6. Curricular Unit

Advanced Physics Topics 1

Module

Graphene plasmonics

Type

Lecture course

Contact hours

18

Professor/Researcher in charge

Nuno Peres/ Yuliy Bludov

Summary of Contents

This module exposes the students to basic concepts of the rapidly emerging area of graphene plasmonics. The practical interest of this area is determined by the small wavelength of the surface polaritons, when compared to that of bulk electromagnetic waves, which allows the miniaturization of photonic components. Furthermore, this gives rise to a higher localization of the surface polaritons, which are characterized by lower damping, in comparison with noble metals. The possibility to dynamically tune graphene's conductivity through the variation of a gate voltage introduces and extra degree of freedom into the problem. In this module students contact with basic knowledge on the optical properties of graphene and on the properties of surface polaritons (a special kind of electromagnetic waves, propagating along surfaces and interfaces) both in noble metals and in graphene (a 2D carbon material). The theory of surface polaritons in graphene, dispersion relations and methods for exciting these type of waves, is explained. Finally the description of experimental works as well as the corresponding operational principles will be detailed. Detailed program:

1.) electronic properties of graphene and its optical conductivity;
2.) Drude model for metals and for graphene;
3.) Surface plasmon-polaritons in noble metals;
4.) Surface plasmon-polaritons in graphene;
4.) Methods for exciting surface plasmon-polaritons;
5.) Some experiments using the excitation of surface plasmon-polaritons;
6.) Localized plasmons in graphene based nano-structures.

Evaluation

1.) For new comers to the subject: One written report and one introductory computational project.

2.) For experts on the topic: One research project, which must be presented in the end of the semester in front of the class.

Note: Any student can opt for one or the other type of evaluation

Jury

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