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## **MASTER IN PHOTONICS – “PHOTONICS BCN” ERASMUS+ “EUROPHOTONICS”**

### **MASTER THESIS PROPOSAL**

**Dates: April - September 2019**

**Laboratory : Ultrafast Dynamics of Quantum Solids**

**Institution: ICFO**

**City, Country : Barcelona**

**Title of the master thesis: Holographic Imaging of nanometer-scale phase-separation during a phase transition**

**Name of the master thesis supervisor: Simon Wall**

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**Keywords : Imaging, Holography, Nano, X-rays**

**Summary of the subject (maximum 1 page) :**

Holographic imaging is a method to image objects without the need to lenses. This is particularly useful in the X-ray region where lenses are hard to manufacture. Lens collects light from the sample and reimages it at a detector. Mathematically, the lens acts as a Fourier transform on the electric field. Numerically, it is easy to perform the Fourier transform, thus images can be made in the computer without the lens, if the electric field can be recorded. However, X-ray detectors only measure the intensity of the field and are insensitive to the phase. As only half of the required information is recorded, images cannot be reconstructed through Fourier transforms.

To measure the phase we can interfere the light from an image with a known reference, in a process known as holography. Now with both amplitude and phase information we can image

an object by the numerical technique of the Fourier transform. As this process is numerical, all aberrations that occur in conventional optics can be corrected and high spatial resolutions can be achieved.

This project seeks a motivated student that is highly competent with programming. You will work with X-ray holograms of coexistence of metallic and insulating states within in the material VO<sub>2</sub>. The holograms have already been collected at the BESSY synchrotron in Berlin. Your task will be to implement several numerical techniques to improve the spatial resolution of the images obtained from our data. A highly motivated student can expect a scientific publication to arise from the work.

**Additional information :**

A good experience with programming, preferentially in python, is required.