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SETI THROUGH FUTURE DEVELOPMENTS OF THE PARKES RADIO TELESCOPE

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Abstract

The Parkes 64m radio telescope, located in Central New South Wales, Australia, has been in operation since 1961. It is part of the CSIRO Australia Telescope National Facility (ATNF) and recognised as a Square Kilometre Array (SKA) Pathfinder. In 2015 a five year agreement was made with the Breakthrough Prize Foundation for the Parkes telescope to Search for Extra-Terrestrial Intelligence (SETI). This officially commenced in October/November 2016, with 25% of the telescope observing time dedicated to this project, with a purpose-built backend installed at the telescope. The data obtained in this project will be open access. The search for intelligent life elsewhere in the universe is one of the key science drivers of the SKA, and this agreement, combined with the state-of-the-art technology developments, will place Parkes at the leading edge of this research. A summary of the current status of the capabilities of the Parkes Radio Telescope in the context of SETI activities is presented, and the planned developments for the coming years outlined. This includes exploring the technologies appropriate for the SKA and efficient SETI searches: an Ultra-Wideband single pixel feed operating from 700 MHz to 4 GHz, and a cryogenically cooled Phased Array Feed operating in the region of 700 MHz to 2 GHz.

Keywords: Radio Astronomy, SETI, Parkes Radio Telescope

1. Introduction

The Parkes radio telescope (Fig. 1), known affectionately as ‘The Dish’, is located in central-west New South Wales in Australia, ~380 km west of Sydney, and has been in operation since 1961. It is a 64-metre parabolic antenna, with receiver systems capable of observing from 700-MHz to 26 GHz (with an effective diameter of 54m at the highest end), with bandwidths up to a GHz, and it operates as part of the Australia Telescope National Facility (ATNF).

The Dish has continued to be at the forefront of radio astronomy and technology research, having had many improvements, including a progressively upgraded dish surface to enable higher frequencies, a new focus cabin to extend the receiver capability (allowing two receiver installations simultaneously), and a number of scientifically productive receivers. This receiver suite has included the 13-beam 20cm multi-beam receiver [1] which enabled unprecedented surveys of atomic hydrogen in the Southern sky, and helped discover approximately half the known population of pulsars. In more recent years Parkes discovered the first Fast Radio Burst [2], and the majority since, and it surveyed the entire Southern Galactic plane for methanol masers, detecting over 1000 with a purpose built 7-beam receiver [3].

2. SETI with Parkes

By virtue of its Southern Hemisphere location, and large diameter, Parkes has a unique capability for searching our Galaxy, the Milky Way, for signs of

extra-terrestrial intelligence, with several projects undertaken in the past [4,5,6]. One such project, ‘Project Phoenix’, was initiated in February 1995, running for several months, observing 209 solar type stars [7]. This project utilised a dedicated receiver system, over a frequency range 1.2 to 3.0 GHz, looking for possible narrow band transmissions. The receiver technology was also used as part of a cooperative observing programme which led to the detection of a possible compound gravitational lens [8].



Fig. 1. The CSIRO Parkes 64-metre Radio Telescope

In 2015 an agreement was made with the Breakthrough Prize Foundation for 25% of the telescope observing time over a 5 year period starting October/November 2016 as ‘Breakthrough Listen’ [9]. Over the course of 2016 and the first half of 2017 new

computing hardware was installed in the telescope tower to enable both single-pixel observing and observing with the 13-beam 20-cm multi-beam system, with the intention to conduct the most comprehensive Southern hemisphere SETI search to date. Observations began with the existing single pixel systems at the end of 2016 and the multi-beam system in July/August 2017. Similar to the previous project, commensal science is planned, with the simultaneous operation of Fast Radio Burst detection software.



Fig. 2. The Ultra-wideband Receiver

3. Future Technology Developments

A number of technology developments are underway at Parkes that should enable leading edge SETI research. These include an Ultra-wide bandwidth single pixel receiver (see Fig. 2) operating between 700 MHz and 4 GHz, which was tested on dish in August 2017 and is due for full commissioning before the end of 2017 with an expected system temperature of ~22 K. In complement to this is a high-frequency counterpart, operating from 4 GHz up to ~25 GHz, which is currently under design. Both these receivers will be able to be housed simultaneously in one half of the focus cabin, enabling SETI searches to span the broad frequency range.

In addition to these single-pixel feeds, a cryogenically cooled Phased-Array Feed is under design, with a funding application submitted. This will be a significant improvement on the existing multi-beam system, providing approximately three times the field of view, with an even sensitivity across it.

4. Conclusions

The Parkes Radio Telescope has a long tradition of new technology enabling state of the art science research, and the current combination of the Breakthrough Listen project with new receivers will push the boundaries of SETI science.

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