

# ET test masses parameter estimations through Virtual Mirror Maps.

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“The sensitivity goal of the Einstein Telescope is to achieve a minimum of tenfold improvement over second-generation interferometers, transitioning from  $Z=2$  to  $Z=100$ . Attaining this precision requires meticulous attention to parameter specifications for the Test Masses. Beam distortions and light scattering significantly influence signal quality, requiring detailed information on surface specifications.

While substrate material and mirror size have already been determined, close-up details about surface specifications are now crucial. In our efforts, we take the initial steps in this direction. Utilizing a blend of Zernike basis and PSD (Power Spectral Density) analyses, we generate a set of Virtual Mirror maps. These maps provide robust statistical insights into the mirror requirements.

By assessing the performance of these virtual optics through simulations, we can predict the modal content of the beam and tailor mirror surface parameters to achieve the desired sensitivity. We construct these virtual maps using surface data from Advanced LIGO and Advanced Virgo, providing a realistic reference point for our research.

Our work address the ability pf well-known mathematical tools to generate realistic mirror surfaces and assesses the performance of virtual mirrors to align with the ambitious goals of the Einstein Telescope.”

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