# PhD Thesis - *advanced*-KWISP - Dottorato in Fisica - UniTS

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## Experimental study of short-distance interactions with a double-membrane opto-mechanical sensor (*advanced*-KWISP)

Abstract
The experimental study of Short Range Interactions (SRIs) between macroscopic bodies might open a window on a range of microscopic processes involving the exchange of exotic particles (for example axions, chameleons, moduli) which are not included in the Standard Model of particle physics. In addition, under special conditions, the hitherto unobserved Topological Casimir might appear beyond the known Casimir effect. The basic concept in SRI studies is setting two bodies at a given separation distance, exciting one of the two (the "source mass") in order to change the distance, and observing the response of the second body (the "sensing mass") to the excitation of the first in search of deviations from the standard Newtonian potential. The field presents a rich panorama of experiments, down to separation distances of the order of a few microns, while at shorter distances the arena is open for investigation. Based on the experience and techniques matured with the KWISP opto-mechanical force sensor, *advanced*-KWISP envisions reaching separation distances of 100 nm or less by using a double-membrane device, dubbed the Double Membrane Interaction Monitor (DMIM), where one membrane acts as the source mass, and the second as the sensing mass. The first membrane is excited with the radiation pressure of a laser beam, while a second laser beam interferometrically detect the displacements of the second one.

Specific thesis topic
Designing and building a first prototype of a DMIM, then testing the device using an opto-mechanical apparatus, starting at room temperature, with a view on subsequently moving to sub-Kelvin temperatures. The optical readout will involve operation of a high-finesse Fabry-Perot interferometer. Initial work will take place locally, while cryogenic operation will move on to an external laboratory, possibly CERN.

Participating Institutions

UniTS
INFN Sezione di Trieste
University of Rijeka, Rijeka, Croatia
University of Camerino
CERN
University of Patras, Patras, Greece
CAPP-IBS, Daejeon, Korea

People locally involved

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