ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ
ΤΜΗΜΑ ΕΠΙΣΤΗΜΗΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΑΣ ΥΛΙΚΩΝ

ΠΑΡΟΥΣΙΑΣΗ ΜΕΤΑΠΤΥΧΙΑΚΗΣ ΔΙΠΛΩΜΑΤΙΚΗΣ ΕΡΓΑΣΙΑΣ

Τίτλος

«Ultrafast THz Optical Modulation with 2D-Material-Based Devices»

της **Ευδοκίας Κυριάκου,** μεταπτυχιακής φοιτήτριας του

Τμήματος Επιστήμης και Τεχνολογίας Υλικών του Πανεπιστημίου Κρήτης

Επιβλέπων Καθηγητής: Στυλιανός Τζωρτζάκης

Παρασκευή 14/10/2022

12:00

Η παρουσίαση θα πραγματοποιηθεί στην **αίθουσα Φ2 του Τμήματος Φυσικής,** του Πανεπιστημίου Κρήτης.

ABSTRACT

Terahertz (THz) radiation technology aims to bridge the realms of electronics and photonics, and therefore it attracts increasing attention over the last two decades. A developing field of applications is that of THz wireless communication systems, particularly within the landscape of the fast-emerging 5G and 6G technologies, where THz waves promise increased bandwidths for the data demanding systems. Therefore, there is a constantly growing demand for efficient modulators that will operate at THz frequencies, with compact size. Under this prism, two-dimensional (2D) materials such as graphene, hold great promise and have sparked widespread interest in the photonics community due to its unique structure and its unprecedented optoelectronic properties.

In this master thesis, graphene is investigated as an efficient non-linear material that can be incorporated in modulation devices that operate at THz frequencies. An electrically gate-tuned graphene-based Salisbury screen device is investigated, which consists of a graphene layer, placed on an ionic liquid substrate, back-plated by a metallic

back- reflector. We demonstrate that the absorption and phase characteristics of the device can be self-modulated when the intensity of the incident THz field is high enough to drive the graphene layer in the non-linear regime. An amplitude modulation of more than three orders of magnitude in the resonant absorption of our device, and an absolute phase modulation of 130^{o} when the THz field strength increases from 102 to 654 kV/cm is demonstrated. The origin of this nonlinear response is explained by the graphene hot carriers' dynamics. Beyond telecommunications, such devices could find applications in future dynamically modulated flat optics devices, as well as for THz beam spatio-temporal modulation.