

After the LHC, the Deluge

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By [Adrian Cho](#) August 29, 2013

"For young particle physicists the issues are jobs, jobs, jobs." —Bjoern Penning

MINNEAPOLIS, MINNESOTA—When he applied for his job, says Peter Onyisi, a 31-year-old experimental particle physicist, he didn't let his hopes get too high. "I tried to remember that if I didn't get an academic job it wasn't the end of the world," Onyisi says. "One has to be careful not to let one's identity get too wrapped up in being a physicist." Fortunately for Onyisi, in the end he didn't have to face an identity crisis. Last year, he was hired as an assistant professor at the University of Texas (UT), Austin, a plum position at any time, but especially now, in perhaps the tightest job market in particle physics in decades.



CREDIT: Adrian Cho
Peter Onyisi

Onyisi edged out 85 other candidates, says Gerald Hoffmann, the physicist at UT who led the job search. Such competition is hardly unusual these days. Stories abound of a single postdoc drawing more than 100 applications and the best and brightest coming up empty in their hunt for academic jobs.

A job crunch

Young particle physicists face a job crunch that some older physicists have predicted for years. In 2010, researchers at the European particle physics laboratory, CERN, near Geneva, Switzerland, started taking data with the world's largest atom smasher, the 27-kilometer-long Large Hadron Collider (LHC). Last year, to great fanfare, the LHC blasted into existence the long-sought [Higgs boson](#), the last piece in physicists' theory of the known particles, the standard model. But the huge teams working on the LHC have also cranked out hundreds of Ph.D.s, and with particle physics budgets in the United States and Europe stagnating, there aren't enough academic positions to accommodate them all.



CREDIT: Adrian Cho
Bjoern Penning

Within the particle physics community, young researchers themselves are drawing attention to the problem. Over the past 10 months, particle physicists in the United States have conducted a planning exercise that culminated recently in a 9-day retreat at the University of Minnesota, Twin Cities, called "[Snowmass on the Mississippi](#)"—after the ski resort in Colorado where physicists used to gather. The grassroots [Snowmass Young Physicist Movement](#) (YPM) conducted an online poll and held more than a dozen town hall meetings to find out what graduate students, postdocs, and untenured faculty members are thinking. "For young particle physicists the issues are jobs, jobs, jobs," says Bjoern Penning, 34, a postdoc at the University of Chicago and [Fermi National Accelerator Laboratory](#) (Fermilab) in Batavia, Illinois, and a co-convenor of the Snowmass YPM.

Young particle physicists say their older colleagues are generally supportive, but don't always fully appreciate their predicament. "I think the senior people, they actually think that if you work very hard, you'll make it, because they made it," says Marcelle Soares-Santos, 31, a postdoc at Fermilab who works on a cosmology project known as the Dark Energy Survey. But that's hardly the case, she says: "We don't control all the variables."



CREDIT: Adrian Cho
Marcelle Soares-Santos

The numbers make the problem clear. In 2007, the year before CERN first powered up the LHC, the lab produced 142 master's and Ph.D. theses, according to the lab's document server. Last year it produced 327. (Fermilab chipped in 54.) The two largest particle detectors fed by the LHC, the A Toroidal LHC Apparatus (ATLAS) and the Compact Muon Solenoid (CMS)—which both independently spotted the Higgs—boast teams of 3000 and 2700 physicists. By themselves, the

CMS and ATLAS teams minted at least 174 Ph.D.s last year. That abundance seems unlikely to vanish anytime soon, as last year ATLAS had 1000 grad students and CMS had 900.

In contrast, [the INSPIRE Web site](#), a database for particle physics, currently lists 124 postdocs worldwide in experimental high-energy physics, the sort of work LHC grads have trained for.

The situation is equally difficult for postdocs trying to make the jump to a junior faculty position or a permanent job at a national lab. The Snowmass Young Physicists survey received responses from 956 early-career researchers, including 343 postdocs. But INSPIRE currently lists just 152 "junior" positions, including 61 in North America. And the supply of jobs isn't likely to increase, says [John Finley](#), an astrophysicist at Purdue University in West Lafayette, Indiana, who is leading a search to replace two senior particle physicists. "For the most part, I don't think departments are looking to grow their particle physics programs," he says.

In spite of the long odds, most young particle physicists still seem set on climbing the academic job ladder. Of respondents to the Snowmass Young Physicists survey, 60% said they planned to pursue an academic job, says Jonathan Asaadi, 32, a postdoc at Syracuse University in New York and a Snowmass YPM co-convener—even though just as many expect funding for particle physics to continue to decline in coming years.



CREDIT: Adrian Cho
Jonathan Asaadi

How would young particle physicists like to see the community respond to the discouraging job prospects? None of the junior researchers *Science Careers* spoke to called for wholesale changes to the traditional system of employment, or thought that such changes were realistic. But some want senior physicists to be more forthright about the prospects of achieving an academic career.

Staffed by trainees

Today's mega-experiments rely on armies of graduate students and postdocs to do the nuts and bolts work, Asaadi says. That's fine, he says, so long as everybody understands the situation from the beginning. "When you're starting graduate school, is your advisor telling you, 'Look, you get this great skill set that will be transferable to other things outside of academic physics'?" Asaadi says. "Or are you being told, 'Just work hard and there will be something or other [in physics] in the end'? It seems like it's more of the latter." He adds, "This is where we got some pushback from advisors—it was seen as whining."

Others question whether such straight-talk will do any good. Young particle physicists are driven by a passion for the science, so such admonitions may fall on deaf ears, says Elizabeth Worcester, 37, a postdoc at Brookhaven National Laboratory in Upton, New York. "Suppose that one in 10 postdocs will get a tenure-track job," she says. "You'll still think you're going to be that one—or else you wouldn't be here." [Elliot Lipeles](#), 40, an assistant professor at the University of Pennsylvania (Penn) says his graduate advisor had such a talk with him, "but I didn't take it seriously."

Some young particle physicists say that they would like to have greater exposure to the job opportunities beyond physics. That suggestion draws support from the larger community. For example, the Purdue physics department has instituted seminars, mandatory for all graduate students, in which physicists who have gone into other fields describe their experiences, Finley says.

But what most young physicists seem to want is help with personal connections and networking. That can be harder to come by, as senior scientists tend to lose contact with their students and postdocs who have left the field. For instance, Finley says he has no substantial network of contacts outside of astrophysics. "There's one person who worked with me who went of into renewable energy," he says, "but I lost touch with him."

Moonlighting

For young particle physicists hoping to stay in the field—and that's most of them—the evolution of the field has forced them to be more strategic in their approach to their work. The enormous projects that dominate particle physics typically take years or even decades to build. To take the extreme example, the LHC was proposed in 1984, approved for construction in 1994, and started taking data in 2010. No grad student or postdoc could hope to work on such a project from its inception to completion. That's a problem, as U.S. graduate students must analyze real data to graduate, and postdocs must do so, too, to have any chance of advancing.

To satisfy both the need for data to analyze and the desire to work on the next big thing, many young physicists are moonlighting. "When I was a graduate student, you worked on one experiment and that was your job," Worcester says. "Now, it's much more common for people to be involved in multiple efforts." Worcester herself works on three different experiments. She's crunching data from the ongoing [Daya Bay Reactor Neutrino Experiment](#) near Huizhou, China, which studies how one type of neutrino morphs into another. She's also helping to develop plans for the proposed [Long-Baseline Neutrino Experiment](#) at Fermilab and another experiment proposed at the lab called ORKA, which would study particles called kaons.

In fact, the results of the Snowmass Young Physicists survey suggest that young researchers prefer smaller experiments to larger ones, says Fermilab's Penning. That may be because they see a better chance of carving out a niche within a smaller team, he says.

Embracing alternatives

Some young scientists say that to increase their flexibility, they're focusing less on identifying themselves with a particular type of physics—for example, neutrino physics or collider

physics—and more on developing a broadly applicable skill set. For example, Penning, who works on the ATLAS detector at the LHC, says that with his experience in collider physics he has gained expertise in sifting out small numbers of "signal" events from huge numbers of spurious "background" events. He's already thinking about how such skills might translate to other types of experiments, he says.

With teams comprising hundreds or thousands of members, young particle physicists face the obvious challenge of trying to stand out in a crowd. Some say the key is to develop a variety of skills—for example, hardware and programming, as well as data analysis—or to be particularly good at articulating the scientific opportunities one envisions. With so many people doing similar work, some resort to self-promotion. "I wish there was less of that," says Penn's Lipeles. "Sometimes the people who do that succeed, and they're not always the best people for the job."

For young particle physicists who won't stay in the field—and that's most of them—the Snowmass Young Physicists survey has some good news. The survey received responses from 74 people who had trained as high-energy physicists but had moved on to other things. Although that sample was small and self-selected, the results it provided were striking. "When you look at the people who left the field, they're overwhelmingly happy and find that their training was incredibly valuable," says Syracuse's Asaadi. In particular, people found training in programming, data analysis, and statistical analysis useful.

That finding should make it easier for older physicists to talk turkey to younger ones. "We have to tell these guys, 'You're going to be very happy and get great jobs—just not in science,'" Penning says.

Some of the young particle physicists say they're already having such discussions with their younger colleagues. Soares-Santos says that she recently received an e-mail from an undergraduate working at the lab who was thinking of going to graduate school. Soares-Santos told her that she had to be aware that in the long run she might not make it as an academic scientist. "I don't think it was what she was expecting to hear," Soares-Santos says.

Similarly, UT's Onyisi says that, although he is not yet supervising anyone's thesis research, he is striving to be honest with the graduate students he's working with. "I'm taking it very seriously in terms of mentoring the people I'm working with," he says. "I do think it would probably help everybody's mental health if we stopped treating not getting a tenure track position as failure." Effecting that cultural change may be the hardest challenge of all.

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