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Astigmatic mode mismatch sensing for the next gravitational wave detectors.

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One of the main limits of the Quantum Noise Reduction in Gravitational Wave detectors is the optical losses generated by the mismatch between the vacuum squeezed beam and the resonant cavities of the interferometer. In order to correct those aberrations, we need to be able to measure them. For this reason, different efforts have been made to develop wave-front sensing techniques to measure the mismatch between optical cavities.

However, the current technologies based on spherical Gaussian beams are not enough for the next generation of Gravitational Wave Detectors. In fact, the higher requirement on the optical losses imposes to compensate also the mode-matching generated by astigmatic aberrations, so a new generation of wavefront sensor technique is needed.

Here we will present an upgrade of the Mode Conversion Telescope technique that extends the mismatch measurement from the only symmetric aberrations to a complete characterisation of the mismatch between an astigmatic Gaussian beam and a resonance cavity. This extension uses four additional Quadrants Photodiodes sensors to detect the beat note between the Sidebands of the TEM00 and the second-order Hermite-Gauss mode TEM11 of the carrier. In particular, we will describe the method and present the first experimental results of this technique.

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