

master. In his view, the term means that “if you make a gain-of-function mutation or switch the gene on ectopically, you get a complete wing or leg or eye or body segment,” he says. *dac* fits this definition, but he thinks it doesn’t quite qualify as a master gene, because *ey* always induces *dac*, but *dac* can’t always induce *ey*. To him, this suggests that *ey* is higher in the regulatory hierarchy. Or perhaps, suggests University of Southern California geneticist

Kevin Moses, it all boils down to semantics: “Any genetic element that can become critical can be seen as a ‘master regulator.’ ”

The “big game” now, says Gehring, is to map out the eye-development pathway in detail, assigning places to *ey*, *dac*, and a handful of other genes known to be involved—including the recently discovered *toy*, a possible “co-master” regulator that seems to help activate *ey*, as Gehring re-

ported at a conference in Tennessee last June. The gene *toy* is even more closely related than *ey* to *pax-6*, a mammalian gene involved in eye development, and may be the ancestral fly-eye gene, with *ey* an accidental duplicate that later took over most of *toy*’s job, Gehring speculates. Whichever gene comes out on top, there will be plenty of depth left to plumb below.

—Wade Roush

ASTRONOMY

Gas Clouds May Be Relics of Creation

TORONTO—Astronomers who study a mysterious set of gas clouds speeding through the Milky Way can appreciate the plight of the very nearsighted tourist in Africa. A gnat seems to be crawling across her glasses, but when she removes them, the gnat is still there; finally she realizes that a rhino is charging over a ridge. Astronomers haven’t had a similar flash of recognition yet. But some have proposed that what they thought were gnats—the spindrift of supernovas exploding in our galaxy—might be something much grander: huge, distant remnants of the galaxy’s formation that extend well beyond the Milky Way and could fuel the formation of new stars for billions of years into the future.

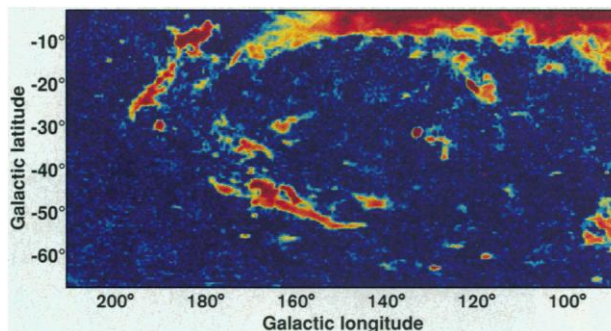
The proposal, presented during an American Astronomical Society meeting held here from 12 to 16 January, relies on computer simulations of gas left over from the formation of the first galaxies and clusters of galaxies. The simulations show that these leftovers could survive until the present as clouds of gas roiling in the gravity of our Local Group of galaxies. “We start these [models] at about 1 billion years after the big bang and just let them evolve,” says Leo Blitz of the University of California, Berkeley. Fast-forwarding to the present, “we get what we see”—assuming the observed high-velocity clouds are lumbering masses in deep intergalactic space.

Few astronomers believe that the evidence is strong enough yet to prove these cosmic claims. But by pointing to the kinds of observations that could finally pin down the nature of the clouds, says Joel Bregman of the University of Michigan, “this breathes new life into the problem.”

The mystery dates back to the 1960s, when observations of radio emissions from hydrogen atoms in interstellar space showed that some of them belonged to clouds stampeding in all directions at hundreds of kilometers per second relative to Earth. The most complete catalog to date, compiled by Bart Wakker of the University of Wisconsin, lists about 550 of these rogue clouds. The biggest obstacle to understanding them is astronomers’ ignorance of their distance and thus their actual size. “Distance is the most critical, but the

most difficult,” says Wakker.

Still, Wakker thinks the clouds are closely associated with our galaxy. One possibility is that they are the handiwork of supernovas. By driving gas out of the plane of the galaxy in “fountains” that would tumble back, supernovas could stir up clumps of interstellar gas. “There are supernovas in the [galactic] plane; they do explode, so where does the gas go?” asks Wakker. “The galactic fountain seems



All in tatters. Radio-emitting clouds of hydrogen (red and yellow) could be left over from the galaxy’s formation.

reasonable.” Wakker has shown that this picture can account for most of the observations, although he and Bregman concede that it has a hard time explaining the very fastest clouds.

Blitz, along with David Spergel of Princeton University, Dap Hartmann of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, W. Butler Burton of the University of Leiden in the Netherlands, and Peter Teuben of the University of Maryland, College Park, decided to try out a grander picture. They suggest that, rather than lying 10,000 or 15,000 light-years away, the high-velocity clouds are scattered on scales of more than a million light-years, stretching well beyond our galaxy toward its neighbors. And instead of being run-of-the-mill interstellar gas, they are relics of the great filament of primordial gas that coalesced to form the entire Local Group of galaxies. If so, the gravity of the Andromeda galaxy and the Milky Way could be accelerating the clouds to the high velocities that have puzzled observers.

To test this idea, says Blitz, the team used “an extremely simplified model of our local

region of the universe.” In the model, the newborn Milky Way and Andromeda galaxies first draw apart with the general expansion of the universe, then move closer again because of their mutual attraction. Based on the changing gravitational field created by the two galaxies, the model calculates how nearby gas clouds should move, how much of the gas should get swallowed up by the galaxies, and how much should survive to the present epoch.

Hartmann says the model’s predictions of where the clouds should tend to congre-

gate in the sky and how fast they should move just about match his own detailed radio observations. The model predicts, for example, that clouds should be concentrated along a line connecting the Milky Way and Andromeda—the orientation of the original gas filament that formed the Local Group. The clouds do seem to cluster along that line, which impresses David Weinberg, a specialist in cosmic structure

formation at Ohio State University. Throughout space, galaxies form patterns “like beads on a string,” says Weinberg. “If this is correct, then in addition to seeing the beads, you can still see the string.”

These leftovers, if that’s what they are, should amount to roughly 100 billion solar masses of material—enough to nourish star formation in the Milky Way for billions of years. That would brighten the galaxy’s future, says Blitz, who notes that observers have had a hard time finding enough fresh gas to sustain the present rate of star formation for much longer. Before astronomers draw too many conclusions, though, they want definitive evidence for or against the new cloud theory. So far, one observation has given it a boost by showing that the composition of one high-speed cloud could be extragalactic. But another has raised doubts by showing that a different cloud lies relatively nearby—too close for comfort in the new scenario. The cloud watchers are still waiting for that shock of recognition.

—James Glanz

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