

Holometer User's Manual: Interferometer Algebra
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ABSTRACT

Holographic theory suggests that physics changes radically at the Planck length. Black hole and string theories theorize that at such small length scales the universe is holographic, with reality existing in two dimensions with the third dimension conjointly linked with time. The Fermilab Holometer is an experiment designed to investigate the nature of space-time on these Planckian length scales. The Holometer is an extremely sensitive laser interferometer that, upon completion, will surpass the sensitivity of the GEO600 and LIGO gravitational wave detectors. At such high sensitivities, the Holometer should detect holographic fluctuations in space-time. The experiment uses two power-recycled interferometers in close proximity of their causal space-time diamonds in order to see correlated holographic noise. In order to understand the power response of the power-recycled interferometers, the equations for the electric fields within the interferometers were derived. These derivations can be understood and utilized in a high school setting being that the highest order of math needed is an algebra background with knowledge in basic complex numbers. With these derivations, one can also investigate various properties of the interferometer such as the power output at the antisymmetric port, the finesse of the lasers, and power spectrum of the holographic noise.