

Scoping out the final frontier —by Joel Achenbach

The bulletins from space arrive almost daily. More than 200 “extra solar” planets, far from our own solar system, have been found over the past dozen years. Most are “hot Jupiters”—gas giants in tight, scorching orbits. But just last April, astronomers said they’d found, mixed with the light of a nearby star, the signature of a planet that might be rocky like the Earth and orbiting at a distance at which liquid water and life could be possible. And in May 2007, astronomers at Harvard said they’d made a rough map of another extra solar planet that they believe has a big red spot and is buffeted by powerful, hot winds.

But behind all this stellar news is another headline: We are in the golden age of telescopes. We know what we know about SN 2006gy and Eta Carinae and all the rest because computer-aided telescopes, both on the ground and in space, have checked them out in multiple wavelengths, from the visible to the X-ray. And we’re seeing a more interesting, chaotic, and preposterously vast universe than anything Galileo could have imagined.

Space-based astronomy is a part of NASA’s space program that really works. Space science has been a great investment at a time when we’ve found so many ridiculous things upon which to waste billions of taxpayer dollars.

But the NASA science budget, currently \$5.5 billion, has leveled off after years of growth, and some major “scoping-out-the-universe” projects have already been put on the far back burner.

In coming years, policymakers will need to remember that telescopes give a big bang for the buck. Each new instrument changes our view of the universe. Go back to Galileo: His great revelation was not merely that Jupiter had some little satellites orbiting it, or that Venus had phases like those of the moon, or that the moon had features that looked like mountains, but that all of these things in the sky were worlds, that they were in the same general category of object as the Earth. Science has steadily removed us from our privileged position in the cosmic scheme of things. Are we really alone? Astronomy may give us the answer.

Last May, a remarkable object materialized on the Mall near the National Air and Space Museum in Washington, D.C. It was a mock-up of the James Webb Space Telescope, which is scheduled to be launched in 2013. The Webb looks ungainly with its 20-foot-diameter honeycomb-like mirror jutting above five layered sun shields that cover an area the size of a tennis court. To squeeze into the



The Hubble telescope drifts through space in a picture taken from the shuttle Discovery during Hubble’s second servicing mission, in 1997. This year, NASA will send a team 380 miles above Earth to service and improve the 16-year-old Hubble Space Telescope, which should continue operating until 2013. [Source: NASA, www.jpl.nasa.gov]



A model of the James Webb Space Telescope displayed on the Mall. [Source: www.nasa.gov.]

rocket at launch time, it has to be folded up. Then it'll have to unfold when it reaches its destination a million miles from Earth—more than four times the distance to the moon.

We need the Web and the Hubble to look into space not because a supernova may zap us, but because it's like a huge message written in code, daring us to read it. Why are we here? Why does the universe exist? What else—who else—is out there? These are simple questions, but they're not easily answered. Still, the information is there, inscribed in electromagnetic radiation that does us the great favor of crossing the universe and landing in the light buckets we call telescopes.

Light moves at tremendous speed, but it is still a finite speed, and thus when we look into space we are seeing the past. Telescopes are time machines. The deeper we look, the farther back in time we see. The Hubble Space Telescope can see all the way back to about one billion years after the origin of the universe. The Webb will look even farther.

"The Webb is going to blow us away in the way the Hubble has blown us away," predicts Matt Mountain, director of the Space Telescope Science Institute in Baltimore. "We're going to penetrate the infrared in a way we've never done before. The Webb will send us very high-resolution infrared images of the Dark Ages of the universe, when galaxies were forming, when the first stars were forming."

Two decades ago, the entire space astronomy program at NASA consisted of a single telescope called the International Ultraviolet Explorer. It had an 18-inch mirror. Since then, we've seen the deployment not only of the Hubble but also of such "Great Observatories" as

the Chandra, the Compton and the Spitzer, and smaller telescopes such as COBE and WMAP. These instruments look at the universe in different wavelengths; combine the images and you get amazing pictures that something like the Hubble alone couldn't make.

The next huge step would be to see an extrasolar planet directly -- not merely infer its existence from wobbles and quirks in a star's light. "We know how to do this," said Ron Polidan, chief architect for civil space for Northrop Grumman. "It's going to be hard. It's going to take a lot of effort. But there's no magic involved."

What's involved is a sun shade. It would be something that looked a bit like a daisy, maybe 10 or 20 meters across. It would need a propulsion system so that it could maneuver in space about 30,000 miles from the Webb. It would be, for the Webb, like a thumb held at a distance, blocking the light from a star. An occulter is what you call

it. The idea is to cover the starlight so precisely that any planets orbiting that star could still be visible.

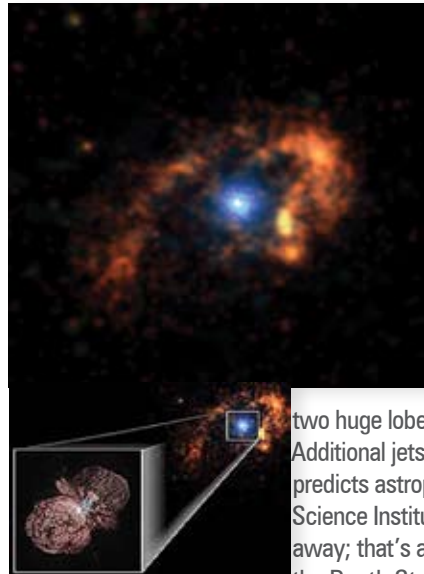
Then we could look for the signature of oxygen, ozone, carbon dioxide, nitrogen, maybe even chlorophyll. Or perhaps we'd see signs of car exhaust. Smog. We'd know that getting stuck in traffic is a cosmic fact of life.

And what of such things as that exploding star, our friend Eta Carinae. Here's what telescopes tell us: Eta Carinae has already spewed forth

two huge lobes of material. They're not coming our way. Additional jets of star stuff will follow the same trajectory, predicts astrophysicist Mario Livio of the Space Telescope Science Institute. Besides, Eta Carinae is 7,500 light years away; that's a pretty long hike. So don't worry. It looks like the Death Star doesn't have our number.

But we should keep our eyes open. A telescope is, after all, an artificial eyeball. Our eyes and brain capture and analyze electromagnetic radiation in a portion of the spectrum that we self referentially call "visible light." With telescopes, we have Superman vision. We have X-ray eyes and can see radio waves. Light at all these wavelengths is essentially immortal; a photon can travel from one side of the universe to the other without flagging.

The secrets of the cosmos are coming at us. All we have to do is look. ■



Center-page: Scaled image of Eta Carina taken by the Hubble Space telescope (bottom) and the much larger nebula discovered by the Chandra X-ray Observatory (top). [Source: www.nasa.gov.]



space shuttle
a.gov.]