Energy Frontier Health Indicators

Positive:

- Phase 1 Upgrades Complete!
- HL-LHC: MREFC and DOE upgrade projects on track for final approval
- Training future leaders: ~350 grad students between ATLAS and CMS
- Diversity and Inclusion efforts bearing some fruit
- Run 2 physics program is very rich

Negative:

- Declining Research and Operations budgets threaten timely exploitation of HL-LHC physics program
  - Overall reduction in personnel contributing to LHC by 20-40% since 2010 (ATLAS)
- Scope Increase (Upgrades on top of full Run2 and Run 3 program) diverts scientific labor to upgrade tasks
  - CMS estimates for FY19-22 needs show fraction of supported FTEs available for research dropping from 35% to 25% due to needs in operation/upgrades
  - Fraction will decrease further as scientific labor is rolled into upgrade program
  - Further erosion of Research and Operations support directly impacts upgrades
 - Fewer US scientists available for leadership positions
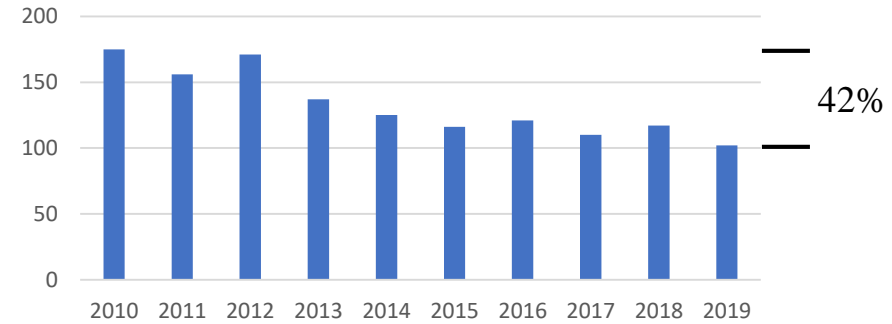
US ATLAS Demographics for past 10 years

US ATLAS composition over time

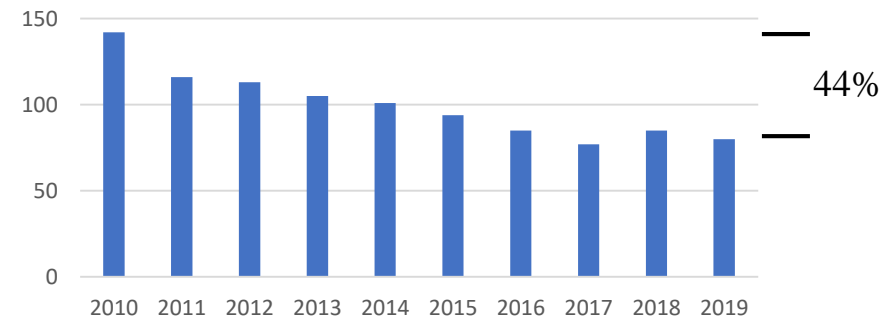|	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Faculty	175	160	162	157	149	146	142	132	138	126
Postdoc	175	156	171	137	125	116	121	110	117	102
Grad Students	223	217	232	212	216	231	216	182	204	181
Res Scientists	142	116	113	105	101	94	85	77	85	80

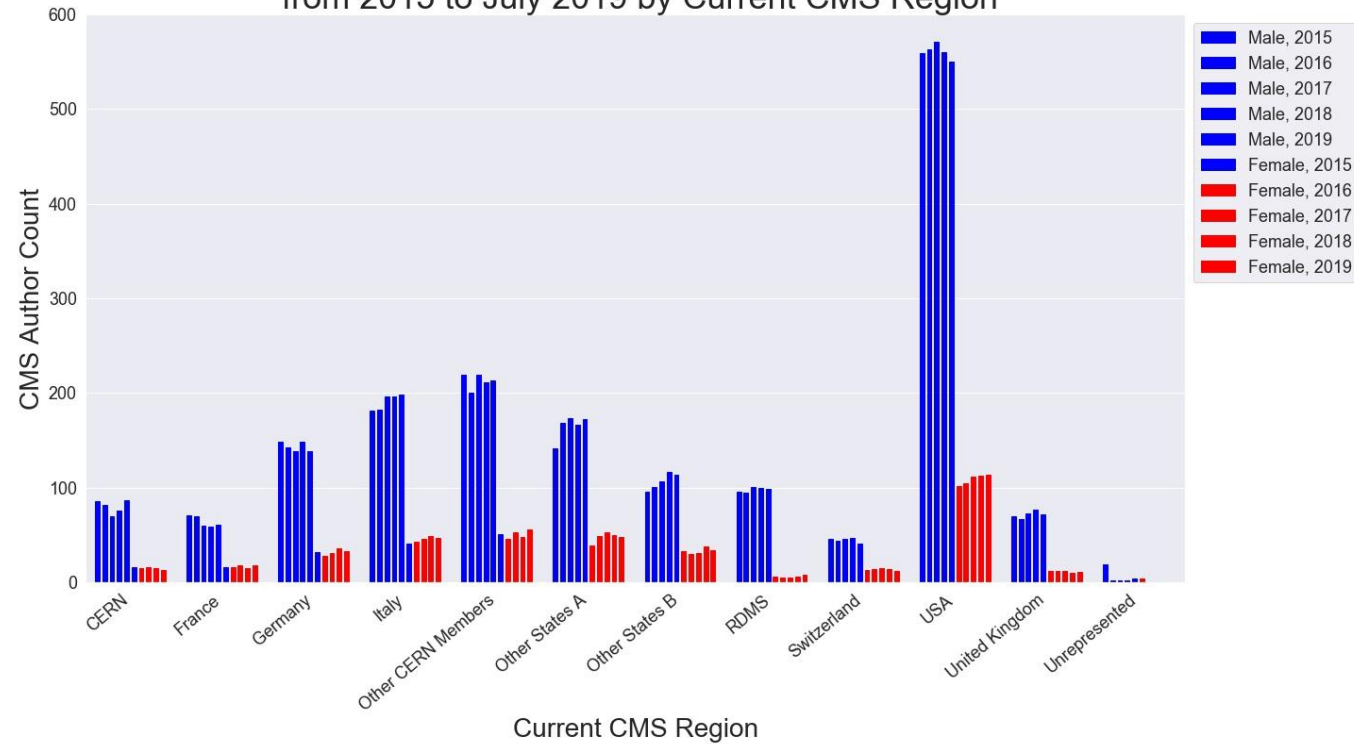Faculty — 28%
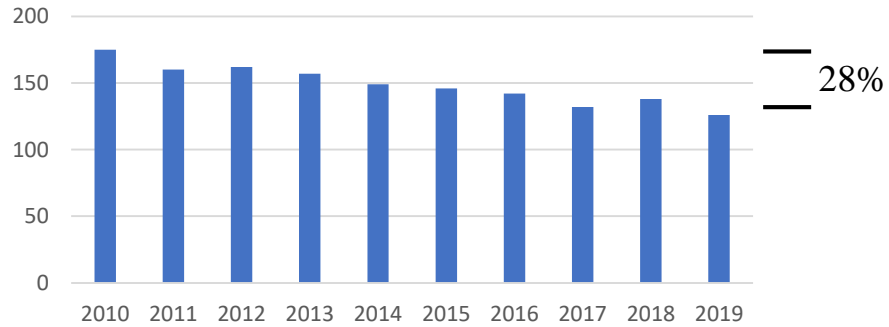
Postdocs — 42%

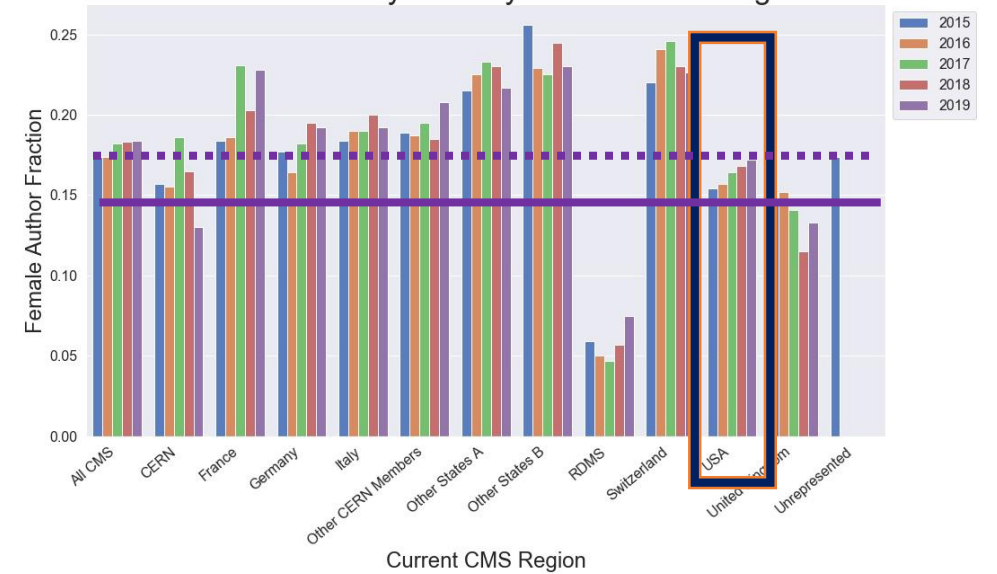Grad Students — 22%
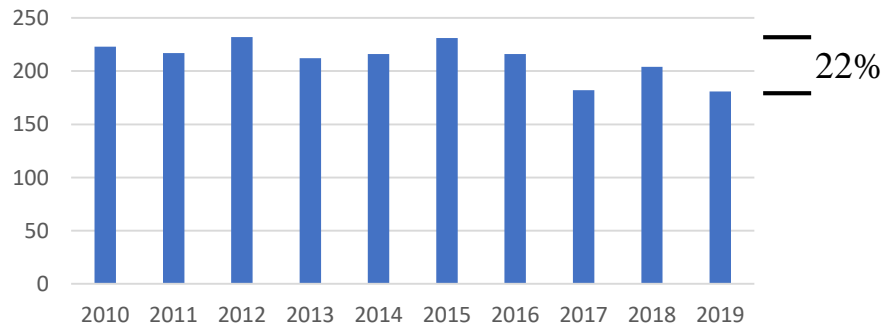
Res Scientists — 44%

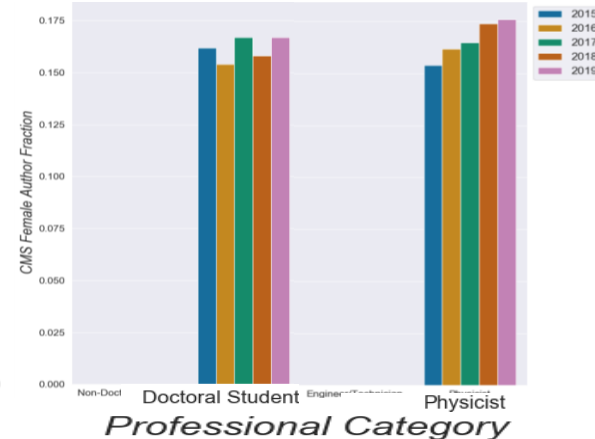# Trends in CMS, USCMS authors by region & gender

Yearly CMS Author Counts by Gender
from 2015 to July 2019 by Current CMS Region

Yearly Female Author Fraction
from 2015 to July 2019 by Current CMS Region

Yearly CMS Female Author Fraction by
Professional Category from 2015 to July 2019 for USA

Female author fraction
U.S. CMS Physicists:
Postdocs: 23±4%
(faculty + researchers):
Junior: 35±10%
Senior: 12±2%

CMS: Training of graduate students

- Given the large size and long time scales of CMS, we recognize our important role in the stewardship of our field, especially in terms of training and mentoring students & postdocs
- Concerns about 15% decrease in graduate students in the last year

Doctoral Student Authors
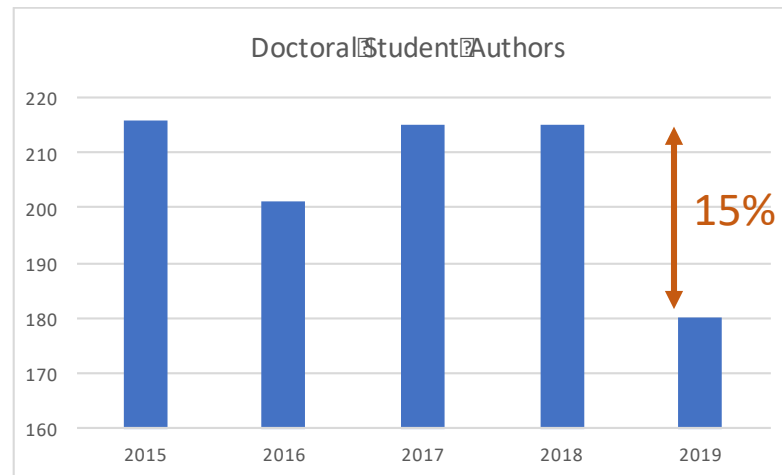
- Mentoring of early-career scientists for leadership roles in the experiment & industry
  - Most U.S. CMS students who completed their Ph.D. since 2008 have followed scientific careers and are distinguishing themselves in academic, research, and industry environments.
  - Outside academia, they have brought expertise on data science and advanced computing techniques e.g. machine learning to a diverse array of projects in high-tech industry, medicine, and other sectors.
    - Autopilot development for Tesla Motors, AI research for DeepMind
    - Educational data mining for Pearson North America
    - Software development for the National Center for Missing and Exploited Children
    - Cloud computing for Amazon Web Services, and applications in the health-care sector.

CMS: Decreasing time available for doing "Science"

- Keep total number of FTE available in FY17 (portfolio review)

- Projected operations FTE needs assumed constant per year (portfolio review)

- Projected needs for scientific labor profile for carrying out HL-HC detector R&D and construction

- Compute "fraction of FTE available" for carrying out "Science tasks" after accounting for FTE needs by operations and upgrade

- Compared to FY17 expect ~40-50% decrease by FY21-22!!
  - Optimistic estimate as EF budgets have decreased consistently since then.

Science tasks defined as:
- performing analysis,
- developing innovative analysis techniques,
- publications,
- studies for HL-LHC,
- indulging in community activities
- (e.g snowmass, outreach, etc)

Science FTE fraction compared to FY17 (innovations+analysis+publications)