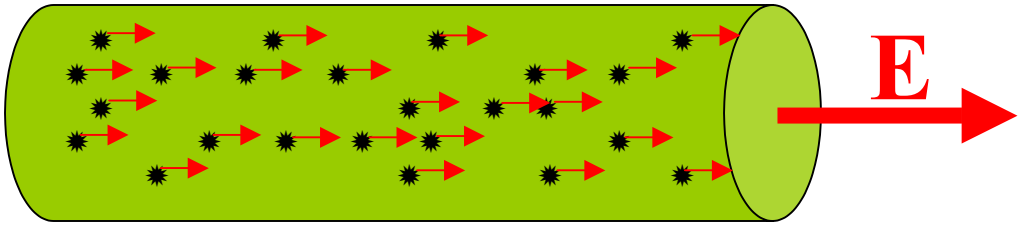
BULK METAL

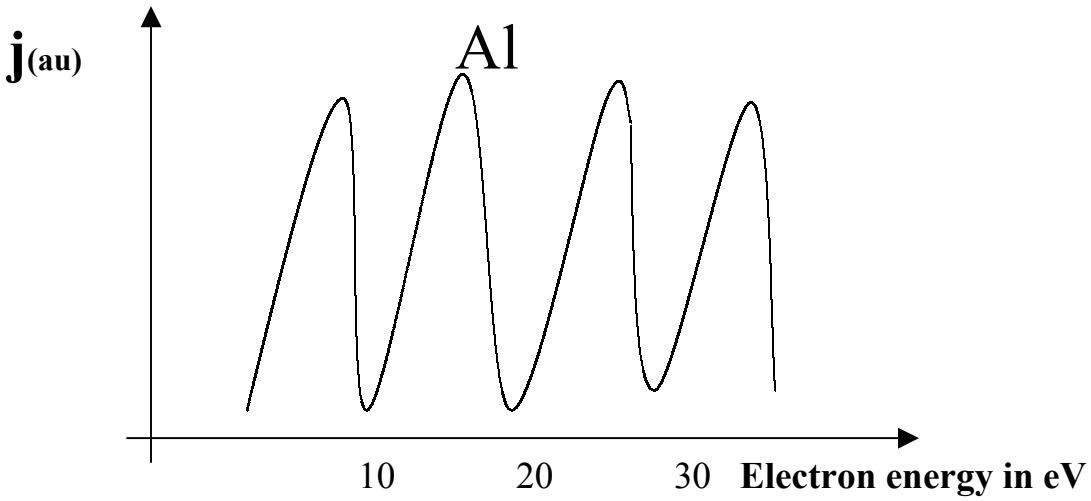


$$\mathbf{j(t)=\sigma E(t),} \qquad \sigma = \frac{ne^2\tau}{m}$$

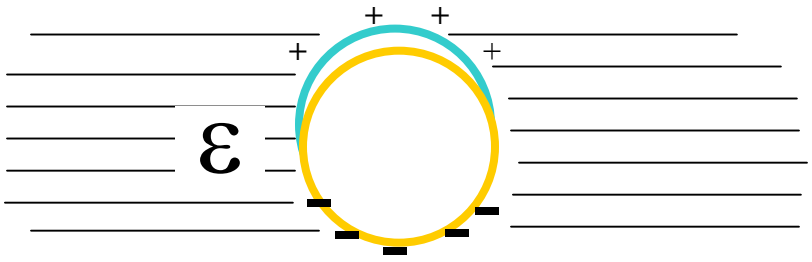
PLASMA OSCILLATIONS

$$\omega_p^2 = \frac{4\pi ne^2}{m}$$

$$\hbar\omega_p \sim 10\,\mathrm{eV} \quad \text{(Ultraviolet)}$$



SPHERIC PARTICLE



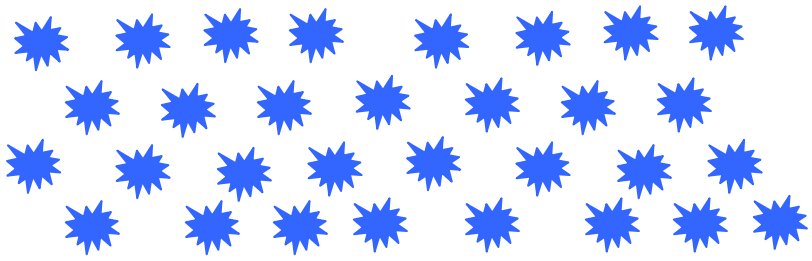
$$R \sim 1 \div 10 \text{ nm}$$

$$\omega_{sp} = \frac{\omega_p}{\sqrt{1+2\varepsilon}}$$

$$\text{For } \varepsilon = 4,\ \omega_{sp} = \frac{\omega_p}{3} \quad \text{Visible !}$$

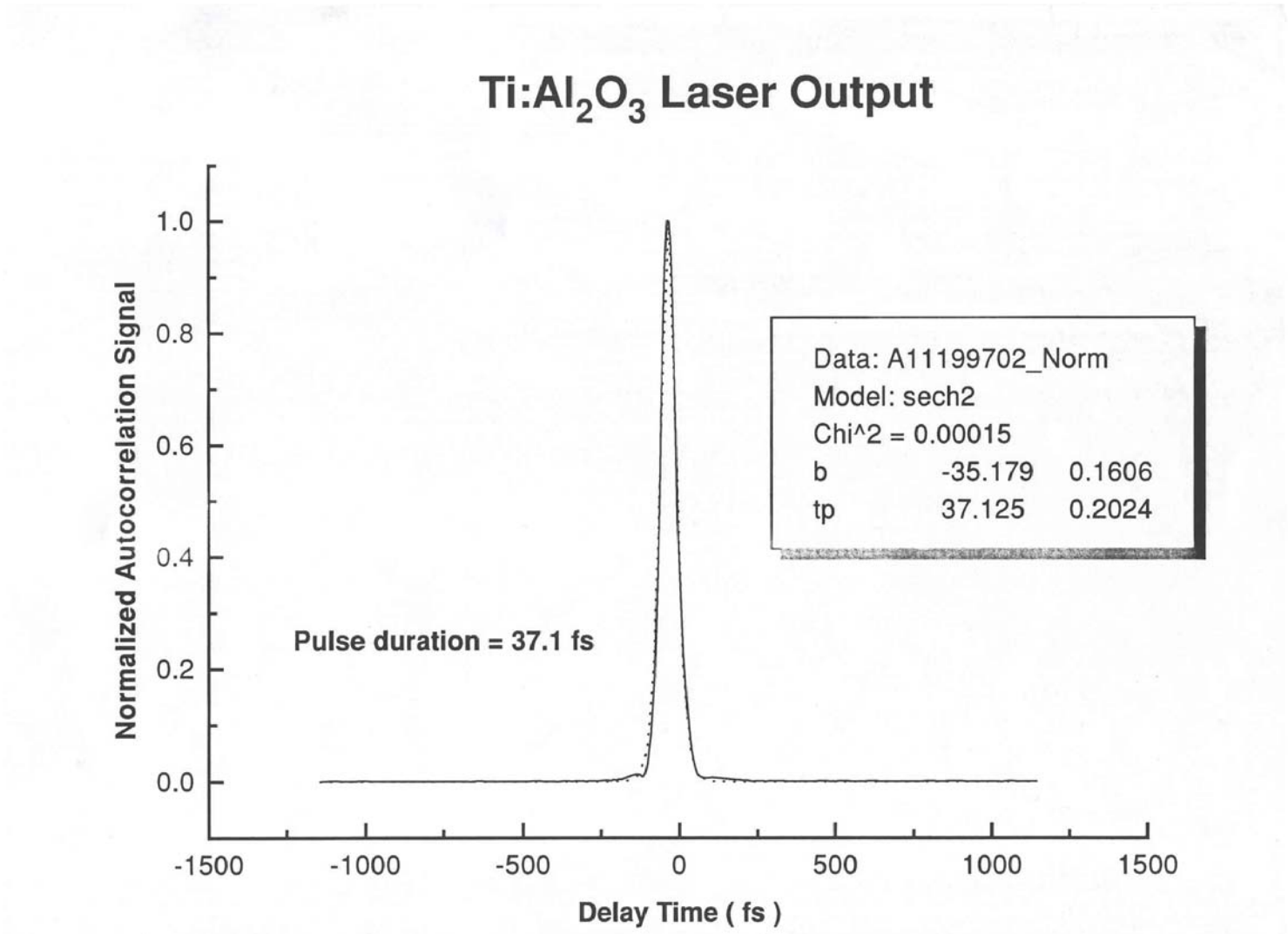
The fame of Roman goblet from 4th century in the British museum is due to the shining colors generated by a composition of Ag and Au clusters.

The earliest scientific investigation of small metallic particles (gold colloid in water) was undertaken by MICHAEL FARADEY



APPLICATIONS

- SELECTIVE ABSORPTION
- CHEMICAL CATALYSIS
- NEAR FIELD ENHANCEMENT
- BIOSENSORICS


Ti:Al2O3 Laser Output
Normalized Autocorrelation Signal
1.0
0.8
0.6
0.4
0.2
0.0
-1500
-1000
-500
0
500
1000
1500
Delay Time (fs)
Pulse duration = 37.1 fs
Data: A11199702_Norm
Model: sech2
Chi^2 = 0.00015
b -35.179 0.1606
tp 37.125 0.2024

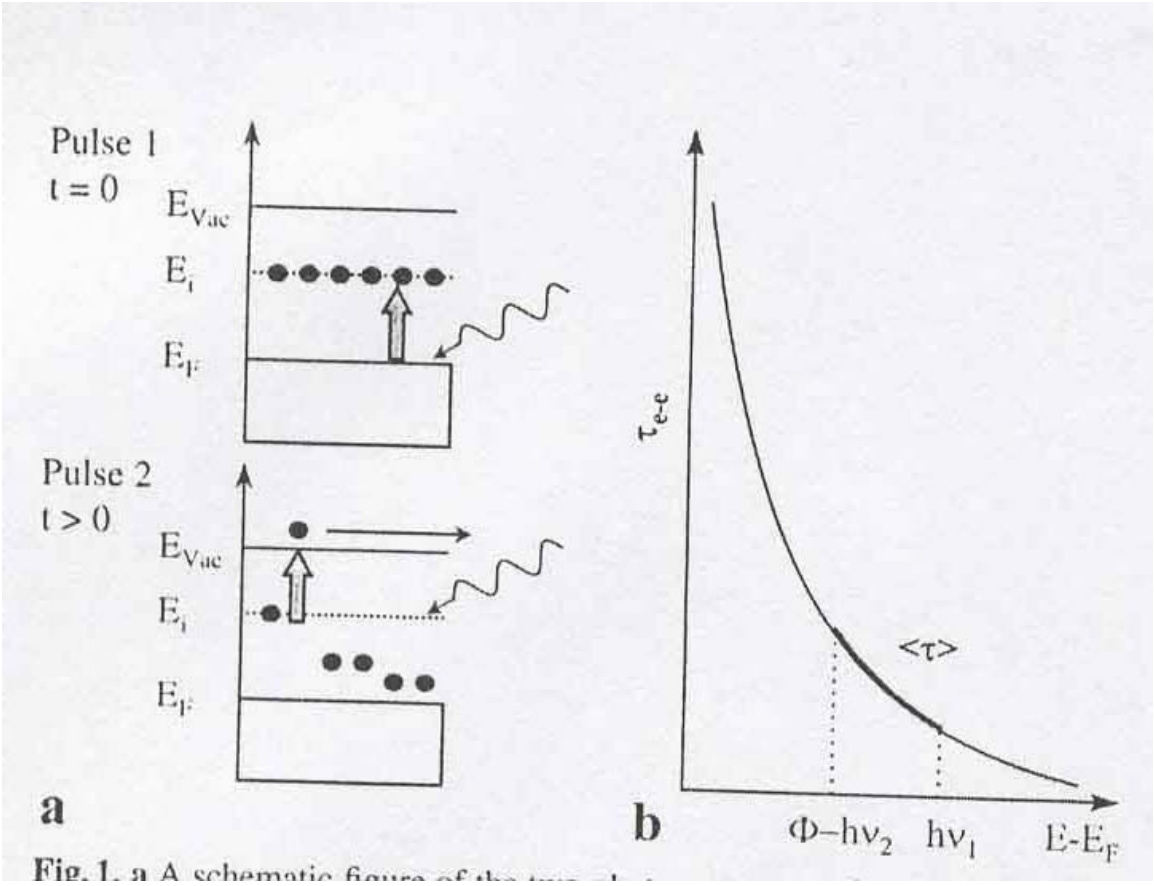
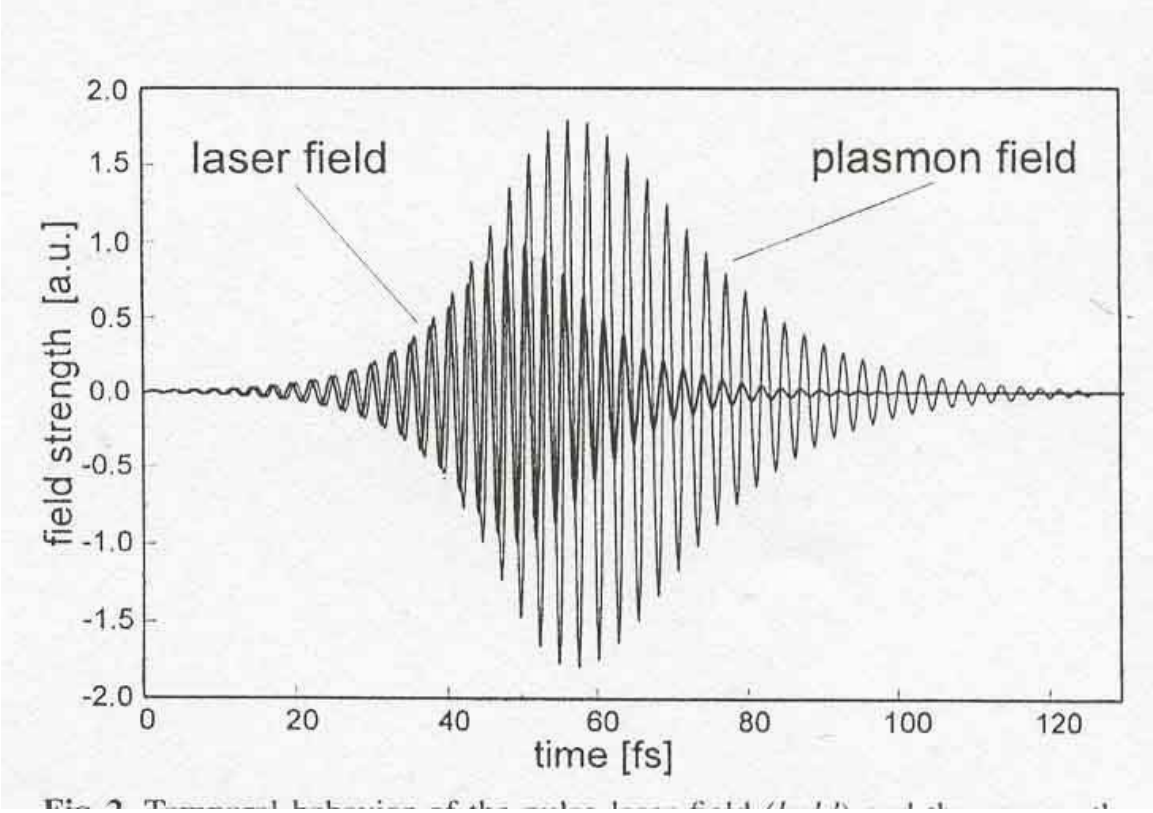


Fig. 1. a A schematic figure of the


laser field
plasmon field
field strength [a.u.]
time [fs]
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0
20
40
60
80
100
120

Identification of the role of matrix in surface plasmon oscillation energy leakage from MNPs.

$$\frac{dW}{dt} = -\left(\frac{1}{\tau_{rad}} + \frac{1}{\tau_{e-ph}} \right) W$$

$$\frac{1}{\tau_{rad}} = \frac{2\omega_p^4}{9c^3} \frac{\sqrt{\varepsilon_1}}{1+2\varepsilon_1} R_0^3$$

$$\frac{1}{\tau_{res}} = \frac{2}{9} c\,\alpha(\omega_{sp}) \frac{1+2\varepsilon_1(\omega_{sp})}{\varepsilon_1^{3/2}(\omega_{sp})}$$

NEXT STEPS

- Development the theory of electron-electron and electron-phonon interactions in MNPs with strong SQ of electron and phonon spectra, and generalization of two temperature model (TTM) theory to size quantized systems.
- Ultrafast transient absorption experiments with prepared nanocomposites for the detection of size dependence of electron-phonon coupling constants.
- Experimental confirmation of electron spectra SQ effect in MNPs and proposition of possible applications.
- Understanding of SP resonance broadening mechanisms in nanocomposites, revealing the contribution of MNPs lattice vibrations, radiation damping and nonsphericity.