Breakthrough Listen begins survey of the plane of the Milky Way at Parkes

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Breakthrough Listen – the initiative to find signs of intelligent life in the universe – announced today that a survey of millions of stars located in the plane of our galaxy, using the CSIRO Parkes Radio Telescope ("Parkes") in New South Wales, Australia, has commenced. Listen observations at Parkes began in November 2016, targeting a sample consisting mostly of stars within a few light years of Earth. Now, observations have expanded to cover a huge swath of the Milky Way visible from the site.

The expanded survey is made possible by new capabilities installed at Parkes by Breakthrough Listen: new digital instrumentation capable of recording the huge data rates from the Parkes "multibeam" receiver. The previous receivers used by Listen only observed a single point on the sky at a time, and were used to perform a detailed search of stars near to the Sun for evidence of extraterrestrial technology. In contrast, the multibeam receiver has 13 beams, enabling a fast survey of large areas of the sky, covering all of the Galactic Plane visible from the site.

In addition to the plane of the Milky Way, observations also cover a region around the Galactic Center, capturing data on one of the densest neighborhoods in the galaxy. This region contains a supermassive black hole, surrounded by tens of millions of stars within just a few light years' distance of the center. The chaotic environment at the very center of the galaxy is probably not well suited to the emergence of life as we know it, but the region surveyed by Breakthrough Listen covers a huge slice of the Milky Way, containing tens of billions of stars, including many that

lie between us and the galaxy's heart

The new digital instrumentation, installed by scientists and engineers from the University of California, Berkeley SETI Research Center (BSRC), expands the existing Breakthrough Listen back-end so that it can now handle 130 gigabits per second—thousands of times the bandwidth of even a fast home Internet connection. This represents over 100 million radio channels scanned for each of the 13 beams—one of the most comprehensive SETI (search for extraterrestrial intelligence) experiments carried out to date.

The survey commits the Parkes telescope to 1500 hours of observations in 2018, resulting in raw data volumes totalling almost 100 petabytes. Reduced data products for all observations will be archived for the long term, in addition to 1 PB of raw data products to be archived at the Pawsey supercomputing center in Perth. Data will then be searched for signals that have indications of artificial origin. The vast majority of such signals come from human-generated radio frequency interference (RFI) - satellites, airplanes, cellphones, and the like—and discriminating between RFI and signals of interest is the major challenge facing any SETI search. In addition to the search pipeline implemented by the BSRC team, Listen invites all those with the relevant technical expertise to contribute to developing signal detection and classification algorithms.

As well as improved survey speed, the multibeam receiver also enables better rejection of RFI, by allowing signals originating from Earthbound technology (typically appearing in multiple beams at once) to be distinguished from signals of interest that may be coming from distant points on the sky. Simultaneously, the Breakthrough Listen data will be searched for signatures of fast radio bursts (FRBs) - mysterious and powerful flashes of radio light seen by other experiments at Parkes, as well as by Listen's instrument on the Green Bank Telescope in West Virginia, USA.

"With these new capabilities," said Danny Price, Parkes Project Scientist with the Breakthrough Listen project at UC Berkeley, "we are scanning our galaxy in unprecedented detail. By trawling through these huge datasets for signatures of technological civilizations, we hope to uncover evidence that our planet, among the hundreds of billions in our galaxy, is not the only one where intelligent life has arisen."

Survey details:

- Total observing time: 1500 hours
- Galactic Plane survey: Galactic longitude -174 degrees to +60 degrees, and Galactic latitudes of 6.5 degrees above and below the plane (total area 3000 square degrees, or the equivalent of 15,000 full moons)
- Galactic Bulge: +/- 12 degrees in Galactic latitude and longitude
- Other targets including nearby dwarf galaxies, the Magellanic Clouds
- Frequencies covered: 1.23—1.53 GHz
- Sensitivity (5 minute integration, 3 Hz bandwidth): 420 mJy (8 sigma)
- Sensitivity to a transmitter at the distance of the Galactic Center: 4 x 1014 W equivalent isotropic radiated power (8 sigma) - 20 times the power of the Arecibo radar

Breakthrough Listen is a scientific program searching for evidence of technological life in the universe. It aims to survey one million nearby stars, the entire Galactic plane and 100 nearby galaxies at a wide range of radio and optical bands.

The Breakthrough Initiatives are a suite of scientific and technological programs investigating life in the universe.