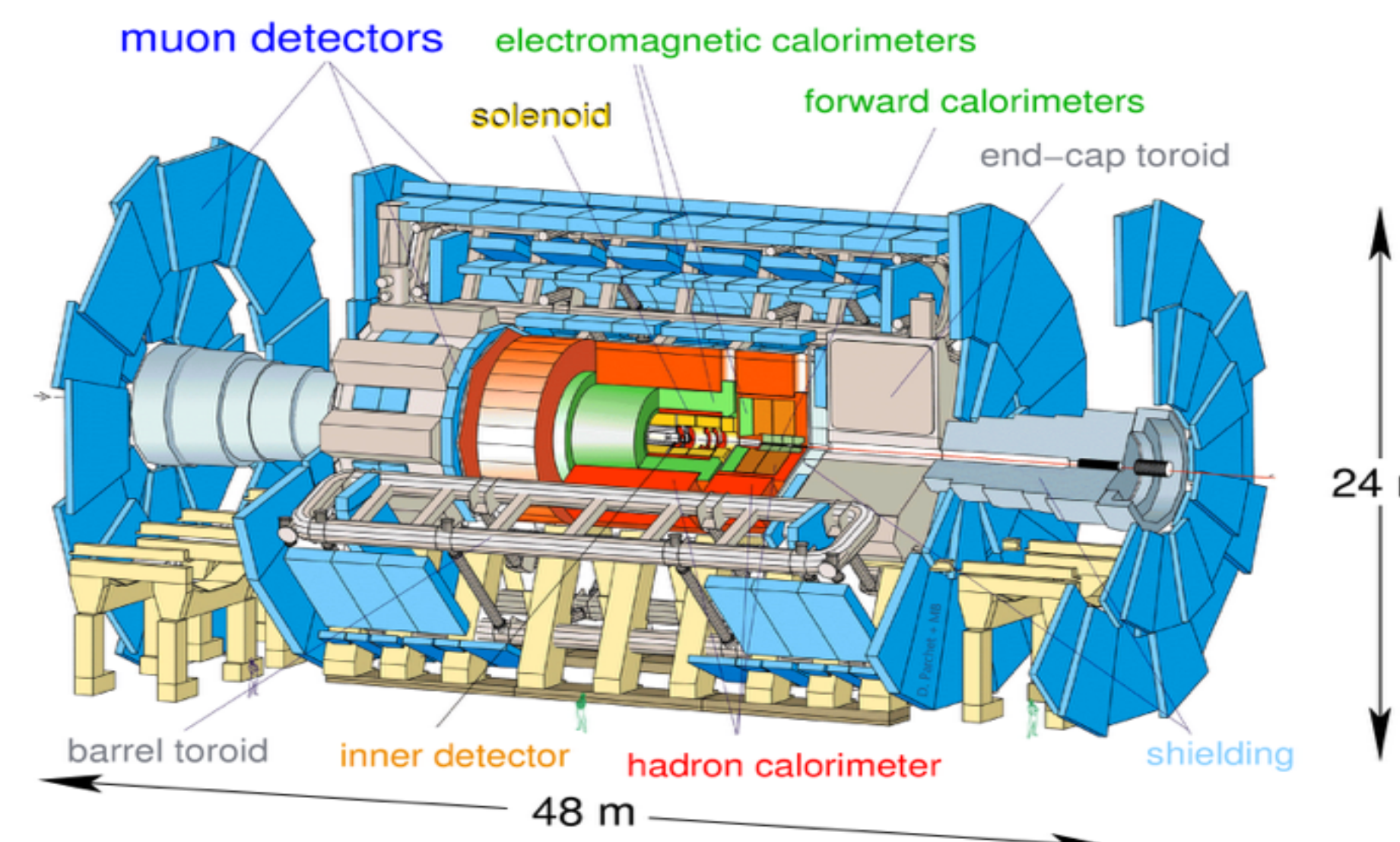
CERN

- CERN (European Organization for Nuclear Research in French) near Geneva, Switzerland
- ~10,000 scientists from ~100 countries working on high energy particle physics experiments

Large Hadron Collider (LHC)



ATLAS Detector



ATLAS Collaboration

- ~3000 physicists from ~220 institutions of ~40 countries all over the world
- **CSU Fresno and Sacramento are the only CSU campuses on the ATLAS or CMS experiments**

CSU Nuclear and Particle Physics Consortium and the CSU ATLAS Program

- **CSU Nuclear and Particle Physics Consortium (NUPAC)** consists of 17 CSU campuses: **Bakersfield, Channel Islands, Chico, Dominguez Hills, East Bay, Fresno, Humboldt, Los Angeles, Long Beach, Northridge, Pomona, Sacramento, San Bernardino, San Francisco, San Luis Obispo, Sonoma, and Stanislaus**
- NUPAC member departments have interests in particle and nuclear physics but not necessarily faculty involved in this area of research
- **Students from NUPAC campuses are eligible to be a part of the CERN summer student program**
- CSU ATLAS group (PI Yongsheng Gao) maintains active research group on ATLAS experiment with postdoc (Harinder Bawa) and 12 undergraduate students since 2007.
- **Recipient of ~\$250K NSF International Research Experience for Students (IRES) grant (8/1/2015 to 7/31/2018) for CERN Undergraduate Summer Student research experiences**
- **Web Page:** <http://zimmer.csufresno.edu/~yogao/ATLAS/>
- **Contact:** Prof. Yongsheng Gao
Phone: (559)-278-4554
Email: yogao@csufresno.edu

CSU Students at CERN during Summer

- Student participation steadily increasing through expansion of campus eligibility, campus support and NSF IRES award

Year	Number of CSU students and their campuses
2016	12 (Fresno: 6; Channel Islands: 1; Humboldt: 1; Los Angeles: 1; Sacramento: 2; Sonoma: 1)
2015	7 (Fresno: 5; Channel Islands: 2)
2014	7 (Fresno: 5; Channel Islands: 2)
2013	6 (Fresno: 3; Channel Islands: 3)
2012	5 (Fresno: 5)
2011	6 (Fresno: 4; Pomona: 2)
2010	5 (Fresno: 2; Long Beach: 2; Sacramento: 1)
2009	5 (Fresno: 4; Sacramento: 1)
2008	5 (Fresno: 5)

Program Structure

- To be eligible for the program, students must attend a NUPAC campus, and take online CSU wide course on particle physics taught by Yongsheng Gao in the Fall semester
- Course performance and CVs are used to select students for the summer program.
- In the spring, accepted students take online tutorials in practical coding and research skills from CSU Fresno, Stanford and UC Irvine graduate students and postdocs.
- Students are assigned mentors chosen for demonstrated mentoring capabilities. 2016 mentors were primarily postdocs from Stanford, LBNL, University of Washington at Seattle, University of Chicago, SLAC, and University of California at Irvine.
- Mentors were given guidance on project selection and mentoring best practices.
- Students get stipend for travel, lodging and incidentals for 8 weeks.
- While at CERN **have weekly student led meeting** to present work to each other, get guidance from faculty members on applying to graduate school, other professional development.
- Attend CERN summer student lecture series with undergraduate students from all over the world.
- To complete the program, students must present in at least one ATLAS working group meeting and complete a write-up.
- Past students have
 - been admitted to Ph.D programs (UC-Berkeley, UCSD, UCSC, Iowa, Hamburg, CEA Saclay, HEPHY Vienna, etc.)
 - Completed masters theses under supervision of summer mentors
 - Gone on to work in high-tech companies, teaching, ...
- **ATLAS/CERN working experience prepares CSU students for their personal and professional success in an increasingly competitive, global, and multi-cultural society**

Student Projects

- Efficiency and fake rate determination of ATLAS hardware based track finder
- Studies of the performance of *b*-hadron identification using Recurrent Neural Networks
- Implementation of a non gaussian error parameterization for Higgs couplings fit interpretations
- Improvement of the ATLAS Pixel detector "auto-recovery" tools
- Understanding the performance expected for the global feature extractor of the ATLAS Level 1 trigger system upgrade
- Studies of beam-related backgrounds for a search for displaced vertices from new long-lived new particles

CSU Students at CERN



Student Feedback

- Unique experience to be amongst so many people (physicists) working together
- Gain confidence in and through presentation skills
- Real world application/development of coding skills
- First time living abroad/away from home
- Excellent mentoring experience
- Empowering to be self-organized for student weekly meetings