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Gravitational Wave Detection: Past, Present and Future

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The direct detection of gravitaitonal waves (GWs) offers a revolutionary new probe of the most energetic processes in the universe and precision tests of fundamental theories of gravity. Through their detailed waveforms, GWs carry information about their parent neutron stars, supernovae and black holes, opening a window to the unexplored strong-field, strong-curvature regime of general relativity.

Several techniques and collaborations are vying to make the first direct detection within the next 5 to 10 years. In this talk, I will describe: 1. the first-generation, kilometer scale LIGO and Virgo interferometers that have demonstrated the sub-attometer displacement sensitivity (< 10ˆ{-18} m/ Hzˆ{1/2}) and continuous operation (> 75\% duty factor) needed to detect GWs from beyond the Virgo cluster; 2. the Pulsar timing arrays that have demonstrated the sub-microsecond timing residuals and multi-year observations needed to detect a passing GW's effect; and 3. the detection of the of a GW's imprint on the polarization of the cosmic microwave background.

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