

# Modeling the Optical Properties of Plasmonic Nanoparticles using Classical Electrodynamics

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## California



Worked With:

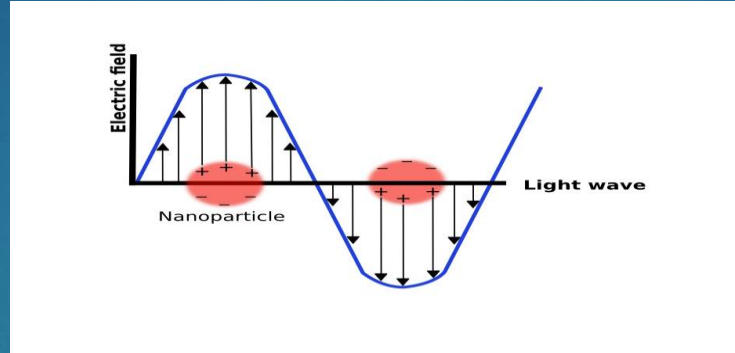
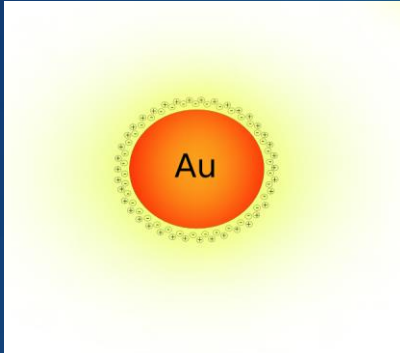


Dr. Lopata

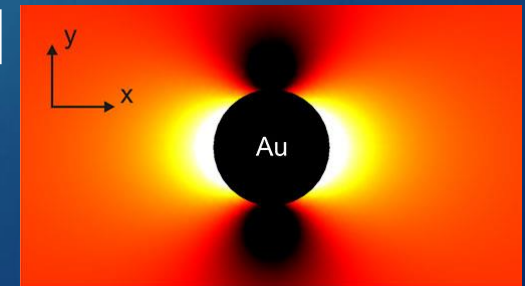


Holden Smith

# Plasmonics



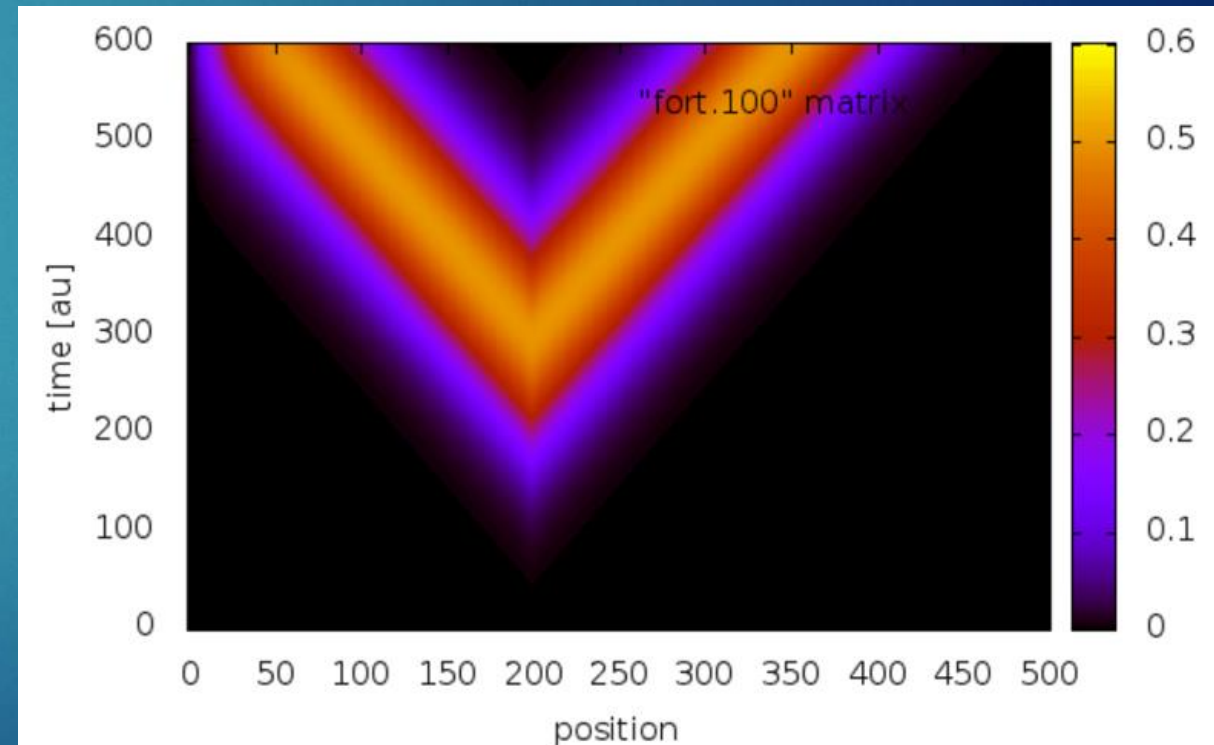
- ▶ This is a representation of a metal nanoparticle that is struck with light.
- ▶ For our simulations we are interested in gold(Au) and silver(Ag) nanoparticle optical properties.
- ▶ Noble metal “nanoantennas” : near-field light intensity enhanced  $\sim 1000 \times$
- ▶ Useful in: cancer therapy, solar cells



# Electrodynamics via Finite Difference Time Domain(FDTD)

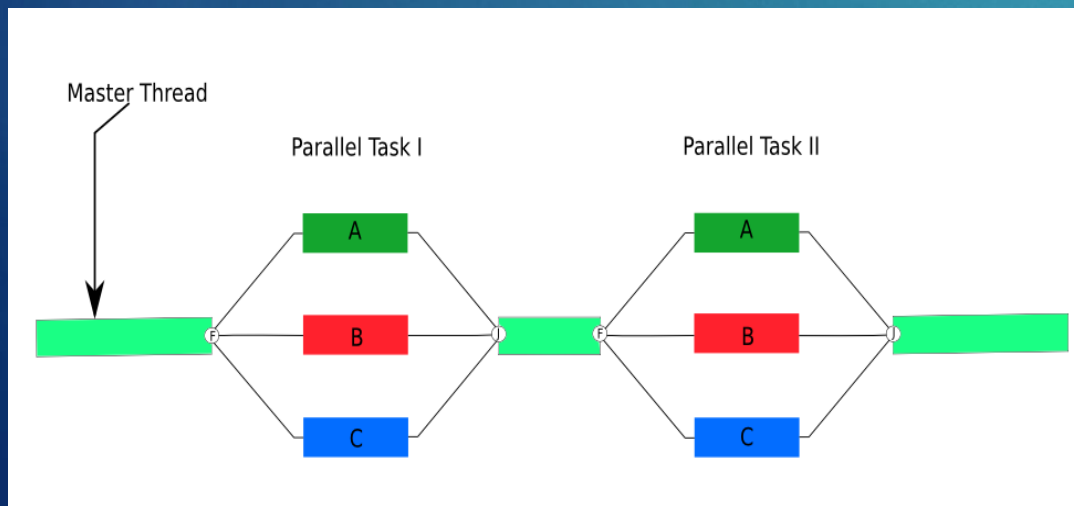
- Solving Maxwell's equation:

$$\nabla \times \mathbf{H} = \frac{\partial \mathbf{D}}{\partial t}$$
$$\nabla \times \mathbf{E} = -\mu_0 \frac{\partial \mathbf{H}}{\partial t}$$



# Research Problems

- ▶ How the frequency of light that is absorbed changes with nanoparticle size.
- ▶ Parallelizing the code
- ▶ Sizing of the simulation box.

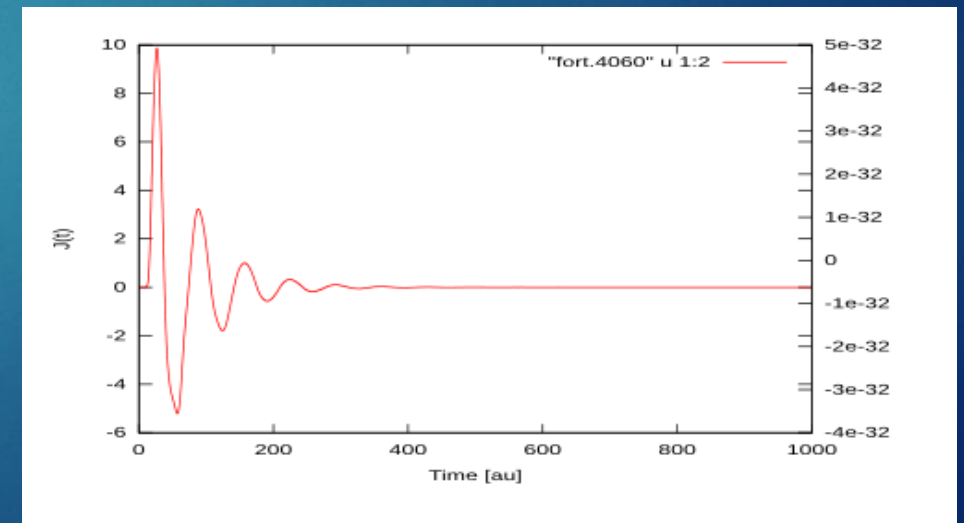
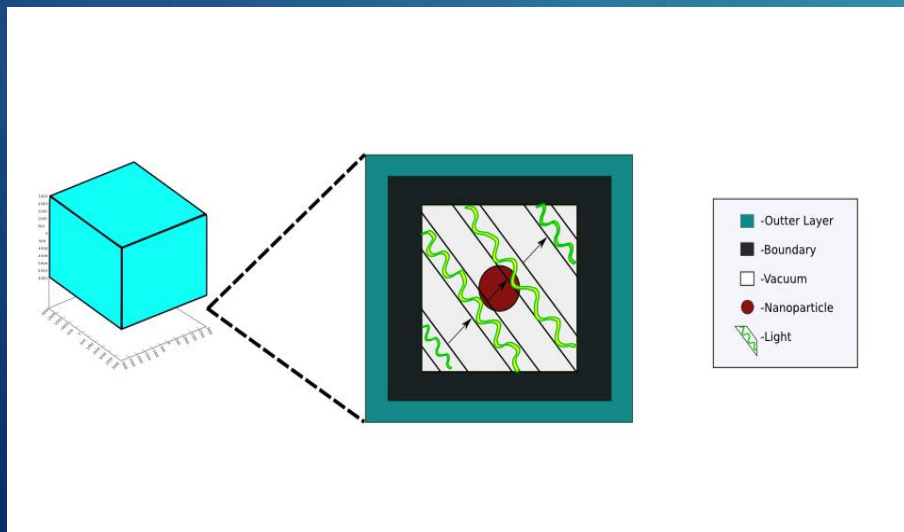


# Challenges

- ▶ Learned to code
- ▶ Learned to work with Linux
- ▶ Learned to use Open MP
- ▶ Learned about Finite Difference Time domain
- ▶ Learned about Plasmons

# Results

- ▶ Parallelized 1D code using OpenMP: ~ 8x speed up on 8 cores.
- ▶ 3D code: 2x speed up on 8 cores (work in progress).
- ▶ Ran simulations using the code.
- ▶ Boundary conditions.
- ▶ Explored size dependence of optical properties



# Plans to do Similar Work

- ▶ Becoming a Civil Engineer
- ▶ Interested in Water Resources
- ▶ Modeling hydrodynamics
- ▶ Similar computation tools and skills as this project

# Acknowledgments

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**Questions?**