Postdoctoral position in *Mitigation of Optomechanical Parametric Instability in Next Generation of Gravitational Wave Detectors*

Applications are invited for a postdoctoral research position in experimental optics for gravitational waves detectors.

General information

Workplace: Nice, France
Contract period: 1 year renewable up to 30months
Expected date of employment: fall 2022
Level of education: PhD in experimental physics
Salary: The monthly gross salary is set by national guidelines between 2664 € and 3173 €, according to work experience.
Required experience: 2 to 4 years

Job description

The position is founded by the French ANR research grant SPINA. The project SPINA is for studying parametric instability (PI) and its mitigation through active damping by radiation pressure force. PI is a nonlinear optomechanical phenomenon occurring in high power cavities. It consists in the amplification of the mirror vibrations (mechanical modes), initiated by thermal excitation. This amplification results from the radiation pressure applied by resonant optical higher order modes which are created by the mirror vibrations themselves. In gravitational wave detectors this phenomenon causes the loss of control of the detector preventing the increase of the laser power inside the arm cavities and thus the increase the sensitivity. A wide variety of techniques have been suggested to overcome PI; one can divide them in two categories: passive and active techniques. The passive techniques aim at preventing the instabilities by changing the cavity and mirrors parameters of the detector so that the PI no longer occurs. While the active techniques consist in monitoring the onset of the instability and suppress it by a feedback actuation that damps the mirror unstable mode. If passive piezoelectric dampers, installed on the sides of all LIGO mirrors, have allowed to operate the detectors with an intracavity power >200 kW, their cost in terms of thermal noise can be a limit for the future generation of GW detectors that aim at ten times better sensitivity with 3 MW of intracavity power. The high density of possible PI with respect to the system optomechanical parameters makes active techniques the unique candidate for damping several unstable modes without adding extra noise to the detectors.
In ARTEMIS laboratory, within the Virgo collaboration, we have started the experimental development of a flexible active PI-damping device based on radiation pressure[1]. It consists in a 4W auxiliary CW laser that is deflected in 2D random-access by two acousto-optic modulators. The idea is to obtain the active damping by applying a radiation pressure force modulated in phase quadrature with respect to the mirror's local displacement. To study and validate this PI mitigation strategy, a high-power table-top optical cavity with macroscopic mirrors able to host PI will be built. The selected candidate will work on the development of the optical cavity and of the control strategy of the PI-damping device.

[1] https://arxiv.org/abs/2201.08272

Environment

The postdoctoral researcher will join the team "lasers and cavities" of the laboratory ARTEMIS which is located at the Observatoire de la Côte d'Azur. ARTEMIS is a founding member of the Virgo collaboration, and it is responsible of the laser source of the detector. The hired candidate will also be part of the Virgo collaboration.

Skills

The candidate must have a solid experience in experimental optics, an expertise in laser-cavity locking techniques would be appreciated. He/She is expected to take responsibilities in the project and to have a teamwork spirit, the mission requires tight interaction with electronic and mechanical engineers.

In order to apply, please send i) your CV with the list of publications ii) a motivation letter and ii) the name and contact of two references to: margherita.turconi@oca.eu with the subject line:
"SPINA postdoc- Name Surname".
Candidates are encouraged to apply as soon as possible. The position is available as early as Fall 2022. Applications will be considered until the position is filled.

For further information please contact Dr. Margherita Turconi : margherita.turconi@oca.eu