venture funding to develop the technology, Burz says, before securing a one-year, \$452 000 grant from ARPA–E's robust affordable next generation energy storage systems (RANGE) program. The company invested \$113 000. NRL performed the development work as a subcontractor, receiving \$465 000 from EnZinc.

Moving away from lithium

Venkat Srinivasan, director of Argonne National Laboratory's Collaborative Center for Energy Storage Science, says the research "provides a first step toward saying maybe there's a different way for us to think about zinc." But Srinivasan, who was not involved in the work, cautions that many more charge–discharge cycles are needed to prove the technology's worth. "If you're going to compete with lithium–ion for a Nissan Leaf, we are talking maybe 1000 cycles. Somewhere between 100 and 1000, all sorts of bad things can happen. We have beautiful pictures from the 1970s and 1980s where after a few hundred cycles you look at the electrode and all the zinc will be sitting on the edges of the electrode, with nothing in the middle."

Debra Rolison, principal investigator of the NRL team, says the zinc sponge technology offers a safe alternative to lithium-ion for both military personnel and shipboard applications. In April the US Navy banned e-cigarettes from ships after several incidents in which the devices, which are powered by lithium-ion batteries, burst into flames. NRL is also developing silver–zinc batteries using the 3D sponge for submarine applications. Silver–zinc technology has been hindered by the same recharge limitations.

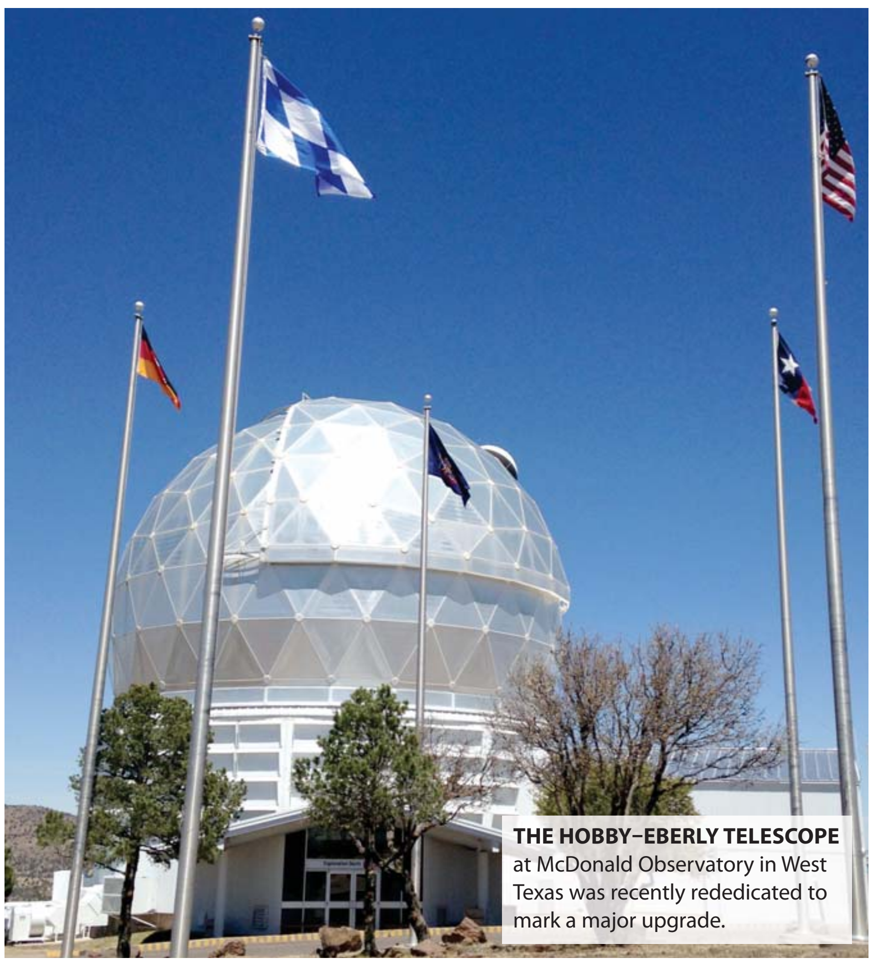
EnZinc's exclusive license from NRL covers the nickel–zinc battery for electric-vehicle and electricity-storage applications. Included in the vehicle sector are so-called microhybrids, whose engines automatically shut off and restart whenever the vehicle stops. More commonly found in Europe, microhybrids require only around a 5% battery discharge, compared with the 40–60% discharge typical of fully electric vehicles. NRL's stop–start prototype batteries have attained 50 000 cycles. Today's microhybrids use a class of lead–acid batteries, which are expensive and have limited lifetimes, says Burz. Up to half of all new vehicles could be microhybrids by 2020, according to some projections.

Burz says the company has lined up investors to finance continued development once the patent for the technology has been issued. The patent application was submitted in May 2014.

David Kramer

Hobby–Eberly Telescope eyes sky with new capabilities

Galaxy mapping, exoplanet searches, and more are getting started on the largest optical telescope on the US mainland.



TONI FEDER

THE HOBBY–EBERLY TELESCOPE at McDonald Observatory in West Texas was recently rededicated to mark a major upgrade.

On 9 April, McDonald Observatory in West Texas celebrated the reopening of its 10 m Hobby–Eberly Telescope (HET) after a roughly three-year shutdown for upgrades and the installation of \$40 million in instruments.

The telescope is located at an altitude of 2030 m on former mountain ranchlands some 300 km southeast of El Paso. Its primary mirror, made up of 91 hexagonal segments, is at a fixed angle and can rotate to access 70% of the visible sky. With its wide, 22-arcminute field of view, the HET is well-suited for carrying out surveys and hunting for planets.

In its new incarnation, the 20-year-old telescope hosts the Visible Integral-field Replicable Unit Spectrograph (VIRUS), the Habitable Zone Planet Finder (HPF), a low-resolution spectrograph for capturing data from weak sources over wide swaths of sky, and a high-resolution spectrograph for brighter sources. Campaigns to study dark energy and to search for potentially habitable planets will have more than half the observing time. The remaining time is open to competition by the telescope's four partners: the University of Texas at Austin, the Pennsylvania State University, the University of Göttingen, and Ludwig-Maximillians University of Munich.

So far 16 of 78 VIRUS modules have been installed. The full spectrograph, with 35 000 optical fibers, is slated to be up and running early next year. In the HET Dark Energy Experiment (HETDEX), astronomers use VIRUS to map galaxies in three dimensions at times going back 12 billion years to when the universe was 13% of its current age.

HETDEX collects light for 20 minutes from a given patch of sky. The telescope is then pointed at an adjacent patch. After three and a half years the instrument will have scanned the visible sky with uniform tiling. The "blind blanketing of the universe" as opposed to targeting is an advantage, says Karl Gebhardt of UT Austin, a leader in the experiment. "We get whatever the universe gives us, with no bias by selection."

Processing the data is not yet automated, so each night the HETDEX team pores through reams of data in search of white dots that could be galaxies; they show up as white dots because as star-forming hot spots they emit mostly at a single hydrogen wavelength.

The aim of HETDEX is to distinguish among cosmological theories about dark energy. Two of the leading theories are that dark energy is a cosmological constant or that it follows from a modification of gravity in Einstein's theory of general relativity. If it's a cosmological constant, says Gebhardt, HETDEX will find the value, and then it will be up to theorists to explain why it's a constant. But if dark energy is the result of a modification of gravity, "we can make important measurements. The galaxies would be either more or less clustered than predicted." HETDEX could also bolster or knock out other theories, such as that dark energy is a changing cosmological constant or that it's an illusion conjured by a nonuniform universe.

Among dark-energy experiments, HETDEX's extent and sensitivity let it look back the furthest in time and put the best constraint on the universe's expansion rate, Gebhardt says. Because the density of far-away galaxies is low, only about 5% of the light collected will contribute to the galaxy mapping. "There is a wealth of information in the other 95% of data," he says, "and no one has looked at that part of the universe. We will find massive black holes, star-forming galaxies, and more."

The other main observational campaign on the HET is a search for habitable planets with the HPF, led by Suvrath Mahadevan of Penn State. It targets red dwarf stars and looks for shifts in their velocities due to the gravitational pull of a companion planet. The instrument works in the near-IR, where red dwarfs are brightest. Light from the HET is carried to the instrument, which is housed at −90 °C in a basement beneath the telescope. The environment is controlled to better than submillikelvin precision.

"We will keep going back to the same stars," says Mahadevan. "It's a time-intensive survey, and that's why HET is so fantastic for this." Having a share in the telescope is a huge boost, he notes. Getting sufficient time on a large telescope like the Keck would not be possible.

Toni Feder PT