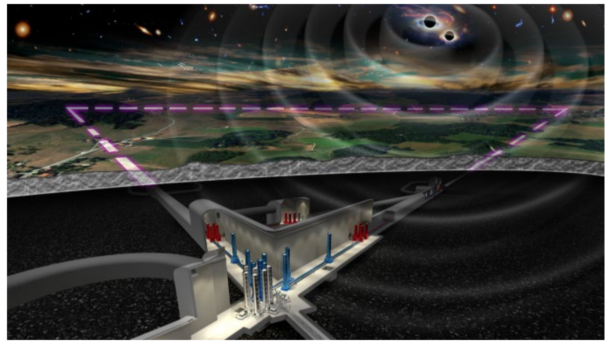
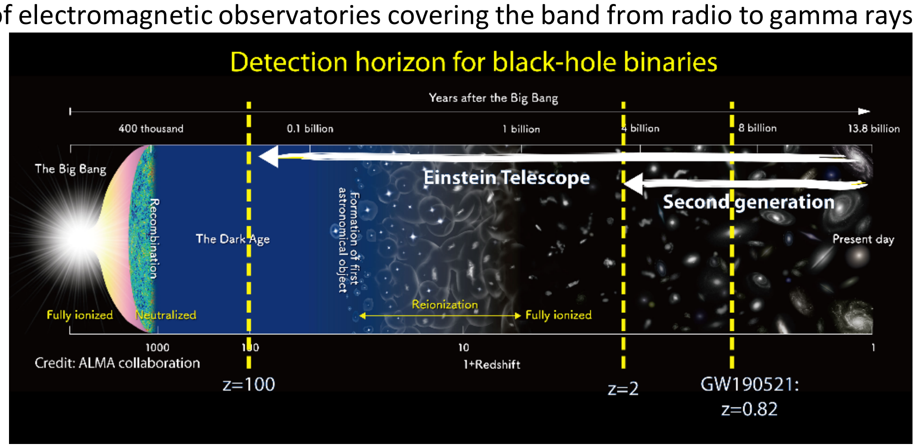
The Einstein Telescope (ET) is a proposed underground infrastructure to host a third-generation, gravitational-wave observatory. It builds on the success of current, second-generation laser-interferometric detectors Advanced Virgo and Advanced LIGO, whose breakthrough discoveries of merging black holes (BHs) and neutron stars over the past 5 years have ushered scientists into the new era of gravitational-wave astronomy. The Einstein Telescope will achieve a greatly improved sensitivity by increasing the size of the interferometer from the 3km arm length of the Virgo detector to 10km, and by implementing a series of new technologies. These include a cryogenic system to cool some of the main optics to 10 – 20K, new quantum technologies to reduce the fluctuations of the light, and a set of infrastructural and active noise-mitigation measures to reduce environmental perturbations.



The Einstein Telescope will make it possible, for the first time, to explore the Universe through gravitational waves along its cosmic history up to the cosmological dark ages, shedding light on open questions of fundamental physics and cosmology. It will probe the physics near black-hole horizons (from tests of general relativity to quantum gravity), help understanding the nature of dark matter (such as primordial BHs, axion clouds, dark matter accreting on compact objects), and the nature of dark energy and possible modifications of general relativity at cosmological scales. Exploiting the ET sensitivity and frequency band, the entire population of stellar and intermediate mass black holes will be accessible over the entire history of the Universe, enabling to understand their origin (stellar versus primordial), evolution, and demography. ET will observe the neutron-star inspiral phase and the onset of tidal effects with high signal-to-noise ratio providing an unprecedented insight into the interior structure of neutron stars and probing fundamental properties of matter in a completely unexplored regime (QCD at ultra-high densities and possible exotic states of matter). The excellent sensitivity extending to kilohertz frequencies will also allow us to probe details of the merger and post-merger phase. ET will operate together with a new innovative generation of electromagnetic observatories covering the band from radio to gamma rays (such as the Square Kilometer Array, the Vera Rubin Observatory, E-ELT, Athena, CTA).



With a successful ESFRI proposal, the project will enter its preparatory phase, which foresees the beginning of construction in 2026 with the goal to start observations in 2035. Two candidate sites are under investigation: one in Sardinia and one in the Euregio Meuse-Rhine. Site-characterization studies are under way towards a site selection, which is expected for 2024. The evaluation of the sites must consider the feasibility of the construction and predict the impact of the local environment on the detector sensitivity and operation. The gravitational-wave community in the US is currently working on its own third-generation detector concept Cosmic Explorer (CE) towards a future global detector network with the Einstein Telescope.