Master in Photonics – "PHOTONICS BCN"
Master ERASMUS Mundus "EuroPhotonics"

MASTER THESIS PROPOSAL

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Laboratory: Institut de Ciències de l'Espai
Institution: CSIC
City, Country: Cerdanyola del Vallès, Spain

Title of the master thesis: Pound-Drever-Hall lock

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Summary of the subject (maximum 1 page):

Optical metrology systems are used for precision measurement and instrumentation, which can has a huge range of appliances in gravitational astronomy, radio astronomy and biomedical analysis, between many others.

In our lab, a temperature sensor in the nano-Kelvin regime is being developed using optical systems, for applications in Gravitational wave detection.

The main element is a Whispering Gallery Mode (WGM) resonator which will serve the purpose of an optical cavity that provides time stability in the low frequency domain. The resonator itself can be used as a temperature sensor.

The Pound-Drever-Hall technique (PDH) is used to stabilize the Laser (which is the source of light for the resonator) in frequency, using the direct outputs of the Cavity (WGM resonator). To implement this technique, a frequency modulated beam is locked to a cavity. The output of this beam is measured and down mixed with an oscillator (in phase with the frequency modulation of the beam) to obtain the "off resonance" of the laser with respect to the cavity. This way a feedback look can be implemented to correct the laser frequency towards resonance with the cavity, in our case, the WGM resonator.

The candidate work will consist of the development of the Feedback control loop of the PDH technique, and apply it to an existing optical setup.

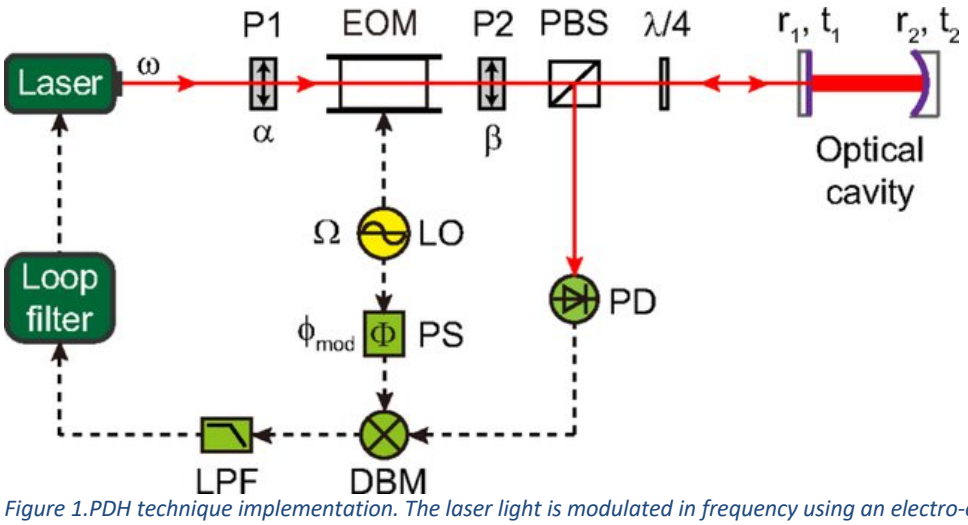

Figure 1.PDH technique implementation. The laser light is modulated in frequency using an electro-optic modulator (EOM) driving by a modulating RF signal. This will add two sidebands to the laser frequency, The beam is then passed through a resonating cavity and measured using a high speed detector. The measured signal which contains the two unaltered sidebands and a phase shifted carrier signal, is down mixed with the Rf signal in phase with the modulation and filtered to obtain a measurement of the "off phase" between the laser and the cavity. Source: Sheng Hui et. Al (2015) (1)