

Towards Advanced Virgo Plus

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Advanced Virgo Plus is the upgrade of the Advanced Virgo detector that will be implemented in two phases, the first one between the LIGO-Virgo observing runs O3 and O4 and the second one between the observing runs O4 and O5. This upgrade should allow to go beyond the design sensitivity of Advanced Virgo and to observe coalescing neutron stars binaries at distances in the range of 250 Mpc.

During Phase 1 the signal recycling cavity will be operated in parallel with a moderate increase of the laser power. These two steps will be done in parallel with the first test of a Newtonian noise cancellation system and the installation of the hardware required to move progressively from the current frequency independent squeezing to the more sophisticated frequency dependent squeezing. These upgrades have to be implemented during a short period of time that will last about one year.

Phase II will consist of a more invasive upgrade including the replacement of some of the main interferometer test masses with larger ones weighting about 100 kg. These new test masses will be coated with the best available materials at that time in order to reduce thermal noise. An R&D program aiming at reducing coating thermal losses is part of the project and will already start in Phase I. The realization of such large test masses also requires an upgrade of the facilities and tools at the Laboratoire des Matériaux Avancés in Lyon, the Virgo laboratory that has been producing the large mirrors for all laser interferometer gravitational waves observatories. Larger test masses will allow to use large optical beams thus reducing further the mirror thermal noise. This will require to revisit the interferometer optical configuration in a manner to maximize the thermal noise reduction while minimizing the detector downtime.