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Short-Term Stability of RF Clock Signal Distribution System Over Different Optical Fibres

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Abstract: The Square Kilometre Array (SKA) and MeerKAT telescope networks rely on highly stable and precise Radio Frequency (RF) clock tone used as timing and synchronization signals transmitted over optical fibre from a central point to remote antennas. The distribution system of an RF clock signal over optical fibre occurs in stages: optical clock signal generation, transfer over optical fibre, receiving of optical signal and conversion to electrical signal; ensuring the signal maintains a certain level of frequency stability for successful operation of the telescope. This is problematic as there is phase deviation introduced as the signal propagates along the optical fibre associated with a change in time delay resulting in a decrease of frequency stability. The phase fluctuation is due to intensity noise, optical fibre loss and chromatic dispersion that is associated with carrier wavelength, transfer distance, and the coefficient of chromatic dispersion respectively. In this work, the received power dependent short-term instability induced on RF clock signal during transmission of different optical fibre types was measured and analysed in the frequency domain. The RF clock tone phase noise at 10 kHz offset frequency was measured as – 108.13 dBc/Hz. Upon transmission over a 22.3 km cabled G.652.C optical fibre and a 23.8 km G.655 spool the phase noise at 10 kHz offset frequency increased to – 105.35 dBc/Hz and – 103.00 dBc/Hz, respectively.

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PhD

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