ASTRONOMY

Peering Through a Lens, Sharply

The Hubble Space Telescope is experiencing a case of double vision, but this time the telescope's faulty optics are not to blame. The lens responsible for a new double image of a distant galaxy is a massive cluster of galaxies that lies along the line of sight, distorting light with the force of gravity. And astronomers are welcoming this optical distortion, which was announced last week by astronomer Richard Ellis of Durham University in England. Astronomer Daniel Weedman of Pennsylvania State University calls the double image the most spectacular example of gravitational lensing yet.

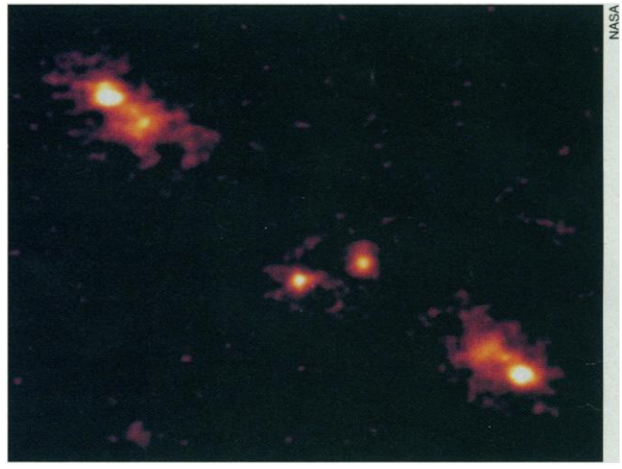
Gravitational lenses are nothing new for astronomers (*Science*, 3 April, p. 30), but normally the image of the galaxy that is stretched or multiplied by the intervening mass turns into "just a blur of light," says Ellis. This latest example—mirror images of a galaxy about 10 billion light-years away—is the first to preserve the detail in the distant galaxy. And that makes this image a powerful probe of the object that is doing the lensing: a cluster of 799 galaxies perhaps 4 billion light-years away called AC 114.

Gravitational lensing is one of astronomers' few strategies for probing the uncharted sea of dark matter—possibly made of dead stars, planets, mini black holes, or exotic particles—that astronomers believe makes up most of the universe. Because dark matter in the lensing object must be affecting the image seen from Earth, astronomers can use the images to get a sense of how much invisible matter the lens must contain and how it is distributed. And the sharper the lensed image, the more clues it can provide about the dark matter.

From the double image, Ellis was able to calculate the amount and distribution of mass in AC 114. He found that the cluster contains 50 times more dark matter than visible matter—about the ratio astronomers expect. More surprising was Ellis' conclusion that most of the unseen matter clumps around the center of the cluster. That's hard to explain with the exotic particles that are the most popular dark-matter candidates; they are expected to spread more evenly through galaxy clusters.

Ground-based observations of other gravitational lenses have pointed toward the same conclusion, note lensing experts Edwin Turner of Princeton University and Nick Kaiser of the University of Toronto. But Ellis argues that the detail in the new images makes the evidence for the clumping of dark matter much stronger. And he recently discovered that the same gravitational lens system produces a third image of the galaxy. That should throw the dark matter doing the lensing into even sharper relief.

–Faye Flam



NASA

Mirror, mirror. An odd-shaped galaxy 10 billion light-years away is refracted into a double image by a foreground galaxy cluster.

THE PRESIDENTIAL CAMPAIGN

Who's Who Among Science Advisers

President George Bush and his challenger, Arkansas governor Bill Clinton, both promise a high-tech future for the country. They have each talked about the need for more investment in R&D and, on page 384 of this issue, they provide detailed answers to questions posed by *Science* about policies for science and technology. So far, however, science has not been a major campaign issue, nor have scientists been prominent among the campaign advisers.

In most previous presidential elections, ad hoc committees of scientists have been formed to channel advice into each camp. And many of those advisers subsequently played roles in planning the transition to a new administration. This year, however, no group has emerged so far on the Republican side and a committee on the Democratic side, put together by former California Institute of Technology president Marvin Goldberger, has had little direct influence on the Clinton campaign.

The lack of an outside committee on the Republican side may not be surprising, since Bush is running on his Administration's record and can draw on the work of political appointees in top science posts. These include science adviser D. Allan Bromley (a former Yale physicist), National Science Foundation (NSF) director Walter Massey (former director of Argonne National Laboratory), energy science director William Happer Jr. (a former Princeton physicist), and National Institutes of Health director Bernadine Healy (a former Cleveland Clinic cardiologist).

Even pro-Clinton scientists like Goldberger, who chairs the Council of Scientists and Engineers for Clinton-Gore, acknowledge that "the Bush Administration has done rather well by science," but the more vocal members of the scientific community have been lining up to support Clinton. Goldberger's group includes about 30 scientists and engineers (including Nobel laureates Charles Townes, Murray Gell-Mann, and Philip Anderson). According to co-chair and Nobel laureate Leon Lederman, a former director of Fermilab, the group is in the process of drawing up several policy statements for Clinton on subjects such as the environment and global overpopulation—topics that are "not very popular" with the Bush Administration, Lederman says. The group will also tackle math and science education and the dangers of focusing solely on short-term applied research goals, he says.

So far, however, the organization's actual impact on the campaign has been negligible. Lederman says the campaign has promised his group a meeting with Clinton but hasn't yet proposed a date. And he admits that having any influence on the candidate—or on a potential Clinton administration—will "take some time."

Clinton is lending his ear to one set of advisers, however: those who emphasize industial applications over basic research. Tom Schneider, the campaign's full-time science and technology policy coordinator and a longtime friend of Clinton, runs a management consulting firm that puts together leveraged buyouts of failing companies. When the campaign took him on, says Schneider, "What they were looking for was someone who brought a more general competitiveness angle [to science and technology policy]." Schneider's deputy Richard Bradshaw, who spent 4 years as an analyst of European science and technology at NSF, also says Clinton will emphasize technology development. And Ellis Mottur, a former aide to Senator Edward Kennedy (D–MA) who is working on technology issues at Clinton's Little Rock headquarters, spends most of his time recruiting endorsements from business leaders.

–David P. Hamilton