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SKA1-Low Engineering

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The SKA Observatory will make use of an ambitious "Large N Array", termed SKA1-Low, to provide sensitive radio astronomy access to frequencies between 50 and 350 MHz [1]. This will complement the dish array, termed SKA1-Mid, which will offer access opportunities to the entire 350 MHz to 50 GHz band [2]. SKA1-Low will utilise some 131,072 broad-band antennas organised into 512 stations, each of about 38m diameter. The configuration of stations is logarithmically distributed with radius beyond a densely packed core of about 700m diameter as shown in Figure 1. Within each station, the 256 antenna elements are randomly distributed and a station beam-former is used to form one dual polarisation beam spanning 300 MHz. Alternatively, multiple full-station beams may be generated with reduced bandwidth or multiple sub-station beams may be generated that individually utilise fewer of the available antenna elements. In this way, it is possible to generate and correlate up to 2048 simultaneous "virtual stations" that sample down to arbitrarily small station separations, albeit with reductions in the processed bandwidth. The overall sensitivity of SKA1-Low is about an order of magnitude greater than today's state-of-the-art and it is being constructed on what has been found to be the most radio quiet, yet accessible site on the planet, the Murchison Shire of Western Australia. These exceptional site characteristics are also protected for the coming decades via rigorous national and regional legislation [3]. The array configuration provides a uniformly high sensitivity (about half the "natural" array sensitivity) over a very wide range (about 500:1) of angular scales. Both the instantaneous and tracking image quality will be one to two orders of magnitude better than existing arrays, allowing superb imaging of complex celestial sources as well as precise characterization of the bright foreground source populations that must be modeled to allow the faintest, diffuse targets, such as neutral hydrogen shells during the Epoch of Reionisation [4], to be directly imaged.

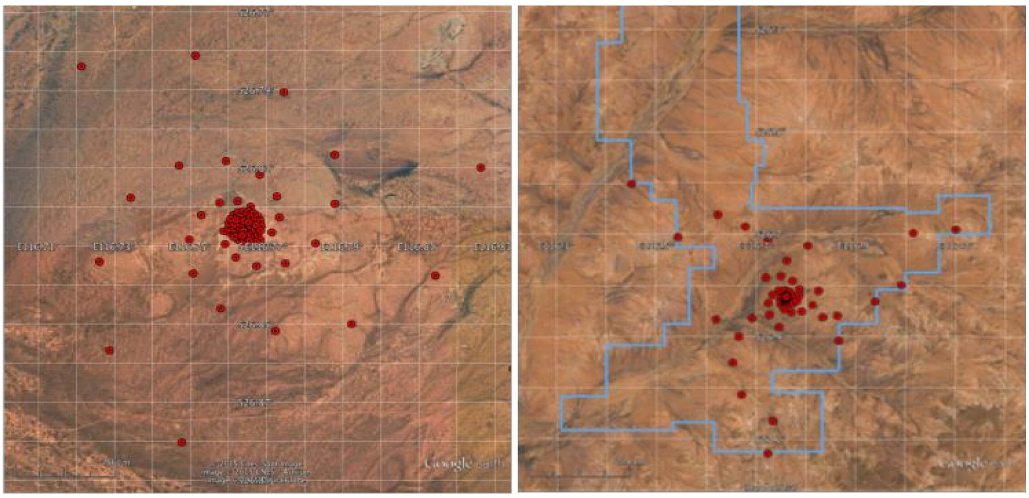

Figure 1. The distribution of SKA1-Low stations. A denesely packed central core of about 700m diameter is embedded in a tighly wound three-arm logarithmic spiral (left), while on larger scales a distorted three-arm logarithmic spiral provides baselines up to about 65km (right).

1. P. Dewdney et al. "SKA1 System Baseline Design", SKA-TEL-SKO-0000002-Rev03, 2016.

2. R. Braun et al. "Anticipated SKA1 Science Performance", SKA-TEL-SKO-0000818, 2017.

3. C. Wilson, M. Storey, T. Tzioumis, "Measures for control of EMI and RFI at the MRO", APEMC, 2013.

4. L. Koopmans et al., "The Cosmic Dawn and Epoch of Reionisation with SKA", Proc. AASKA, 2015.