the absence of dark matter[3].

The EDGES researchers have now started another round of observations with a new, smaller antenna. They have "preliminary evidence" that this antenna also sees the original feature, says lead scientist Judd Bowman, an astronomer at Arizona State University in Tempe.

Competing experiments are also trying to reproduce the EDGES result. In April, Lincoln Greenhill, a radio astronomer at the Harvard–Smithsonian Center for Astrophysics in Cambridge, Massachusetts, flew to the arid Owens Valley in California to test a modified version of the Large-Aperture Experiment to Detect the Dark Ages (LEDA). The experiment — an array of antennas that look like umbrella frames — might have just missed the EDGES signal because it originally operated with filters that cut off frequencies above 82 megahertz. The EDGES signal seems to be centred at about 78 megahertz, so is very near the top of that range. The team is testing filters that allow detection of higher frequencies. If things go well, Greenhill says, it might take a few months to collect and analyse enough data.

Meanwhile, at the Raman Research Institute in Bangalore, India, Ravi Subrahmanyan and his colleagues have quickly built a version of their spherical antenna, called SARAS-2, that is sensitive to the range of the EDGES signal. They plan to deploy the new antenna in May at a site outside town, and to later move it to the Tibetan Plateau.

Places without radio interference are rare now, but "we might have the most radio quiet place on Earth", says physicist Jonathan Sievers at the University of KwaZulu-Natal in Durban, South Africa. The spot is on Marion Island, halfway to Antarctica, and the only way to get there is on a ship that goes once a year, in April. A small KwaZulu-Natal team led by physicist Cynthia Chiang installed its cosmic-dawn experiment, Probing Radio Intensity at High-Z from Marion (PRIZM), there last year. Chiang is now at the island station again, retrieving data from the past year and upgrading their telescope for new observations.

But one of the quietest places for radioastronomy in the Solar System would be the far side of the Moon. Jack Burns, an astrophysicist at the University of Colorado Boulder, is leading a proposal to put a 10-metre-long wire antenna on a small lunar orbiter. From there, the probe should detect not only the EDGES absorption feature, but also one from an earlier epoch known as the dark ages — before stars existed. The feature would appear at around 15 megahertz, a band that is not accessible from Earth. ■

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SYNTHETIC BIOLOGY

Genome-synthesis effort shifts focus

GP-write project to make virus-resistant human cell lines.

BY ELIE DOLGIN

A bold plan to synthesize an entire human genome has been scaled back to a more technically attainable near-term goal. Instead of synthesizing all of the human genome's 3 billion DNA base pairs, the project will now attempt to recode the genome to produce cells immune to viral infection.

Organizers of Genome Project–Write (GP-write), a global public–private partnership that includes around 200 scientists, announced the priority shift at a meeting in Boston, Massachusetts, on 1 May.

But even the downsized ambitions might be difficult to achieve soon, because the two-year-old effort still has no dedicated funding for what's estimated to cost tens, if not hundreds, of millions of dollars and last a decade or more.

"We thought it was important to have a community-wide project that people could get behind," says project co-leader Jef Boeke, a yeast geneticist at New York University. When the effort launched in 2016, the creation of a virus-resistant human cell line was listed as one of several pilot projects that would develop the technology to synthesize the full genome[1]. With the cell line now the focus, raising money should be easier, says Nancy Kelley, a biotechnology lawyer who is co-leading the effort with Boeke and George Church, a genome scientist at Harvard Medical School in Boston.

"It would be great if we accomplish the goals of GP-write entirely with pre-existing or unlabelled funds."

Onlookers generally approve of the priority shift. "This is a terrific idea," says Martin Fussenegger, a synthetic biologist at the Swiss Federal Institute of Technology in Zurich. "It's more geared toward utilities and applications" — not just DNA synthesis for its own sake, he adds.

A virus-proof human cell line would let firms make vaccines, antibodies and other biological drugs without risk of viral contamination. It could also help to make protein drugs with chemical ornaments similar to those in human proteins, to decrease the risk of the body's immune system rejecting them. However, the organizers' main goal is still to improve DNA technologies, not to create a particular product.

"The idea is to develop the technologies to do this very quickly and easily using a variety of gene-editing and synthesis techniques," says Harris Wang, a synthetic biologist at Columbia University Medical Center in New York City, and a member of GP-write's scientific executive committee. The "ultra-safe" human-cell-line project, Wang adds, has "the right level of complexity, difficulty and many different facets of design" to push those technologies forward.

One thing it doesn't have going for it, however, is much dedicated funding. Although a gene-editing technology company said it would donate technical expertise at the meeting, no financial backers have stepped forward.

Church estimates that the consortium has more than US$500 million in "related funding" — but he includes, for instance, $40 million earmarked for his own work on synthetic-biology projects including engineered bacteria and miniature organ-like structures. He also counts $23.4 million for an international initiative led by Boeke to synthesize the yeast genome. Both efforts started years before GP-write.

And the lion's share of the related funding is investment money raised by loosely affiliated biotech companies. Church includes it in his estimates not because the firms have given money to the effort, but because he is tabulating what he calls "a rough-draft market summary" of the gene-synthesis "ecosystem".

As such, he includes hundreds of millions of dollars collectively raised by eGenesis, a start-up that he co-founded in Cambridge, Massachusetts; Twist Bioscience in San Francisco, California, of which he is a shareholder; and Ginkgo Bioworks, a Boston synthetic-biology company that last year acquired another Church-backed venture, Gen9. And although leaders of eGenesis and Twist have been active in GP-write, Ginkgo senior management has not. "We're not involved in GP-write at all, and I'm surprised to see that they included us on that list of funding," says creative director Christina Agapakis.

Church defends his accounting. "It would be great if we accomplish the goals of GP-write entirely with pre-existing or unlabelled funds," he says. "Companies like Gingko are relevant independent of their formal ties."

When (and if) the consortium can secure funding for its ultra-safe human-cell-line project, the team plans to imitate previous efforts by Church's lab to recode the genome of *Escherichia coli* bacteria, making it resistant to viruses.

In that project[2], researchers swapped all 321 instances of one 3-letter genetic word, or codon, with another that conveys the same message. They then eliminated the gene that allowed the cell to read the original codon. This didn't much affect the redesigned microbe, but it did neutralize viral invaders because, like all natural life, they rely on that codon for proper protein assembly.

Extending this recoding technique to the human genome won't be easy. Repurposing just one codon across all 20,000 human genes will require hundreds of thousands of DNA changes. It might be easier to synthesize large swathes of the genome rather than edit letters one by one.

Church's team used synthesis in follow-up work[3] to recode seven codons in the *E. coli* genome. That effort needed close to 150,000 genetic changes, and it revealed unexpected design constraints and difficulties in stitching together DNA fragments. These have stymied efforts to make the reconstructed bacterium viable.

That should be a sobering reminder as the ultra-safe human-cell-line project gets off the ground, says Nili Ostrov, a postdoc in Church's lab who is leading the research. "In humans," she says, "there are going to be a lot of design rules that we just don't know." ■

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ENVIRONMENT

Brazil's lawmakers push to weaken environmental rules

Legislation includes proposals to open up the Amazon rainforest to agriculture.

NACHO DOCE/REUTERS

Trees taken in illegal logging operations in the Brazilian Amazon lie in piles at a sawmill.

BY JEFF TOLLEFSON

A conservative coalition that dominates Brazil's Congress is girding itself for a final push to roll back environmental regulations before campaigns for the country's October presidential election ramp up.

The legislation under consideration includes proposals to open up the Amazon rainforest to sugarcane farming — which was banned in 2009 over concerns about deforestation. Another proposal would weaken licensing requirements for infrastructure such as dams, roads and agricultural projects. But the rural–agricultural coalition behind the proposals is running up against public opposition that has thwarted previous efforts to loosen environmental rules.

Further complicating this fight is an ongoing corruption scandal that has landed former president Luiz Inácio Lula da Silva in jail. He was a leading candidate in this year's election before his conviction.

"There's this very delicate balance," says Mercedes Bustamante, an ecologist at the University of Brasilia. The conservatives have support from Brazilian president Michel Temer as well as the votes they need to move legislation through Congress, she says. Lawmakers could push forward, Bustamante adds, but they're wary about sparking a public backlash before the election.

Previous efforts to scale back protected areas and indigenous rights in the Amazon rainforest floundered as activist groups and celebrities mobilized public opposition.

The conservatives have had only one major success on the environmental-regulation front so far. In 2012, they revised the Brazilian law governing forests, making changes such as eliminating penalties for any illegal deforestation that took place in the Amazon before July 2008. Environmental groups challenged the constitutionality of the revised law, but in February Brazil's Supreme Court upheld those changes.

"It was the worst thing that could have happened," says Carlos Nobre, a climate scientist in São José dos Campos and former secretary for research and development at Brazil's Ministry of Science, Technology and Innovation. But he thinks the conservative coalition's broader environmental agenda has stalled and is unlikely to advance in the coming months.

Brazil was once seen as a global leader on environmental issues, in large part because of its success in curbing deforestation. Between 2004 and 2012, the annual amount of rainforest that was cleared for agriculture fell by nearly 84% to 4,571 square kilometres. Those numbers subsequently crept back up, peaking at 7,893 square kilometres cleared in 2016. However, deforestation dropped by 16% to 6,624 square kilometres in 2017, partly because of lower demand for beef and the restoration of law-enforcement funding, which had been cut during a prolonged financial crisis.

The environment will certainly be on the election agenda, says Bustamante, because Lula's first environment minister, Marina Silva, is one of the candidates.

Regardless of the outcome, the political dynamic in Brazil's Congress is unlikely to change, says Paulo Barreto, a senior researcher with the activist group the Amazon Institute of People and the Environment in Belém. The conservative coalition is strong, and Barreto thinks that it will stay in power. ■