



**BOSTON
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Lasers~Rainbows & Photons: Introduction to the Nanoworld

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LERN_{et}
Boston University's Learning Resources Network



Abstract

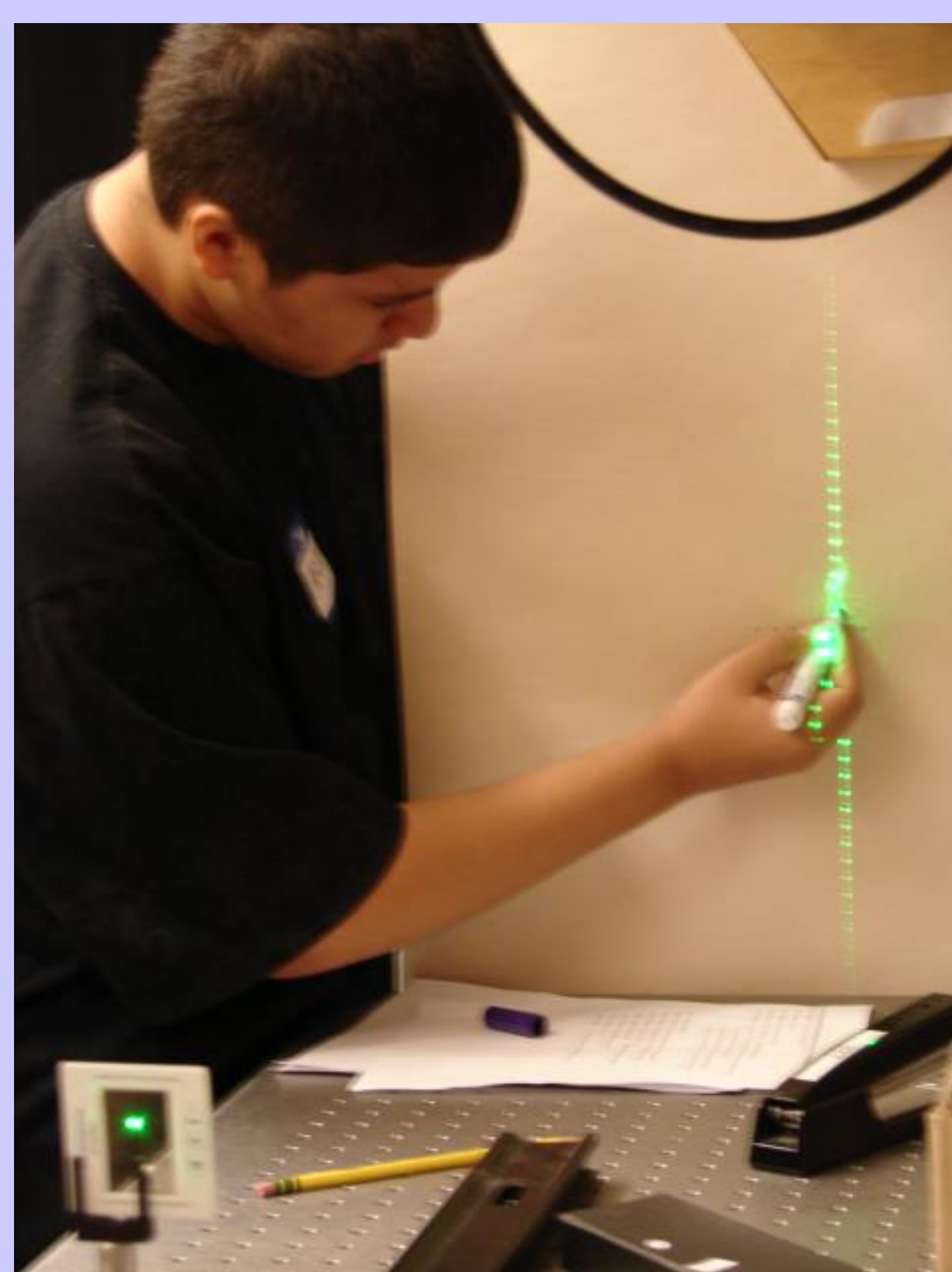
The focus of my research experience resulted in the examination of the Fraunhofer theory of a mathematical explanation to the phenomena of light diffraction. Two different monochromatic lights were projected through diffraction gradients of different spacing between structures. Two separate experiments were conducted using red and green lasers. The distance from the grating to the far screen (L) was measured. The distances between projected dots on the far screen (X) were measured and averaged. Fraunhofer's equation was used to solve for the unknown in each of the two experiments. Data indicates the longer the wavelength (red) and higher the frequency and the greater the diffraction. The shorter, green wavelength, produced *closer* far field dots, resulting in less diffraction, higher image resolution and higher frequency. Although Fraunhofer's equation supports wave theory, scientists have utilized the duality of light as both wave and particle to manufacture diffracting gratings on a scale close to, or smaller than, the wavelength of light. Light beamed through these minute gratings produce unusual electron behaviors. Exciting molecular bonds on the nanoscale often changes the chemical, physical, thermal and mechanical properties of those molecules. Similarly, photons can be manipulated on the nanoscale: $1 \times 10^{-9}\text{m}$! Application of nanotechnologies were investigated as well as ways to integrate nanoscience/technologies into the middle school.

Methodology:

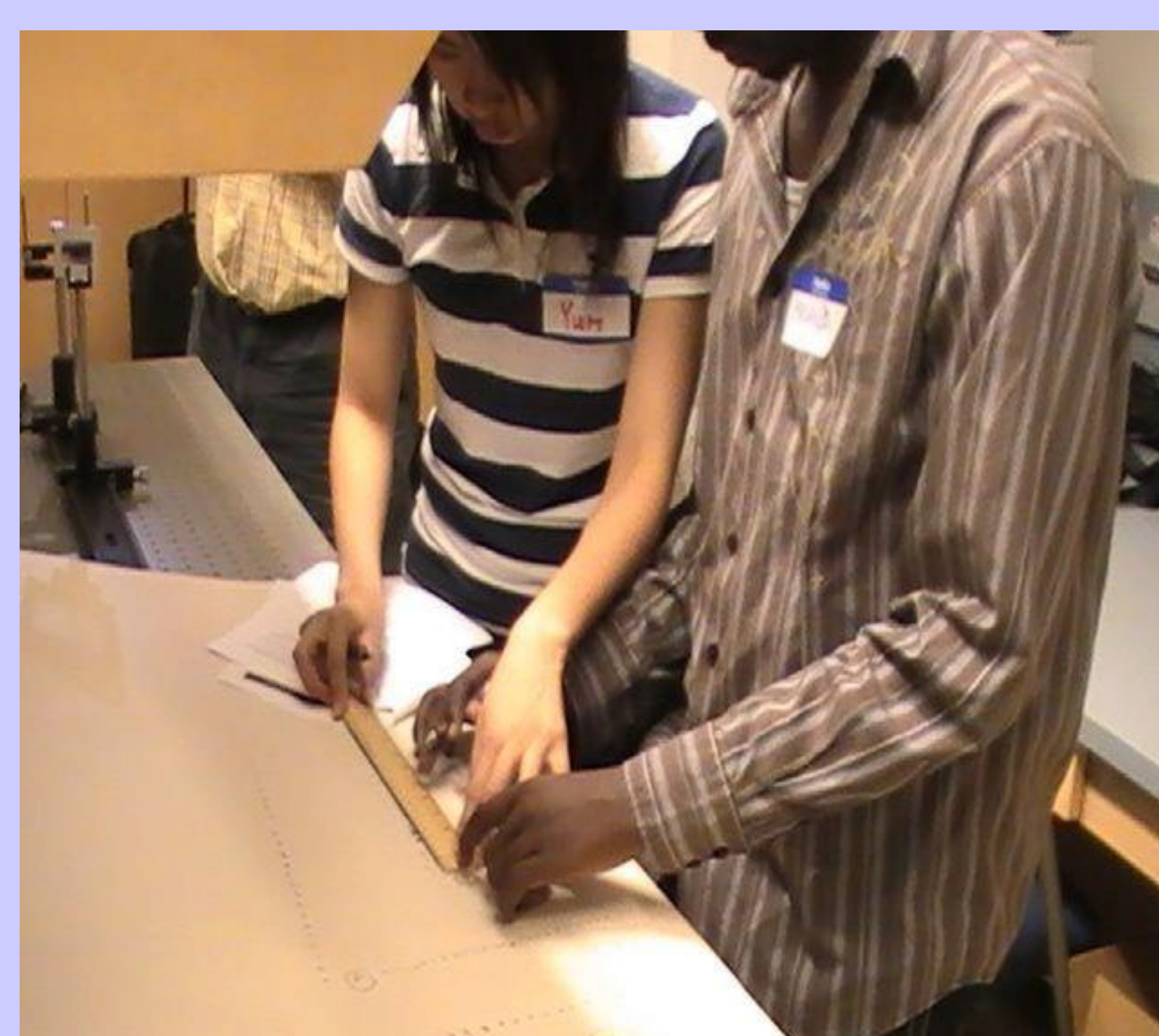
$$\sin(\Phi)\lambda = X/L$$

Diffraction and PDMS Soft Lithography

Boston Public School students collect and analyze diffraction data, make PDMS molds and observe PDMS diffraction patterns using green and red lasers.

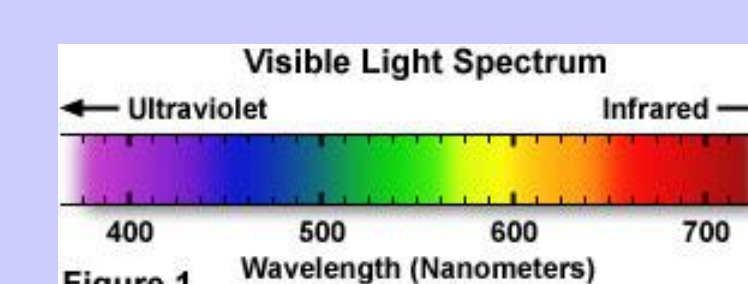
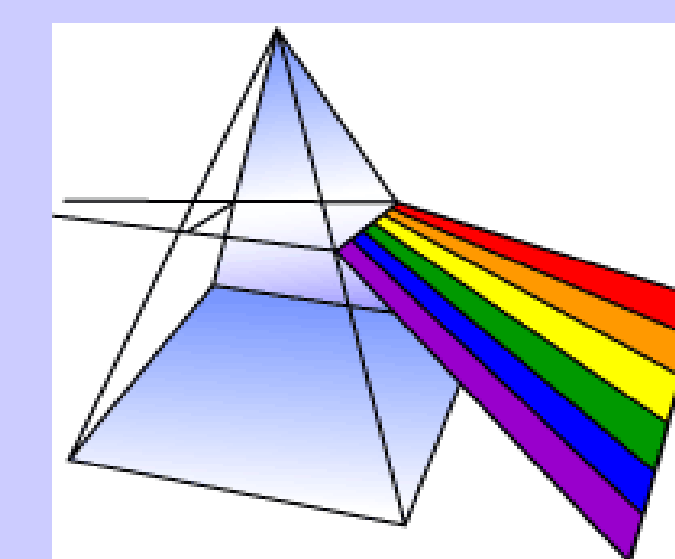
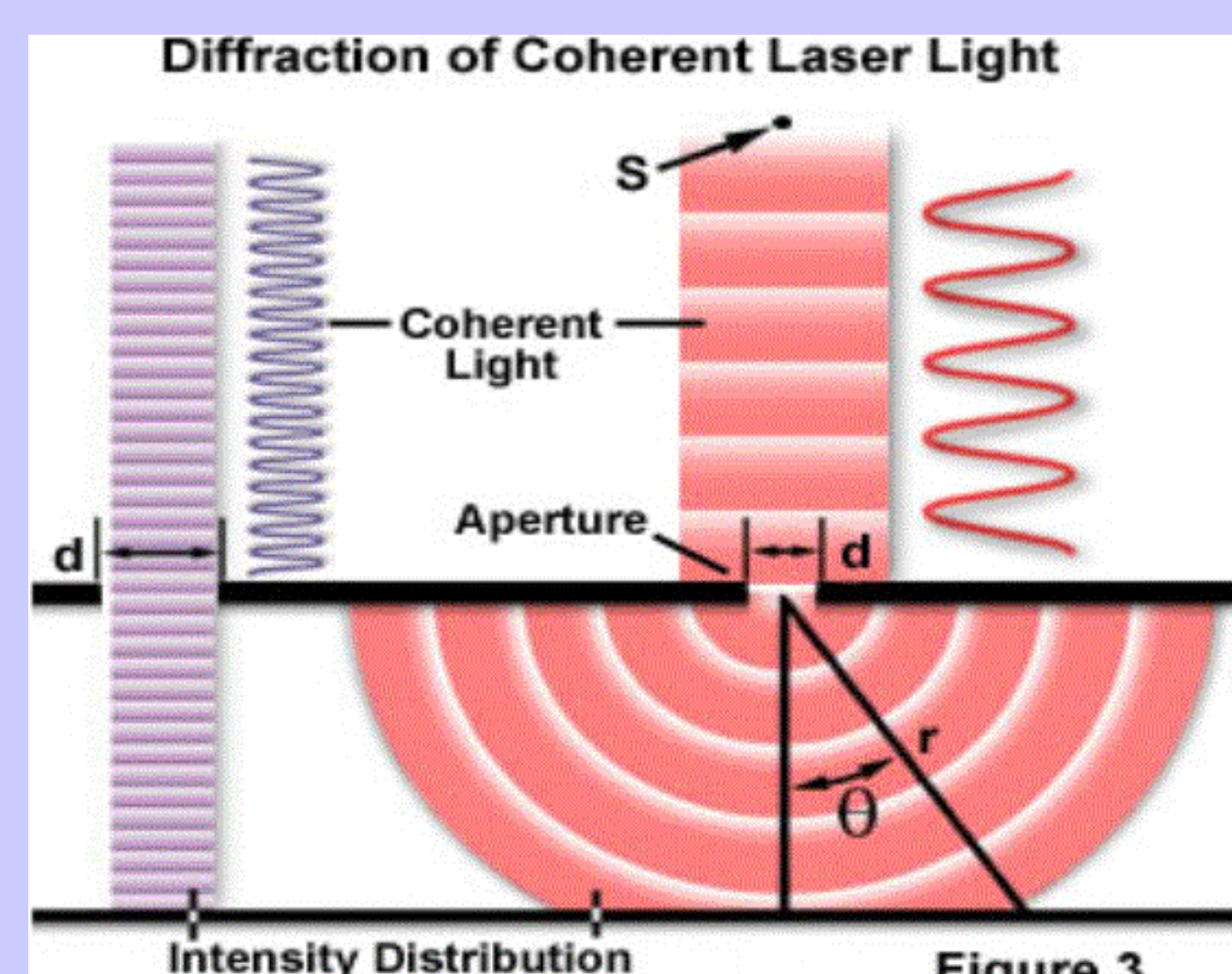


Variations in spacing of diffraction grating



Data Analysis

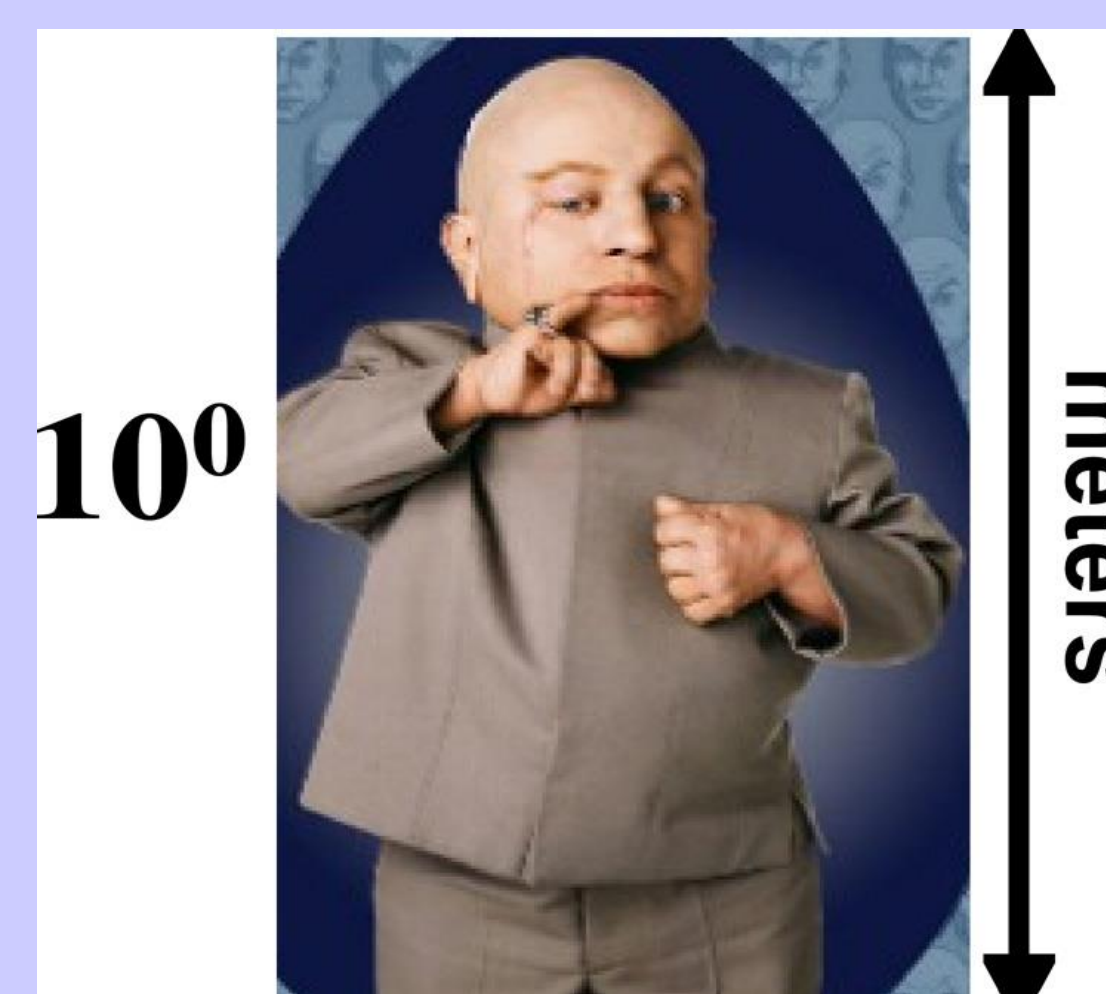
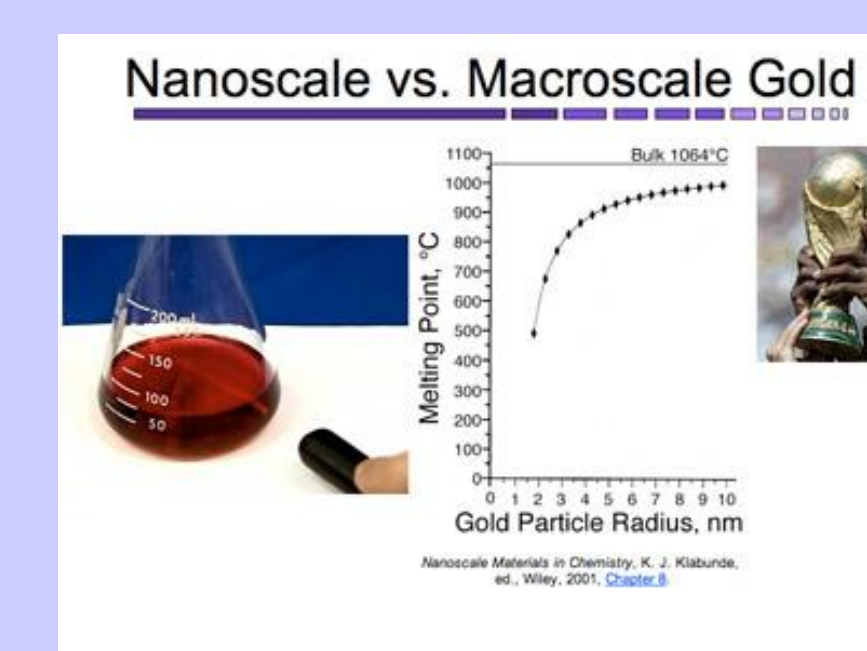
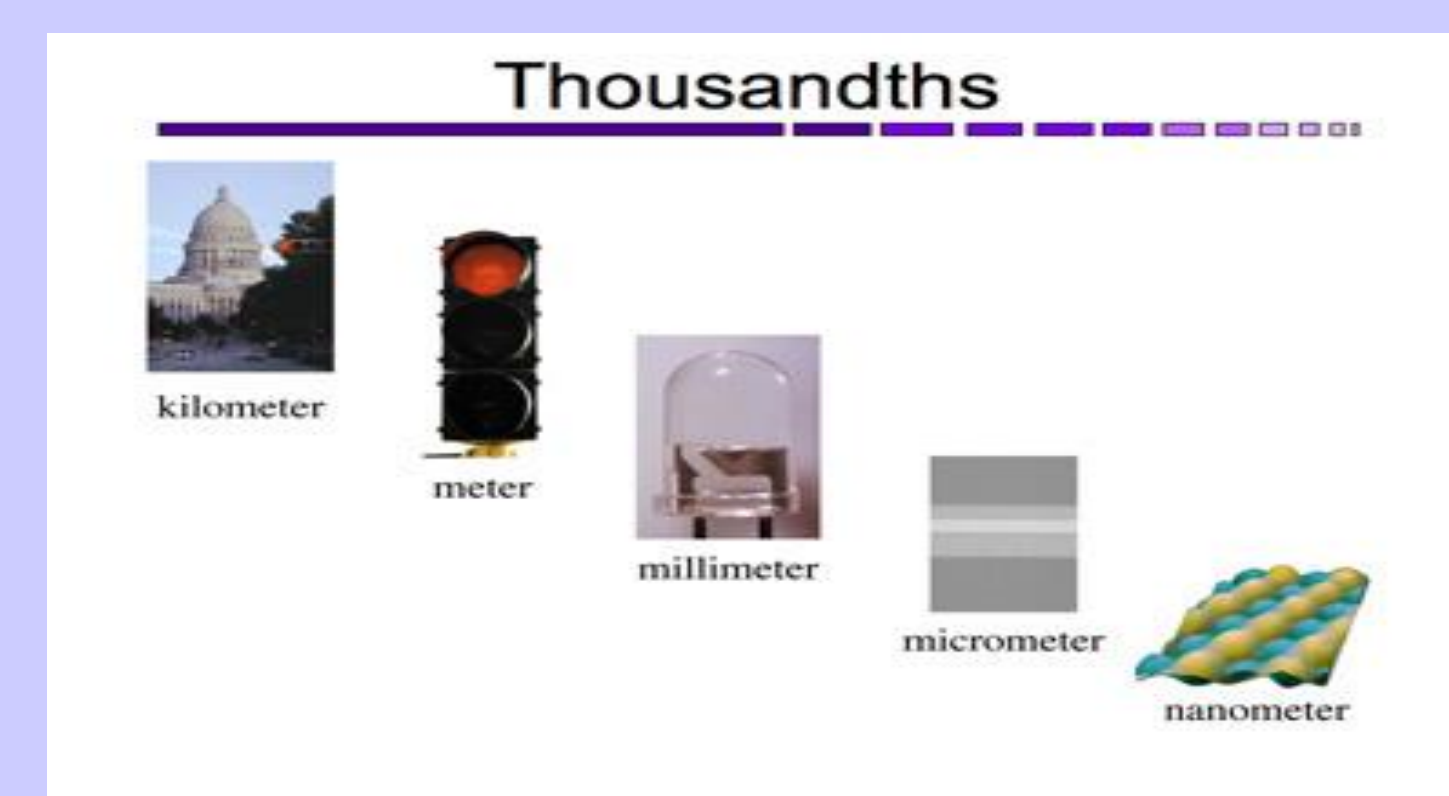
Light Diffraction Model



Conclusion

- If aperture is larger than the wavelength, then no diffraction.
- Smaller the wavelength, the smaller the aperture, the smaller the diffraction.
- Less diffraction, greater the amplitude clearer resolution and higher frequency.

How Might Light Behave if Beamed Through Diffraction Gratings on a micron scale?

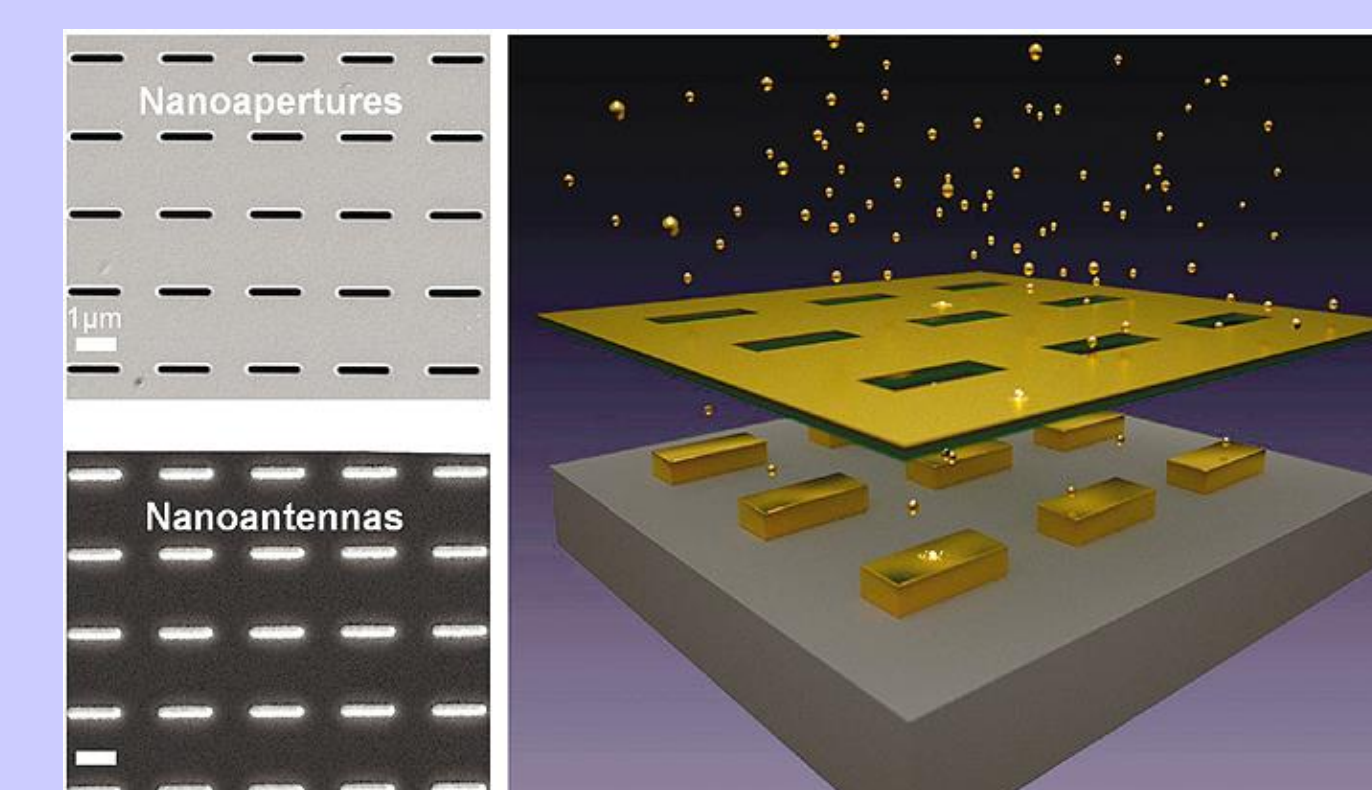


Welcome to nanoscience and nanotechnologies

Recent and Future Applications of Nanotechnologies

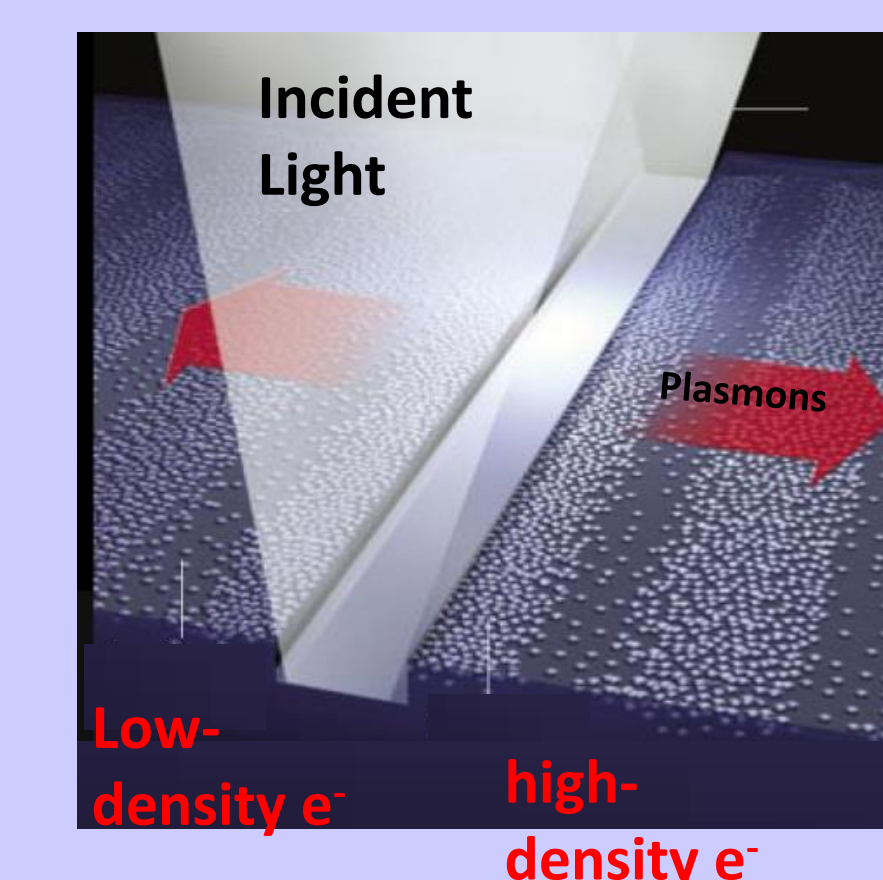
Professor Hatice Altug

NanoStencil Lithography



ExExtreme Light Manipulation:

Plasmonics



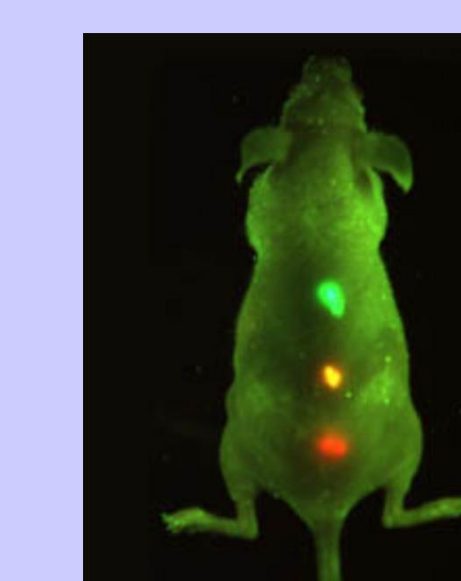
Consumer Products



Defense Products

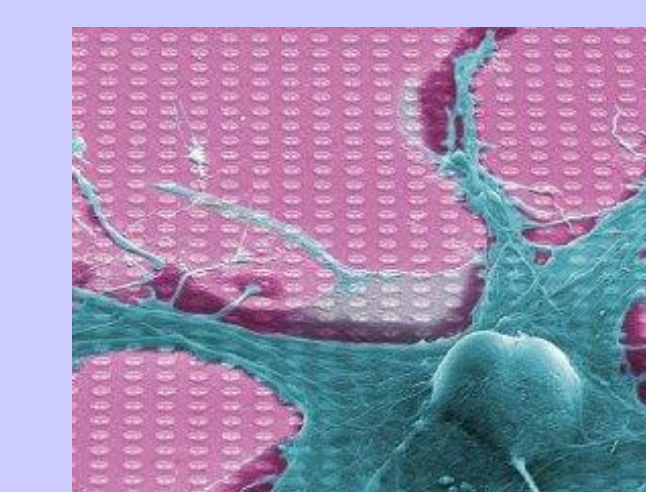


Inorganic nanorods mixed with polymer



Quantum dot nano crystals glow in UV light

Snail Neuron Grows on Chip



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