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Optimizing Hartmann Wavefront Sensor performances for direct measurement of optical aberrations.

Increasing the sensitivity of gravitational wave detectors is a highly complex challenge which requires their stable operation at progressively higher power levels. Optical power absorption in the Fabry-Perot cavities leads to thermally induced aberrations that, if not compensated, degrade the interferometer's performance. Therefore, the measurement and correction of these optical aberrations stand as one of the key technological challenges for the operation of gravitational wave interferometers. The Virgo-ET research group at the University of Rome "Tor Vergata" is actively involved in the development of the Thermal Compensation System (TCS), designed to measure and mitigate optical aberrations, to meet the highly demanding requirements of future detectors such as Einstein Telescope.
Currently, in Advanced Virgo, direct wavefront monitoring is performed by the Hartmann Wavefront Sensor (HWS), a differential measurement device developed in collaboration with the LIGO group at the University of Adelaide (AU). To meet the demands of next-generation detectors, a new HWS has been designed featuring a CMOS sensor. Testing has confirmed that the new system achieves a wavefront reconstruction accuracy ≤ 0.4 nm RMS.
This presentation will describe the Hartmann Wavefront Sensor ongoing improvements in preparation for its use in third-generation detectors.

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