other reasons. (Nearly half of all junior faculty members, male and female, do not receive MIT tenure.) "Department heads in science are committed to gender diversity, but sustained progress is difficult," he adds. Silbey also notes that he has appointed women to various leadership positions, and that three of the 10 members of MIT's science council are female.

But Hopkins argues that recruitment of distinguished women scientists needs to be more aggressive at the level of the individual science department. "The standard hiring process does not work," she says. Indeed, the pattern found by Hopkins "is really not surprising," says Alice Hogan, who heads a program at the National Science Foundation called Advance, designed to increase women's participation in science and engineering. "If you let the normal processes go their way, you get what happened at MIT." The Advance program has given 19 awards averaging $3 million to $3.5 million during the past 5 years to encourage universities to devise strategies to recruit more women in science and engineering. At the University of Michigan, Ann Arbor, for example, search committees receive extensive briefings on diversity issues. At the University of California, Irvine, faculty members act as "equity advisers" to monitor and assist with searches. And at the University of Washington, Seattle, department chairs are trained to encourage diversity. Abigail Stewart, the principal investigator on Michigan's Advance grant, says there has been a "sharp upturn" in hiring women there since the grant began but adds that her analysis is not yet complete. Representatives from major research universities plan to meet in June in Ann Arbor to compare data and approaches.

Hogan and others say that for now, strong deans willing to push their department chairs may be the most effective tools for recruiting a new generation of female scientists. At MIT, Silbey says he will push harder to find young and excellent women for his departments. Of 10 new hires starting in July, he says four are women.

–ANDREW LAWLER

COSMOLOGY

Skewed Starlight Suggests Particle Masses Changed Over Eons

New measurements suggest that the ratio of the proton's mass to the electron's mass has increased by 0.002% over 12 billion years, a team of astronomers and physicists reports. If so, the ratio and other fundamental "constants" of nature may not be constant after all.

"If this small variation exists, it's a revolution in science," says Victor Flambaum, a theoretical physicist at the University of New South Wales in Sydney, Australia, and a member of a different team that 7 years ago reported that another constant may have changed. But some theorists say inconstant constants may clash with well-established physics.

Big diff. Researchers compared the absorption of light by ancient hydrogen clouds to absorption in the lab.

To spot the change, two groups joined forces to compare starlight to laser light. Using the Very Large Telescope in Atacama, Chile, Alexandre Ivanchik, a theoretical physicist at the Ioffe Physico-Technical Institute in St. Petersburg, Russia, and Patrick Petitjean, an astronomer at the Institute for Astrophysics of Paris, France, and colleagues studied light from two quasars, the hearts of ancient galaxies. The light filtered through clouds of molecular hydrogen billions of light-years away when the universe was in its youth. Meanwhile, physicists Wim Ubachs and Elmar Reinhold of the Free University of Amsterdam, the Netherlands, and colleagues shined laser light through molecular hydrogen in the lab.

Molecular hydrogen absorbs light of distinct wavelengths, and the resulting spectrum of "absorption lines" creates a kind of bar code. The positions of the lines depend on the ratio of the mass of the proton to the mass of the electron. So, by comparing the absorption spectrum from the clouds with the one measured in the lab, the researchers could tell whether the mass ratio had changed.

That's easier said than done. Because of the expansion of the universe, the quasar light is stretched from ultraviolet to visible wavelengths, an effect for which researchers must correct. Measuring the ultraviolet absorption lines in the lab is also challenging. Also, to make a meaningful comparison, Reinhold and Ubachs had to calculate how much each line should shift and in which direction—toward longer or shorter wavelengths—as the mass ratio changed.

The researchers found that the ratio has increased by about 20 parts per million over the past 12 billion years, they report this week in *Physical Review Letters*. The measurement is at the edge of statistical significance. "We have an *indication*," Ubachs says. "I wouldn't call it proof."

The change is plausible, Flambaum says. Such variations arise naturally in "grand unified theories" that attempt to roll the electromagnetic force and the strong and weak nuclear forces into a single unified force, he says. Michael Dine, a theorist at the University of California, Santa Cruz, says that's true in principle. But variable constants would require new particles that generally would either interfere with gravity or cause mind-boggling swings in the energy of the universe, Dine says: "It's very hard to fit varying constants into our conventional notion of how nature works."

Even so, other researchers have turned up occasional hints of inconstancy. In 1999, a team led by John Webb, an astrophysicist at the University of New South Wales, reported measurements of absorption of quasar light by various metal ions. The team found that the "fine-structure constant," which determines the strength of the electromagnetic force, appears to have changed by about six parts in a million. Ironically, Petitjean and colleagues studied that constant and found no change.

To nail down whether the mass ratio has indeed changed, researchers need to study more quasars and clouds, Webb says. He is already working on the problem, so stay tuned for more weighty measurements.

–ADRIAN CHO

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