A.1.1 Title

Enabling Einstein Telescope

A.1.2 Abstract (max. 300 words)

Gravitational-wave observations have opened up a new way to observe the Universe and to shed light on its constituents. With LIGO and Virgo we now observe signals of merging compact objects (black holes and neutron stars) on a routine basis, providing unprecedented insights into gravitation, astrophysics, astronomy, and nuclear physics. In 2021 the next generation European gravitational-wave observatory, the Einstein Telescope (ET), was admitted to the ESFRI roadmap. In 2022 the Dutch government made a 870 million Euro commitment towards the construction costs in case ET will be approved and built in the border region of The Netherlands, Belgium and Germany.

ET has an undisputed and spectacular science potential, providing a hundred thousand to a million of observations per year, many of which with an extremely high signal-to-noise-ratio and spanning the whole universe, even back to the 'dark ages' before the first stars and galaxies were formed.

The unprecedented sensitivity of ET is relies on a variety of new technologies and data analysis ideas that go far beyond the state-of-the-art in LIGO-Virgo. Urgent research and development is needed, to ensure a timely and successful construction of ET and to be able and ready to analyse the ET data streams. Here we (as the nationally coordinated Nikhef Gravitational Wave Program) propose to step up to this opportunity, by developing ultra low-noise techniques for mirror materials and coatings, cryogenic cooling of the mirrors, seismic sensors and isolation, innovative control techniques, as well as high-accuracy calibration techniques and data analysis tools to cope with long and overlapping signals.

This program will allow us to match the Dutch leadership ambitions for hosting the Einstein Telescope, with also taking leadership positions in the critical detector instrumentation and data analysis efforts (with all their innovation potential and economic impact).