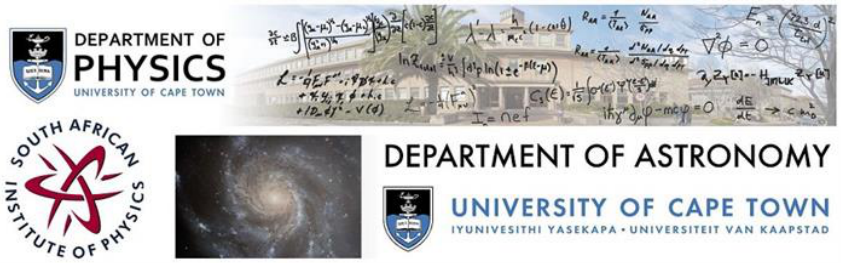

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Effect of 1.712 GHz RF-Clock Signal Distribution on 10 Gbps 1550.89 nm VCSEL Based Transmission over Single Optical Fibre for Square Kilometre Telescope Array

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Abstract content
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Distribution of timing and frequency reference signals from the central science processor station to each of the antenna array over optical fibre is of extreme importance to overall Square Kilometre Array (SKA) project. Clock tones are used for data time-stamping, as well as other monitoring and control functions that ensures the telescope array maintains phase coherence during an astronomical observation. After a fast, high resolution sampling process, individual dishes collect enormous amount of data which needs to be transmitted back to the central processor station. The current telescope array network distributes clock tones to digitizers at individual dishes over optical fibres. The collected data from these remote antennae is then transmitted over separate optical fibres back to the processor centre. This does not only increase the complexity in the telescope array network, but also increases the fibre deployment cost due to large amounts of optical fibres required in such a network. In this work, we experimentally demonstrate a cost effective bidirectional VCSEL based clock tone distribution and data transmission over single optical fibre for a telescope array network. A 10 Gbps VCSEL was modulated with a 1.712 GHz RF-clock signal and tuned to achieve different wavelengths by varying its bias current from 4.95 mA to 5.68 mA. Its effect on a 10 Gbps 1550.89 nm VCSEL based transmission at 8.5 mA bias current was then studied for 50 GHz, 75 GHz and 100 GHz channel spacing, at counter propagation direction. A negligible RF-clock interference penalty of 0.07dB, 0.05 dB, and 0.04 dB was incurred for 50 GHz, 75 GHz and 100 GHz channel spacing respectively. Results from this work show that the two signals can be integrated successfully over a single optical fibre without any remarkable interference penalty on the transmitted data, even at a small channel spacing of 50 GHz

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