

XII<sup>th</sup>-IIC-EMTCCM

European Master in Theoretical Chemistry and Computational Modelling

# Quantum Dots: Periodicity, spatial confinement and external fields

J. Planelles



**What is a quantum dot?**

**Why is it called artificial atom?**

# Ask the Expert



STANFORD UNIVERSITY

What is an artificial atom and why would we make one?

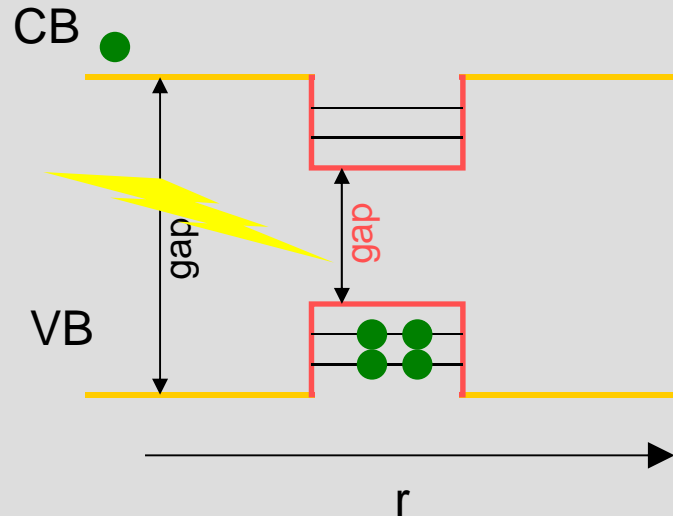


**Professor  
James Harris**  
EE

Artificial atoms, also called quantum dots, are actually made of dozens of atoms, but they act very much just like

a single atom in one important respect: when you provide them with the right amount (quanta) of energy, they will emit light with a very distinct color. This property makes them useful in applications as diverse as data communications and medical testing.

# So, what is a quantum dot?



- Discrete energy levels: “Artificial Atoms”
- Control over the number and type of carriers
- Flexible design of energy spectrum



# What is a quantum dot good for?

nature

SPECIAL RE

## Quantum d

A small industry could be on the

Nanocrystals called quantum dots have promised to revolutionize display technologies, solar power and biological imaging for more than a decade. Yet the quantum-dot market has remained small, with a handful of companies selling dots directly to researchers, using the particles to develop their own products or licensing their technology to partners.

"Quantum dots have been around for quite a while, but they're taking a really long time to mature," says David Hwang of the market-analysis company Lux Research in New York.

Quantum dot memory may be 'Holy Grail' of compu...

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## Quantum dot memory may b

17:14 07 March 2008 by [Mason Inman](#)  
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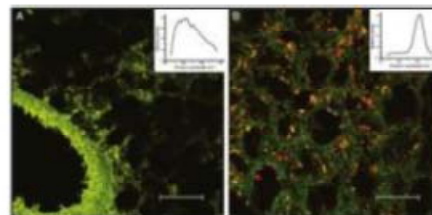
## Samsung and Evident Technologies Enter Into LED Patent Agreement

TROY, N.Y. and SEOUL, South Korea, May 5, 2011 /PRNewswire/ -- Evident Technologies, Inc. and Samsung Electronics Co., Ltd have entered into a comprehensive patent licensing and purchasing agreement for Evident's quantum dot LED technology. This agreement grants Samsung worldwide access to Evident's patent portfolio for all products related to quantum dot LEDs from manufacture of the quantum dot nanomaterials to final LED production.



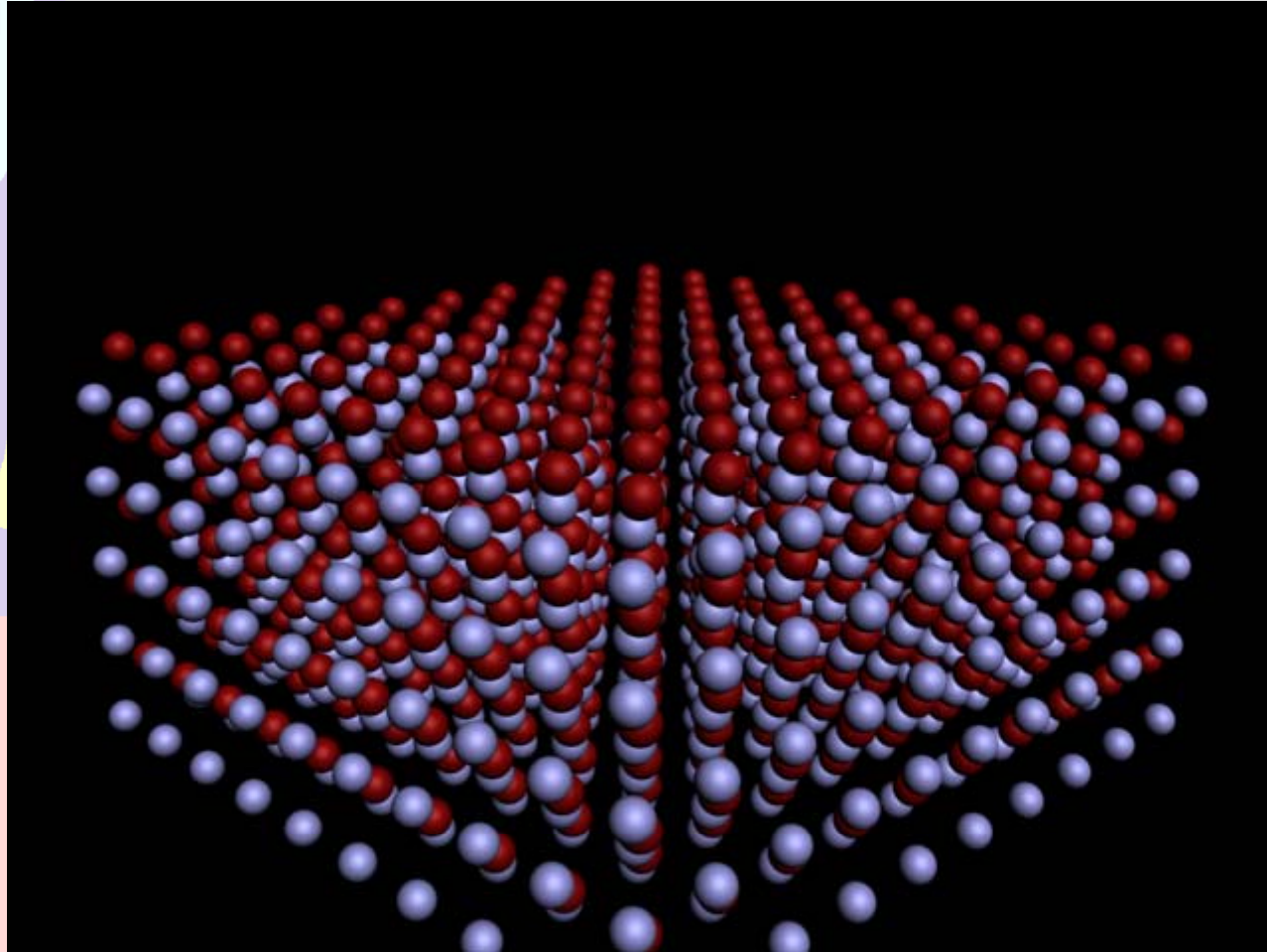
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## Cancer drug linked to quantum dots increases drug uptake, reduces inflammation



The left image shows lung tissue injected with doxorubicin alone, while the image on the right (yellow dots) indicates the increased uptake of the quantum-dot delivered drug. Credit: University at Buffalo

## A closer view



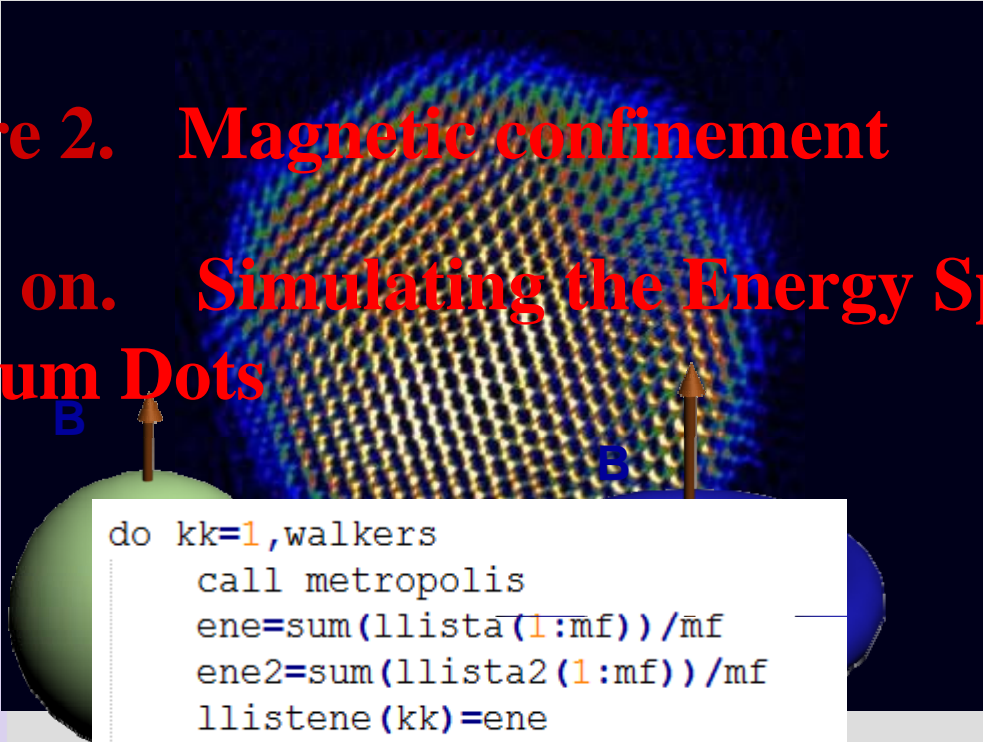
QDs are periodic inside

# Today, in this course...

**Lecture 1. Periodicity and Spatial Confinement**

**Lecture 2. Magnetic confinement**

**Hands on. Simulating the Energy Spectrum of Quantum Dots**



```
do kk=1,walkers
  call metropolis
  ene=sum(llista(1:mf))/mf
  ene2=sum(llista2(1:mf))/mf
  llistene(kk)=ene
  llistene2(kk)=ene**2
  llistvar(kk)=ene2-ene**2
enddo
```