

SPACE SCIENCE

NASA Chief Blasts Science Advisers, Widening Split With Researchers

NASA Administrator Michael Griffin this week read the riot act to the outside scientists who advise him, accusing them of thinking more of themselves and their research than of the agency's mission. Griffin's harsh comments come on the heels of the resignation of three distinguished scientists from the NASA Advisory Council (NAC), two of whom have questioned Griffin's plan to dramatically scale back a host of science projects (*Science*, 12 May, p. 824).

"The scientific community ... expects to have far too large a role in prescribing what work NASA should do," Griffin wrote council members in a blistering 21 August message. "By 'effectiveness,' what the scientific community really means is 'the extent to which we are able to get NASA to do what we want to do.'"

The outside engineers, scientists, and educators on the council traditionally offer advice on the agency's policies, budget, and projects. Placed in limbo for nearly a year after Griffin took over as NASA chief in spring 2005, NAC was reorganized this spring under the leadership of geologist Harrison Schmitt, a former U.S. senator and Apollo astronaut who is very enthusiastic about President George W. Bush's plans to send humans back to the moon and to Mars. Schmitt replaced Charles Kennel, director of the Scripps Institution of Oceanography in San Diego, California, who resigned last week from his post as chair of the council's science committee. Two other NAC members—former NASA space science chief Wesley Huntress and Provost Eugene Levy of Rice University in Houston, Texas—resigned last week in response to a direct request from Griffin that they step down.

Schmitt and members of that committee have clashed repeatedly in recent months over the role of science at the space agency. In a pointed 24 July memo to science committee members, Schmitt complained that they lacked "willingness to provide the best advice possible to Mike," refused to back Griffin's decision to cut research funds for astrobiology or recommend an alternative



Unhappy family? NASA's Michael Griffin and his science advisers aren't on the same page.

cut, and resisted considering the science component of future human missions to the moon. "Some members of the committee," he concluded, "are not willing to offer positive assistance to Mike."

Both Levy, a physicist, and Huntress, an

CHEMISTRY

New in Nanotech: Self-Folding Delivery Boxes

"Some assembly required." Those words on a box from the store spell agony for a parent. Chemists face similar headaches while designing new drug-delivery agents or trying to control their actions in the body. But researchers in Maryland may have found a pain reliever.

In a paper published online last week in the *Journal of the American Chemical Society*, researchers at Johns Hopkins University in Baltimore, Maryland, reported creating tiny two-dimensional cutouts that fold themselves up into porous cubes and other 3D containers. The containers can then be

astrochemist now at the Carnegie Institution of Washington, D.C., say they support human space exploration but fear that science is now taking a back seat after years of a careful balance between human and robotic efforts. NASA spokesperson Dean Acosta acknowledged that the scientists and Schmitt "weren't working well together," and that Griffin telephoned Huntress and Levy last week to ask for their resignations. Griffin's memo points to what he calls "the inherent and long-standing conflict of interest" of giving advice to an agency on which members depend for funding. And he offers them a clear way out. "The most appropriate recourse for NAC members who believe the NASA program should be something other than what it is, is to resign."

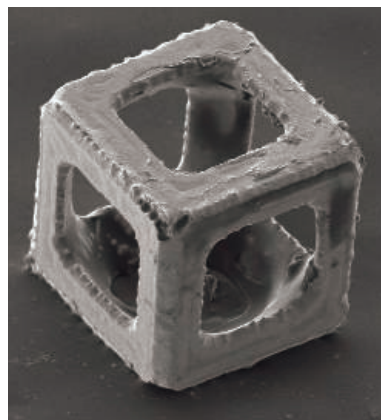
Huntress says Griffin told him that his advice exceeded the council's charge. "This is a different NAC. Our advice was simply not required nor desired," Huntress told *Science*. The current council, he adds, "has no understanding or patience for the science community process." Kennel, who had been named chair of NAC's science committee, was unavailable for comment, but Norine Noonan, a former NAC member and dean of math and science at the College of Charleston in South Carolina, called Griffin's action "very distressing" for scientists. "If we can't have a robust debate at the NAC level," she says, "then where in the heck is it supposed to happen?"

—ANDREW LAWLER

used to ferry compounds to a site where chemists want them to react. Metal versions can even be steered there using magnetic fields.

Researchers say the new nanocontainers could be useful as novel drug-delivery vehicles and in tiny lab-on-a-chip reactors. "This is very elegant work," says Mauro Ferrari, a nanomedicine expert at the University of Texas Health Science Center in Houston. "It brings an innovative element to the field of controlled release of drugs. [But] it has a long way to go" before it can help patients, he warns.

Team leader David Gracias, a chemical ▶



Presto. A series of six flat squares fold themselves into 3D cubes.

CREDITS (TOP TO BOTTOM): REUTERS; ZHIYONG GU/JOHNS HOPKINS UNIVERSITY

engineer, says the idea for porous nanocontainers grew out of decades of work in patterning computer chips. The first steps involved producing ultraprecise 2D structures on flat silicon slabs and other surfaces. In recent years, the chip industry's primary patterning technique, called photolithography, has also spawned efforts to craft everything from tiny gears to microscopic channels and reservoirs for tiny chemical reactors. But making 3D porous containers remained a challenge.

Gracias and his lab members—graduate student Timothy Leong, postdoctoral candidate Zhiyong Gu, and undergraduate Travis Koh—made their nanocubes using standard photolithography techniques to etch a series

of six squares, 100 to 200 micrometers on a side, each shot through with anywhere from one to hundreds of tiny holes. These squares were attached to one another in a crucifix pattern, with a strip of metal between each square that acted both as hinges and solder. The tiny crucifixes were placed in a liquid bath and heated until the hinges melted. Surface tension along the faces of the crucifixes caused the square faces to collapse into cubes. As the bath cooled, the hinges hardened again, soldering the faces in place.

Gracias's team then filled the cubes with different reagents that would leak out at different rates depending on the size of the pores and used them to carry out a variety of chemical reactions. The researchers also

used magnetic fields to redirect cubes made out of nickel and other metals.

Ferrari notes that metallic nanoparticles capable of delivering drugs aren't new. And he warns that it could take years to prove that the cubes are safe and effective in clinical settings. The "great upside" of the Johns Hopkins team's work, he says, is that they can build upon advances in lithography to create very precise structures.

Someday, Ferrari predicts, transistors, sensors, and other information-processing devices may be implanted directly onto their carriers to control exactly when and where chemicals are released. Now, if only parents could get toys to assemble themselves.

—ROBERT F. SERVICE

ASTRONOMY

Satellite's X-ray Vision Clinches the Case for Dark Matter

A fantastically energetic collision between clusters of galaxies has demolished a challenge to the law of gravity, providing the clearest evidence yet for the existence of intergalactic dark matter.

For decades, astronomers have inferred that unseen matter lurks within and between galaxies. Luminous stars alone, they realized, don't exert enough gravitational force to explain how individual galaxies spin and clusters of galaxies clump together. Something invisible must be pulling, too.

Some of the extra matter in galactic clusters is just hot gas. But even more mass seems to exist in the form of "nonbaryonic" dark matter, made of something other than ordinary atoms.

A few holdouts have insisted that the observations could be explained by modifying the law of gravity at great distances. But a new result from the Chandra X-ray Observatory satellite offers clear-cut evidence that dark matter really does infuse galactic clusters. "It demonstrates beyond a reasonable doubt that dark matter exists," says Sean Carroll, a cosmologist at the University of Chicago, Illinois, not involved in the study.

Speaking this week at a NASA briefing, astronomers reported on new Chandra images of the "bullet cluster" of galaxies, 1E0657-56, created by an energetic collision of smaller clusters. It is the most explosively violent such merger ever observed, said astrophysicist Maxim Markevitch of



Dark evidence. A composite image depicting normal matter (pink) and gravity (blue) shows dark matter's presence in the "bullet cluster" of galaxies.

the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts.

The shock wave from the cluster collision dragged the hot gas between galaxies into its unusual shape but would not have affected dark matter, which interacts only via gravity. Consequently, the explosive collision stripped the ordinary gaseous matter away from the nonbaryonic dark matter.

"Because of this collision, for the first time, we're actually able to see dark and ordinary matter separated in space. And this proves in a simple and direct way that dark matter exists," Markevitch said at the briefing.

With no dark matter, the gravity of the cluster would remain concentrated on the gas, which vastly outweighs the galaxies it surrounds. But in fact, the gravitational field of the cluster no longer matches the location of

the gas. Astronomers measured the cluster's gravitational influence by tracking its effect on the light from more distant "background" galaxies, a phenomenon known as gravitational lensing. The results show a clear separation between the gas and the gravity.

"In the bullet cluster, we've seen for the first time a large spatial separation in the sky between where the majority of the normal matter is found and where most of the gravity is found," said team leader Douglas Clowe of the University of Arizona, Tucson. "This cannot be explained by altered gravity for normal matter." A paper describing the results will be published in *Astrophysical Journal Letters*.

While the new result specifically demonstrates the existence only of intergalactic dark matter, it strengthens the case for dark matter within galaxies as well. The same dark matter could explain both why clusters of galaxies do not fly apart and why galaxies themselves rotate as rapidly as they do, Carroll says. There is no need to invoke modifications to Newtonian gravity.

Carroll pointed out that it remains possible that the laws of gravity may need to be modified. But those modifications can no longer do away with dark matter. "No matter what you do, you're going to have to believe in dark matter," he said at the briefing. "It is once and for all the case that dark matter does exist."

—TOM SIEGFRIED

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