

Accelerator Science & Engineering Contrasts: *Careers and Training the Next Generation*



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Snowmass 2022

Plenary Session, Tuesday, 7/19



Accelerator Community Graduate-Level Training

US Particle Accelerator School (USPAS): Due to lack of critical mass in Universities, USPAS fills specialty education role for Accelerators

- **Developed Format:** Since 1987 regularly holds two 2-week intensive sessions/year distributed near accelerator labs/facilities around country.
 - **Academic Format; credit & graded** NOT a workshop
 - **Yearly Impact:** 20-28 courses /year delivered by 45-70 scientists, engineers, & TA/graders to 240-350 students. Class notes commonly posted for resources to field
 - **Pandemic:** 2 years moved online, return to historical in-person format starting 2023
- **Topics Evolve with Field:** Early years HEP-centered, now very diverse

DOE Accelerator Science & Engineering Traineeships: Four Traineeships now funded to start *domestic* (US Citizen or Permanent Resident) grad students in field

- **@ Steady State:** start 15-25 students/year: some focus MS (needed in Accel), others PhD & MS
- **Present Traineeships:**
 - 1) Michigan State U (MSU)
 - 2) Stony Brook U & Cornell
 - 3) Illinois Inst Tech & Northern Illinois U
 - 4) Old Dominion U & Hampton U & Norfolk U
- **Traineeships Emphasize 4 Need Areas of Large Accel Facilities:**
 - 1) Physics & Engineering of Large Accel Systems
 - 2) RF Power Engineering
 - 3) SRF Technology
 - 4) Large Cryogenic System

Many Accelerator Work Prospects Benefits Early Career

Plethora of Jobs: in recent years & foreseeable future (decade + ?) due to facilities and projects outside of HEP with an active suite of new facilities, upgrades, etc.

Nuclear Physics (EIC & FRIB)

Light Sources (LCLS-II, ALS-U, NSLS-II, APS-U, ...) & **Spallation Neutron Sources** (SNS)

Serving Materials Science, Biology & Medicine

Medical (for Radioisotopes, Tumor Therapy, ...) & **Industrial** (Materials Processing)

& NNSA (DARHT, Scorpius, Marie) + **More as Time Advances** (Energy Production, ...)

- **Training Usually for Skill “Toolkit”:** Fungible skills (e.g. SRF Technology) vs application specific (e.g., SRF for a HEP Collider) so many workers can apply skills in spectrum of projects
- **Most Recent Grads Find Work in Field:** within National Labs, Academia, Industry, Medicine

Difficult to recruit grad students to Accelerators: in spite of job situation and the field being diverse with broad physics driving areas with high impact

- **Few undergrads enter grad School seeing themselves as Accelerator Scientists & Engineers:** so it is difficult to rapidly reach/recruit those entering graduate programs
- **Accelerators Lower Profile:** Faculty representation weak, field has less awards & high profile publications, field struggles to capture public imagination

Diversity Equity & Inclusion Efforts in Accelerator Training

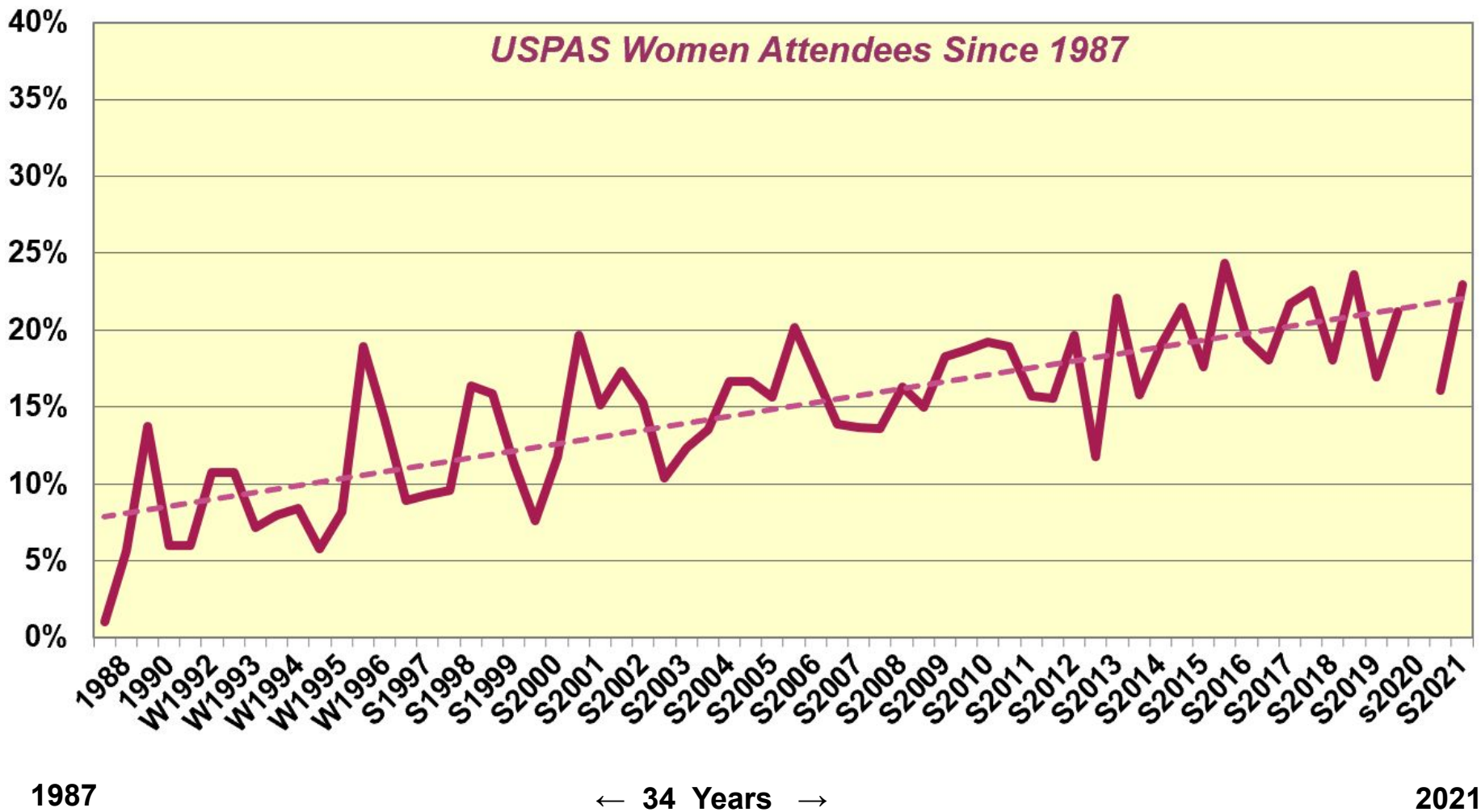
US Particle Accelerator School (USPAS):

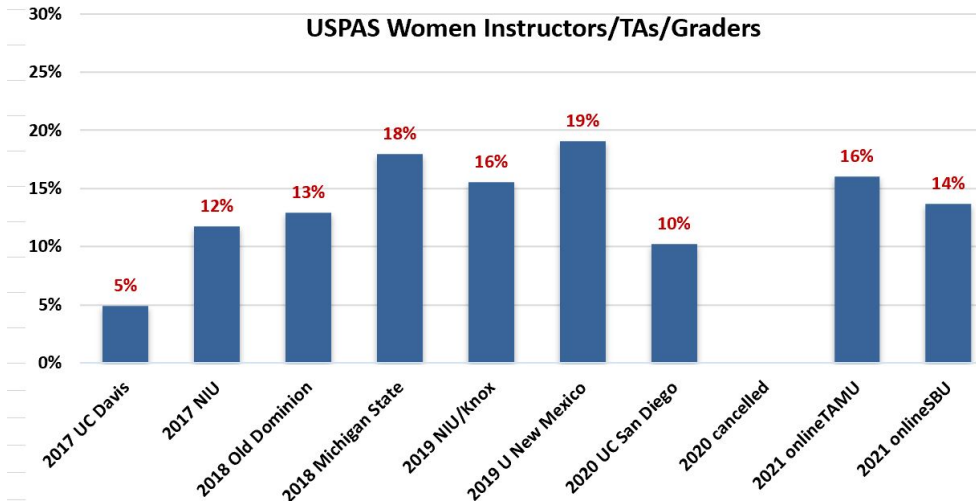
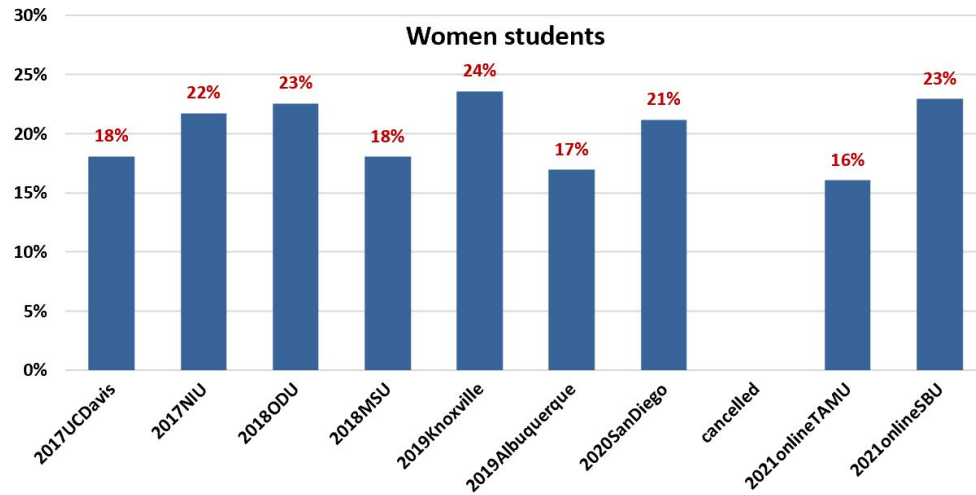
- **Recruit Women & Underrep Minority (URM) Instructors** – especially early career to be more welcoming
- **Sekazi Mtingwa URM Scholarships:** available with full support, every session, to remove possible barriers
- **Performance:**
 - **Women Students:** 18-25% recent sessions ... slowly increasing year-by-year (see plot)
 - **URM Students:** ~15% Last few sessions (Mostly Hispanic/Latin-X)
 - African Ancestry was often zero, now 3-5 students/session
 - **Instructors:** Women: Prior very small now ~20% but variable
Non-Hispanic URM very poor representation

DOE Accelerator Traineeships:

- **New FY22 Traineeship: Old Dominion U paired with HBUs Hampton U & Norfolk U** with component to recruit URMs at undergrad level

USPAS Women Attendees Since 1987





Women teaching team members increasing consistent with fraction women students – hopefully drawing in more women

Recruiting Needs Focus on Draw Highest Quality

– Not Just High Numbers & Retain Talent Long-Term

Universities observing more sensitivity to stress in younger generation

- Exams/Qualifiers, Research Stress, Discourse Tone trigger increase complaints
- Grad research intrinsically difficult and easily generates stress

Need to attract the best talent that we can and then retain long-term while engaged in a manner to maximize abilities

- Best talent helps ensure future of field
- Want to draw from full community (balanced gender, ethnicity, etc)
- Retain talent long term via an effective work environment with rich opportunities

How can we best improve work environment and recruit?

- Many perspectives to balance
- Recruit: likely must target efforts earlier than entering grad students: National Undergrad outreach and recruiting sorely needed

Conclusions

Sub-fields within HEP have varying concerns with training and career paths for the next generation

Accelerators are in a fortunate situation due to the “toolkit” of skills impacting accelerator applications outside of HEP leading to relatively healthy job and career opportunities

- Intensive school (USPAS) evolves to meet broad training needs
- New DOE Traineeships (4) starting to launch talent
- Diversity, Equity & Inclusion efforts ongoing

Future Trend: HEP should increasingly benefit from accelerator technology developed for non-HEP applications and talent in the accelerator workforce outside of HEP can be drawn into HEP projects as opportunities present