Astronomers seek to explore the cosmic Dark Ages

October 15 2009, By Robert S. Boyd

No place seems safe from the prying eyes of inquisitive astronomers. They've traced the evolution of the universe back to the "Big Bang," the theoretical birth of the cosmos 13.7 billion years ago, but there's still a long stretch of time -- about 800 million years -- that's been hidden from view.

Astronomers call it the Dark Ages, and now they're building huge new radio telescopes with thousands of detectors that they hope will let them peer back into the period, when the first stars and galaxies began turning on their lights.

If they succeed, it will be an unprecedented, three-dimensional look at a previously unknown swath of the cosmic history. Some astronomers compare the venture to Galileo's first crude telescope.

"We are taking the same step that Galileo made when he introduced the optical telescope," said Lee Rickard, an astrophysicist at the University of New Mexico in Albuquerque, in an e-mail.

Colin Lonsdale, an astronomer at the Massachusetts Institute of Technology's Haystack Observatory in Westford, Mass., said the new detectors would provide "the first view of the cosmic Dark Ages and early structure formation in the universe."

For this voyage into deep time, astronomers are using radio telescopes because radio waves -- which are much longer and slower than light

waves are -- can pass through cosmic dust clouds that optical telescopes can't penetrate.

Furthermore, radio waves coming from such enormous distances are stretched, or "redshifted," toward the red end of the electromagnetic spectrum, where optical telescopes can't observe them.

Because far-off radio signals are so faint, and so easily confused with background interference, only the largest telescopes can even hope to do the job.

At least three major projects are under construction in the U.S., Europe and Australia. Even more ambitious ones are proposed, possibly including a telescope on the dark side of the moon.

The big three are:

• The Long Wavelength Array (LWA), which will consist of about 13,000 spindly antennas in the desert west of Socorro, N.M. The first 256 detectors arrived on site last week, and the completion date for the system is 2010.

The LWA is sponsored by the University of New Mexico, the Los Alamos National Laboratory, the Naval Research Laboratory and others.

• The Murchison Widefield Array (MWA) will have 8,192 antennas in the western Australia outback, an area of low population and modest radio interference. (It's also known as the Mileura Widefield Array because it's near the Mileura Station.)

"The race is on to get it all done in 2010," MIT's Lonsdale said.

The MWA is sponsored by MIT, the National Science Foundation, the

U.S. Air Force and the Australian Research Council.

• The Low Frequency Array (LOFAR) will consist of about 5,000 antennas stretching across northern Europe from a center in Holland. It's supposed to be finished in 2011.

LOFAR will detect "the first sources of light in the universe, the first stars and accreting black holes," said radio astronomer Rob Fender, a member of the LOFAR team from the University of Southampton, England. "These will be vital clues to the formation of galaxies and clusters, the building blocks of the universe today."

This array's prime sponsor is ASTRON, the Netherlands Institute for Radio Astronomy. Astronomers in England, France, Germany, Poland and Sweden are also involved.

These big new radio telescopes will be looking for faint radio waves from the time the universe was 380,000 to roughly a billion years old -- the Dark Ages. Astronomers aren't sure when that epoch ended.

The signals are coming from ancient hydrogen, which can be detected by a special line in the electromagnetic spectrum. Tiny variations in the hydrogen line indicate regions of slightly higher or lower density in the early universe. Over time, gravity accelerated the growth of these clumps, which became the seeds of the first generation of stars and galaxies.

Astronomers aren't sure whether their new machines will be able to detect luminous objects as they were forming during the Dark Ages, or only at the end of that epoch.

Lonsdale, the MWA investigator, said the Australian telescope should be able to collect signals with usable information "during, but not before"

the epoch at the end of the Dark Ages. "It will take a bigger array, perhaps on the moon, to see hydrogen from before," he said in an e-mail.

Rickard, the LWA executive director at the University of New Mexico, said that his project would be searching for hydrogen signals "from the Dark Ages." He cautioned, however, that success will be very difficult because "the brightness variation we are talking about is very small" and will be obscured by "very bright emission from our own galaxy," the Milky Way.

"We won't know until we try," Rickard said.

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ON THE WEB

Netherlands Institute for Radio Astronomy: www.astron.nl

The Murchison Widefield Array: www.mwatelescope.org

The Long Wavelength Array: lwa.unm.edu

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