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Techniques to extend the reach of ground based gravitational wave detectors

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While the current generation of advanced ground based detectors will open the gravitational wave universe to observation, ground based interferometry has the potential to extend the reach of these observatories to high redshifts. Several techniques have the potential to improve the advanced detectors beyond design sensitivity, including the use of squeezed light, upgraded suspensions, and possibly new optical coatings, new test mass materials, and cryogenic suspensions. To improve the sensitivity by more than a factor of 10 compared to advanced detectors new, longer facilities will be needed. Future observatories capable of hosting interferometers 10s of kilometers long have the potential to extend the reach of gravitational wave astronomy to cosmological distances, enabling detection of binary inspirals from throughout the history of star formation.