

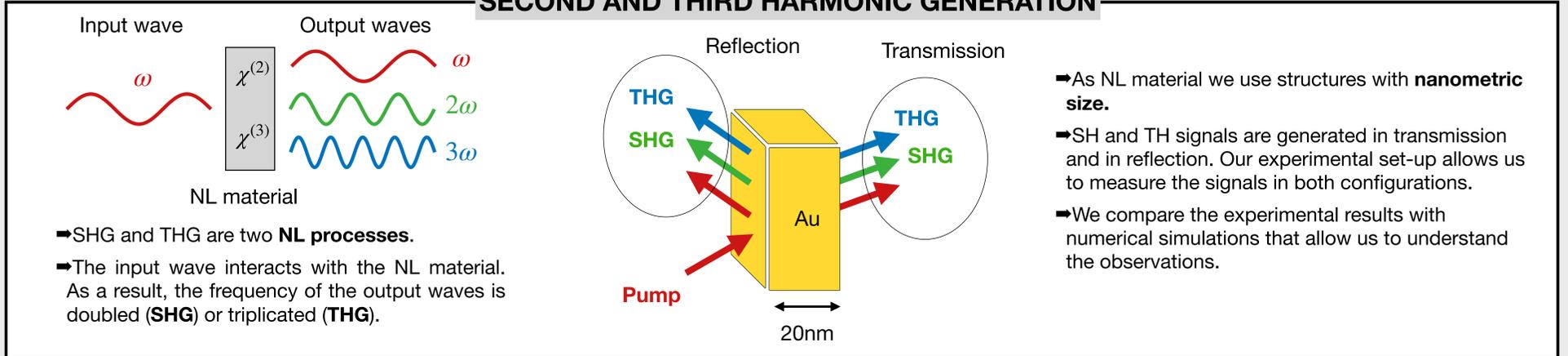
L. RODRÍGUEZ-SUNÉ,^{1,*} C. COJOCARU,¹ M. SCALORA,² J. TRULL¹

¹Department of Physics, Universitat Politècnica de Catalunya, 08222 Terrassa, Spain
²Charles M. Bowden Research Center, CCDC AVMC Redstone Arsenal, AL 35898-5000 – U.S.A.
 laura.rodriguez.sune@upc.edu

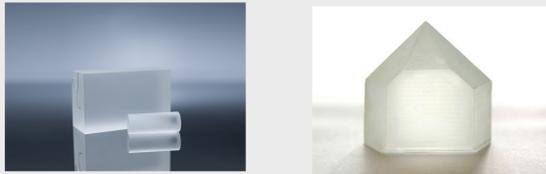
ABSTRACT

Nowadays structures with nanometric size are produced and integrated in different photonic devices and applications. At this scale light-matter interaction displays completely new phenomena. Understanding how light interacts at the nanoscale with metals, semiconductors, or ordinary dielectrics is pivotal if one is to properly engineer and implement nano-antennas, filters and, more generally, devices that aim to harness the effects of new physical phenomena that manifest themselves at the nanoscale. For this reason, we study experimentally the processes of second and third harmonic generation in different nanolayers and compare our measurements with numerical results based on our theoretical model which allows us to understand and explain the light-matter interaction at the nanoscale.

SECOND AND THIRD HARMONIC GENERATION



BULK NONLINEAR OPTICS



BBO crystal, LiIO₃ crystal

- Highly NL material
- High SHG efficiencies
- $\mathbf{P}_{ED} = \epsilon_0[\chi^{(1)}\mathbf{E} + \chi^{(2)}\mathbf{E}^2 + \chi^{(3)}\mathbf{E}^3 + \dots]$

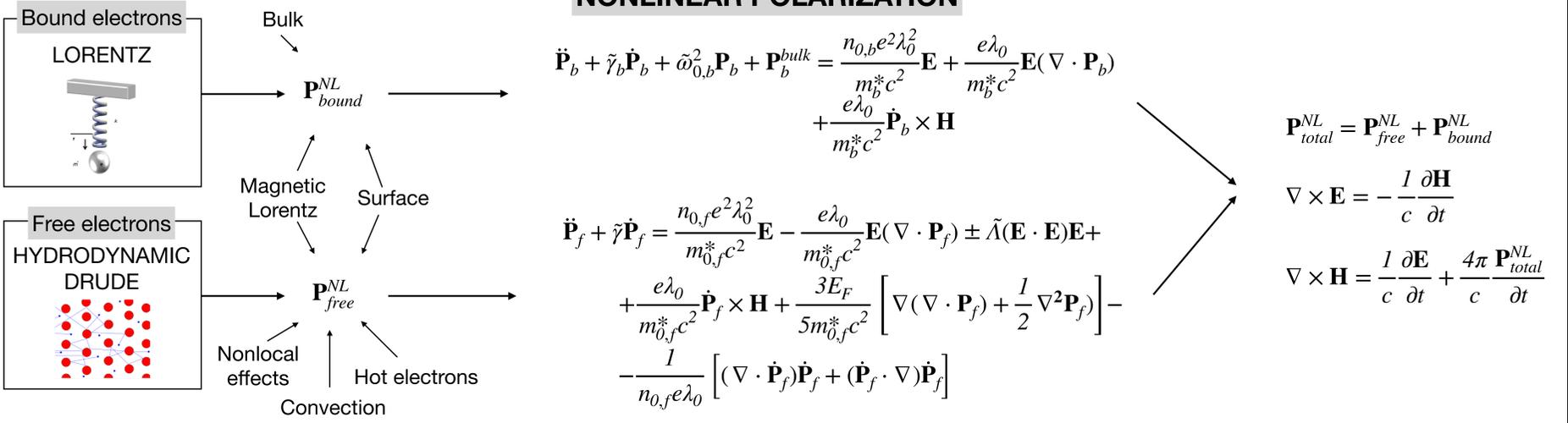
SURFACE NONLINEAR OPTICS



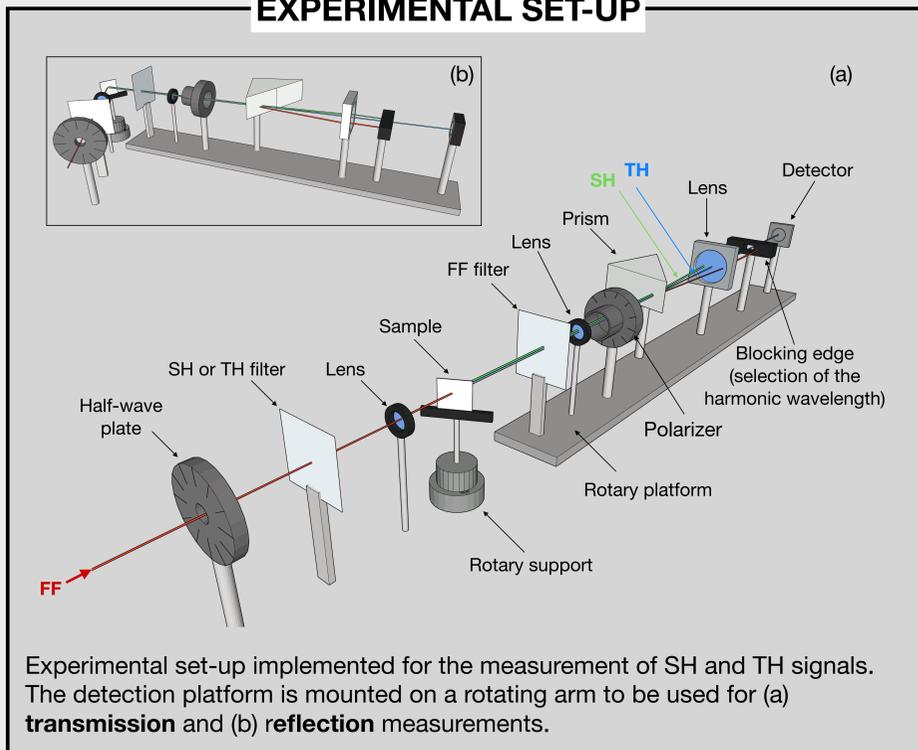
GaAs wafer, ITO nanolayer, Gold nanoantennas, Gold nanolayer

- Bulk contribution to the SHG drastically decrease and other terms like MD and EQ become important
- New light-matter interaction phenomena: $\mathbf{P}^{NL} = \mathbf{P}_{ED} + \mathbf{P}_{MD} + \mathbf{P}_{EQ} + \dots$
- Conventional approximations no longer valid

NONLINEAR POLARIZATION

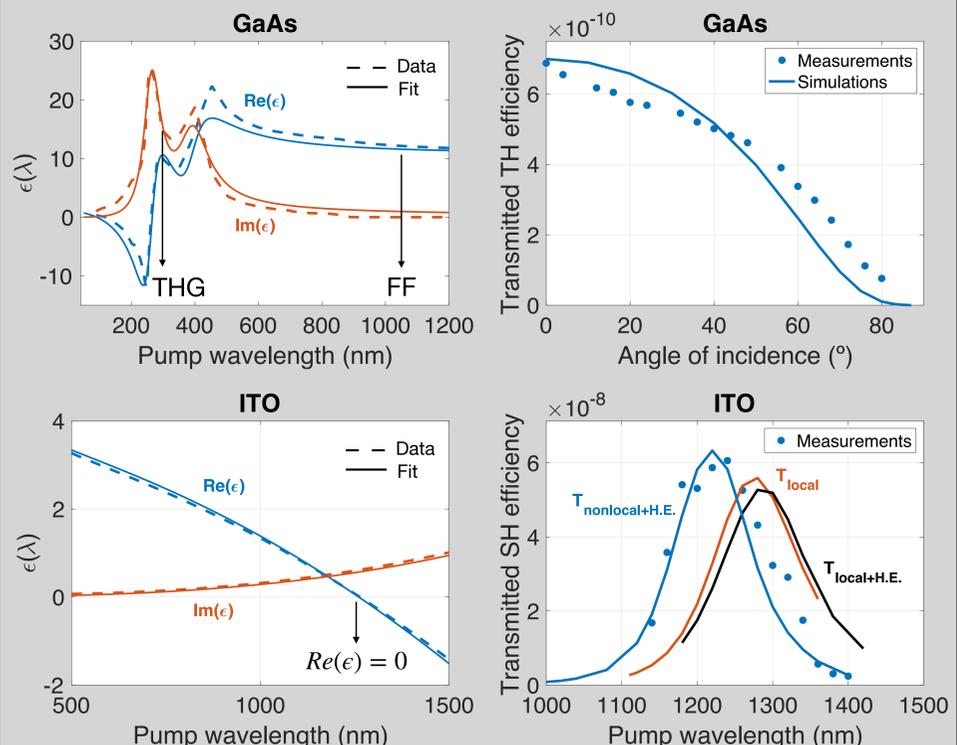


EXPERIMENTAL SET-UP



HARMONIC GENERATION FROM GaAs AND ITO

- Measurements: we take measurements of the harmonic signal as a function of the angle of incidence and input wavelength.
- Simulations: reproducing the experimental situation we calculate the nonlinear polarization and with Maxwell's equations we extract the fields.
- A very good agreement is found.



REFERENCES

• L. Rodríguez-Suné et al., "Harmonic generation in the opaque region of GaAs: the role of surface and magnetic nonlinearities," Opt. Express 23, 26120-26130 (2019)
 • L. Rodríguez-Suné et al., "Study of second and third harmonic generation from an indium tin oxide nanolayer: Influence of nonlocal effects and hot electrons," APL Photonics 5, 010801 (2020)