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Telescopes for a Space-Based Gravitational Wave Observatory SHANNON SANKAR, NASA/GSFC/USRA/CRESST, JEFFREY LIVAS, NASA/GSFC — Telescopes are an important part of the science measurement for a space-based gravitational wave observatory. The telescopes should not introduce excess phase noise which might lower the signal-to-noise of the gravitational wave signal. This requirement constrains both the telescope stability and the phase noise due to scattered light. The photoreceiver senses a combination of a local beam, the received beam and scattered light. If the scattered light has significant spatial overlap, and if there is displacement noise in the scatter path, the signal-to-noise of the main measurement can be impacted. We will discuss our approach to addressing this concern. We model the scattered power from the telescope under expected conditions and use these models for evaluating potential telescope designs. We also determine allowable mirror surface roughness and contamination levels from the scattered light models. We implement the best designs by fabricating a series of prototype telescopes of increasing flight readiness, using eLISA as a reference mission for design specifications. Finally, we perform laboratory tests of the fabricated prototype telescope to validate the models and inform our understanding of the eventual flight telescopes.

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