UNIVERSITÀ DEGLI STUDI
DI TRENTO
Dipartimento di Fisica

Dott. Matteo Leonardi

National Astronomical Observatory of Japan, Osawa, Mitaka, Tokyo

Monday 5rd September 2022 - 11:00 a.m.
Room A203

Integrated squeezed vacuum source for measurements beyond the quantum limit

Abstract:

In high-precision laser-based measurements such as gravitational wave interferometry, precision metrology, quantum information, the quantum nature of light sets a fundamental noise source limiting the sensitivity of the experiment. Optical quantum noise can appear in two forms: shot noise and radiation pressure noise, which are the manifestation of the amplitude and phase noise of the coherent vacuum state. This state is ubiquitous and combines with the signal beam through some “open port”, generally at the detector level, producing the quantum noise. Due to the Heisenberg uncertainty principle, amplitude and phase noises cannot be suppressed simultaneously. However, it is possible to create exotic states (squeezed states) in which the noise on one quadrature is reduced at the expense of increasing it in the other one. In this way the shot noise, the radiation pressure noise, or a suitable linear combination of the two can be reduced, increasing the Signal-to-Noise Ratio beyond the standard quantum limit.

Currently operating squeezed vacuum sources are very complex systems which require extensive know-how, funding, dedicated space and cannot be easily implemented into an already designed experiment.

The goal of my “Rita Levi Montalcini” project is the realization of an integrated (hybrid on-chip and fibered) squeezed vacuum source capable of providing high purity squeezed vacuum states. Once compactness and operating stability will be achieved, these integrated devices will open the possibility of upgrading experiments to performances beyond the standard quantum limit, with huge advantages in terms of costs, ease of implementation and range of applicability.

Contacts:
Department of Physics
Via Sommarive, 14
38123 Povo, Trento
df.supportstaff@unitn.it

Scientific Coordinator:
Franco Dalfovo