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Advanced Optics Research in Gravitational Wave Detection

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The detection of gravitational waves has opened a new era in astrophysics, providing unique insights into some of the most energetic events in the universe. Central to the success of detectors such as Virgo and LIGO are advanced optical technologies that enable unprecedented sensitivity and precision.

As we push for higher laser power to reduce shot noise and improve detector sensitivity at high frequency, power-induced optical aberrations become a significant challenge. Adaptive optics systems are essential in compensating for these aberrations. The concepts behind the system that monitors and actively corrects aberrations in current and future detectors will be reported.

Furthermore, the development of materials for ultra-low-loss optical coatings and substrate that minimize thermal noise in the sensitivity curve bucket will be presented.

By advancing our understanding and application of these optical technologies, we can pave the way for next-generation observatories. These improvements not only will allow higher detection rate but also enable the observation of fainter and more distant sources, thereby expanding our understanding of the universe.

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