

# Mechanics Scholars Luncheon

Texas A&M University



## *Opportunities for Talented People with Physics Training*

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<http://people.physics.tamu.edu/toback/>

# Good news and Bad news

- **Good news**

- You have been identified as being in the top 1% of all physics performers in Physics 218
- You get a free lunch

- **Bad news:**

- You clearly have the talent and the “right stuff” to get further training in physics
- You have to listen to me give a pitch on why you should SERIOUSLY think about taking more physics classes

# Common Myths

I'd like to start by listing some common myths

## 1. People

- *I don't know ANYONE who does physics except my high school teacher and my Professor from this last semester*
- *Frankly, they're kinda dorky and weird like on Big Bang Theory*

## 2. Jobs:

- *My high school advisor said "You're good at math and science? You should be an engineer!"*
- *If you have a physics degree, you can either be a professor or a high-school teacher. Either do research or teach*
- *Physics is all theory, engineering is where you do REAL things*

# Common Myths cont...

## More common myths

### 3. *Money:*

- *All the people I know with physics degrees don't dress well so they must be poor*
  - *Have you seen the car they drive?*

### 4. *Uhhh... Physics? Really?*

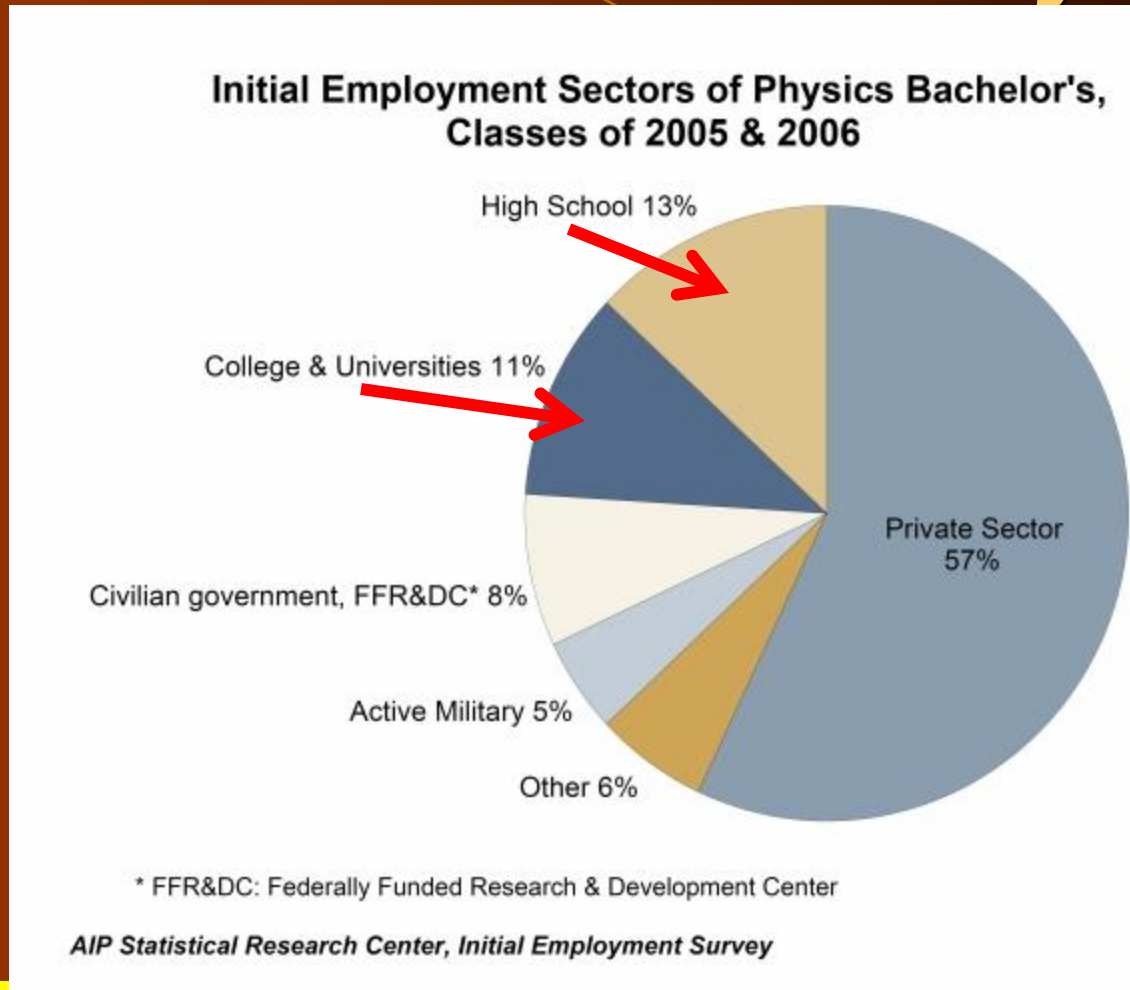
- *What do people who get physics degrees DO anyway?*
- *I've heard about some cool physics things but they aren't relevant to the "real world"*
- *The cool stuff isn't covered in any of the classes*

**Warning: My answers may be more blunt than you wanted...**

Let's talk *Jobs* and *Money*  
first

**After I've convinced you not  
to worry, then we can talk  
about the fun stuff...**

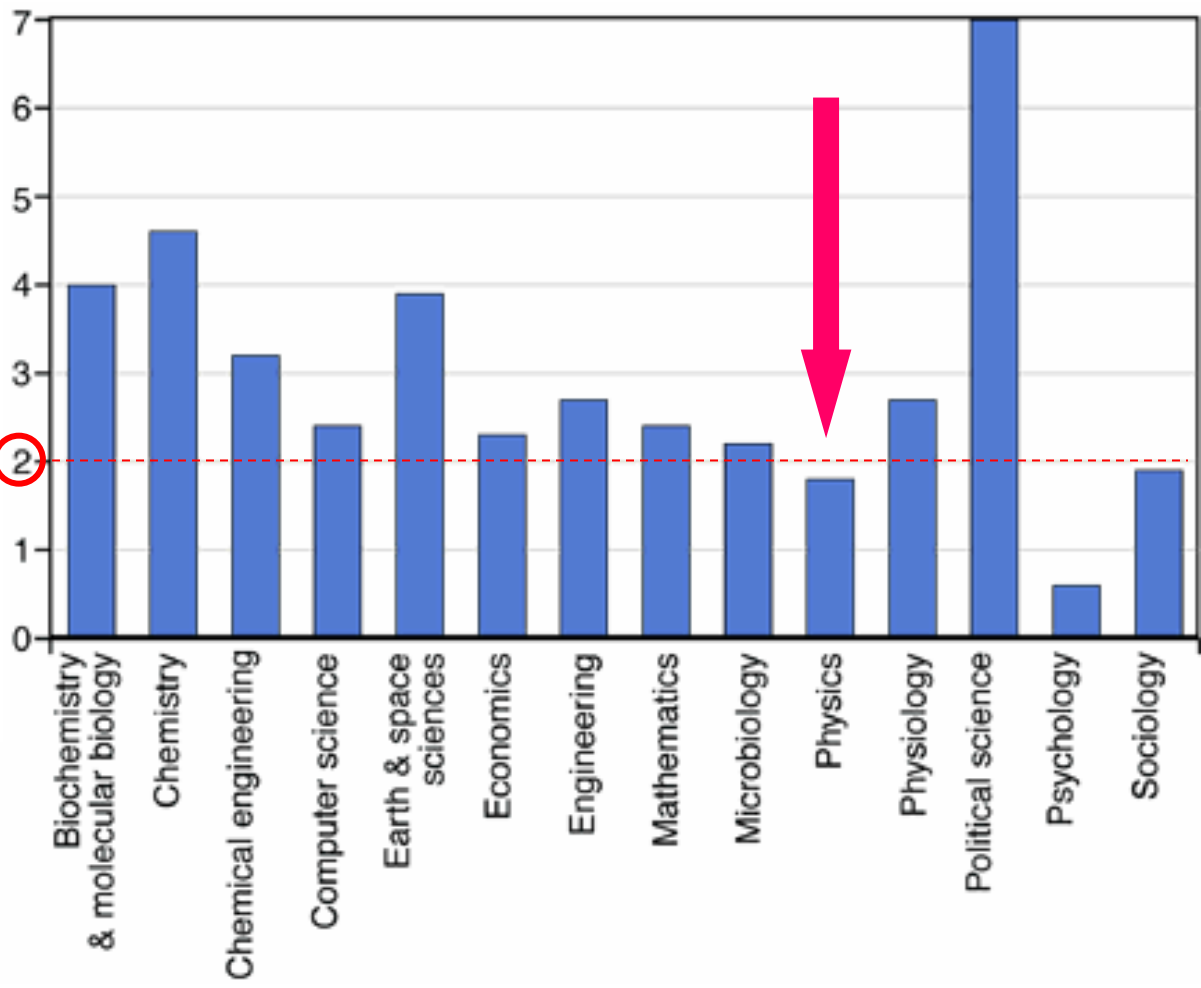
# High School Teacher or a Professor only? No!



*People who say that don't know what they were talking about!*

# High Unemployment? Fact or Fiction?

Unemployment rate in Percent



*Ok... what kind  
of job?*

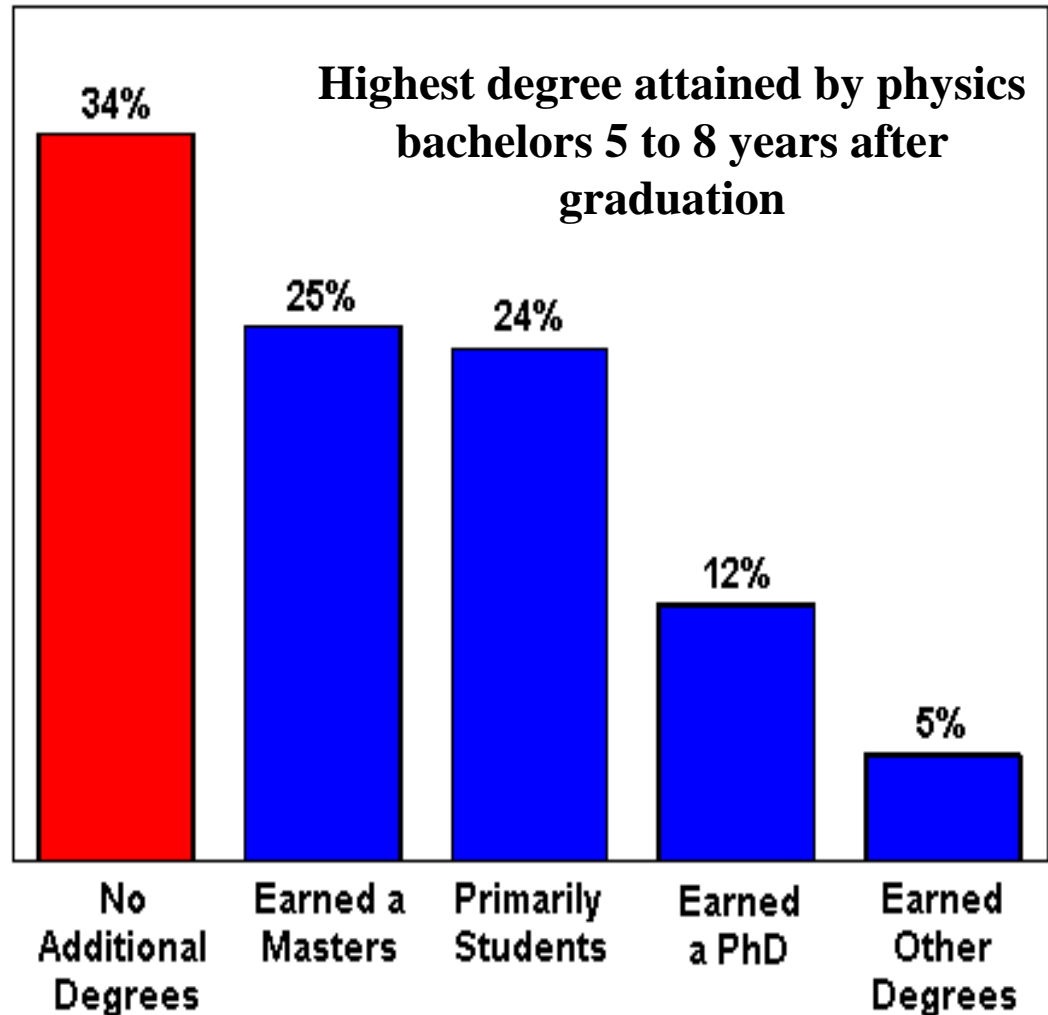
**Depends on what kind of  
degree you get... :**

- Bachelors**
- Masters**
- Ph.D.**



*Ok... Lets say I get a bachelors... then what?*

Most people go on to get advanced degrees, but many get jobs right out of college



# Who's going to hire me?

## *Companies hiring people with physics degrees in Texas*

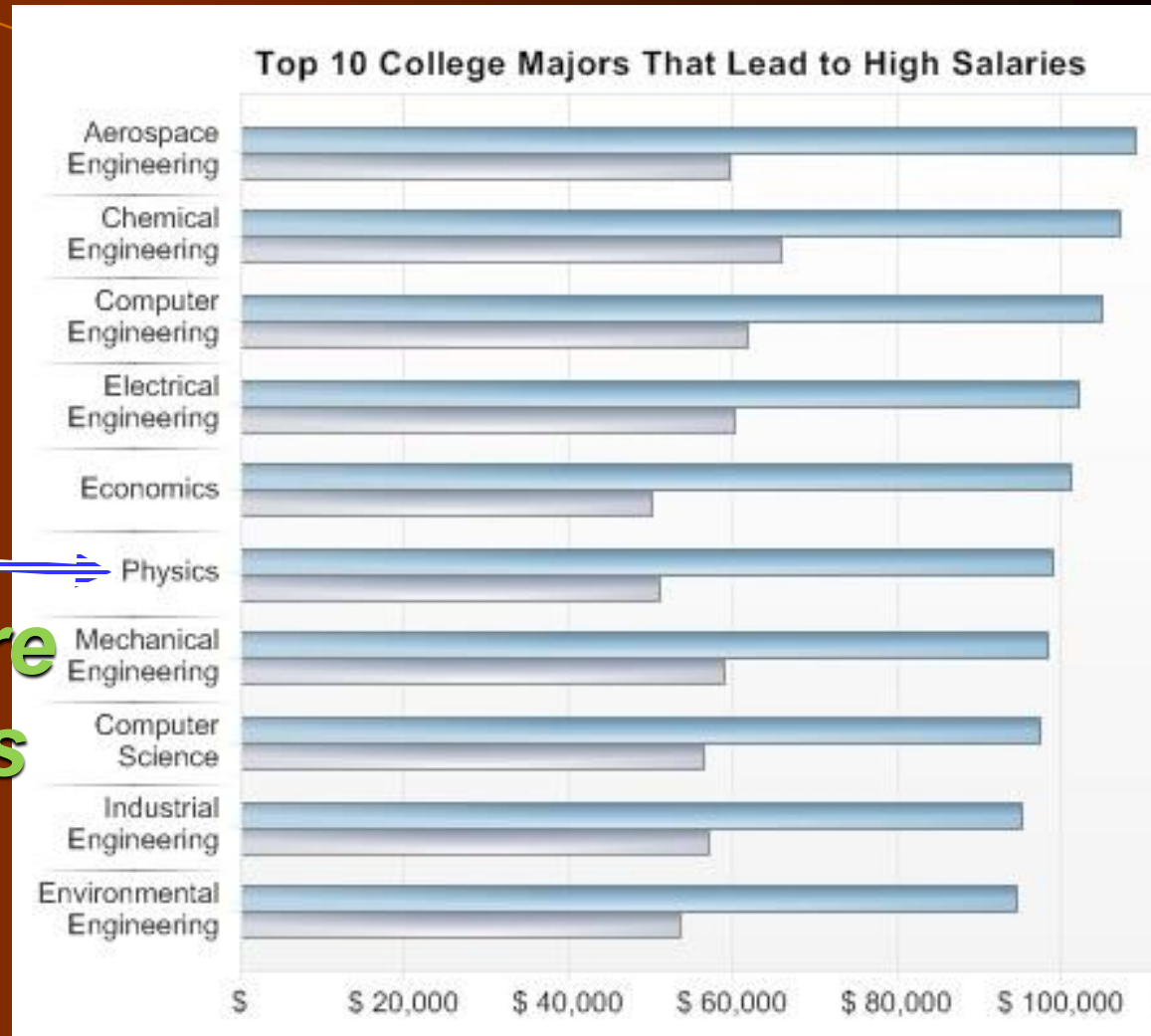
**Advanced Micro Devices**  
**Alcatel**  
**Allstate Insurance Company**  
**Alpha Sim Technology, Inc.**  
**Avant! Corporation**  
**Ball Semiconductor, Inc.**  
**Boral Material Technologies**  
**Camp, Dresser & McKee**  
**Control Systems International**  
**Cypress Semiconductor**  
**Dell Computers**  
**DRS Technologies, Inc.**  
**Fairfield Industries**  
**Helena Laboratories Corporation**  
**Insurdata**  
**Kellogg, Brown & Root**  
**Kelly Scientific Resources**  
**Law Office of Robert Swafford**  
**Litton-TASC, Inc.**

**Litton-TASC, Inc.**  
**Lockheed Martin**  
**Milsoft Integrated Solutions**  
**Mobilestar Network**  
**Motorola**  
**National Instruments**  
**National Semiconductor Corporation**  
**Nortel**  
**PGS Tensor**  
**Radiant Photonics**  
**Raytheon**  
**Reltec Corporation**  
**Sercel, Inc.**  
**Sony Semiconductor**  
**Southwest Research Institute**  
**Technical Alliance Recruiters**  
**Traas Ionics Corporation**  
**United Space Alliance**  
**Verizon Wireless**

**Q: Is the money any good compared to other majors I might choose?**

**A: Yup!!!**

**Bottom line: There are many reasons not to get a physics degree, but making enough money isn't one of them**



[http://physicsworld.com/blog/2009/07/big\\_bucks\\_for\\_physicists.html](http://physicsworld.com/blog/2009/07/big_bucks_for_physicists.html)

# Other questions..

- *More years of school? How am I going to convince my mom to pay for that?*
  1. Believe it or not, in graduate school your tuition is paid for you
  2. Even better... you are often given a salary to take classes and do research!

Compare to Law school or Med school which can be about \$250k in loans

**Switching topics...**

*Do physicists do anything useful or interesting?*

*Yes... The whole reason for doing physics is that it's the most interesting thing in the world to do!*

# What are the cool things physics research have produced?

- Radar
- Lasers
- The Internet
- Medical imaging (MRI)
- Optical fibers
- Power: Nuclear, Solar, Hydro, Fusion(?)
- Semiconductors (chips for computers, DVD players, video games etc...)
- Superconductors
- Lots more...

# Example Differences Between Science and Engineering

- Scientists came up with the understanding of how to make the perfect wing for an airplane
- Scientists figured out how to make electronics out of materials
- Scientists figured out how to make the Internet
- Engineers worked to find which materials made it cheaper and lighter
- Engineers figured out how to put more chips on a circuit board
- Engineers figured out how to make cable cheaper so lots of people could use it <sup>15</sup>

# What are the interesting

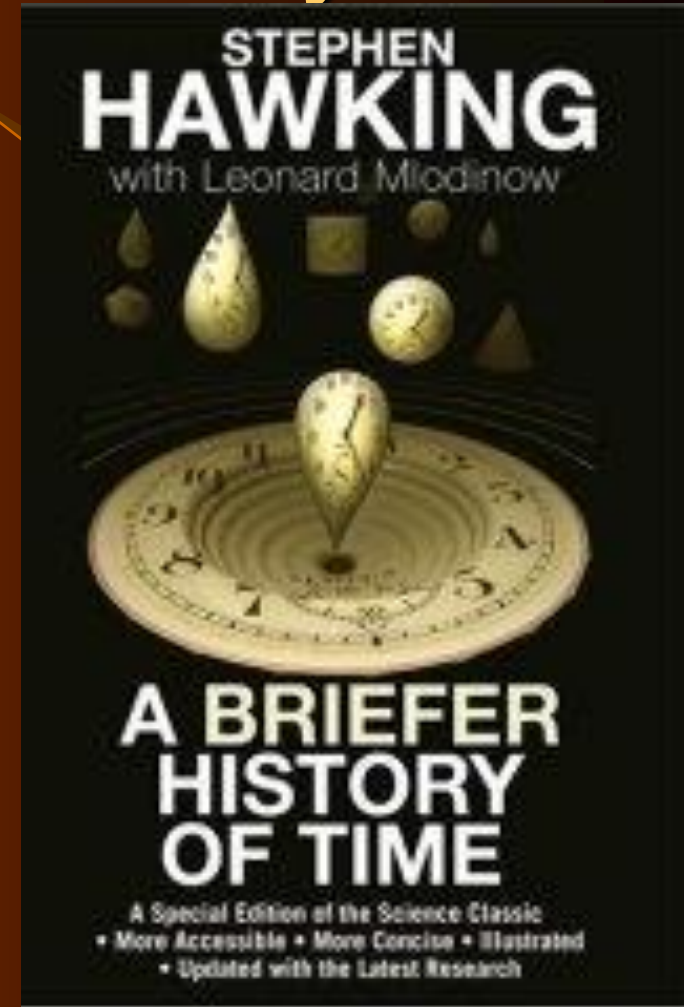
- **Current Research areas: physics areas?**
  - **Astronomy, Astrophysics and Cosmology**
    - **Relativity, Origin of the Universe, Dark Energy**
  - **Condensed Matter & Materials Physics**
  - **Atomic/Laser Physics**
  - **Nuclear physics**
    - **What's inside the nucleus?**
  - **Particle physics**
    - **What's inside a proton? Dark Matter, LHC**
  - **String theory/Theory of Everything**
    - **What are particles made of?**
- **Quantum Mechanics (which is also kinda neat !)**



# Interested in Learning more of the “Cool” Physics?

**Physics department now offers a course entitled “*Big Bang & Black Holes*”**

- Covers Stephen Hawking’s “*Brief History of Time*”
- Cross listed as ASTR/PHYS 109/119
  - Tier 2 Science Distribution Class
- Answers many of the questions you want to know about
  - Cosmology
  - Stars
  - Black Holes
  - General Relativity & Quantum Mechanics
  - Particle Physics
  - Etc....



<http://people.physics.tamu.edu/toback/109/>

# Interested in Undergraduate Research?

Physics department has a long history of award winning undergraduate research in many areas:

- Applied Physics
- Astronomy, Astrophysics and Cosmology
- Atomic Physics
- Condensed Matter Physics
- Materials Physics
- Nuclear Physics
- Particle Physics
- Quantum Optics
- String Theory...



<http://www.physics.tamu.edu>

***Scholarships available  
to the types of students  
who do well on  
Challenge Exams ;-)***

# Keep in Touch!

**Interested in a physics degree? Minor?  
Double major? Applied physics?**

- **Pick up a Department Brochure**
- **<http://www.physics.tamu.edu/>**
- **Contact the undergraduate advisor:**
  - **Ms. Sherree Kessler**
  - **979-845-7738,**  
**skessler@physics.tamu.edu**

**Good Luck on  
your finals!**

*Ok... what kind  
of job?*

**Depends on what kind of  
degree you get... let's do them  
one at a time:**

- Bachelors**
- Ph.D.**

# PHYSICS TRENDS

Contact: Raymond Y. Chu  
rchu@aip.org

Winter 2004

Let's say you  
get a Ph.D.  
*Will that  
improve your  
earning  
potential?*  
**Yup!!!**

## PhD Salaries 10 Years Later

### Place of Employment

Hospital, medical services  
Federally-Funded R & D Center  
Industry or self-employed  
Government  
University Research Institute  
University, 11-12 month  
University, 9-10 month  
4-year college, 9-10 month



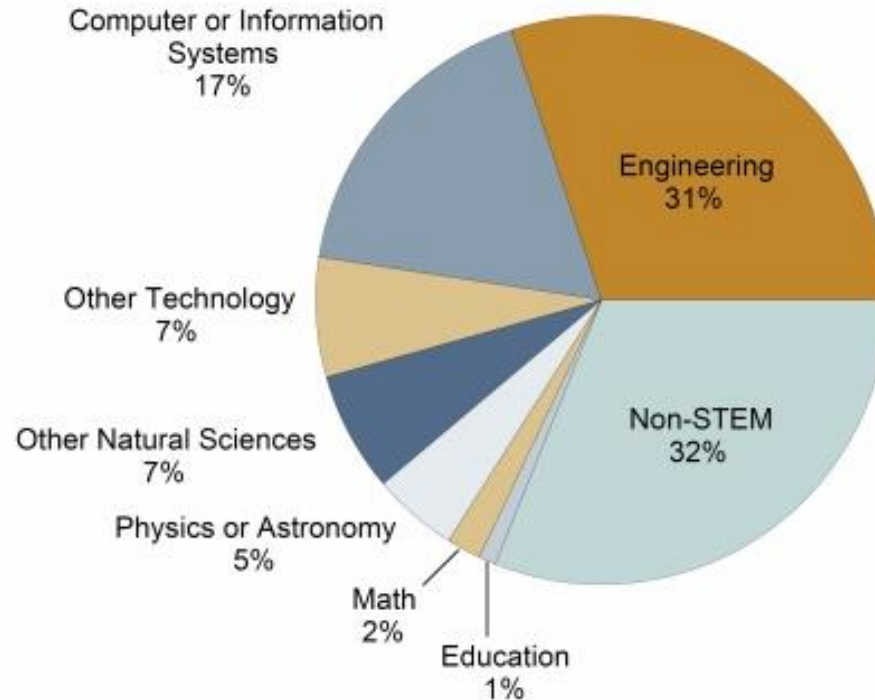
Typical salaries are the middle 50%, i.e. between the 25th and 75th percentiles, reported by US resident members of the 10 AIP Member Societies who earned their PhDs 10 to 14 years ago.

Source: 2002 Salaries - Society Membership Survey

**AMERICAN  
INSTITUTE  
OF PHYSICS**

**Statistical Research Center**  
[www.aip.org/statistics](http://www.aip.org/statistics)

## Field of Employment for Physics Bachelors in the Private Sector, Classes of 2005 and 2006



STEM: Science, Technology, Engineering and Math

*AIP Statistical Research Center, Initial Employment Survey*

***Ok... What  
can you do  
with your  
degree?***

*Extra slides on some of the  
research we do here at the  
Physics Department at  
Texas A&M University*



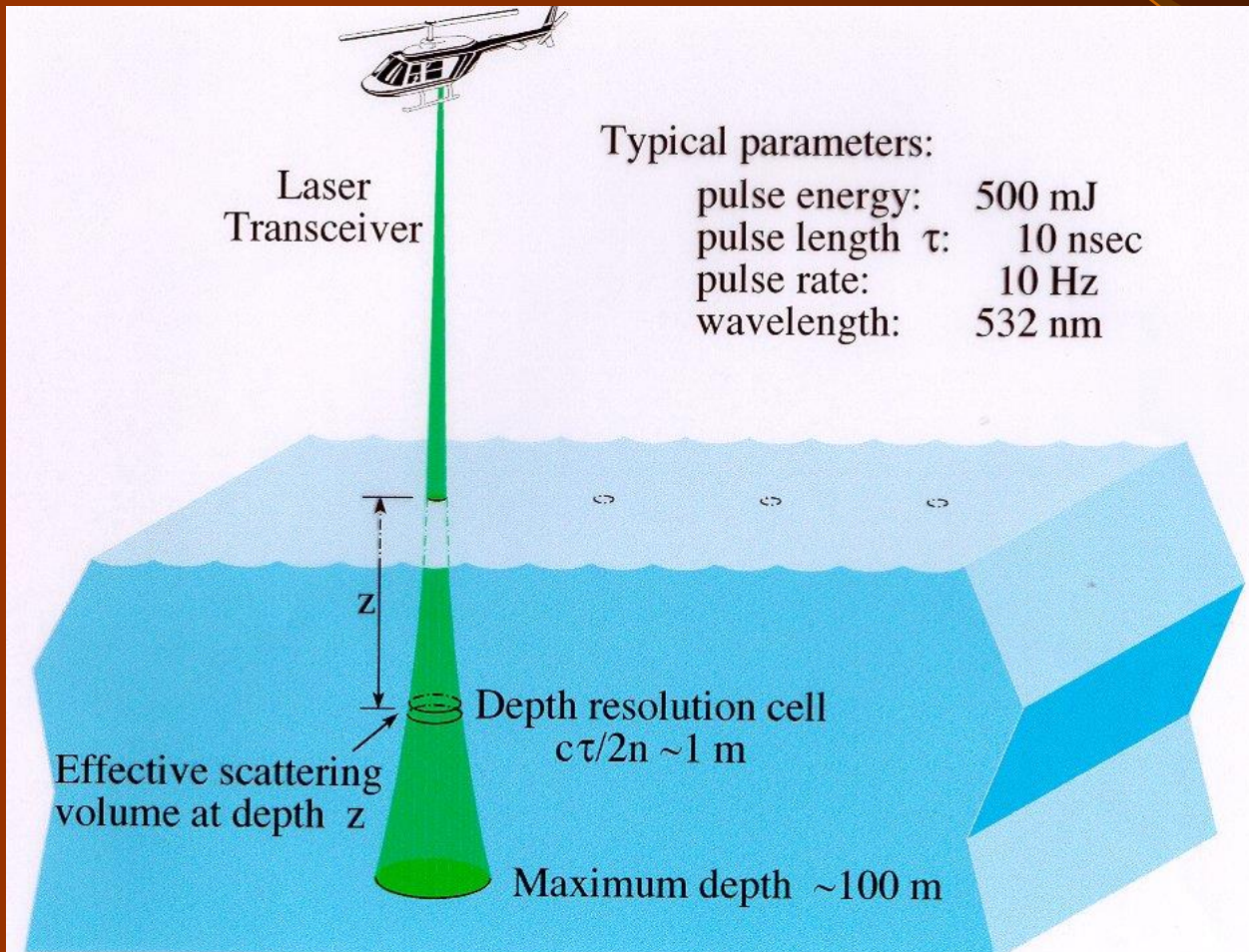
# A “Theory of Everything”

String Theory,  
Grand Unified  
Theories, Theory  
of everything...



# Ocean Temperature Profile

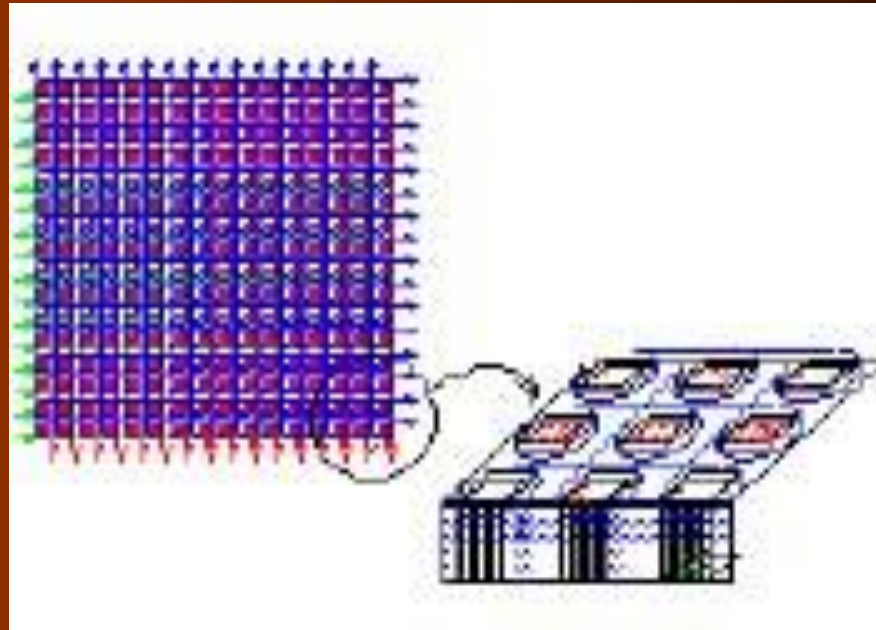
## Remote Laser Sensing



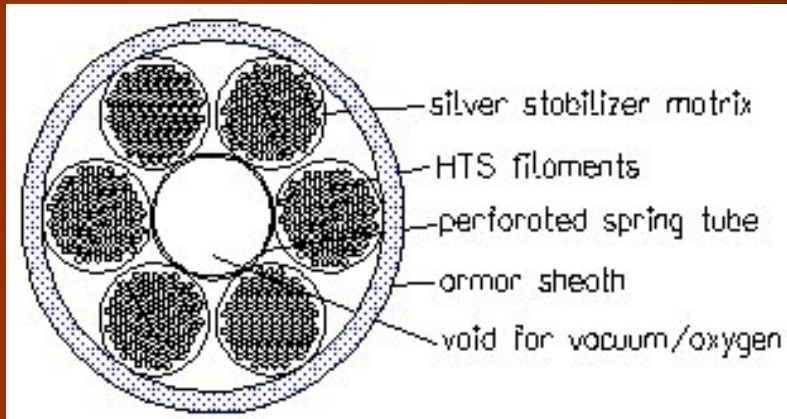
# DNA Sequencing



lab-on-a-chip using  
nanotechnology

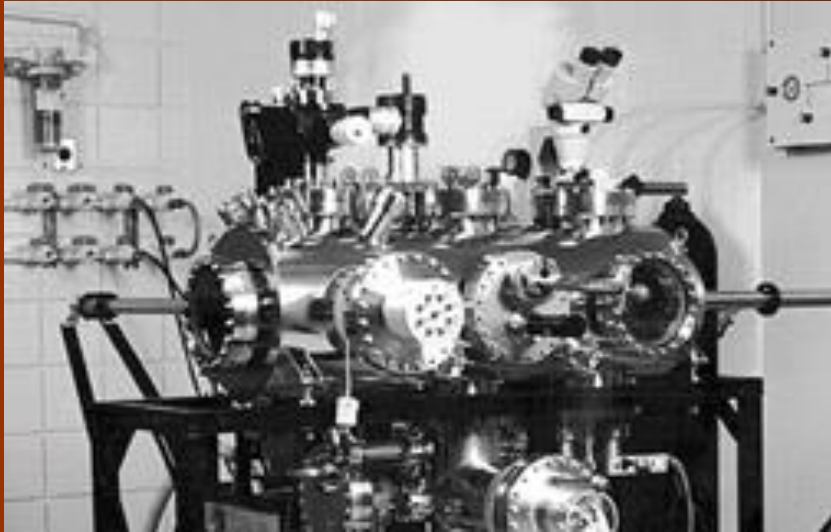


# High $T_c$ Superconductors

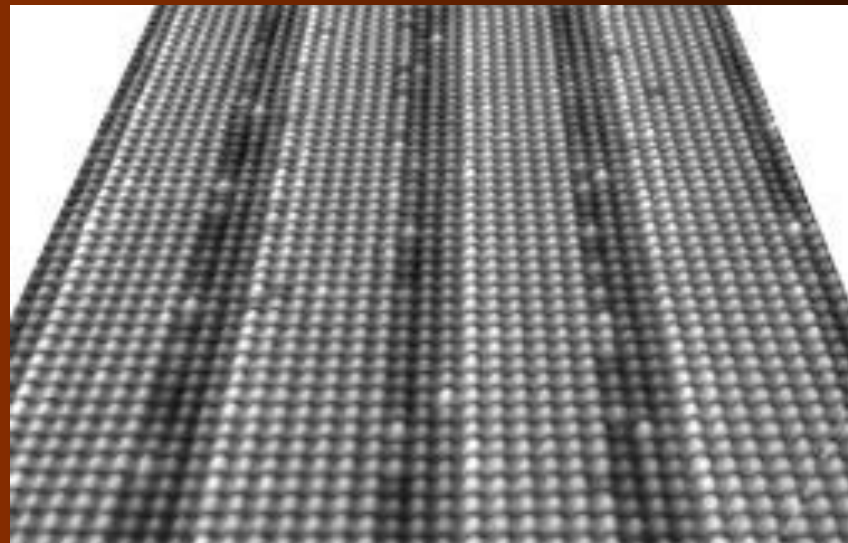


structured 1,000 A  
cable for Bi-2212

# Characterization at the Nanoscale



Scanning Tunneling  
Microscopy e.g. an  
atomically flat surface  
of GaSb/InAs



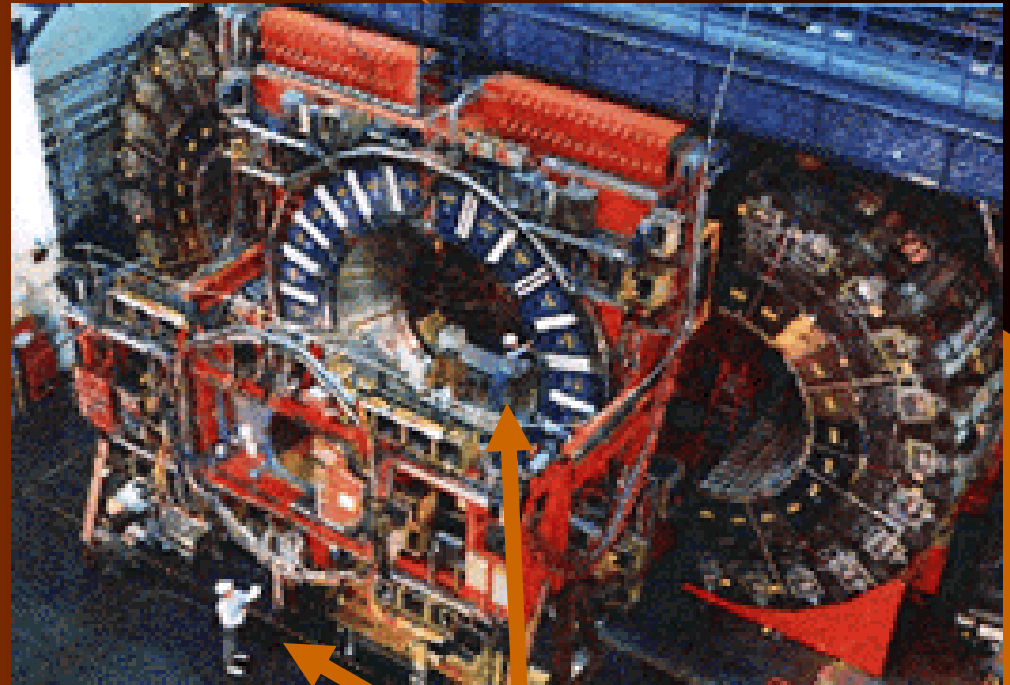
# Supersymmetry Experiments



- Collider Detector at Fermilab (CDF) and CMS at the Large Hadron Collider (LHC) at CERN

- High energy frontier; Big toys

- Searching for Supersymmetry, the Higgs boson

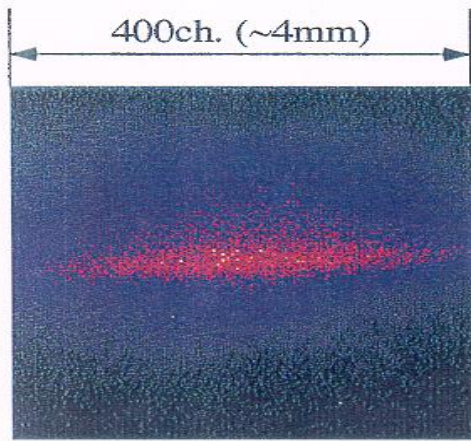


Yes that's a person!

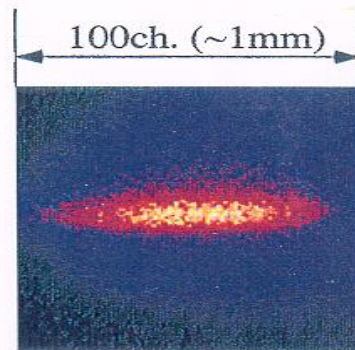
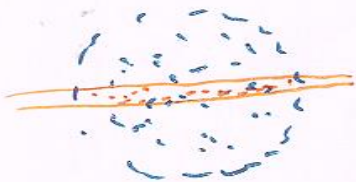
# Applied Physics at Texas A&M

- Physics is crucial to many important advances
  - Computing (classical and quantum)
  - DNA sequencing and other biotech areas
  - Laser Remote Sensing
  - Magnetic Devices and Data Storage
  - Nanotechnology and Sensing
  - Optical Technology
  - Superconductivity (low  $T_c$  and high  $T_c$ )

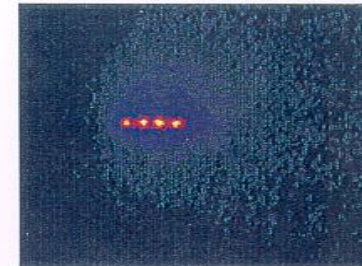
# Fluorescence from laser cooled ions



a) Ion cloud condition soon after trapping



b) Cooled ion cloud



c) Four ion crystal



d) Three ion crystal



e) Single cooled ion

**Space charge distributions in a linear RF ion trap (storage time ~40 sec)**



# The Cyclotron

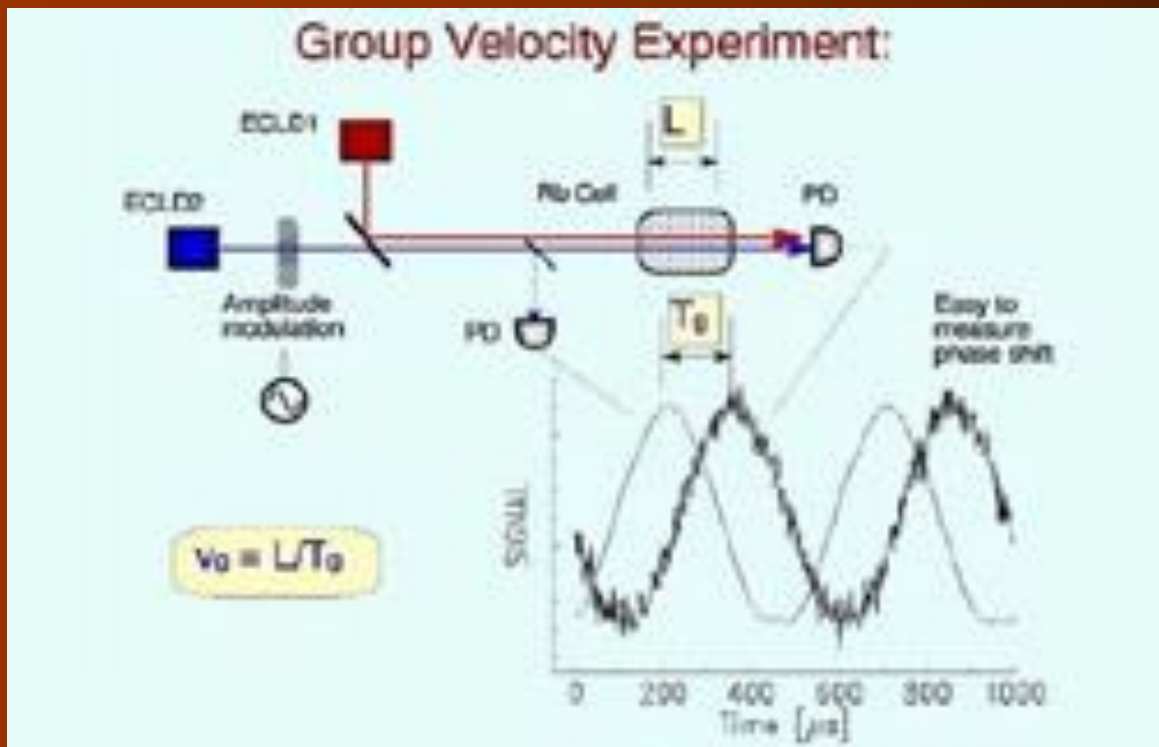


One of two  
University based  
Cyclotrons in  
the US



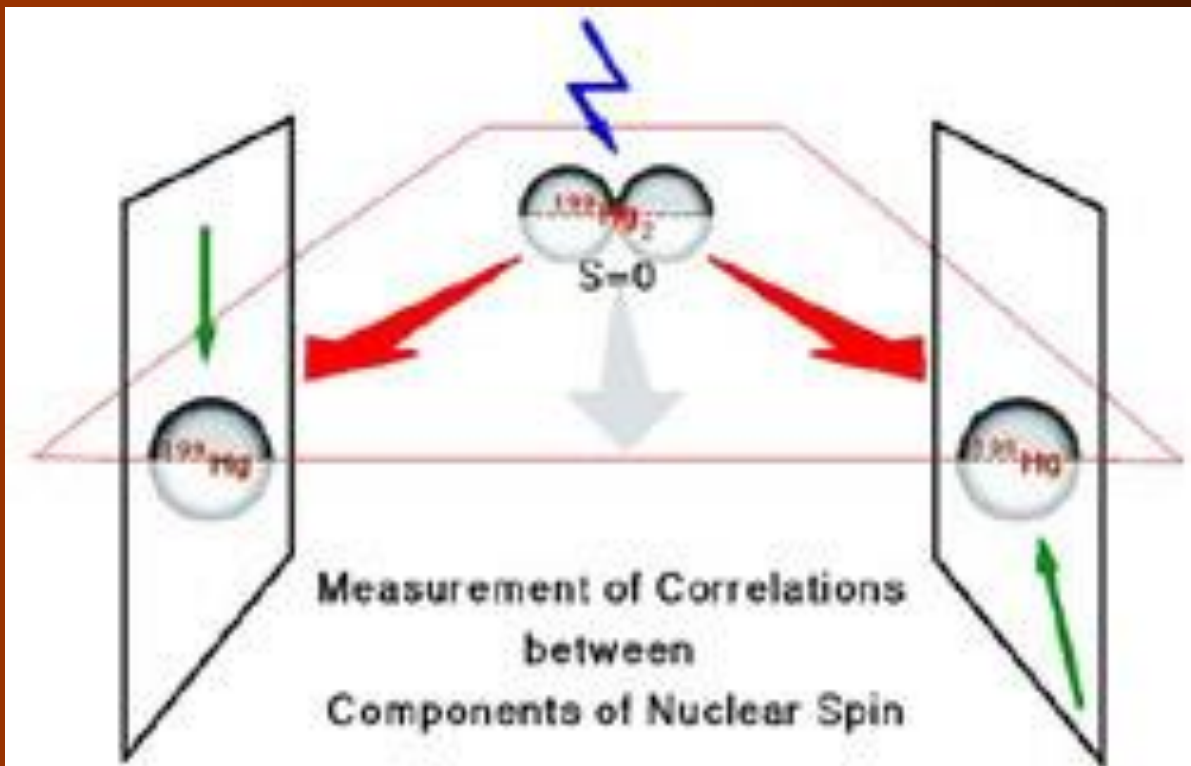
# “Slow Light”

Welch: Group Velocity of Light can be reduced



# Quantum Mechanical Foundations

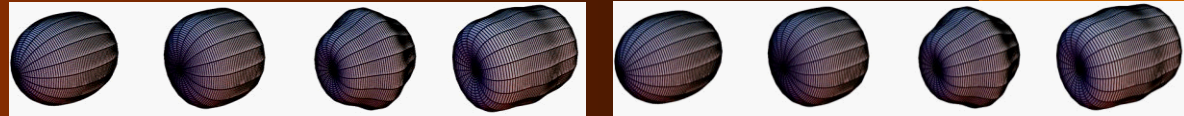
Fry, Walther: Einstein-Podolsky-Rosen  
Experiment based on atoms



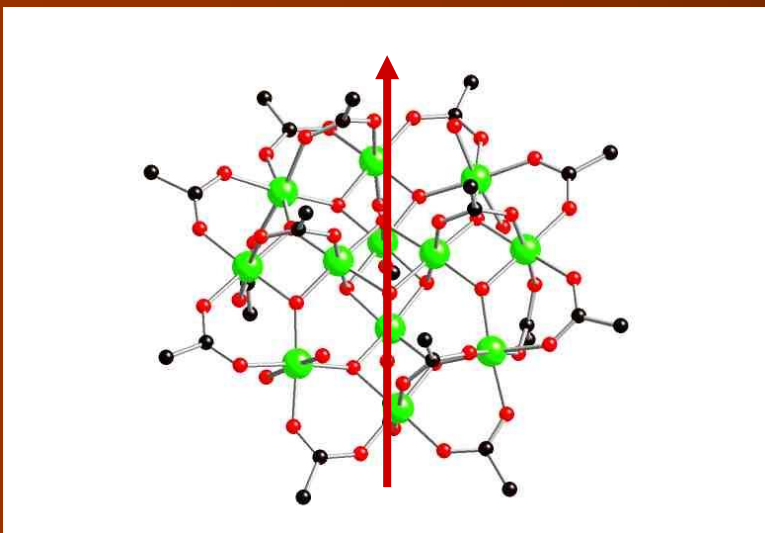
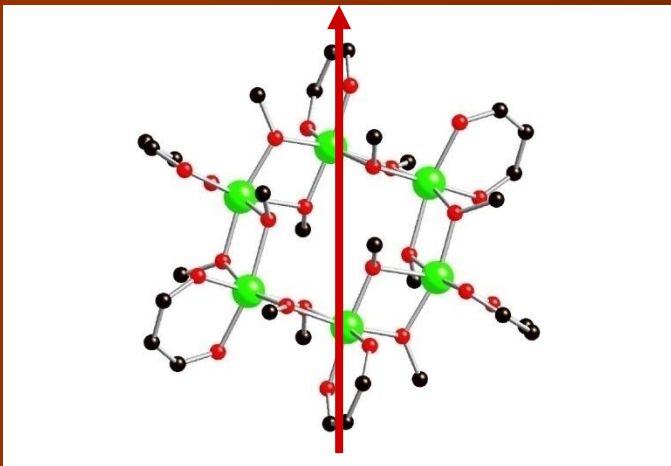
# Collinear Raman Generator



- A new light source to study new physics
- Extension of EIT ideas to molecular systems
- Photoionization with single-cycle pulses.
- Possible extensions of our technique:
  1. studying complicated motion of complex molecules
  2. probing ultrafast electronic dynamics in atoms.



# Devices based on Molecular Nanomagnets



**Large Magnetic Moment**

Potentially useful for:

- Magnetic storage
- Quantum Computing

# Nanomagnetic Sensing

Teizer: Micro-  
and NanoSQUIDs

