

Bachelor Thesis 2016

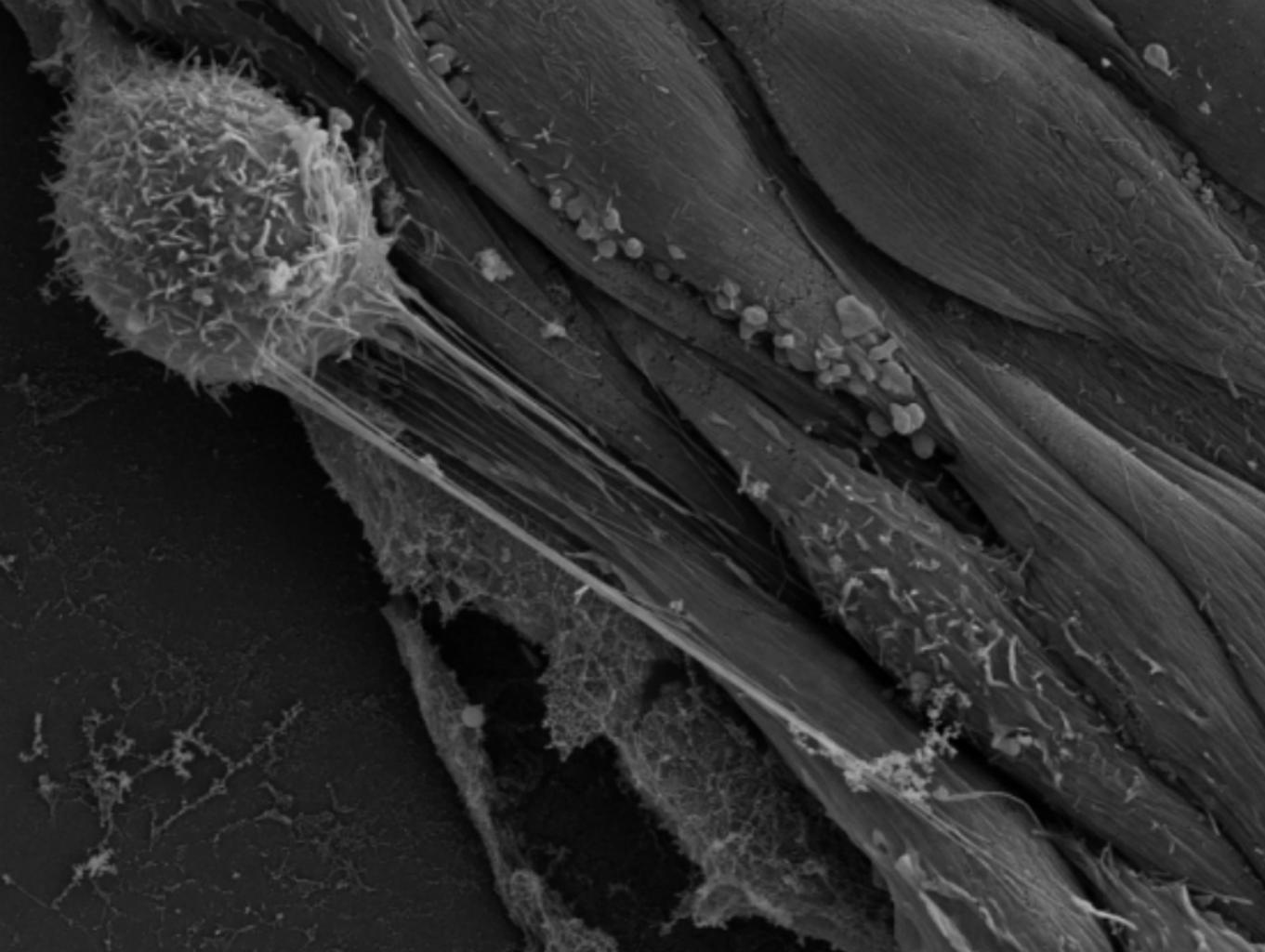
# Radiosensitization using gold nanoparticles

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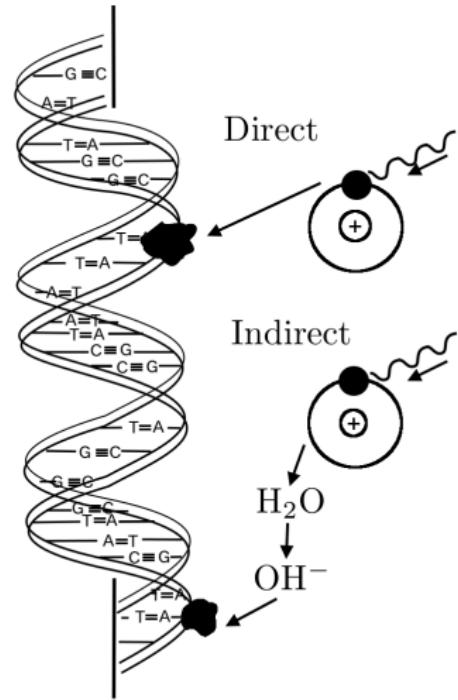
Professor: Chris Van Haesendonck



# DNA damage using ionizing radiation

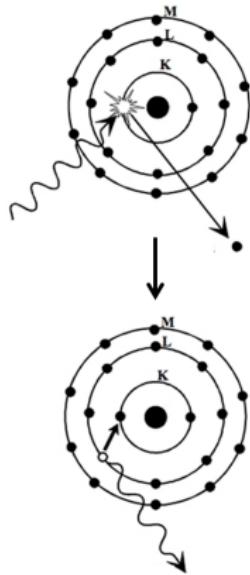
- Chemotherapy
- Surgery
- **Radiation therapy**

Energy  $\sim$  MeV

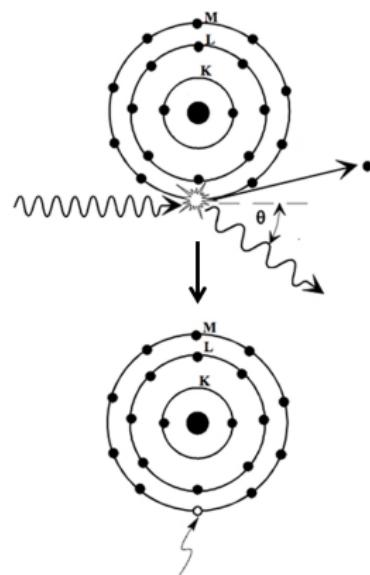


# Radiosensitization of cancer cells with gold nanoparticles (GNP) $E \sim \text{keV}$

Photoelectric absorption

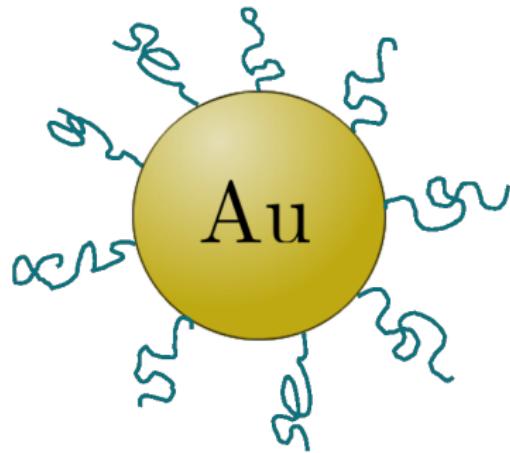


Compton effect

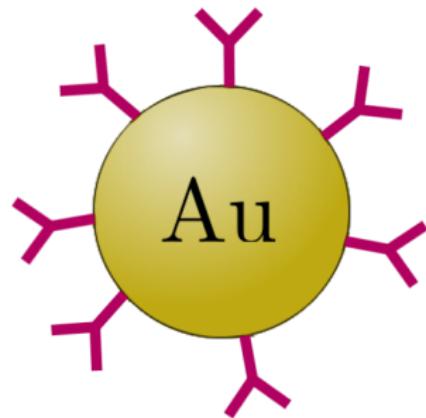


# Targeting of the GNP to the tumor

**Passive targeting**  
PEG coating



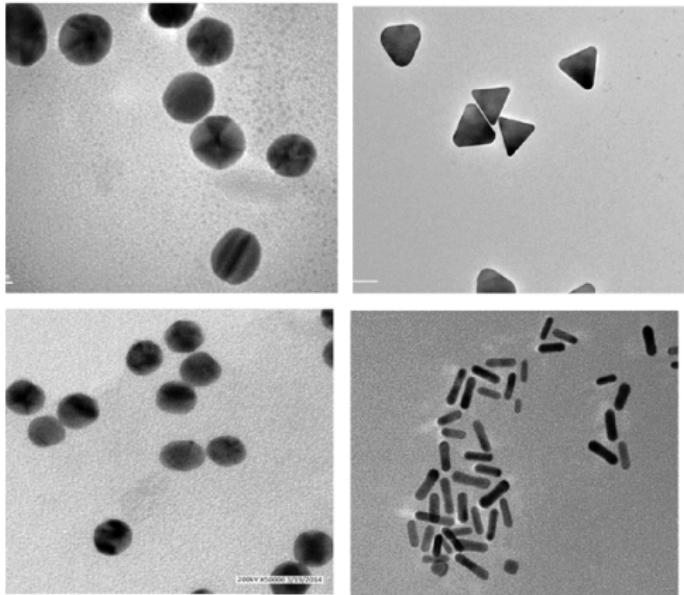
**Active targeting**  
Antibodies



# Overview Project

Radiosensitization of cancer cells  
using gold nanoparticles

1. Synthesis
2. Characterization
3. Radiosensitization



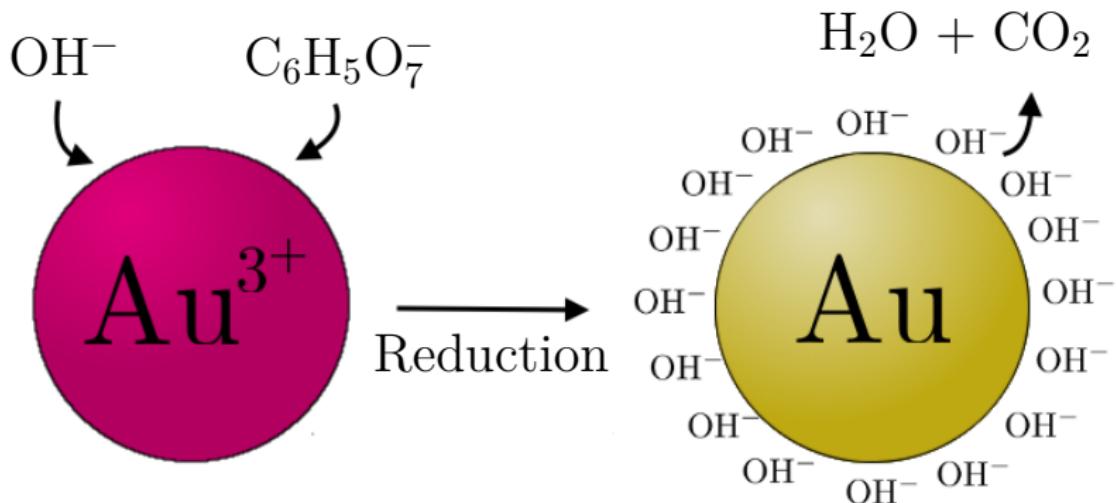
# Reduction of gold ions to form GNP



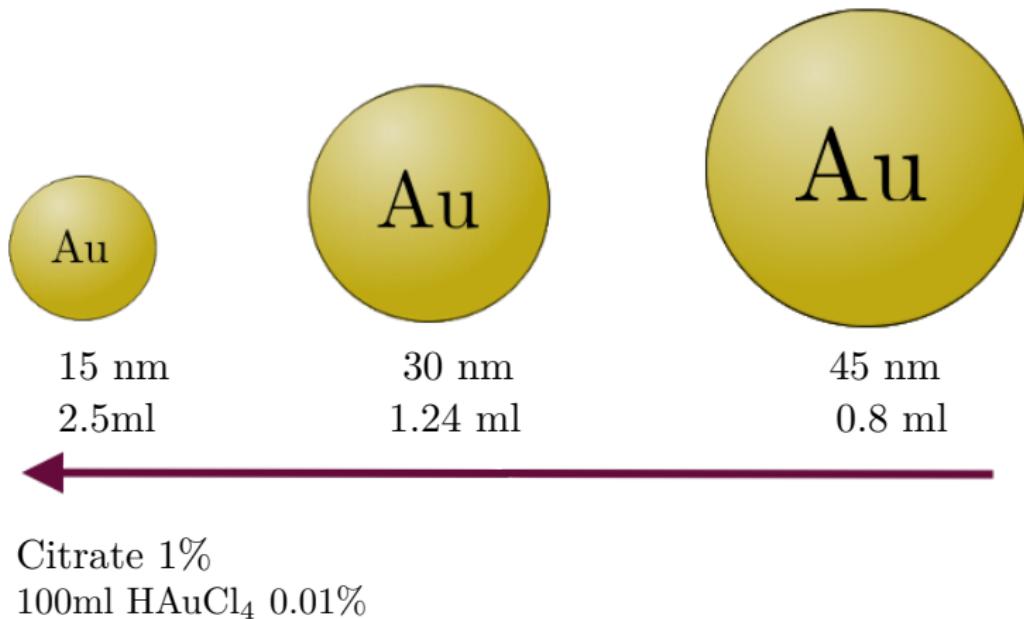
Gold ions: HAuCl<sub>4</sub> solution

Reducing agent: Na<sub>3</sub>C<sub>6</sub>H<sub>5</sub>O<sub>7</sub>

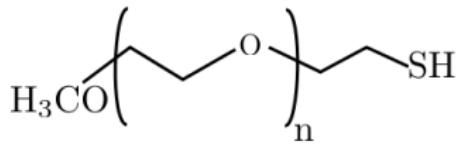
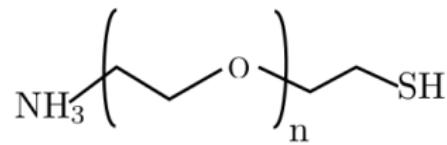
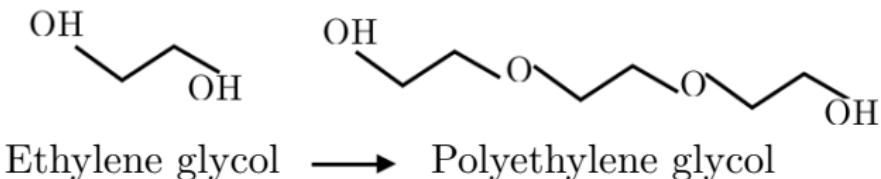
# Reduction of gold ions to form GNP



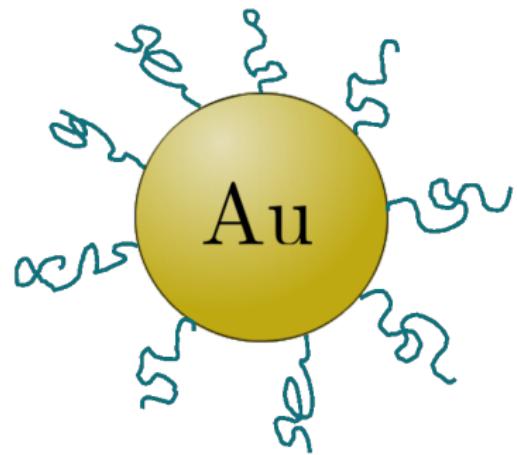
The amount of citrate controls the size



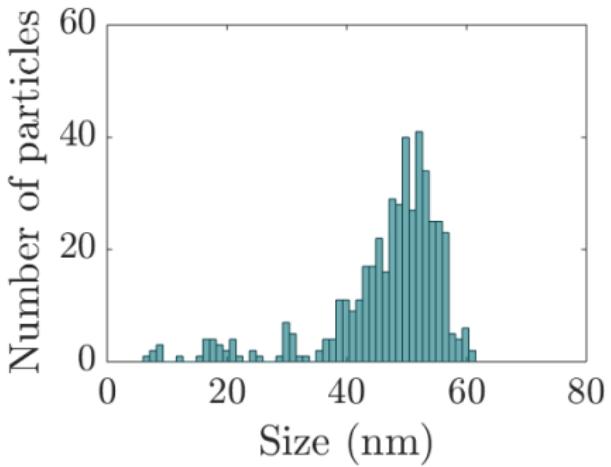
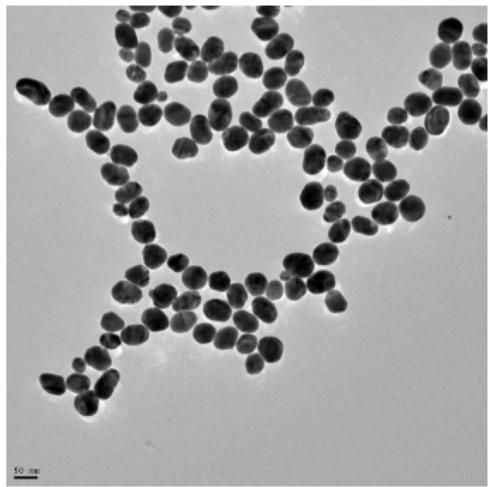
# PEG for targeting and stabilization



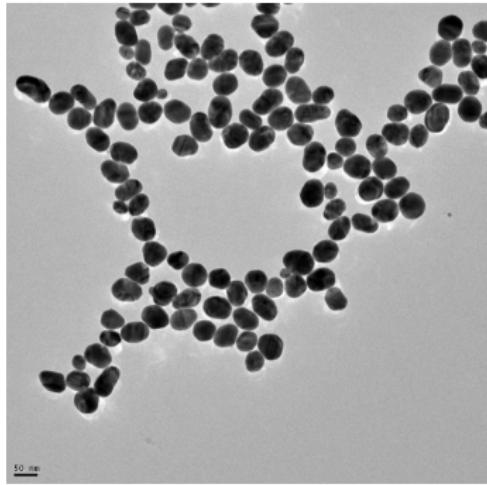
1k, 5k, 10k, 20k



# TEM image analysis to determine the core diameter



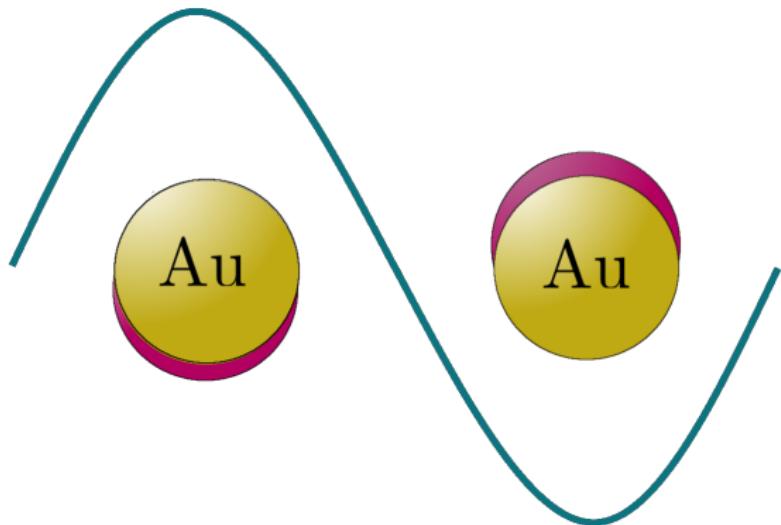
# TEM image analysis to determine the core diameter



Exp. Size (nm)	Size (nm)
15	$12.98 \pm 0.23$
	$2.99 \pm 0.16$
30	$18.29 \pm 0.23$
45	$46.75 \pm 0.47$

# UV-Vis spectroscopy

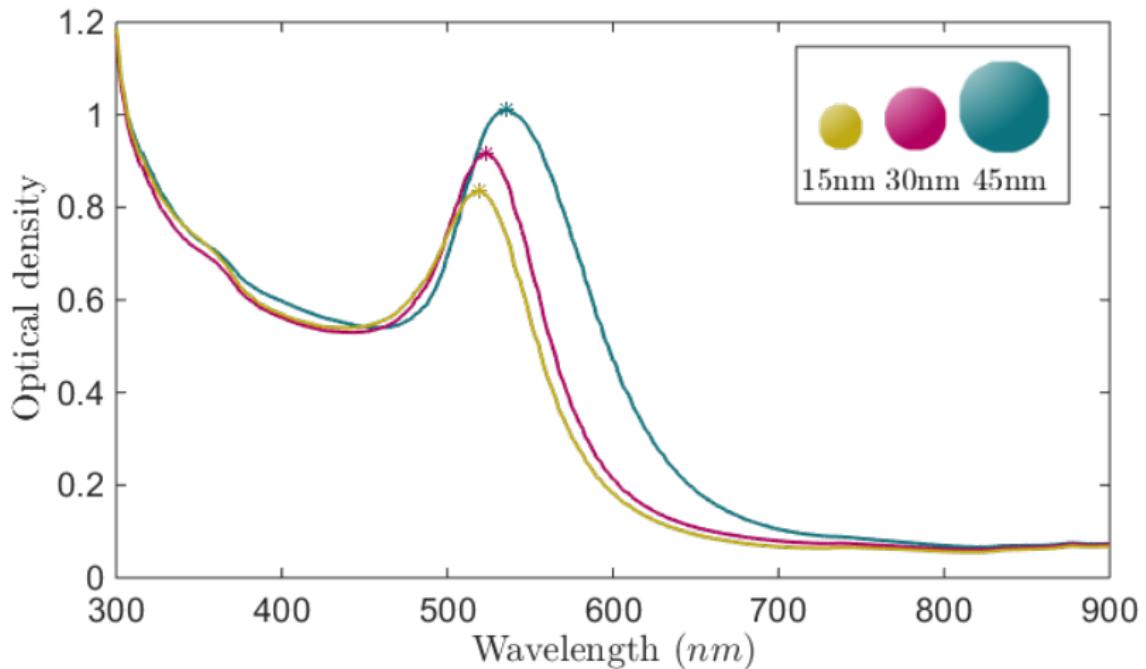
1. Add PEG
2. Size GNP
3. Add NaCl
4. Size GNP



bigger size → too little PEG  
same size → enough PEG

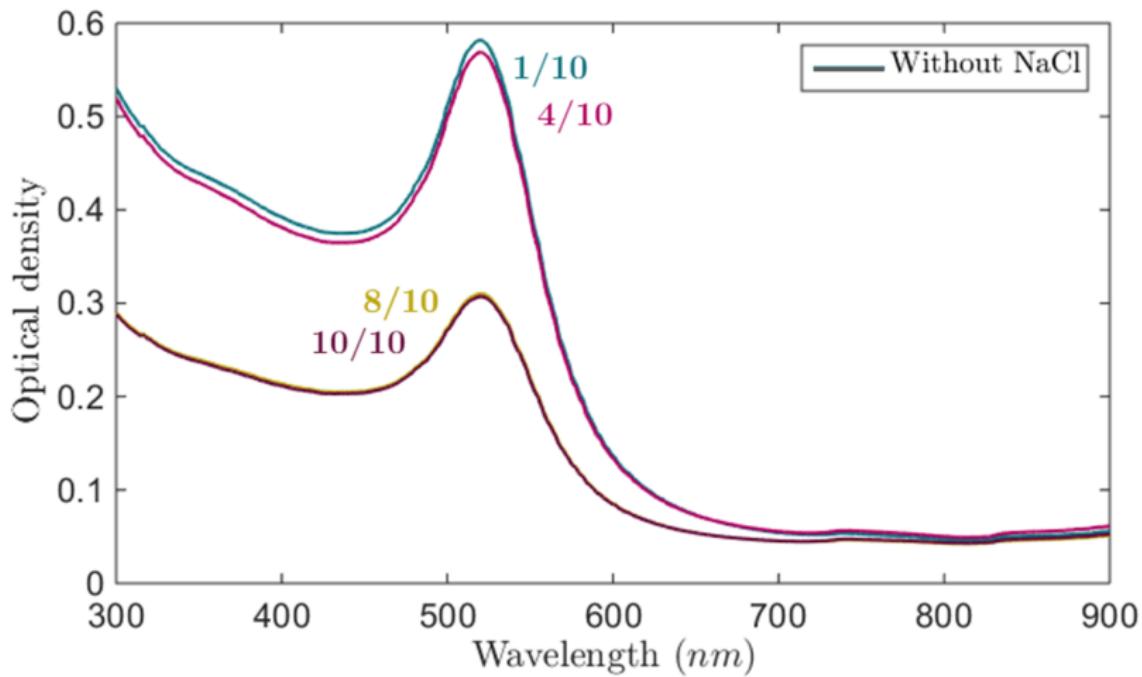
# Results

## GNP no PEG



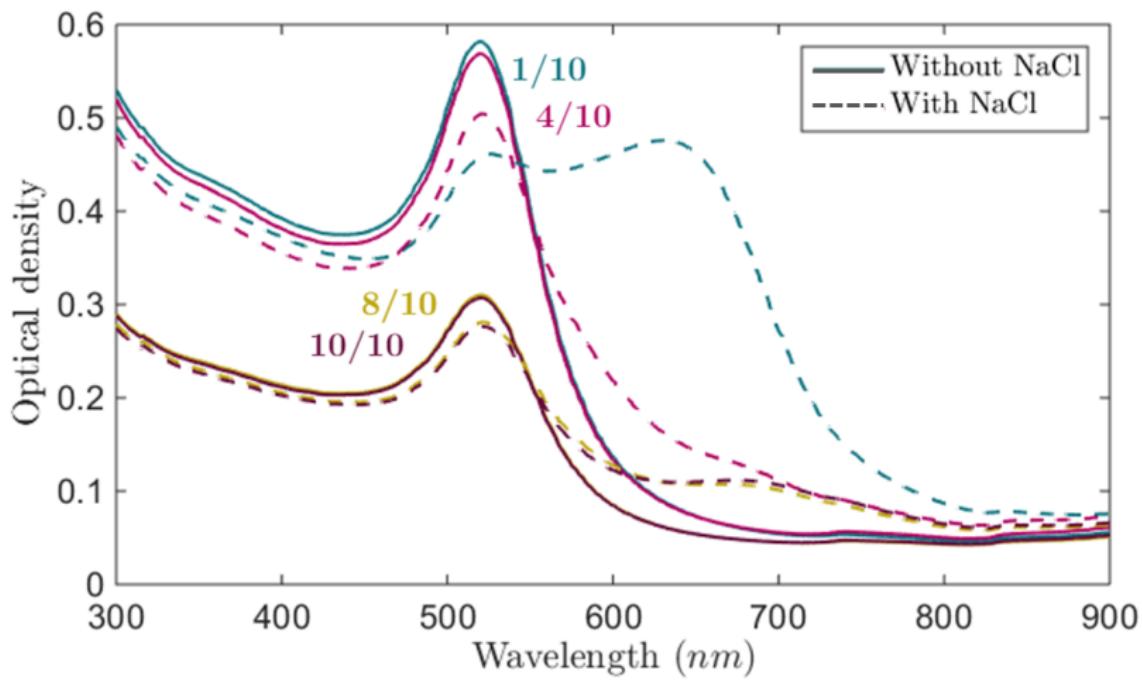
# Results

15nm GNP 20k PEG for different PEG/GNP



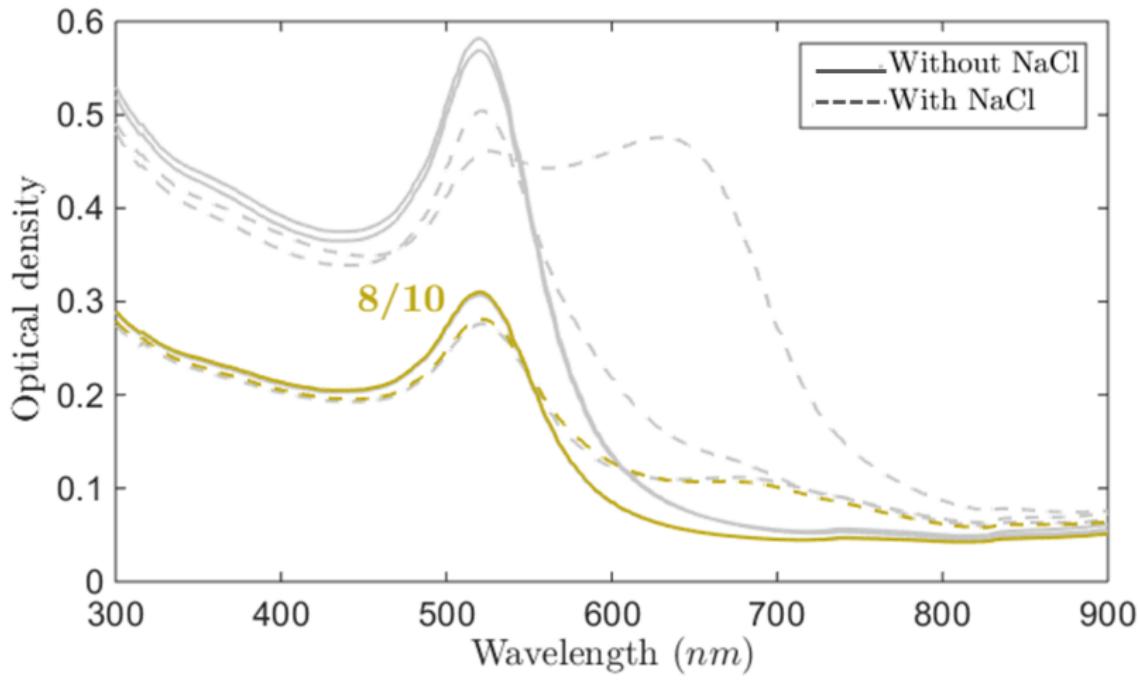
# Results

15nm GNP 20k PEG for different PEG/GNP



# Results

15nm GNP 20k PEG for different PEG/GNP



# Overview

Introduction

Synthesis GNP

Chemical Protocol

Size GNP

Stabilization

Characterization

Size GNP

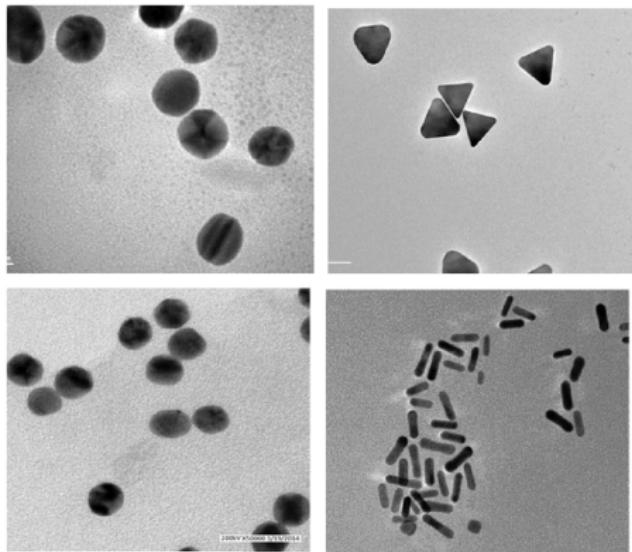
Chemical Protocol

UV-VIS

TEM

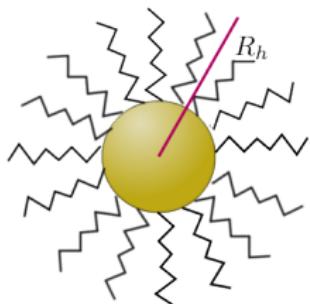
Hydrodynamic Radius

DLS



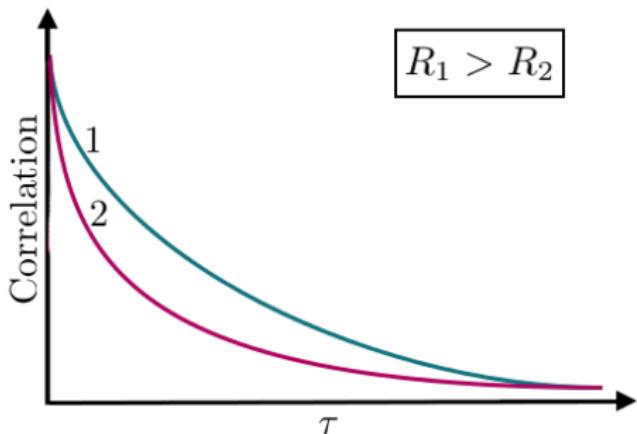
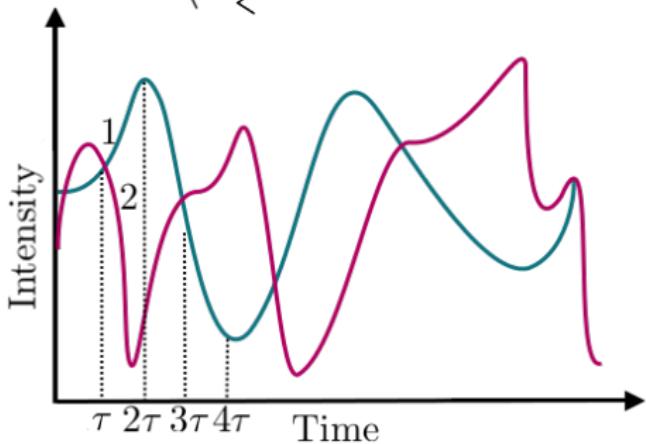
# Light scattering experiments to determine the hydrodynamic radius ( $R_h$ )

Important for diffusive properties

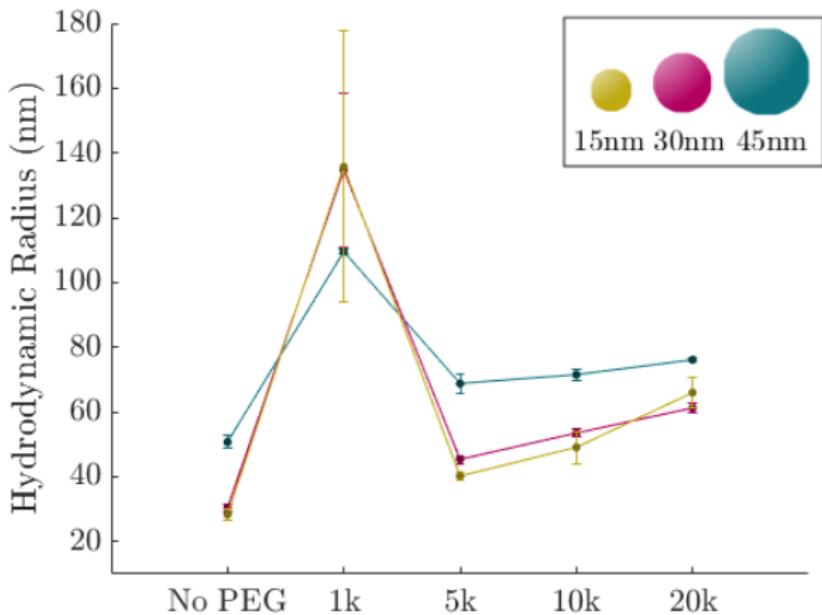


Correlation:

$$g(\tau) = \frac{\langle I(t) \rangle \langle I(t+\tau) \rangle}{\langle I(t) \rangle^2}$$



# Hydrodynamic radii for the three different GNP with different functionalizations



# Conclusion

- Synthesis of GNP
- Characterization
- Stabilization with neutral PEG
- Stabilization with positively charged PEG
- X-Rays
- Analyze effect on DNA
- Solve problem with DLS

