Quasars: The Brightest and the Farthest

Astronomers have discovered the most brilliant known object in the universe. The luminosity of this celestial powerhouse—a quasar glowing with the brightness of more than 10^{15} suns—exceeds by 25 percent that of the two previous record-holding quasars. Moreover, the newly detected quasar is one of the three most distant objects ever observed.

The quasar's light, which takes 12 billion years to reach Earth, enables researchers to peer back in time to shortly after the Big Bang. The brilliance of this light also makes it easier to examine the galaxies and hydrogen gas clouds lying between the quasar and Earth, says Richard McMahon of the University of Cambridge in England. In fact, he notes, a telltale absorption of blue light by hydrogen helped him and his colleagues to identify the ultrabright quasar.

McMahon, working with Michael Irwin of the Royal Greenwich Observatory in Cambridge and Cyril Hazard of the University of Pittsburgh, computer-scanned some 25 million celestial objects depicted on photographic plates from the U.K. Schmidt Telescope in Epping, Australia, and found several star-like entities characteristic of distant quasars — glowing brightly at red wavelengths but dimly in the blue. Subsequent observations with the Jacobus Kapteyn and Isaac Newton telescopes in the Canary Islands confirmed that the object, called BR 1202-07, is indeed the most brilliant ever observed. The team announced its discovery in a press release last week.

The quasar's luminosity and distance may pose new problems for the "cold-dark-matter" theory of galaxy formation (SN: 1/26/91, p.52), McMahon says. The simplest version of this popular theory suggests that fluctuations in the density of primordial matter could not have grown fast enough to form most galaxies soon after the Big Bang.

But most cosmologists contend that quasars, thought to lie at the center of some galaxies, form only after galaxies emerge. In addition, black holes or other quasar-fueling objects inside galactic cores would need time to evolve—particularly the more massive power sources required by the brightest quasars. Thus, the extreme features of BR 1202-07 indicate that some galaxies must have existed when the universe was only 7 percent of its current age—during the first billion or so years of its existence, according to some estimates. The cold-dark-matter theory cannot easily explain such an early origin, McMahon says.

Another recent quasar discovery, widely discussed among astronomers but not yet publicly announced, may also strain the theory of cold dark matter, several scientists say. Using the 5-meter telescope at Palomar Observatory near Escondido, Calif., James E. Gunn of Princeton (N.J.) University and Maarten Schmidt of Caltech in Pasadena found a faint quasar that is the most distant object known. Its redshift of about 4.9 indicates the object dates to a time when the universe was about 6.7 percent of its current age. "It's a consensus finding," says McMahon, noting that the two discoveries may pose similar challenges to the cold-dark-matter theory.

Gunn told SCIENCE NEWS he would not disclose details of the work until his team announces the results. He cautions that the handful of distant quasars so far observed cannot overturn — or even force major alterations in — accepted cosmological theories, which rely largely on statistical arguments. "As long as one has just one or two other [very distant] objects, as we do at the moment, it is very hard to make quantitative statements that will get theories in trouble," says Gunn.

He notes, however, that several proposed scenarios for the evolution of the universe would have difficulty accounting for the presence of many distant quasars. McMahon adds that if the search for faraway quasars ever reveals a distance limit, it may indicate when galaxies first turned on and quasars first shined.

— R. Cowen

Two-pronged vaccine blocks malaria

When it comes to malaria vaccines, two may be better than one, according to a new study in mice.

A vaccination containing two proteins from the surface of the early-stage malaria parasite completely protects mice from the disease, reports a research team from Bethesda, Md. The experiment marks the first time a protein vaccine has completely prevented malaria infection *in vivo*, says Stephen L. Hoffman of the Naval Medical Research Institute, who conducted the work with colleagues there and at the National Institute of Allergy and Infectious Diseases (NIAID).

The findings, described in the May 3 SCIENCE, could shift the focus of malaria research away from vaccines based on a single type of protein and toward those based on multiprotein "cocktails."

At present, physicians have no effective vaccine for this mosquito-borne disease, which kills more than 2.5 million of the 270 million people it strikes each year. In human trials, test vaccines incorporating only one type of protein from the malaria parasite have protected only half of those immunized (SN: 3/26/88, p.202). The quest for a reliable vaccine has intensified as a growing proportion of *Plasmodium falciparum* — the malaria organism that most often causes death — has grown resistant to antimalarial drugs.

The new two-protein vaccine blocks the first stage in the parasite's life cycle — the sporozoite, which mosquitoes inject as they suck blood. Sporozoites travel through the bloodstream to the liver, where each can divide into thousands of merozoites. A week later, the merozoites leave the liver to invade red blood cells. The fever, chills and aches of malaria result when infected red cells explode, releasing more merozoites. Other red cells release gametocytes, the parasite's sex cells. The life cycle comes full circle when a mosquito withdraws the gametocytes in a blood meal and they combine in the insect to produce new sporozoites.

Hoffman's team injected 18 mice with mouse tumor cells engineered to contain the genes for two proteins found on the sporozoite surface. The researchers anticipated that the tumor cells would manufacture the sporozoite proteins and display them along with their own immunity-stimulating surface proteins, thereby boosting the immune reactions of the mice. Indeed, none of the immunized mice developed malaria infection, even when injected with more than 10 times the number of sporozoites known to cause malaria in mice. In contrast, when the team injected two groups of mice with tumor cells that produce only one of the sporozoite proteins, only 33 to 75 percent escaped the infection.

"This vaccine might prevent the blood stage [of malaria] from ever occurring," Hoffman told SCIENCE NEWS. But he cautions that the *Plasmodium* species that cause malaria in mice differ from those infecting humans. He and his co-workers are now working to isolate *P. falciparum* sporozoite proteins that parallel those used in the mouse vaccine.

Louis H. Miller of NIAID, who was not involved in the study, notes that Hoffman's group must find another way to give such a vaccine to humans. "Obviously you can't give cancer cells to patients," he says.

— C. Ezzell