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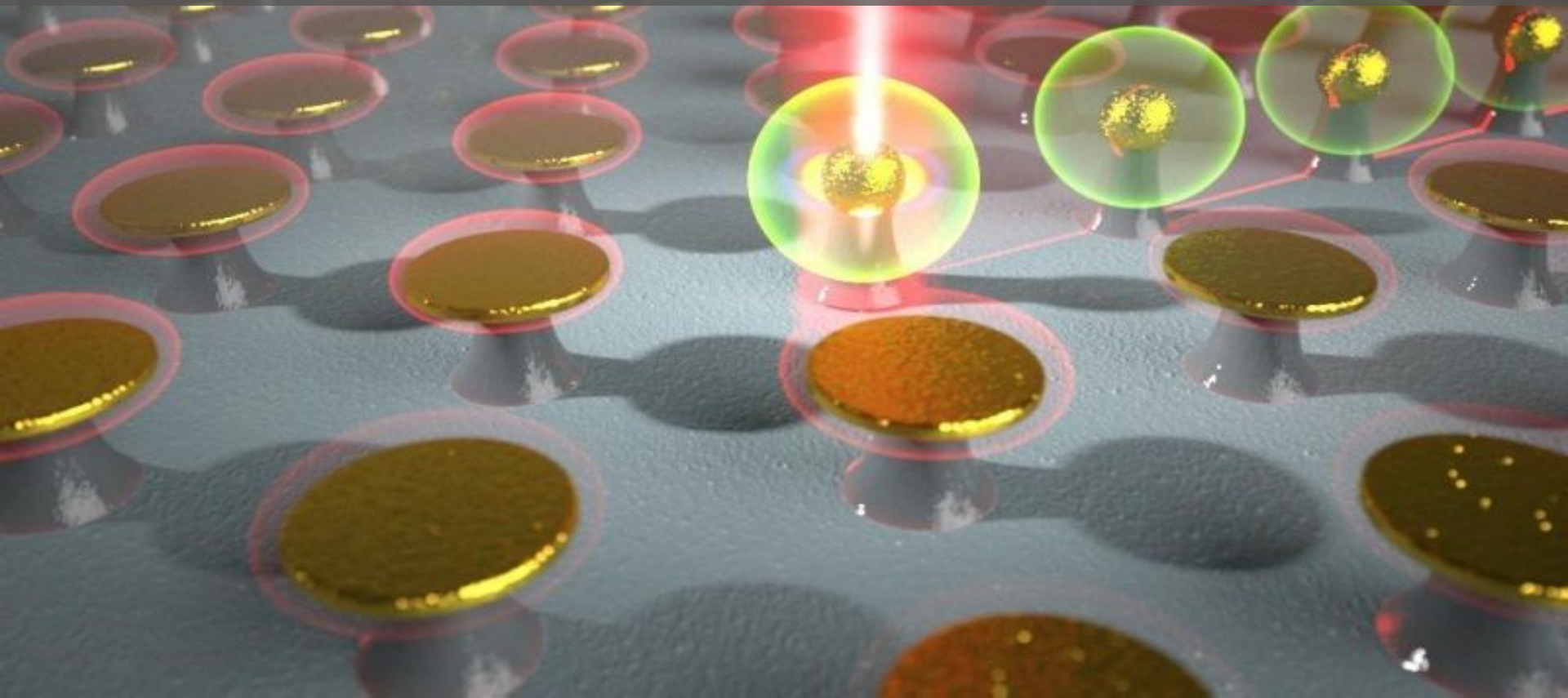
Nanofotónica y Metamateriales (Teoría)

José A. Sánchez Gil & Vincenzo Giannini



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Dpto. Espectroscopía Nuclear, Vibracional y de Medios Desordenados

Espectroscopías de Superficie y Fotónica de Plasmones Superficiales

Jose A. Sánchez Gil
Diego Romero Abujetas

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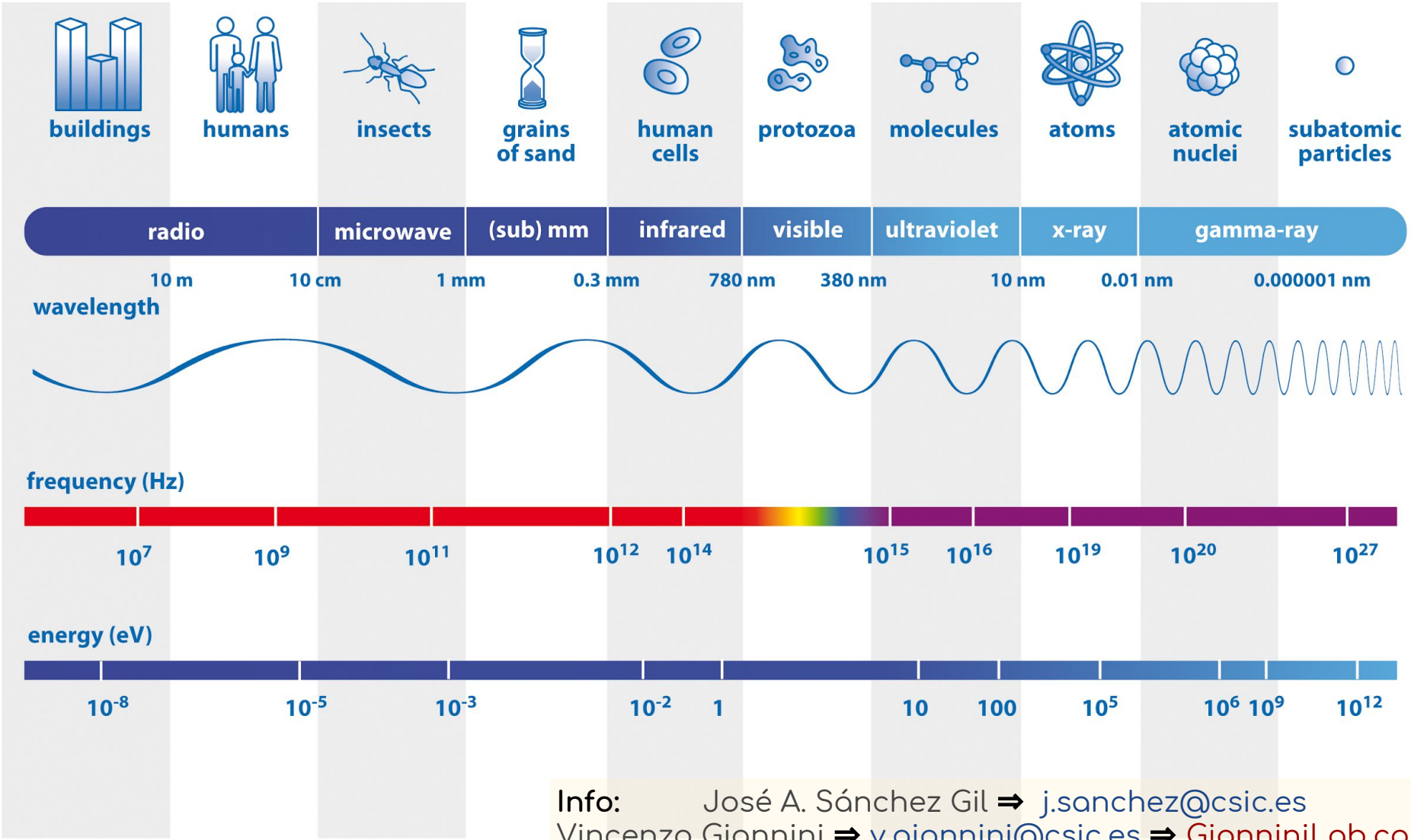
Vincenzo Giannini ⇒ v.giannini@csic.es ⇒ GianniniLab.com

¿Qué es la nanofotónica?



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¿Qué es la nanofotónica?

ELECTROMAGNETISMO + MATERIA CONDENSADA

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla \cdot \mathbf{D} = \rho$$

$$\nabla \times \mathbf{H} = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t}$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

- Medio contínuo
- Propiedades Macroscópicas
- Ecs. Constitutivas para ***D*** y ***B***

$$\frac{\hbar^2}{2m}\nabla^2\Psi + V\Psi = \frac{i\hbar\partial}{\partial t}\Psi$$

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METALES EN EL VISIBLE

Teoría de Drude para metales: el modelo de electrones libres

$$\mathbf{D}(\mathbf{r},\omega) = \epsilon(\omega)\mathbf{E}(\mathbf{r},\omega), \epsilon(\omega) = 1 - \frac{\omega_p^2}{\omega(\omega + i\gamma)}$$

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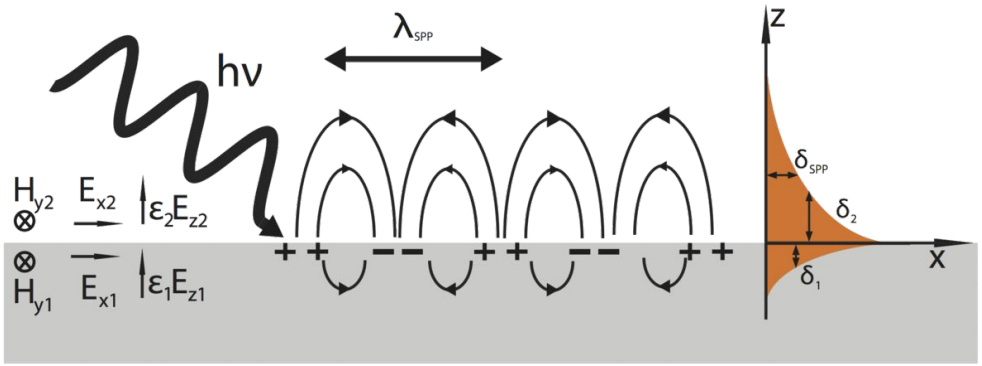
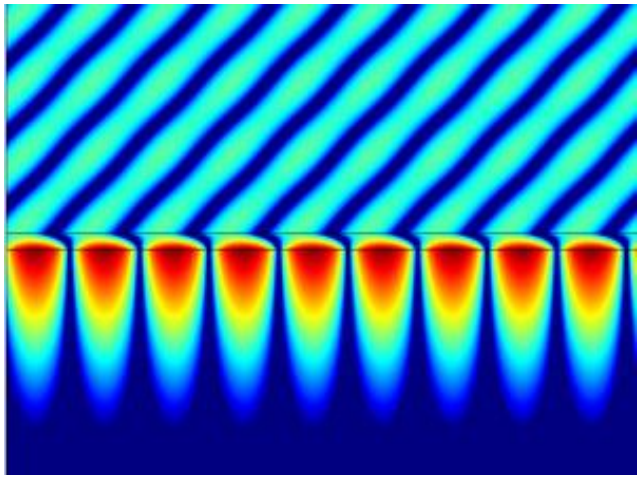
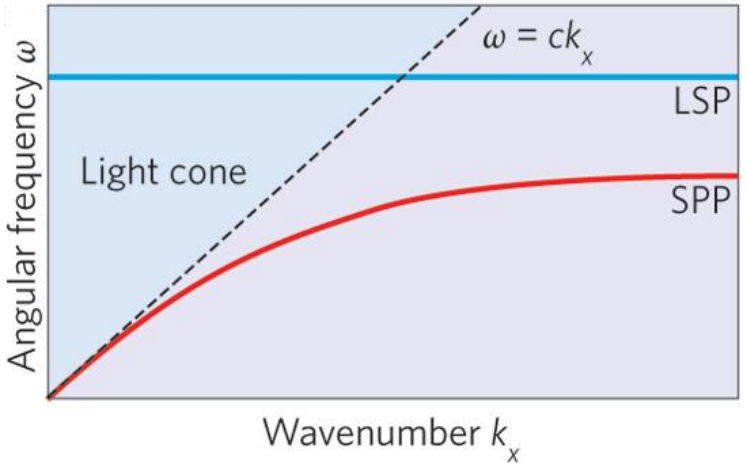
PLASMONES SUPERFICIALES

¡SOLUCIONES CONFINADAS EN LA FRONTERA METAL-DIELÉCTRICO!







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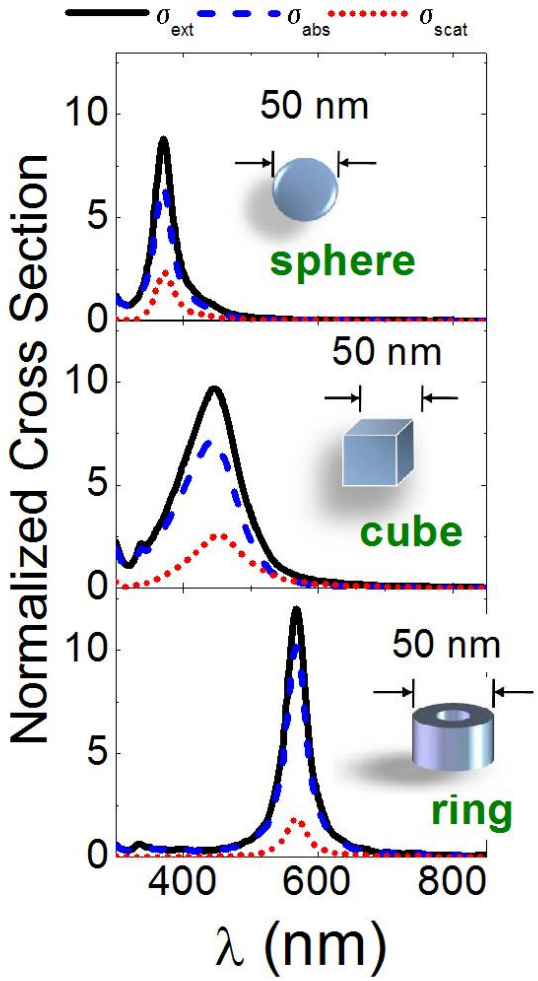
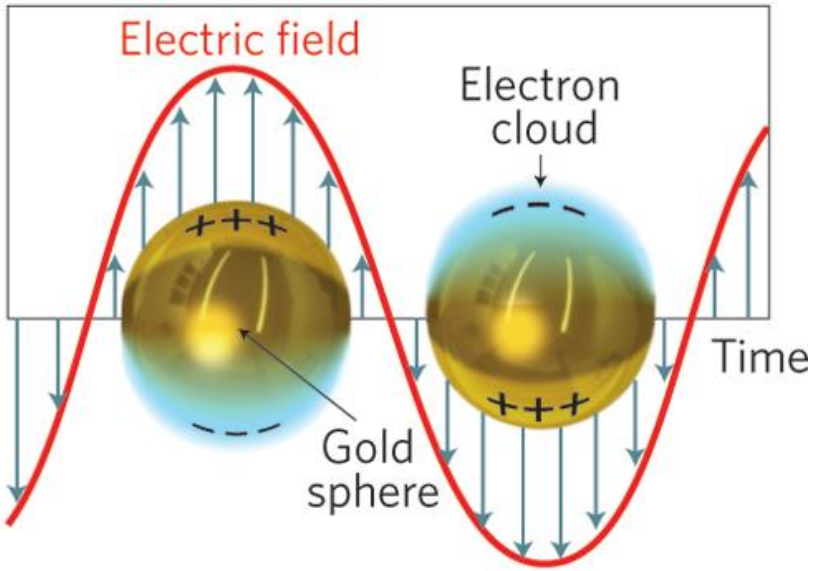
PLASMONES SUPERFICIALES LOCALIZADOS (LOCALIZED SURFACE PLASMON RESONANCES)





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Intereses en Nanofotónica

- Plasmones Superficiales Localizados
- Metamateriales y refracción negativa
- Luz Magnética
- Nanohilos semiconductores
- Aislantes topológicos fotónicos
- Plasmónica en Grafeno
- Plasmónica Cuántica

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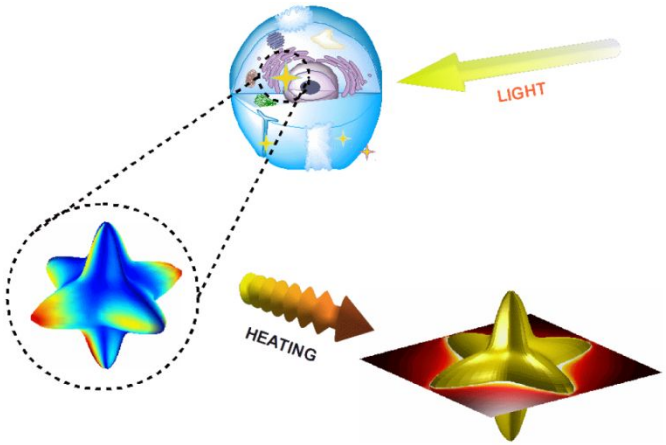
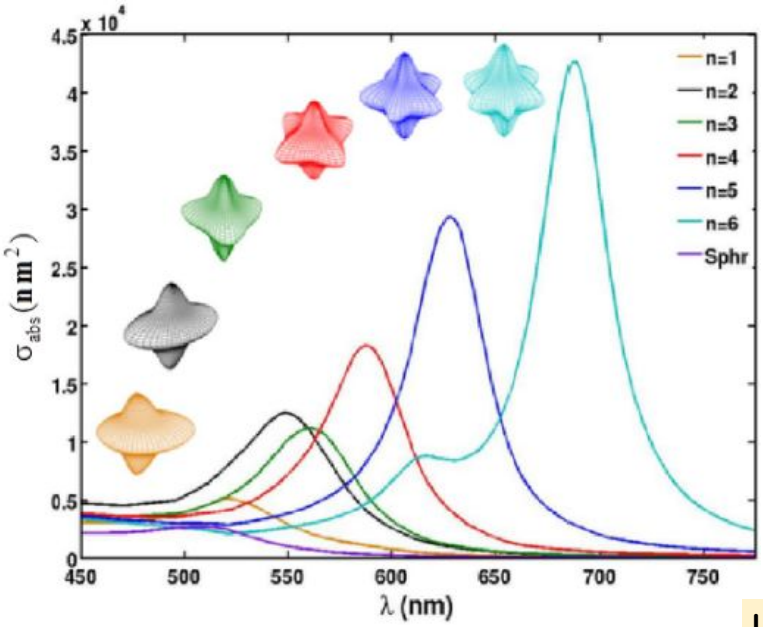
Rodríguez-Oliveros & Sánchez-Gil, *Opt. Express* (2012)





Science NOW UP TO THE MINUTE NEWS FROM SCIENCE

*Science*Shot: Gold Nanostars for Attacking Cancer

by Kate McAlpine on 6 January 2012, 1:40 PM | 1 Comments

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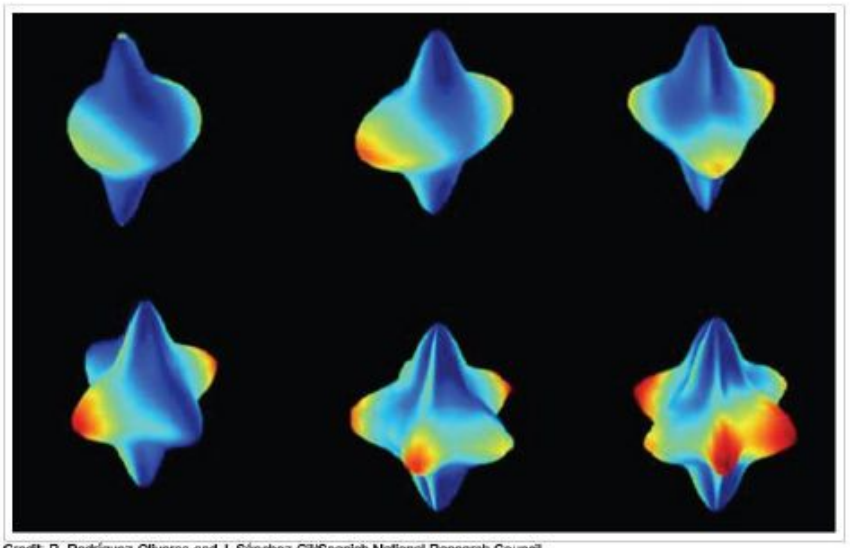

Credit: R. Rodríguez-Oliveros and J. Sánchez-Gil/Spanish National Research Council

Gold stars, so tiny that it would take a thousand of them to span the diameter of a human hair, could be effective tumor-fighters. Previous studies have shown that minuscule particles of metal or other materials, directed to a tumor and then manipulated by lasers or magnetic fields, can kill off malignant cells by heating them up. Now, researchers suggest that golden particles could burn hotter if fashioned into stars. Gold is already an excellent radiator because electrons on its surface efficiently capture light, but when that surface is spiky, the energized electrons collect at the points, producing higher temperatures, as illustrated above. In a paper published this week in *Optics Express*, the team reported that an eight-pointed star could generate temperatures more than ten times higher than a spherical particle. Moreover, it absorbs lower-energy light, and this would make the treatment easier on healthy cells caught in the beam. A 20-pointed star might be even better, but the scientists haven't done those calculations yet.

ScienceNOW. ISSN 1947-8052

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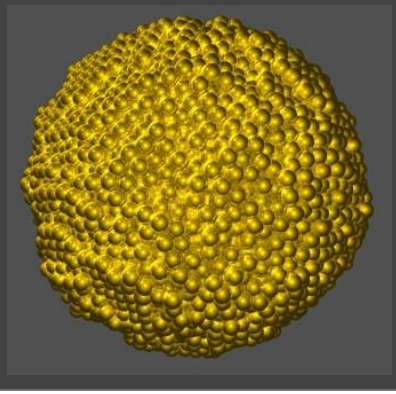
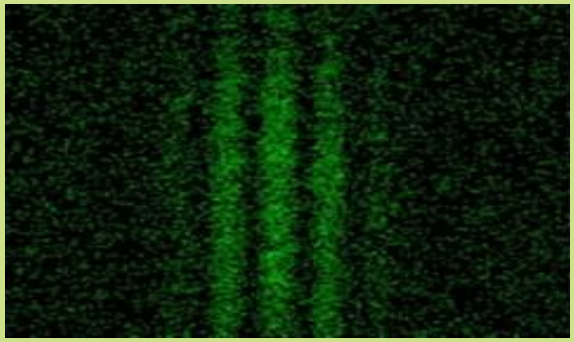
PLASMÓNICA CUÁNTICA

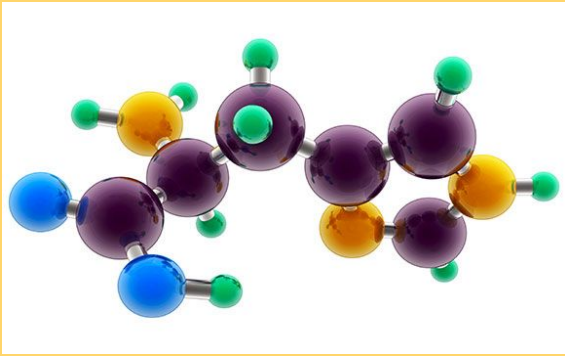
Átomos



Fotones



Moléculas



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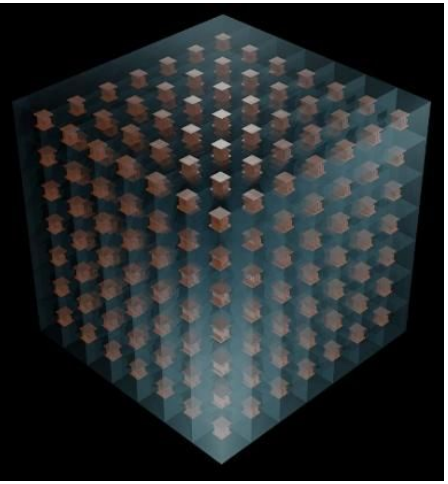
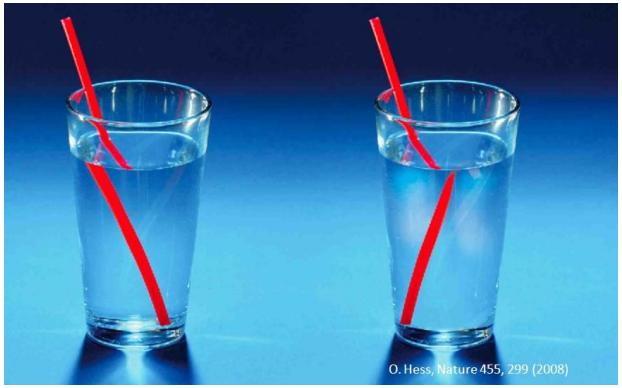
¿Qué son los metamateriales?

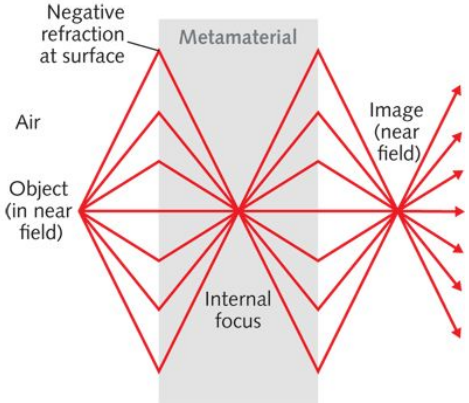


ϵ_m, μ_m

$L << \lambda$

$$\langle \boldsymbol{D}(\boldsymbol{r}) \rangle = \epsilon_0 \epsilon_{eff}(\omega) \langle \boldsymbol{E}(\boldsymbol{r}) \rangle,$$
$$\langle \boldsymbol{B}(\boldsymbol{r}) \rangle = \mu_0 \mu_{eff}(\omega) \langle \boldsymbol{H}(\boldsymbol{r}) \rangle$$





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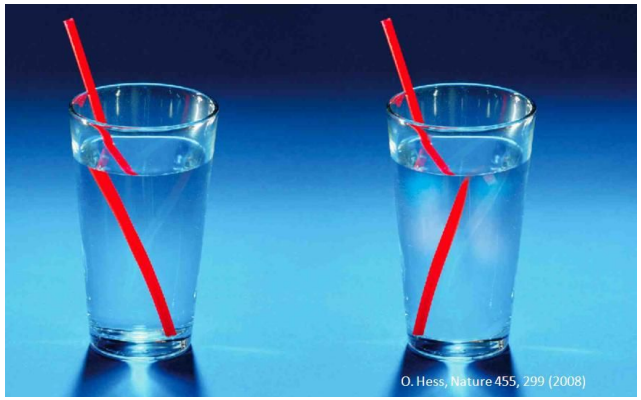
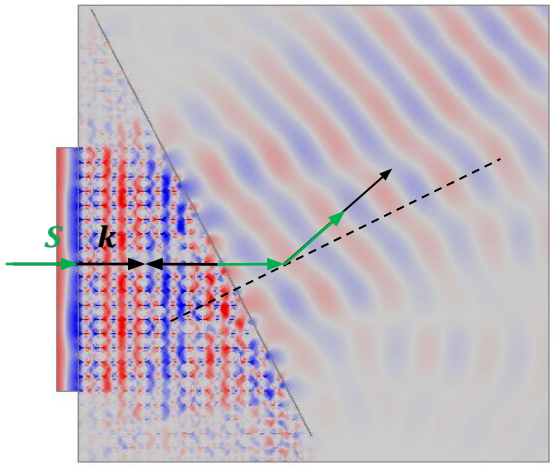
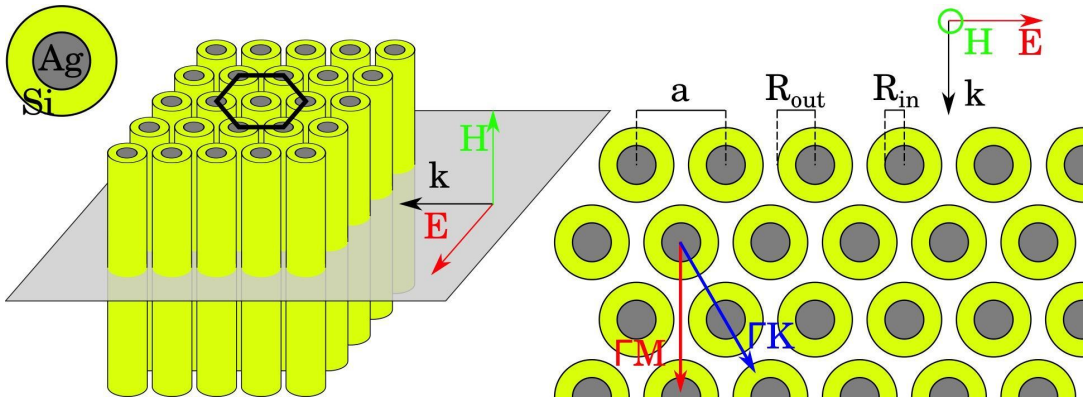
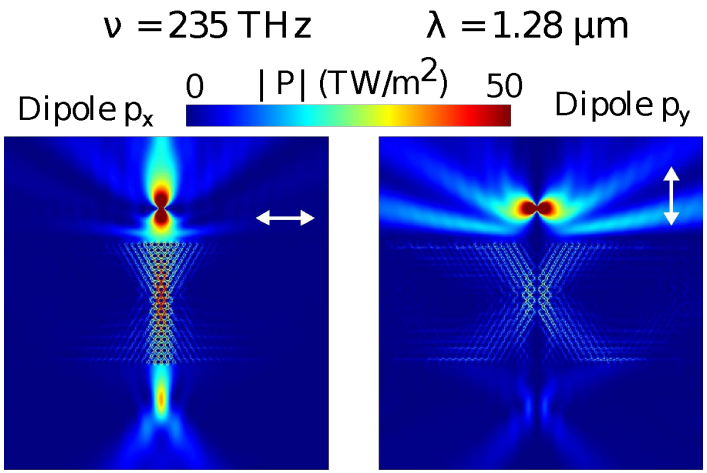
Negative Refraction









Flat lensing

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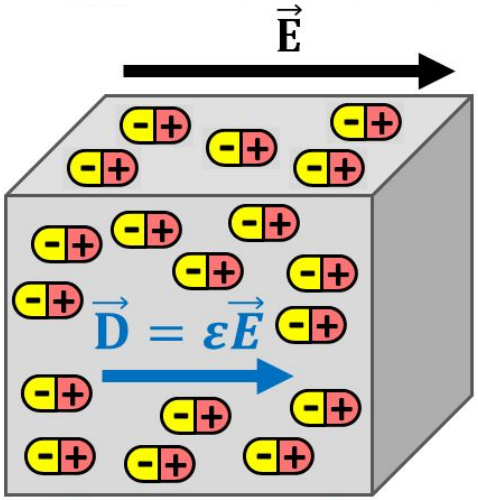

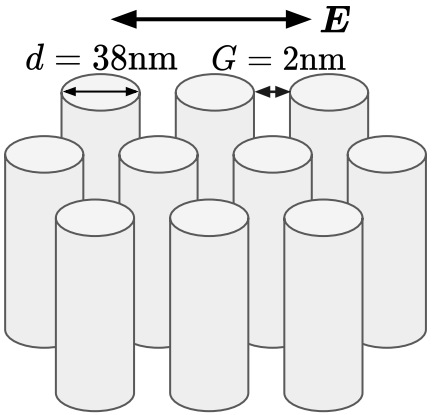

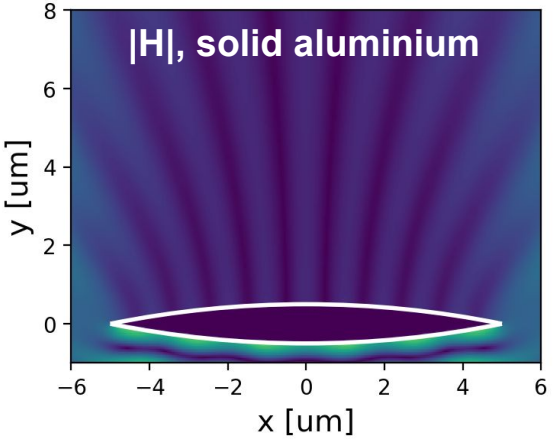

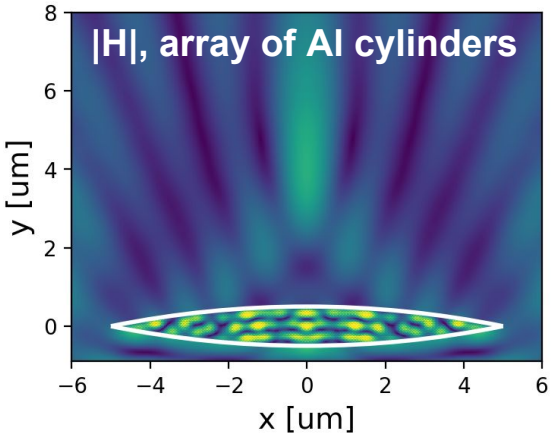

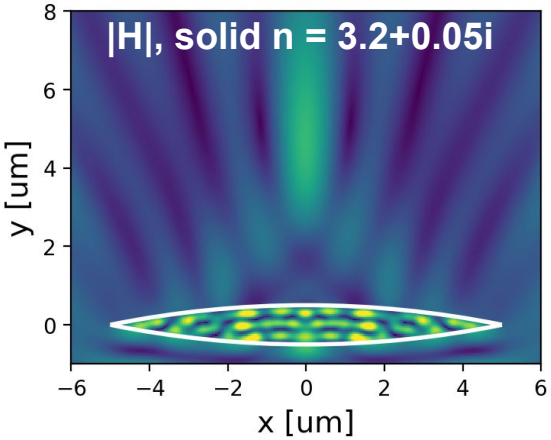

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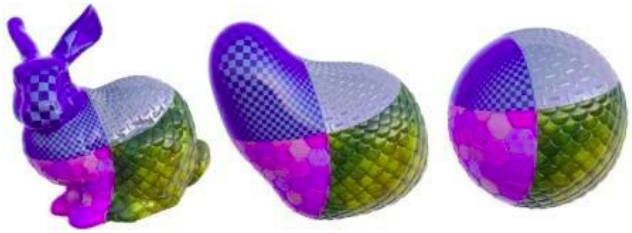

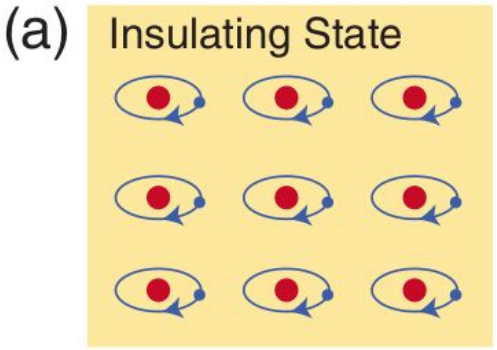

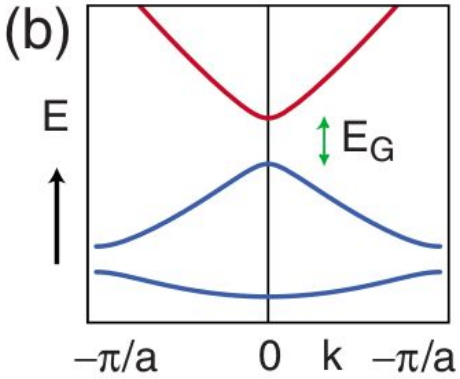

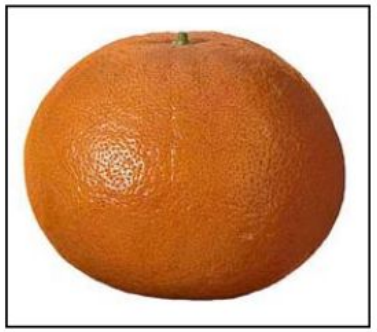

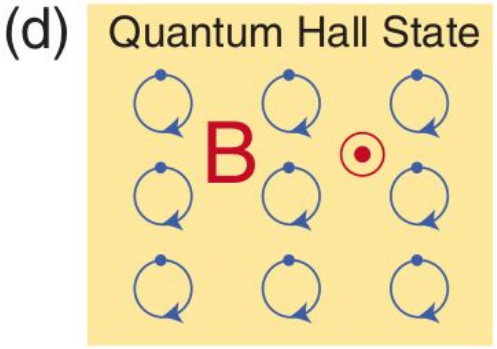

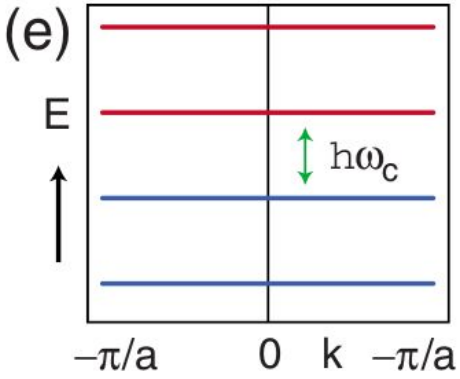

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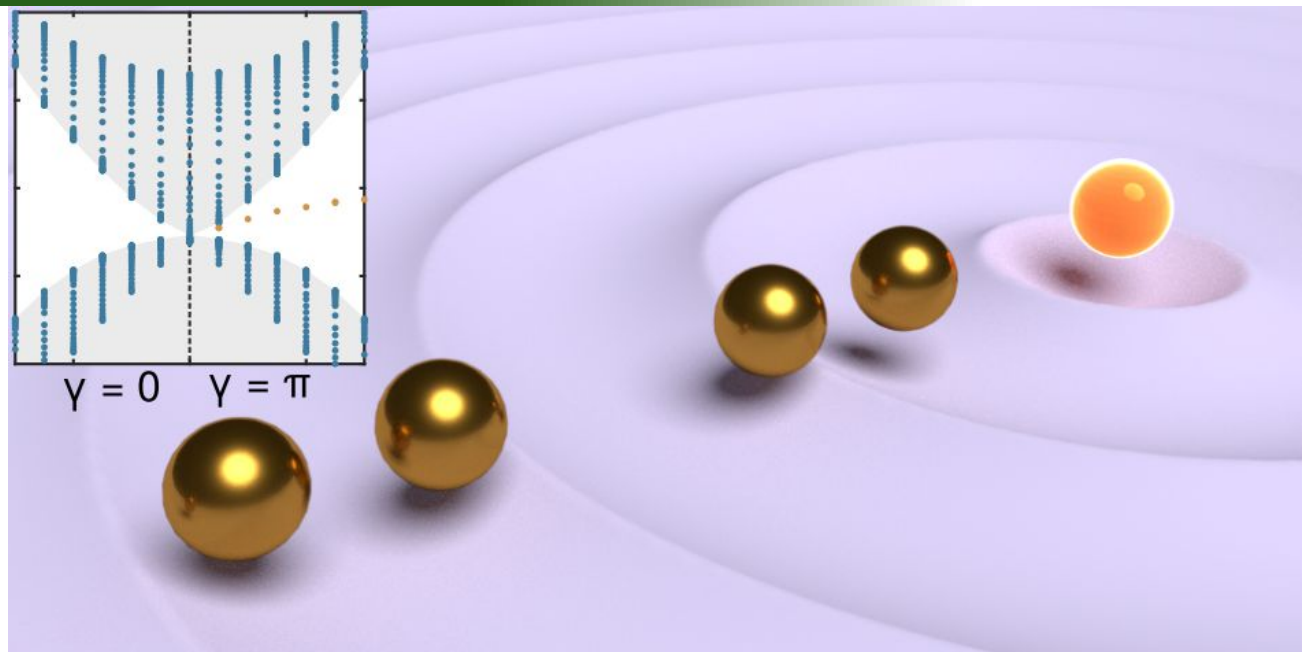

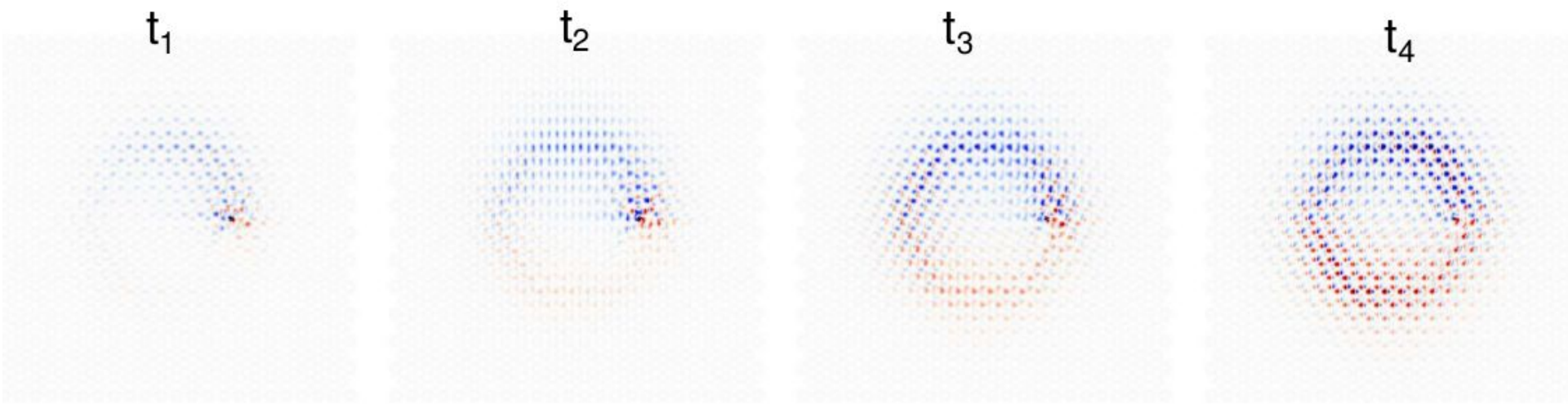

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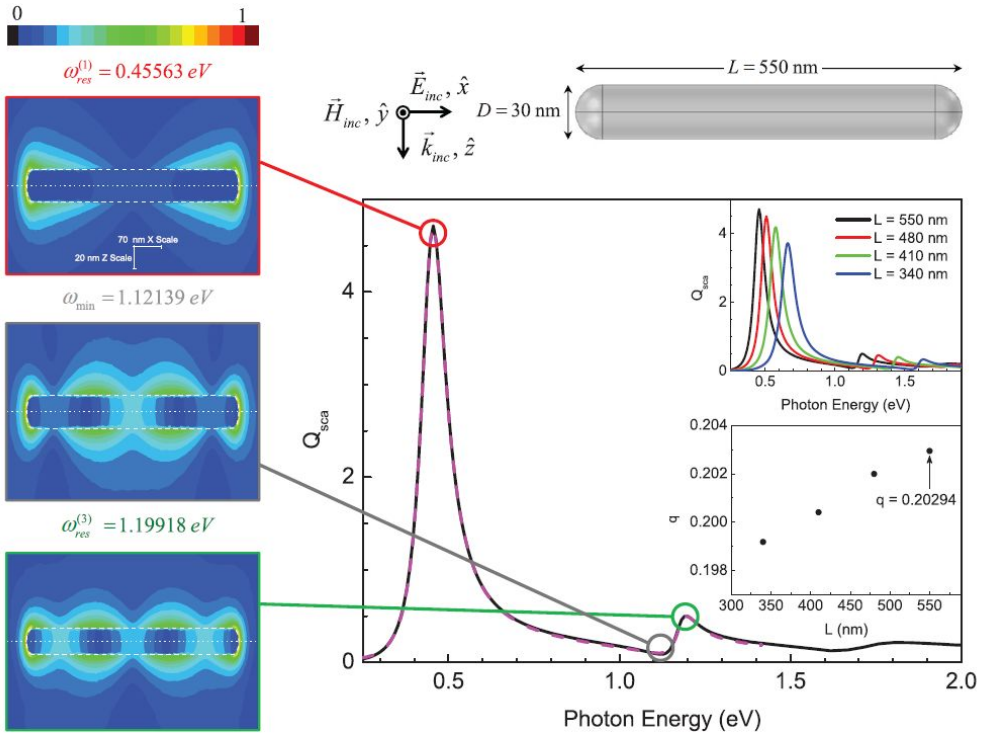
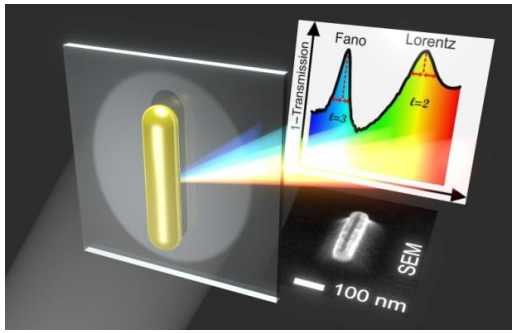
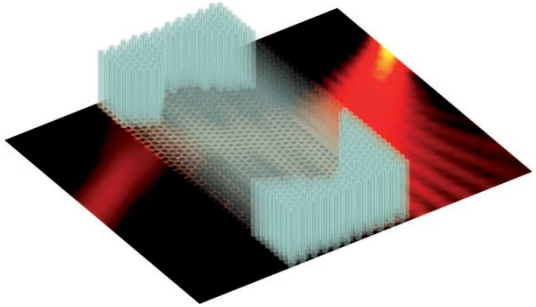
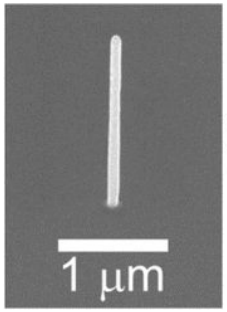
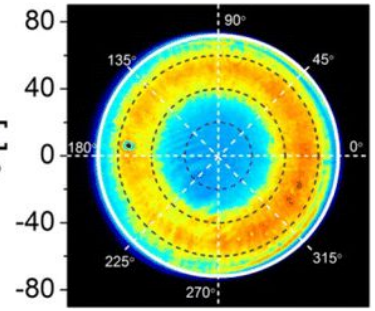
DE LO TEÓRICO... ...A LO APLICADO











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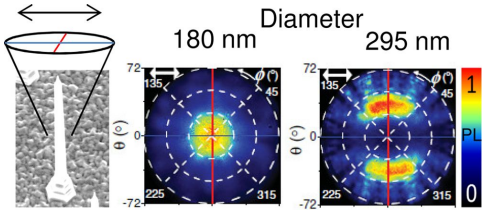
NANO LETTERS Letter pubs.acs.org/NanoLett

Directional and Polarized Emission from Nanowire Arrays

Dick van Dam,*[,†] Diego R. Abujetas,[‡] Ramón Paniagua-Domínguez,[‡] José A. Sánchez-Gil,[‡] Erik P. A. M. Bakkers,[†,§] Jos E. M. Haverkort,[†] and Jaime Gómez Rivas*[,†,∥]



NANO LETTERS Letter pubs.acs.org/NanoLett

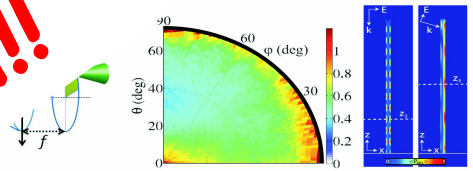
Nanowire Antenna Absorption Probed with Time-Reversed Fourie Microscopy

Grzegorz Grzela,[†] Ramón Paniagua-Domínguez,[‡] Tommy Barten,[†] Dick van Dam,[§] José A. Sár and Jaime Gómez Rivas*[,†,§]

[†]FOM Institute for Atomic and Molecular Physics (AMOLF), c/o Philips Research, High-Tech Campus 4, 5656 Netherlands

[‡]Instituto de Estructura de la Materia (IEM-CSIC), Consejo Superior de Investigaciones Científicas, Ser Spain

[§]COBRA Research Institute, Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindh



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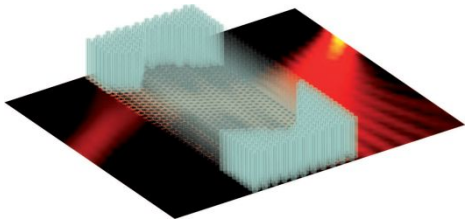
NANOPHOTONICS AND PLASMONICS

Ultra low-loss, is negative-index m hybrid metal-semic d on nowires

R. Paniagua-Domínguez, D. R. Abujetas & J. A. Sánch.

Instituto de Estructura de la Materia, Consejo Superior de Investigacione ntíficas, Serrano 121, 28006 Madrid, Spain.



NANO LETTERS Letter pubs.acs.org/NanoLett

Mode Parity-Controlled Fano- and Lorentz-like Line Shapes Arising in Plasmonic Nanorods

Niels Verellen,*[,†,‡] Fernando López-Tejeira,[§] Ramón Paniagua-Domínguez,[∥] Dries Vercruysse,[‡,†] Denitza Denkova,[†] Liesbet Lagae,[‡,†] Pol Van Dorpe,[‡,†] Victor V. Moshchalkov,[†] and José A. Sánchez-Gil[∥]

[†]INPAC and Department of Physics and Astronomy, KU Leuven, Celestijnenlaan 200 D, B-3001 Leuven, Belgium

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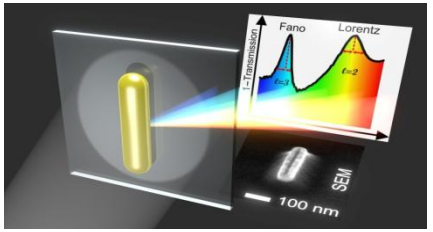

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