

# MÁSTER DE FÍSICA BIOMÉDICA. CURSO 2020/21

## PROPUESTA DE TRABAJO FIN DE MÁSTER

Título: Pinzas ópticas holográficas para controlar el ciclo celular

Title: Holographic Optical Tweezers for controlling the cellular cycle

### Tutor 1

Nombre, e-mail Niccolò Caselli, ncaselli@ucm.es

Centro y Departamento Departamento Química-Física

### Tutor 2\*

Nombre, e-mail

Centro y Departamento

### Resumen\*\*

The cell nucleus is the library of encoded instructions that biological cells use to execute a living program of structural functioning that is preserved as a genetic heritage stored in DNA molecules. The project carried on in the group of Prof. F.Monroy aims at understanding the interactions between the nuclear components, including physical forces distributed across the nuclear territories, which make the cell operates in a complex network that determines its non-equilibrium dynamics. The applicant's Master project will focus on using holographic optical tweezing devices capable of inducing and detecting local forces (down to pN) inside the nucleus of eukariotic cells. Optical tweezers, by manipulating laser beams, use radiation pressure to move tiny objects, like living cells or protein molecules, providing direct access to the micro and nano scale world [1,2]. The key element in the optical tweezers we developed is a spatial light modulator: a liquid crystals screen in which the refractive index of each pixel is electrically controlled in order to properly modify the phase of the incident light beam [3].

The project main goal will be address the possibility to exert external control on the cellular cycle by optically intervening on the physiological trade-off of nuclear forces. These forces will be locally exerted and programmable at ease by means of holographic optical tweezers. Variations in the force distribution are expected to catalyse (or even prevent) the internal action exerted by microtubules in the dividing cell. Particularly, he/she will study how external driving correlate with RNA production inside the nucleus.

The candidate will gain experience into the design and implementation of the optical set-up and in programming phase retrieval algorithm through the MATLAB platform.

[1] Nat. Nanotechnology 8 (2013) doi:10.1038/nnano.2013.208

[2] Nature 424 (2003) doi:10.1038/nature01935

[3] Optical Imaging and Metrology: Advanced Technologies (Wiley, 2012), Chap. 1.

### Observaciones\*\*\*

\* Solo en el caso de dos co-tutores.

\*\* Breve resumen de los objetivos.

\*\*\* Optativo. Por ejemplo si se recomienda tener algun conocimiento o experiencia previa.