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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty</td>
<td>175</td>
<td>160</td>
<td>162</td>
<td>157</td>
<td>149</td>
<td>146</td>
<td>142</td>
<td>132</td>
<td>126</td>
<td></td>
</tr>
<tr>
<td>Postdoc</td>
<td>175</td>
<td>156</td>
<td>171</td>
<td>137</td>
<td>125</td>
<td>116</td>
<td>121</td>
<td>110</td>
<td>117</td>
<td>102</td>
</tr>
<tr>
<td>Grad Students</td>
<td>223</td>
<td>217</td>
<td>232</td>
<td>212</td>
<td>216</td>
<td>231</td>
<td>216</td>
<td>182</td>
<td>204</td>
<td>181</td>
</tr>
<tr>
<td>Res Scientists</td>
<td>142</td>
<td>116</td>
<td>113</td>
<td>105</td>
<td>101</td>
<td>94</td>
<td>85</td>
<td>77</td>
<td>85</td>
<td>80</td>
</tr>
</tbody>
</table>

- Faculty: 28%
- Postdocs: 42%
- Grad Students: 22%
- Res Scientists: 44%
Female author fraction
U.S. CMS Physicists:
Postdocs: 23±4%
(faculty + researchers):
Junior: 35±10%
Senior: 12±2%
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

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)