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Advanced Virgo+ Status and Perspectives

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The Virgo detector contributed to the observations in the O3 observing run and increased its sensitivity from the initial 46 up to 60 Mpc during the run.

The detector has undergone to a series of improvements since the end of the O3 observing run in view of O4, that will last 18 months, at present planned to start on 24 May 2023 preceded by an engineering run.

The major upgrades with respect to the Advanced Virgo configuration are the implementation of an additional recycling cavity at the output of the interferometer –the Signal Recycling cavity (SRC) –to broaden the sensitivity band and the Frequency Dependent Squeezing (FDS) to reduce quantum noise at all frequencies, and a new higher power laser.

The interferometer is still in the commissioning phase and some criticalities have emerged mainly due to the presence in Virgo of marginally stable cavities with respect to the stable recycling cavities present in the LIGO detectors, which increases the difficulty in controlling the interferometer in presence of defects as those introduced by the higher power on the mirrors.

A new stop of about 2 yr is planned between O4 and O5 starting in 2027, to implement new upgrades (phase II). The more invasive change, to improve the behaviour at high power, is the installation of larger and heavier new generation mirrors with the consequences on suspensions and a more powerful laser. The aim is to reach a 200Mpc sensitivity.

Plans are being made for the post-O5 period as a bridge between 2nd and 3rd generation detectors and a new collaborative effort has born under the name of Virgo_nEXT with the aim to keep and push the infrastructure and maintain alive the community.

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