other two—energy and climate change policy—that featured refreshingly nonpartisan discussion of underlying scientific issues. Boehlert also plans to wade into the growing debate over "balance" between government spending on biomedical and nonbiomedical science. Science funding debates "sometimes seem composed entirely of randomly generated numbers," he said in an 11 February speech to the Universities Research Association, which manages Brookhaven National Laboratory in Upton, New York. "We really need to push for more data."

The speech alarmed some biomedical backers. "The call … for a balanced federal research portfolio is not, as I understand it, a call to halt or limit growth in the NIH budget," wrote a worried Nils Hasselmo, president of the influential Association of American Universities, which represents 63 major research institutions, in a letter to Boehlert shortly after the speech. Boehlert says Hasselmo and others misread his message. "I was just saying we need to ask some tough questions before we go to the appropriators with big plans."

Boehlert says such polite tiffs are unavoidable in forging stronger political support for increased research spending. "You can count on me to ask uncomfortable questions," he promises. He also knows that taking a stand on science policy is unlikely to generate the large campaign contributions that are the mother's milk of modern electoral politics. But he was "embarrassed," he says, by the research community's tepid response to a standard gambit by legislators seeking a committee chairmanship—the formation of a political action committee that would make donations to colleagues. "Scientists are tighter than bark on a tree," he says.

Still, Boehlert relishes his chance to be science's champion in the House of Representatives. And it's still early enough in the policy-making season for researchers to think that all things are possible. Indeed, meeting those rising expectations may be the toughest task Boehlert faces.

–DAVID MALAKOFF

MEETING AMERICAN PHYSICAL SOCIETY

'Extreme Science' Fans Have a Capital Time

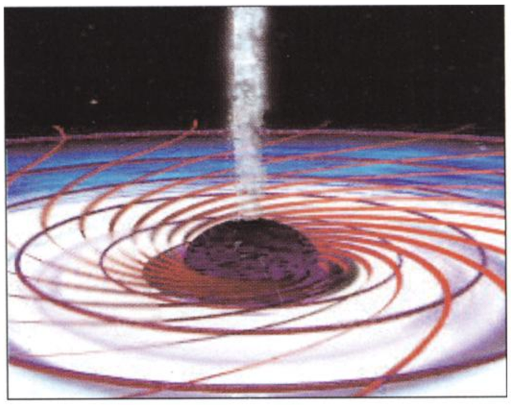
WASHINGTON, D.C.—The April meeting of the American Physical Society (28 April–1 May) was a Mecca for 1050 devotees of the very large or the very small, as cosmologists and astrophysicists hobnobbed with particle and nuclear physicists. Highlights included a spinning black hole and a lunar telescope.

Blips Show Black Hole's Whirl

A furiously blinking x-ray source near the center of the Milky Way has given the best evidence to date that black holes spin, astronomers reported at the meeting. But to say for certain how fast the hole is whirling, theorists must figure out what makes a black hole blink.

The source, named GRO J1655-40, first caught the attention of astronomers with a tremendous blast of x-rays in July 1994. The x-ray intensity fluctuated wildly before fading out 450 days later. Follow-up observations revealed that GRO J1655-40 is a microquasar, a mysterious double fountain of plasma and radiation within our galaxy, thought to come from an ordinary star orbiting a black hole. The black hole's gravity siphons gas off the star into a so-called accretion disk in which it slowly spirals toward the hole, radiating x-rays as it goes. About half the gas eventually falls into the hole; the rest streams outward from opposite sides of the black hole in narrow jets resembling those of quasars, the vastly more distant, more enormous energy sources thought to inhabit the hearts of many galaxies.

Even though they have never seen it spin, astronomers are almost certain that the black hole in GRO J1655-40 rotates. One reason for their confidence is that the black hole probably formed from the implosion of a heavy star. Even if the star starts out rotating very slowly, the collapsing material in the nascent hole must spin ever faster for the same reason whirling figure skaters accelerate as they pull in their arms. Theorists have suggested that spinning black holes power both microquasar and quasar jets.



Whip it. Fast-swirling matter on a close approach writes the signature of a rotating black hole.

CREDIT: NASA

But proving that a black hole is rotating is tricky. Unlike the spinning neutron stars called pulsars, whose thick crusts anchor radio-frequency searchlights that sweep past Earth with a precision that shames any clock, black holes have no hard surface on which to ground a beacon. As a result, astronomers have to deduce the rotation rate of a black hole with other timekeepers.

One of them is called a quasi-periodic oscillation (QPO). Close examination of the 1994 GRO J1655-40 x-ray flare—and a second flare in 1996—revealed a hidden rhythm to the flare's seemingly random intensity gyrations. A small percentage of the x-ray light, within a narrow frequency range, winked on and off about 300 times per second. Theorists speculate that bright blobs in the black hole's accretion disk caused the quasi-periodic fluctuations. In this picture, the orbiting blobs shine a beam of x-ray light in our direction like the headlights of passing cars on a circular racetrack. The disk material circles faster as it approaches the black hole. If the hole is not rotating, the QPO-emitting blobs in GRO J1655-40 must be on the verge of falling into the hole to reach 300 cycles per second.

A spinning black hole, however, puts a slightly different dimple in the fabric of space-time. And the faster it spins, the closer the disk can get without being devoured. So when astronomer Tod Strohmayer of the Goddard Space Flight Center in Greenbelt, Maryland, noticed a second QPO winking even faster, at 450 Hz, in archival Rossi X-ray Timing Explorer data from the 1996 outburst, he drew the obvious conclusion. "The only way to get a QPO that fast is if the black hole is spinning," Strohmayer says. Although single QPOs have been detected in other microquasars, this is the first time two have been seen. And if Strohmayer is right, it marks the first definitive detection of a spinning black hole.

If so, theorists have some work to do. The frequency of the new QPO is "strikingly inconsistent" with the predictions of any of several proposed mechanisms for creating a pair of QPOs, says astrophysicist Fred

Lamb of the University of Illinois, Urbana-Champaign. Until scientists clear up the discrepancy, basic information such as the black hole's speed will remain unknown. All the same, Lamb says, a spinning black hole remains the most plausible explanation for what astronomers are seeing. "This is a remarkable discovery," he says.

–MARK SINCELL

Mark Sincell is a science writer in Houston.

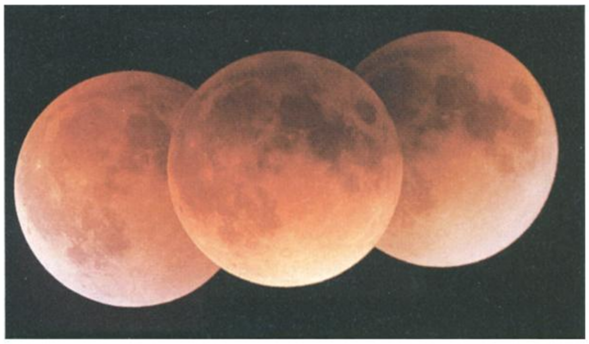
Trapping Neutrinos With Moondust

While astronomers clamor for bigger and bigger telescopes, physicists have quietly brought into play the largest instrument yet: the moon. Of course, such an enormous (and opaque) chunk of rock isn't much use for gathering light. But a 40-year-old theory has shown a way to turn it into a neutrino detector.

Neutrinos are haughty particles, so reluctant to interact with matter that they often pass right through Earth unhindered. To catch them, modern neutrino detectors rely upon a huge blob of mass, usually a tub of heavy water or a chunk of ice. When a swift neutrino interacts with the mass, it creates a cascade of particles that move too fast for the medium they're in, so they release the electromagnetic equivalent of a sonic boom—a faint glow called Čerenkov radiation.

In 1961, Soviet physicist Gurgen Askaryan suggested that if the incoming neutrino is energetic enough, the particle cascade will drag hordes of electrons from the matter along with it, generating coherent, polarized radio and microwave emissions in addition to the visible light typically associated with a Čerenkov shower. David Saltzberg, a physicist at the University of California, Los Angeles (UCLA), and his colleagues realized that this "Askaryan effect" might give them a unique opportunity to detect ultrahigh-energy neutrinos coming from outside our galaxy. If a superfast neutrino passed through the moon and then struck an atom near its surface, the cascade of particles would generate radio waves that Earth-based antennas could detect. Astrophysicists believe that such high-velocity neutrinos exist but have never identified them.

The only problem was that the Askaryan effect had never been tested in the lab in a solid medium like the moon's surface. So Saltzberg's team shot a powerful gamma ray beam at the Stanford Linear Accelerator into a three-and-a-half-ton box of moon-surface–like sand. The beam whipped up particle showers roughly as energetic as a shower created by an ultrahigh-energy neutrino—about 10^{19} electron volts. Sure enough, the scientists saw polarized, coherent pulses of radio waves, just as Askaryan predicted. "This has been talked about for more than 30 years," says team member Dawn Williams, a physicist at UCLA who described the experiment at the meeting. David Besson, a physicist at the University of Kansas, Lawrence, hails the test as "the first demonstration of the Askaryan effect in a dense medium."



Luna trick. Astronomers hope to detect high-energy neutrinos by listening for radio transmissions from the moon.

CREDIT: STEPHEN BARNES/SKY OPTICS

Encouraged by their success, Saltzberg's team turned its attention skyward. Borrowing downtime on radio antennas in the Mojave desert that NASA ordinarily uses to communicate with spacecraft, the scientists swiveled the dishes toward the moon to listen for the radio waves from high-energy neutrino strikes. After 30 hours of observations, Williams says, "we have no signals above five sigma"—in other words, no evidence of ultrahigh-energy neutrinos. But it's still early in the game, Besson says; with 120 hours still to go, he expects that something will turn up soon.

–CHARLES SEIFE

HUMAN ANTHROPOLOGY

Modern Men Trace Ancestry To African Migrants

Examination of markers on the Y chromosome add to the growing evidence that modern humans descended from people migrating out of Africa

When scientists sequenced DNA from the mitochondria of a Neandertal 4 years ago, they found that it was very different from that in living humans. The implication: We did not inherit mitochondrial DNA (mtDNA) from Neandertals. That finding provided a big boost to the leading view of human origins: the "Out of Africa model," which says that the ancestors of living humans swept out of Africa in the past 200,000 years and replaced all indigenous people they encountered (*Science*, 11 July 1997, p. 176).

But the backers of a dissident view—which holds that living humans are descended from several indigenous populations of the Old World, including Neandertals—did not give up the fight. They retreated to another fortress: Asia. A recent analysis of fossils, they argue, shows that an archaic *Homo erectus* from Java shared key features with living Asians and early modern humans in Australia. Their conclusion: Asian *H. erectus* passed on some of its DNA to modern Australians and Asians (*Science*, 12 January 2001, p. 293). Now, geneticists are storming this stronghold of multiregional evolution, as well.

In work described on page 1151, a team of Chinese and American geneticists examined characteristic DNA sequences called markers on the Y (male) chromosome in a huge sample of men in Asia and Oceania. The Y chromosomes of every one, they found, could be traced to forefathers who lived in Africa in the past 35,000 to 89,000 years. Two other groups who have examined the geographic distribution of a large set of markers on the Y chromosome in men around the world have come to similar conclusions.

Together with a variety of studies showing that mtDNA is of recent African origins, anthropologists now have two strong lines of evidence in favor of the replacement hypothesis. Indeed, at the annual meeting of physical anthropologists in Kansas City, Missouri, last month, one self-described "dedicated multiregionalist," Vince Sarich of the University of California, Berkeley, admitted: "I have undergone a conversion—a sort of epiphany. There are no old Y chromosome lineages [in living humans]. There are no old mtDNA lineages. Period. It was a total replacement."

But the backers of the replacement hypothesis are not dancing on the grave of multiregional evolution. They note that evolutionary studies of nuclear DNA are just getting under way. And because human genomes are a mosaic of genetic lineages inherited from different ancestors, it is still