floating planet formed by agglomeration would not have a disk, Lada explains, so these dwarfs must have formed the way stars do. The disks could even spawn small inhospitable planets, Lada says.

"This is compelling evidence," says Geoff Marcy, an astronomer at the University of California, Berkeley. Although he is confident that the disks are real, Marcy points out that astronomers' models of brown dwarfs are still in their infancy, so it's hard to predict exactly how much infrared radiation dwarfs should produce. Better models should soon reduce that uncertainty, he says.

–MARK SINCELL

Mark Sincell is a science writer in Houston.

ASTROPHYSICS

Quasars or Blazars? It's All in the Angle

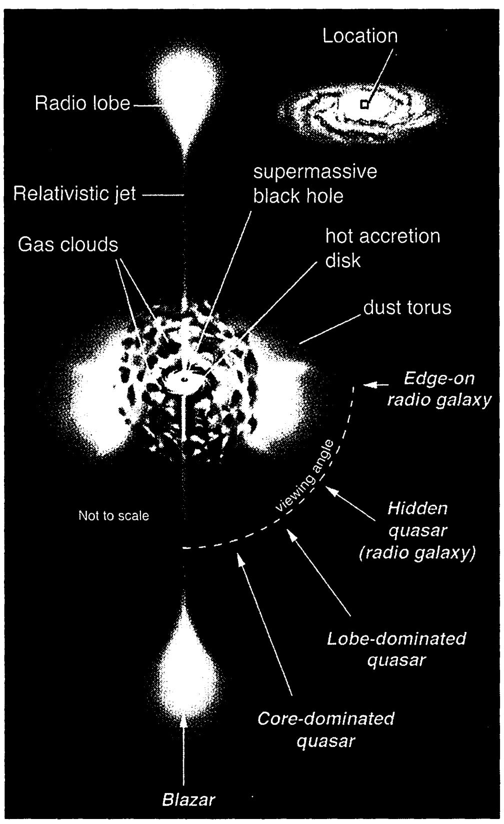
If you had never seen a peacock and then suddenly stumbled across a pair of them—one strutting past in profile, the other facing you in full display—you might think you were looking at two different animals. Astronomers suspect they've been making a similar mistake. New observations strongly suggest that a wide variety of extragalactic objects are actually the same cosmic animal seen from different angles.

The objects in question are blazars, quasars, and radio galaxies. Astronomers think that all are variations on a theme: distant galaxies, each revolving around a nucleus in which a supermassive black hole slowly consumes a hot accretion disk of swirling gas and spews some of it out in powerful jets. Blazars are extremely luminous, highly variable sources of radiation. Quasars are less energetic and steadier, and the ones that emit radio waves come in two varieties. In one case, most of the radio waves come from the quasar's bright core; in the other, most are emitted by two lobes on opposite sides of the galaxy. Finally, the objects known as radio galaxies sport two radio lobes but show no core activity at all.

Over the past 15 years or so, astronomers have suggested different models to describe this bewildering variety of active galaxies. The most radical proposal came from Peter Barthel of the University of Groningen in the Netherlands, who suggested that every radio galaxy is really a quasar seen edge on, its bright core hidden by a torus of dust.

Klaus Meisenheimer of the Max Planck Institute for Astronomy in Heidelberg, Germany, disliked that idea. "I couldn't believe that a quasar could be hidden from view so completely," he says. Using the European Infrared Space Observatory (ISO) satellite, Meisenheimer set out to disprove it. If a dust torus were absorbing radiation from the central quasar, he reasoned, it would reemit the energy as infrared light. So if Barthel were right, radio galaxies and quasars should look the same to ISO. In a paper accepted for publication in *Astronomy & Astrophysics*, Meisenheimer and his colleagues report that that is exactly what they found. "I was really astonished," he says. "I'm [now] convinced that the unification scheme is in principle correct."

Meanwhile, Feng Ma and Beverley Wills of the University of Texas, Austin, were working on what Ma calls "the other end of the unification scheme": the idea that a blazar is just a radio-emitting quasar with one of its jets pointing straight at Earth. On page 2050, Ma and Wills describe how they used a sensitive spectrograph at the 2.7-meter Harlan J. Smith Telescope at McDonald Observatory in Texas to study light emitted by ionized carbon and hydrogen atoms in gas clouds close to the cores of 62 quasars. The emissions are powered by radiation from the quasars.



Slanted story. Seemingly diverse astronomical objects may be different views of galactic cores.

Comparing their measurements with readings taken over the past 20 years, Ma and Wills found that in many cases the relative strength of the carbon and hydrogen emissions shows large variations, indicating that the central source varies as much as a blazar does. Their conclusion: There's really no difference between radio-emitting quasars and blazars. Blazars look more volatile and variable only because astronomers are viewing their jets head on. "There's a blazar hidden in every radio-loud quasar," says Ma.

Barthel says he is delighted with the new results, particularly those of Ma and Wills. The ISO data are less convincing, he says, because in many cases Meisenheimer's group could not detect any infrared radiation from the sources they studied. Working with his graduate student Ilse van Bemmel, Barthel has made more-sensitive observations indicating that quasars seem to be on average a little bit brighter in the infrared than radio galaxies. "But this can easily be explained by assuming certain properties for the obscuring dust torus," he says.

Meisenheimer acknowledges that his results are tentative. "But this is so different from what I had expected that I'm convinced," he says. And with new evidence for the unification scheme arriving almost weekly, there seems little doubt that all radio-emitting active galaxies are equal—although some of the cosmic peacocks hide their dazzling tails.

–GOVERT SCHILLING

Govert Schilling is an astronomy writer in Utrecht, the Netherlands.

ILLUSTRATION: C. SLAYDEN

ANIMAL MODELS

EC Boosts Funds for Mutant Mice

The European Commission (EC) has awarded a $3.8 million grant to a "virtual archive" of mutant mice used in research on cancer and a variety of other human diseases. Announced at an 11 June press conference in Rome, the award will go to the European Mouse Mutant Archive (EMMA), a consortium of European institutes that create and store mutant mice and their frozen embryos. The money comes from a special $21 million fund created last year by EC research commissioner Philippe Busquin to support bioinformatics and animal model research. Just over half of these earmarked funds were awarded last month to the European Bioinformatics Institute near Cambridge, U.K. (*Science*, 18 May, p. 1275). "The idea is to take programs that are working well and ensure that they are operating at the maximum possible level," Busquin told *Science*.

The new funds will help EMMA—which is headquartered at Monterotondo, outside Rome, and coordinates the activities of institutes from seven European countries—to keep up with the ever-increasing demands for mutant mice, whose altered genomes can serve as models for human diseases (*Science*, 14 April 2000, p. 248). Over the past decade, some 2500 mutant mouse lines have been created or identified worldwide, including nearly 1000 in Germany and the U.K. alone. And although only a small fraction of the mutants are stored as living animals, the cost of maintaining their frozen embryos—about 500 of which need to be kept on hand for each mutant line—runs at least $4000 annually for each strain.

Expensive date. Maintaining embryos of mutant mouse strains can cost $4000 a year.

Yet the money is well spent, comments biochemist Adelbert Roscher of the University of Munich, who works with a group of German labs that recently created several dozen new mutants. "Mouse models are necessary initial steps for transferring the new knowledge coming out of genome programs into clinical use," he says. "The work of EMMA will speed up this process."

–MICHAEL BALTER

CONDENSED-MATTER PHYSICS

Switch-Hitter Materials Tantalize Theorists

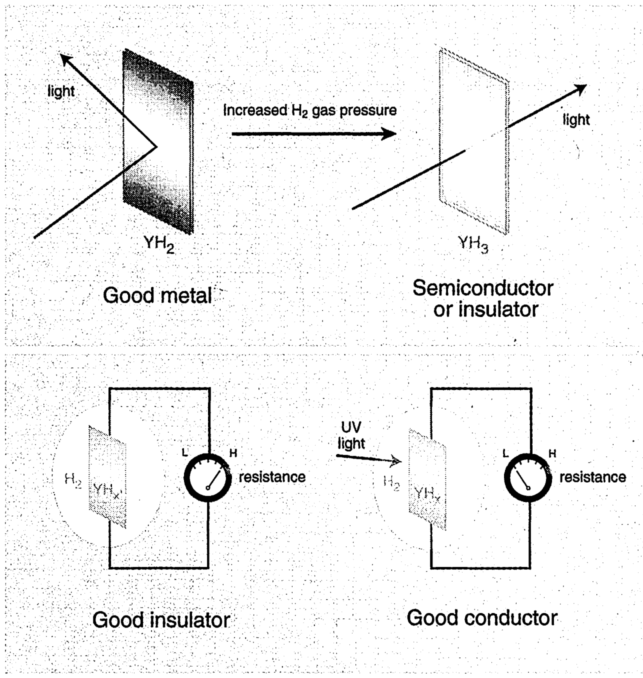
At one point in the movie *Blade Runner*, the evil techno-mogul Eldon Tyrell presses a button that suddenly darkens his office windows. A science-fiction moment? In fact, physicists have known for years that by lacing certain simple compounds with hydrogen they can perform the opposite trick, turning shiny metal conductors into clear insulators.

Now a team of physicists and materials scientists has closed the loop. In the 4 June issue of *Physical Review Letters*, they report that they take the compounds—hydrides of the rare earth elements yttrium and lanthanum—and change them back into shiny conductors by flashing them with ultraviolet (UV) light. The UV-triggered switchable mirrors are intriguing both in their basic physics and for possible applications to optoelectronics, says co-author Tom Rosenbaum of the University of Chicago. "These are amazing materials."

The strange properties of hydrides first came to light 5 years ago, when researchers led by Ronald Griessen of Free University in Amsterdam were searching for new superconductors. His team looked at metal hydrides, materials that act like sponges capable of absorbing huge amounts of hydrogen. They didn't find superconductivity in samples of yttrium hydride, but they did discover that high-pressure hydrogen turned it from a shiny metallic YH_2 film to a transparent insulator made of YH_3.

In the latest work, the Amsterdam group has joined forces with physicists at Chicago and learned to trigger the reverse effect with light. They took a thin yttrium film sealed with palladium and placed it in a hydrogen pressure cell cooled to a temperature of 0.35 kelvin. By dosing it with hydrogen, they made the insulating compound YH_3 and monitored its electrical conductivity with tiny wires attached to the sample. When they flashed the film with a UV strobe light, the conductivity shot up—a sure sign that the insulating material had changed into a metallic form. "We can basically 'dope' this material with UV light," says Rosenbaum.

The results may help illuminate one of the toughest questions in condensed-matter physics: how materials go from metal to insulator and back again. Such transformations, called Mott transitions after the British physicist Neville Mott, who first tried to nail down the theory, have vexed researchers for years. Many of them are tied to basic changes in a material's crystal structure—changes that take place abruptly enough to pull the rug out from under researchers probing the mechanisms of how the electrons interact and influence the change from metal to insulator. As a result, says theorist Steve Girvin of Indiana University, Bloomington, "our theoretical understanding of the metal-insulator transition remains very poor and confused despite a lot of work on this."



Mirror, mirror. "Doped" with hydrogen or with ultraviolet light, yttrium hydrides acquire new optical and electrical properties.

But remarkably, the metal hydrides undergo a smooth, continuous transition rather than an abrupt one. That makes them a valuable test-bed for studying these peculiar quantum phase transitions. In one series of experiments, the researchers were able to extract so-called critical exponents—numbers that characterize how the conductivity changes with temperature and electron density in the hydrides. They discovered that the hydrides have unusually large exponents unlike those of any other metal-insulator transition. That may indicate that hydride transitions belong in a theoretical category, or universality class, all their own, Rosenbaum says. "Either we have a new universality class, or we really don't know how to do the theory yet. Either way, it's an interesting package."

Other physicists say it's premature to speculate about what the data from the hydrides mean; quantum phase transitions are still too difficult to understand, they caution. "It's a wonderful new system," says Subir Sachdev of Yale University, "but the interpretation of the critical exponents is less persuasive." Much more work needs to be done to make this part conclusive, he says. "For these transitions with disorder and strong electron interactions, nobody has a clue what is going on."

In addition to opening up some deep puzzles for condensed-matter physicists, the metal hydrides might provide an interesting material for practical applications. High-tech window shades aside, companies such as Phillips have already started looking at the hydrides for computer displays. The latest work, in which UV light triggers the switching of metal properties, hints at the possibility of light controlling light—a trick that researchers in fields such as optical computing and fiber-optical network switching are eager to master. Taming the rare earth hydrides and understanding their fundamental physics should keep researchers busy for some time to come.

–DAVID VOSS

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