Dutch National Institute for Subatomic Physics

Particle Toys

Do-it-yourself precision physics

# Michelson Interferometer Construction kit

## *Assemble your own detector*

and

## *measure sub-micrometer vibrations*

and possibly even …

## *gravitational waves*

Price: € 98, incl. VAT, excluding shipping

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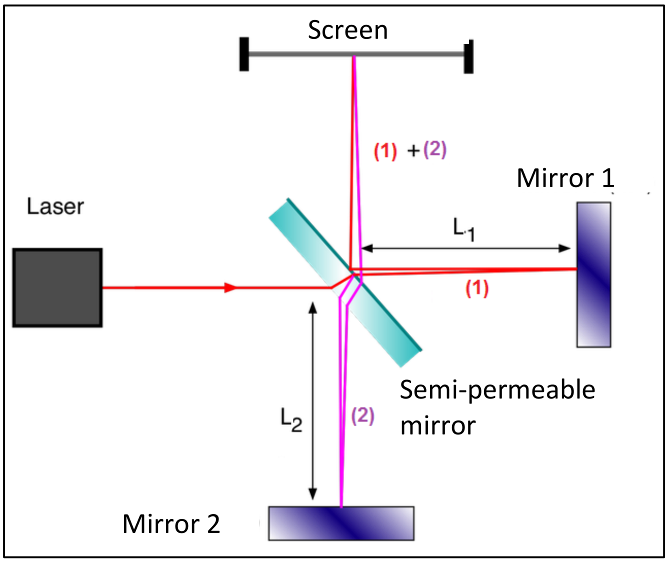
**With this construction kit you (or your pupil) is challenged to assemble a Michelson interferometer from its basic components, and make it work. Then you can use it to test its sensitivity for vibrations and deformations**

*The kit consists of these components (a.o).:*

- Base plate and 5 angle brackets
- Two flat mirrors, one of them on a adjustment holder
- Beam splitter (semi-permeable mirror)
- Diverging lens mounted in a holder
- Class 2 (<1 mW) laser pointer
- Diverse fixing materials (screws, wing nuts etc)
- Extended user manual including instructions and information: how does an interferometer work, why do you see ring patterns, how to measure and increase its sensitivity, applications etc.

*Short introduction.*

In an interferometer a light beam is split into two beams by a semi-permeable mirror, see Figure. Both beams are reflected by flat mirrors and projected on a screen or light sensor, using the beam splitter again. The result is a pattern of light and dark stripes, both beams may either amplify or cancel each other. With an interferometer you can perform very precise measurements on phenomena that influence the optical path length of light beams.




*Applications.*

The first application was the experiment of Michelson and Morley (1887), showing that the “ether”, up to then assumed to be the carrier of light waves , does not exist. This result freed the way for Einstein’s theory of Special Relativity (1905). Nowadays interferometry is applied in metrology, Fourier transform spectrometry, vibration sensing, optic testing, material research, atmospheric research, astronomy, in space missions, etc.

*Gravitational waves*

The world’s largest and most sensitive interferometers are built to measure gravitational waves. They have laser beams up to 4 km length. Such waves arise for instance when neutron stars or black holes collide somewhere in the universe. The resulting huge deformations of space-time propagate outward as a wave. Such phenomena were already predicted by Einstein in 1916, based on his Theory of General Relativity. Since 2015 a number of such events have been measured with the LIGO interferometer in US and the European detector “Virgo” in Italy. Nikhef is participating in the exploration of Virgo. A much larger detector, the Einstein Telescope, with 10 km underground arms, is foreseen to be built in the south of the Netherlands (Limburg) in the 2030’s.