University Programs in Fusion Science and Technology are Reaching a Tipping Point

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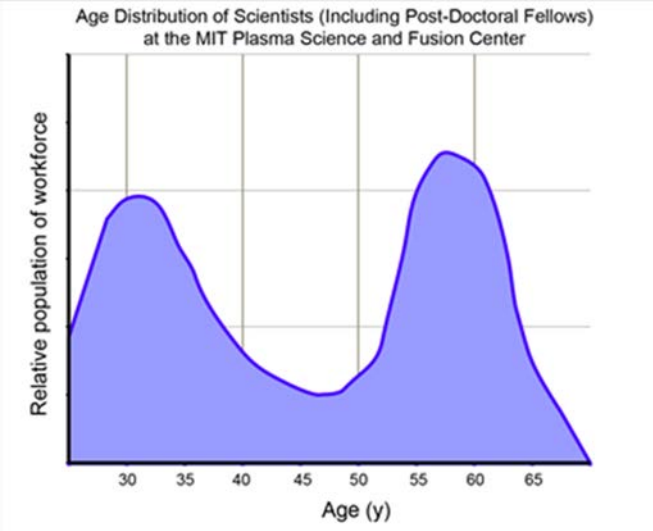
Budget stresses on the Fusion Energy Sciences program over the last few years, and even greater prospective pressures from any attempt to support ITER construction on flat or decreasing total funding in FY13 and beyond, put the national FES University-based research enterprise at risk of collapse. Decisions already made by OFES to end several smaller university experiments, and proposals for even larger cuts in the FY13 request, including close-out of Alcator C-Mod, accompanied by broad and deep cuts to theory and modeling, are having immediate and potentially devastating effects. Academic departments are discouraged from taking on new graduate students, hiring post-docs, opening new faculty positions, and nurturing the careers of junior faculty toward successful tenure decisions. Applications from top students for graduate school in plasma science and fusion engineering are rapidly declining.

This situation is unfolding in the context of an aging US fusion workforce. Based on a survey of the age distribution of scientists at MIT's Plasma Science and Fusion Center, the figure shows a two-humped distribution; the first peak, around age 30, is mainly post-docs and junior (untenured) faculty, while the peak around age 60 shows that most of the scientists are near, or at, retirement age. I believe the workforce distribution for the entire US fusion program is not very different from that for MIT. This is backed up by previous reports from FESAC[1], the National Academy of Sciences[2], and the GAO[3]. Note that the big dip in the middle of the distribution largely resulted from cuts to the domestic program in the mid-1990's, and shows that even transient decreases can have effects that last for decades.



Age distribution of scientists at the MIT Plasma Science and Fusion Center.

ITER is now scheduled to begin operations around 2020, with serious burning plasma regimes not being accessed until 2027 or later. If we jettison the current student, post-doc and junior faculty population, there will be almost no mid-career US fusion scientists left in the program 15 years from now. One clearly predictable result will be that our participation in ITER will be anemic, with little or no benefit accruing to the US from our massive hardware investments. With or without ITER, the development of fusion in the US would likely be deferred for more than a generation, and most probably we would permanently cede that effort to other nations.

Recommendations: Under all budget options being considered, University programs must receive increased priority. A domestic fusion program at the FY13 request level is sub-critical, and essentially guarantees that US investments in ITER will bear no fruit for our nation. At the FY12 level, the domestic program is only marginally sustainable, and priority for the health of University programs is a critical prerequisite for the long-term survival of the enterprise.

[1]Edward Thomas, Jr., et al., *Fusion in the era of burning plasma studies: workforce planning for 2004-2014*, J. Fusion Energy 22(2003)139.
[2]*Plasma Science: Advancing Knowledge in the National Interest*, Plasma 2010 Committee, Plasma Science Committee, National Research Council, ISBN:0-309-10944-2, http://www.nap.edu/catalog/11960.html.
[3*] Fusion Energy: Definitive cost estimates for U.S. contributions to an international experimental reactor and better coordinated DOE research are needed*, GAO-08030, October, 2007.