


budget details are released.) The White House also rejected attempts to divert some of the core money into new facilities not already in the budget. Thus, OMB blocked a last-minute NSF push to shoehorn in a $30 million downpayment for an Integrated Ocean Observing System—a $100-million-a-year network of data-gathering and communications instruments—although NSF won $6 million to continue planning it as part of an interagency initiative in the 2002 budget.

NSF has won support for other new starts, however, including the first three of a planned 10 or so high-tech ecological field stations, and the first portion of an ambitious network of instruments to monitor seismic activity across the country. Colwell is also touting a proposed major expansion of an effort to create a dozen or more Centers for Teaching and Learning; by last week, NSF had received 115 letters of interest for the pilot phase. The centers aim to train better math and science teachers and improve the skills of those already in the classroom by involving discipline-based faculty in kindergarten through grade 12 education.

Now that the Administration has spoken, the next steps are up to Congress. NSF supporters take heart from the bipartisan applause by legislators that greeted Clinton's announcement of a science initiative in his State of the Union address last week. But they know that the devil is in the details, and that a lot of political decisions have to fall into place before NSF can get what it needs.

–JEFFREY MERVIS

ASTRONOMY

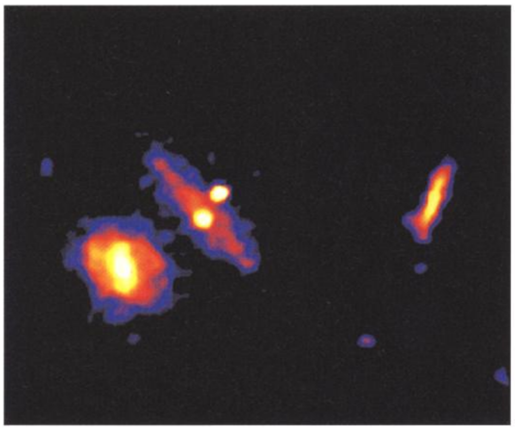
Signs of MACHOs in a Far-Off Galaxy

For the past 20 years, astronomers have been using a technique called gravitational lensing to study exotic objects from the universe's infancy, such as superluminous quasars many billions of light-years from Earth. A gravitational lens is a massive object, such as a normal galaxy or galaxy cluster, that happens to lie directly in the line of sight between the object of study and Earth, bending and amplifying its light. But in a recent study carried out by Dutch astronomers, the lens itself turned out to be more interesting than the quasar under examination.

The radio signal focused by the lens—a normal spiral galaxy like our own Milky Way but 3.5 billion light-years from Earth—appeared to flicker. This odd behavior, the astronomers believe, is caused by compact, dark objects in a halo surrounding the lensing galaxy. The objects themselves appear to be acting as microlenses, focusing the radio signals as they pass through the line of sight. "To explain our observations, you probably need massive objects like neutron stars or black holes," says Léon Koopmans of the Kapteyn Astronomical Institute in Groningen. If so, it would be the first time that microlensing has spotted such objects—called massive compact halo objects, or MACHOs—in a very distant galaxy.

Koopmans and Ger de Bruyn of the Netherlands Foundation for Research in Astronomy used the Very Large Array radio telescope in Socorro, New Mexico, and the Westerbork Synthesis Radio Telescope in the Netherlands to study radio waves from a distant quasar known as B1600+434. It is located some 6 billion light-years from Earth in the constellation Hercules. The normal galaxy sitting in front of B1600+434 gives the quasar a "split personality": Its gravitational pull bends the radio signals passing through it to produce two images of the quasar.

"The lensing galaxy is a spiral galaxy like our Milky Way, seen exactly edge-on," says Koopmans. The faintest of the two quasar images is produced by radio signals that pass through the star-studded central bulge and disk of the galaxy, while the brighter image is formed by signals that miss the main galaxy altogether and only pass through its outer dark halo. Surprisingly, the image seen through the galaxy's halo displays extremely fast variations in its brightness. "The radio brightness varies wildly, by as much as 10% in a few weeks," says Koopmans. The other image remains relatively quiet, however.



Double vision. A normal spiral galaxy (upper right) focuses two images of quasar B1600+434 behind it.

CREDIT: L. KOOPMANS/NORDIC OPTICAL TELESCOPE

In a paper submitted to *Astronomy & Astrophysics*, Koopmans and De Bruyn attribute the flickerings to additional lensing by isolated dark objects in the galaxy's halo: The gravity of a compact object passing between the distant radio source and Earth produces short-lived brightness variations. The second image shows no sign of such flickering, they argue, because there are so many microlensing stars in the galaxy's bulge that the sharp peaks are smoothed out.

If they are right, these observations strengthen the idea that MACHOs account for some of the universe's unseen "missing mass." Our own Milky Way galaxy is endowed with a similar dark halo, which, according to gravitational studies, must contain a lot of dark matter, but no one is quite sure what form it takes. Microlensing studies at optical wavelengths have turned up tantalizing evidence for MACHOs in the Milky Way's halo (*Science*, 7 January, pp. 67 and 74); now Koopmans and De Bruyn may have spotted them in a similar spiral galaxy.

"This sounds very interesting," says gravitational lens pioneer Anthony Tyson of Bell Laboratories, operated by Lucent Technologies in Murray Hill, New Jersey. "It could certainly give information on the compact forms of dark matter in galaxy halos." However, he says, some theorists have proposed that a major part of the dark matter in the universe might consist of a diffuse gas of exotic elementary particles, which the microlensing technique would not be able to detect. Since they submitted their paper, Koopmans and De Bruyn have observed even stronger flickerings in B1600+434, up to 30% in less than a month. These results will be presented later this month at a microlens conference in Cape Town, South Africa. "Originally, we derived a lower limit for the mass of the microlensing objects of about half a solar mass," says Koopmans, "but this may be too conservative. To explain variations of 30%, you probably need objects that are much more massive, like stellar black holes."

–GOVERT SCHILLING

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