

Seismic shock damper: New in-air seismic attenuation system for the Advanced Virgo gravitational wave detector

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The Virgo gravitational wave detector near Pisa Italy is a Michelson interferometer, whose arms are 3km long Fabry-Perot cavities. Currently, a large upgrade of the detector is being undertaken to increase its sensitivity by a factor 10 and its expected detection rate by a factor 1000! This enhanced detector is known as Advanced Virgo. Together with its American counterpart, Advanced LIGO, it will start the era of gravitational astrophysics.

During the combined commissioning and science run of Virgo in 2010, an extensive noise study revealed that some of the injection/detection optics on the external injection bench (EIB) made a significant contribution to the Virgo noise budget. Resonances of the EIB were excited by seismic ground motion and introduced a significant amount of beam jitter between 10 and 100 Hz and between 200 and 300 Hz. This beam jitter would limit the sensitivity of Advanced Virgo and needs to be reduced to allow the detector to reach its full potential.

Therefore, a new support structure that will isolate the EIB from seismic ground motion in six degrees of freedom has been constructed and tested at Nikhef. The system uses passive mechanical filters (inverted pendulums and geometric anti-spring filters) and feedback to obtain the desired level of isolation while operating in air. The isolation capabilities of the system have been measured up to 400 Hz with a setup that uses piezoelectric crystals to shake to base of the system. All requirements set by the collaboration are met and the system will be installed in November 2013. We will give an overview of the system and show the performance we have achieved with an emphasis on its seismic attenuation capabilities that we measured with our piezoelectric shaker setup.

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