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NEW LIMITS ON THE PRESENCE OF TECHNOLOGICAL CIVILIZATIONS IN THE UNIVERSE FROM BREAKTHROUGH LISTEN

Abstract

The Breakthrough Listen Initiative is a ten-year program that represents our most significant effort to date to quantify the distribution of technologically advanced life in the Universe. Listen uses some of the world's most powerful observing facilities (including the Green Bank Telescope - the largest steerable radio telescope in the world) to search for signatures of technology. Additional Listen facilities include the 64-meter Parkes dish in Australia, the Automated Planet Finder telescope in California, the South African MeerKAT array, the VERITAS Cherenkov Array, the Murchison Widefield Array and the International Low Frequency Array Stations in Birr, Ireland and Chilbolton, UK. Listen is also partnering with the Jodrell Bank Observatory, home to the 76-meter Lovell Telescope and e-MERLIN network, and China's 500m FAST telescope, the world's largest single dish. Additional facilities under development include the 64m Sardinia Radio Telescope, the m-wave and cm-wave facilities of the Nancay Radio Observatory (NenuFAR, NRT), the Nobeyama 45m mm-wave dish and the Cherenkov Telescope Array pathfinder telescopes.

Breakthrough Listen observational programs generically target radiation exhibiting spectral and temporal features that are inconsistent with known astrophysical backgrounds, consistent with emission that could be expected from technology and known to be capable of transiting interstellar or intergalactic

space without being absorbed or obscured. Examples of such signal types include spectrally and temporally confided radio emission (sinusoids and pulses) and monochromatic or pulsed infrared or optical laser emission. Listen is undertaking a detailed census of hundreds of nearby stars, in addition to casting a wider net across millions more stars, the entire plane of our Milky Way Galaxy, and additional galaxies beyond. Listen partners with interdisciplinary academic departments, government and industry to employ state-of-the-art data analytics and high performance computing.

Here we will describe the status of the Breakthrough Listen program, its observational facilities and data processing systems. Using observations conducted to-date, we will present limits on the presence of technologically capable life in the universe and describe how those limits are expected to improve as we undertake broader and more detailed searches in the future.