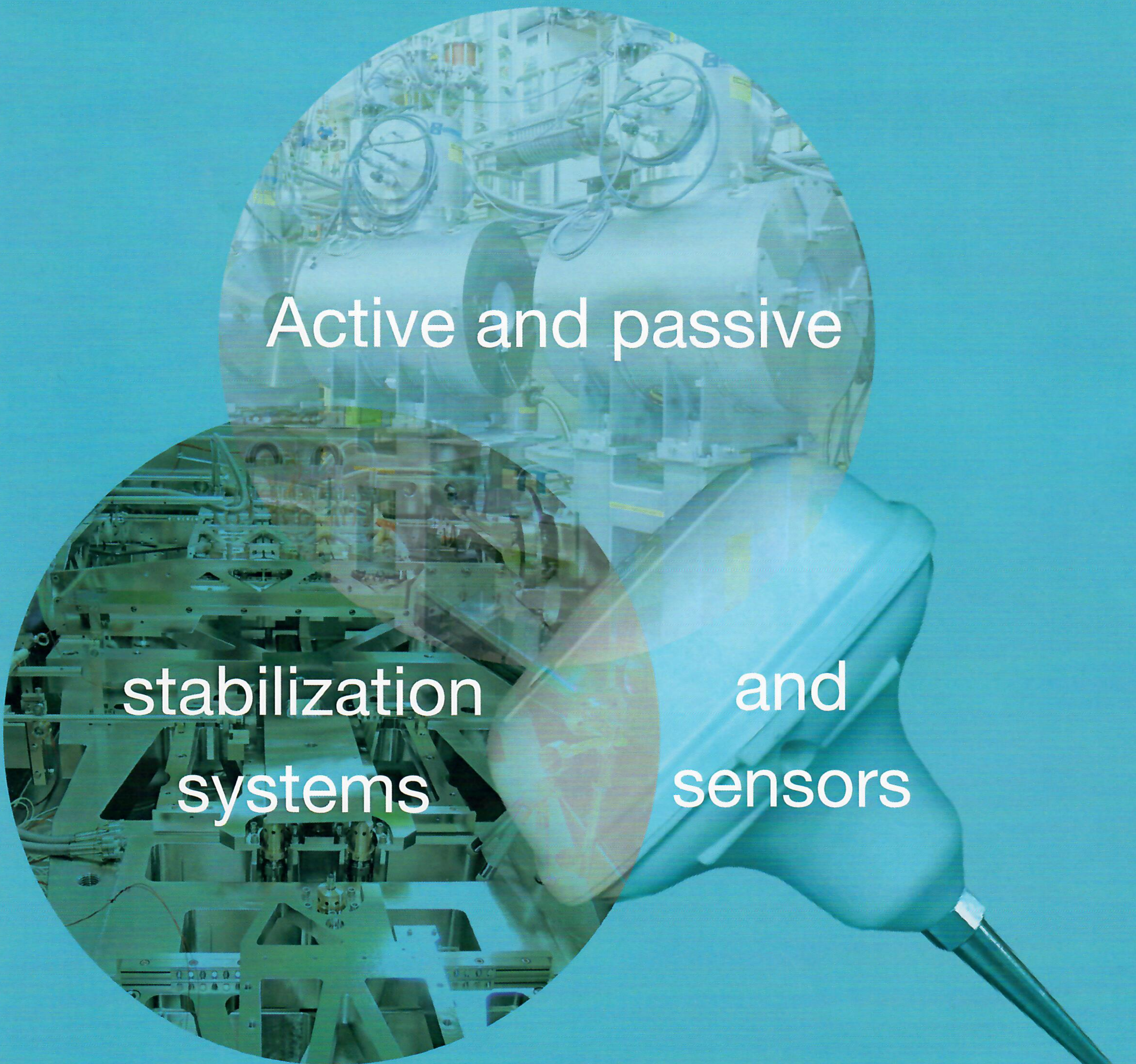
APPEC Technology Forum 2018



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12-13 November 2018 | Veldhoven Koningshof

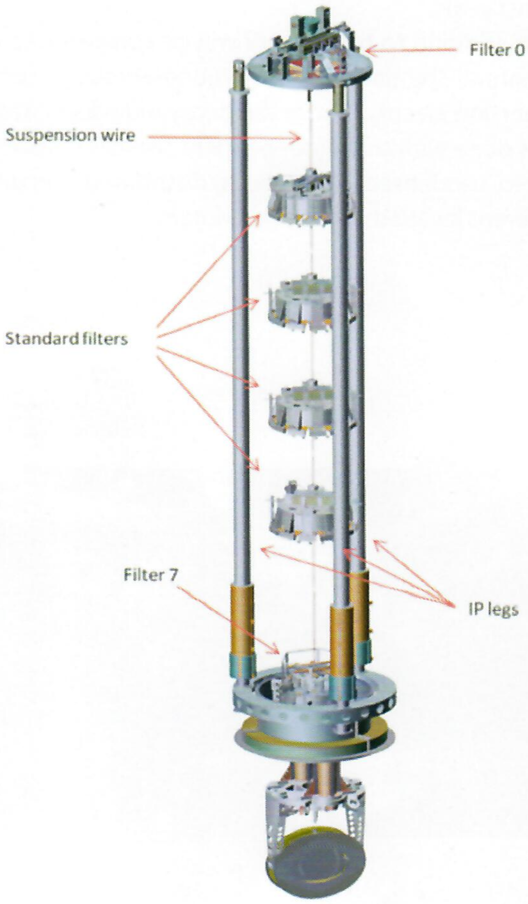
The advanced Virgo Superattenuator

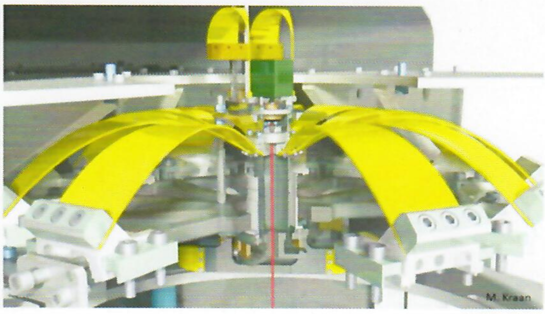
for Virgo

General

In the last two decades a big effort has been done in the conceptual design and construction of the modern ground based interferometric detectors for gravitational-wave observation. A further jump in forward direction was done with the introduction, in the experimental apparatus, of complex mechanical structures filtering seismic noise and local disturbances with the intent to extend the detection bandwidth in the low frequency region (below 100 Hz) where many astrophysical sources are expected to emit mainly low frequency gravitational waves. To this purpose the second-generation interferometers have been equipped with mechanical structures based on the working principle of a multi-stage pendulum to overcome the most limiting factor, in the low frequency region, represented by seismic noise. An important pioneering activity in this field was carried out by the INFN Pisa Group involved in the construction of the Virgo detector for which a complex structure, called Superattenuator, has been developed as suspension system to filter seismic noise down to the optical components.

In his talk, **Franco Frasconi** will present an overview of the techniques developed in the contest of gravitational-wave research, emphasizing the importance of these mechanical structures for the 3rd Generation interferometric detectors. The description of the main elements of the Superattenuator together with the technological solution adopted to fulfil the requirements of the second-generation interferometers, Advanced Virgo, will be presented. A quick comparison between two different methods to create an anti-spring effect on board of each pendulum stage along the suspension chain will be described, too.





Istituto Nazionale di Fisica Nucleare
Sezione di PISA

https://www.pi.infn.it/

Development of an active seismic isolation stage

for high-precision active-isolation projects

General

At the Precision Mechatronics Laboratory, they are working on the development of a new active isolation system which fulfills the high performance criteria in the low frequency domain (from 10 mHz to 10 Hz). To reach the requirements, a high-resolution optical inertial sensor is currently under development. It combines good mechanical properties of a STS-1V seismometer with a low-noise interferometric readout. The sensor is insensitive to magnetic fields as it does not contain any coil or magnet. The sensor has a resolution of 10^{-13} m/rtHz at 1 Hz. The ability to isolate actively a platform with this sensor has already been demonstrated in the vertical direction. The transmission of vibrations from the ground to the structure has been attenuated by at least a factor 100 between 10 mHz and 10 Hz.

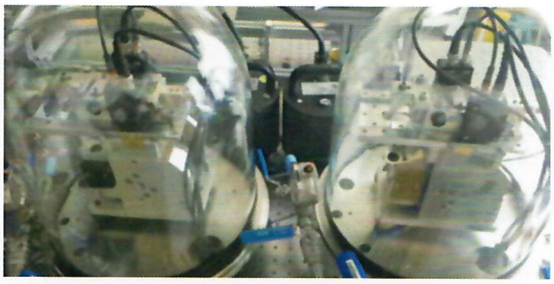
In his talk, **Christophe Collette** will explain in details the working principle of the sensor and its performance. Also, an isolation project with the sensor will be introduced.

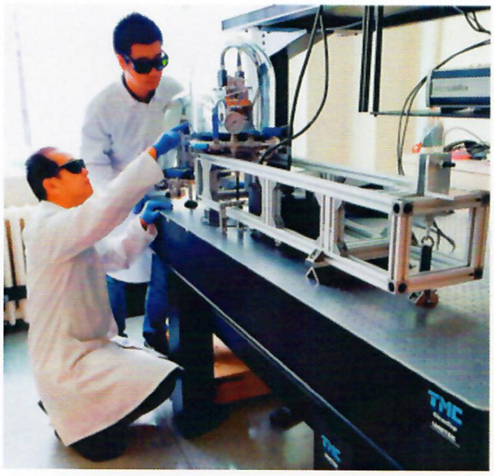
Requirements:

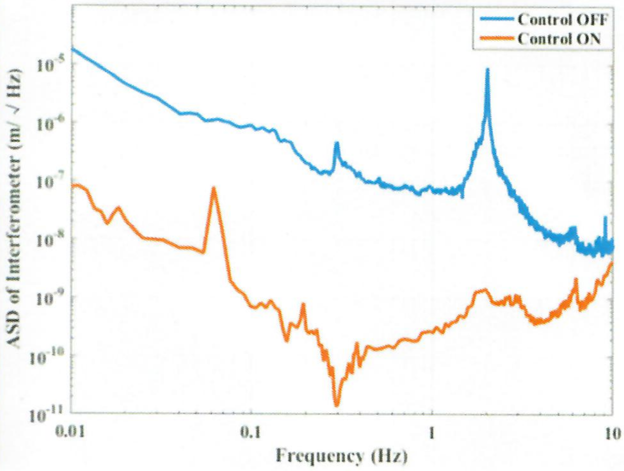
- Optical inertial sensor with
  - Low thermal noise
  - Low resonance frequency
  - High quality optics
- Versatile active isolation system with
  - Good architecture that reduces coupling between directions
  - Robust controller
  - Low noise instrumentation
  - Performance between 10 mHz and 10 Hz

Applications:

- Atom gravimetry
- Gravitational-wave detectors
- Lithography
- Medical imaging







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