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Straylight suppression with tunable coherence in a power-recycled Michelson at 10 Hz

As straylight is an important limitation for the sensitivity of gravitational wave detectors, we investigate new laser operation concepts and interferometer topologies for a more straylight-resilient detector configuration. Our focus is the use of tunable coherence realized by phase modulation following a pseudo-random-noise (PRN)-sequence on the interferometer laser. This breaks the coherence of the delayed straylight reducing its intrusive impact with the remaining coherence length only depending on the PRN frequency. Thus, effectively realizing a pseudo white-light interferometer with tunable coherence length.

After successful demonstration in a Michelson interferometer and optical cavity, we now optimized our setup of a power-recycled Michelson interferometer. With this, we present successful suppression of straylight by more than 50 dB at 10 Hz. Further, relying on the resonant enhancement inside a cavity, we demonstrate the reduction of coherence length down to the wavelength scale by using a PRN frequency of up to 10 GHz.

Combining these results, we discuss what constrains a potential implementation for straylight reduction in the Einstein Telescope.

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