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From Einstein's Theory to Gravity's Chirp

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The tortuous journey from theoretical suspicions to direct detection of gravitational waves took a hundred years and followed a crooked course. The field equations of general relativity evidently have wave-like solutions, but physical reality of these implied waves was doubted by many — including Einstein himself — for nearly fifty years. The question of physical reality was settled theoretically by the late 1950s, but for several more decades serious questions remained about what types of astrophysical systems might generate gravitational waves, and with what energies. The discovery of binary pulsar PSR B1913+16 led to dedicated development of much more accurate pulsar timing techniques, and results of these experiments motivated further theoretical work to clear up the quantitative questions about energy generation. By the late 1980s the generation of gravitational waves by the Hulse-Taylor binary pulsar was firmly established to be in quantitative agreement with general relativity. This experimental proof was almost surely a prerequisite for the funding of LIGO, the Laser Interferometer Gravitational-Wave Observatory, in 1992, which after nearly another quarter century achieved the first direct detection of gravitational waves.