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Listening to the Universe with Next Generation Ground-Based Gravitational-Wave Detectors

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Upgrades in instrumentation and technology over the next five to ten years will enable the LIGO and Virgo detectors to explore gravitational-wave sources with higher fidelity and the potential to make phenomenal new discoveries. To realize its full potential gravitational-wave astronomy would require the construction of new facilities that can host increasingly improved instrumentation for a period of ~ 50 years. In this study, we use simple performance metrics to assess the science capabilities of planned and future networks. These metrics all refer to coalescences of binary neutron stars and black holes and include: (i) network detection efficiency and detection rate of cosmological sources and their number densities as a function of redshift, (ii) signal-to-noise ratios and the accuracy with which intrinsic and extrinsic parameters would be measured, and (iii) enabling multimessenger astronomy with gravitational waves by accurate 3D localization and early warning alerts. We will in addition discuss the science enabled by the small population of loud and rare events. While imminent upgrades will provide impressive advances in all these metrics, future observatories of Cosmic Explorer and Einstein Telescope, currently being planned, will realize the full potential of gravitational-wave astronomy over the next two to three decades and observe coalescing compact binaries from epochs before the formation of first stars, should they exist.

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Classifica Sessioni: Recorded talks: Third Generation Design

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