OCTOBER 2024

Astronomy®

The world's best-selling astronomy magazine

ANNUAL STAR PRODUCTS ROUNDUP: BEST SCOPES & MORE!

INSIDE THE WORLD OF DEEP-SKY OBJECTS

- BLACK HOLES CONVERGE AT COSMIC DAWN
- OBSERVE GALAXIES IN SCULPTOR
- NEXUS COMA CORRECTOR REVIEWED
- STEVE O'MEARA ON A BLACK RING IN CYGNUS

BONUS ONLINE CONTENT CODE p. 3

Vol. 52 · Issue 10

BLACK HOLE BUGALOO

JWST discovers a pair of black holes merging in the early universe.

BY RICHARD TALCOTT

WHEN THE JAMES WEBB SPACE TELESCOPE (JWST) first opened its eye to the universe in 2022, astronomers looked forward to gaining a fresh perspective on galaxy evolution. The powerful observatory has not disappointed. Perhaps the biggest surprise so far has been the telescope's discovery of a large population of active galaxies in the first billion years of cosmic history.

Active galaxies represent nature's way of turning darkness into light. At the heart of each of these energetic systems lies a black hole with a mass millions or billions of times that of the Sun. The beast's strong gravity pulls in nearby gas, creating an accretion disk that can reach a temperature of millions of degrees. This hot gas produces the intense radiation we see coming from these galaxies.

RECORD-SETTING DUO

Now astronomers have detected an ongoing merger between two extraordinarily distant active galaxies and their central black holes. The pair is so remote that the universe's expansion has shifted its light far to the red. The radiation JWST records has a wavelength 8.15 times longer than when it left the galaxies. This means all the visible light they emit ends up in the infrared part of the spectrum where the space telescope operates.

The system, known as ZS7, existed when the universe was just 740 million years old. This makes the galaxy pair both the most distant and the youngest known merging black holes.

Hannah Übler of the University of Cambridge in England led the team that made the discovery. The researchers analyzed the system's spectrum and found one source exhibits a broad line of neutral hydrogen, identifying it as a so-called Seyfert 1 galaxy. This radiation comes from a region close to its black hole where high-density gas moves fast. The team estimates this black hole contains about 50 million solar masses, making it more than 10 times larger than the Milky Way's central black hole.

The second source displays narrow lines of doubly ionized oxygen, which classifies it as a Seyfert 2 galaxy. These narrow lines originate from hotter gas located farther from its black hole. JWST's exquisite resolution places this black hole just 2,000 light-years from its neighbor. Dense gas obscures the black hole, though the team suspects it weighs about the same as the other.

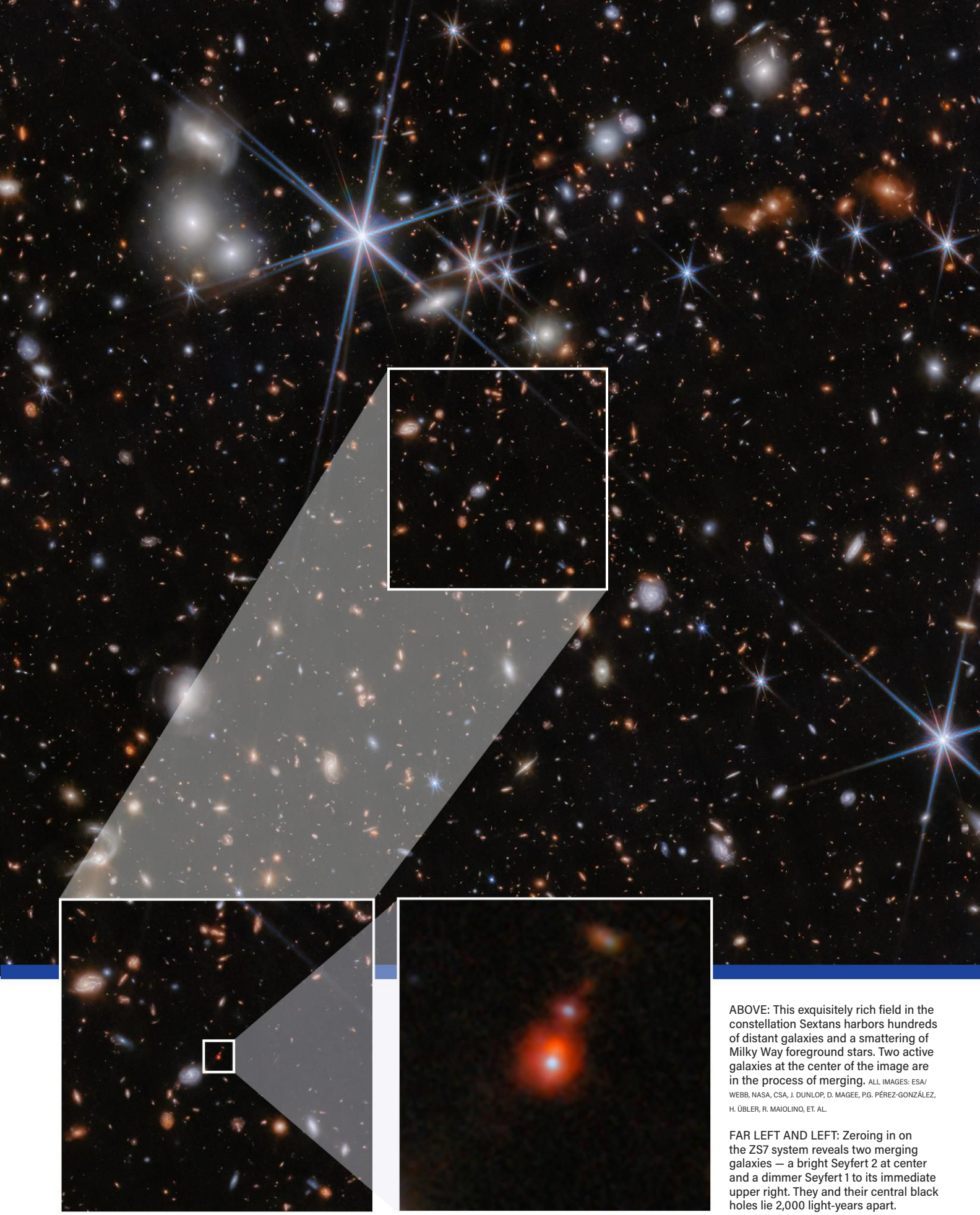
Both galaxies are rather small by Milky Way standards. They likely hold several billion solar masses of material, roughly equivalent to the mass of our galaxy's largest satellite, the Large Magellanic Cloud. JWST also found three fainter galaxies belonging to the ZS7 system, though they show no signs of activity.

DYNAMIC UNIVERSE

"Our findings suggest that merging is an important route through which black holes can rapidly grow, even at cosmic dawn," said Übler in a press release. The results will help scientists better understand the role these behemoths play in how galaxies evolved in the chaotic early universe.

The finding also will open up an exciting new dimension in multi-messenger astronomy. Merging black holes generate gravitational waves, and systems like ZS7 should be visible to future detectors such as the Laser Interferometer Space Antenna (LISA), currently scheduled for a 2035 launch. "Webb's results are telling us that lighter systems detectable by LISA should be far more frequent than previously assumed," says LISA Lead Project Scientist Nora Luetzgendorf of the European Space Agency. "This is just the tip of the iceberg."

Contributing Editor ***Richard Talcott*** *wrote about JWST's observations of globular star cluster NGC 6440 in the September issue.*



ABOVE: This exquisitely rich field in the constellation Sextans harbors hundreds of distant galaxies and a smattering of Milky Way foreground stars. Two active galaxies at the center of the image are in the process of merging. ALL IMAGES: ESA/WEBB, NASA, CSA, J. DUNLOP, D. MAGEE, P.G. PÉREZ-GONZÁLEZ, H. ÜBLER, R. MAIOLINO, ET. AL.

FAR LEFT AND LEFT: Zeroing in on the ZS7 system reveals two merging galaxies — a bright Seyfert 2 at center and a dimmer Seyfert 1 to its immediate upper right. They and their central black holes lie 2,000 light-years apart.