

# Mechanics Scholars Luncheon

Texas A&M University



## *Opportunities for Talented People with Physics Training*

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# Good news and Bad news

- **Good news**

- You have been identified as being in the top 2% 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*

- *All physics majors are dorks and kinda weird*
- *I don't know ANYONE who does physics except my high school teacher and my Prof from this last semester*

## 2. *Jobs:*

- *The advice I got in high school was “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. Right?*
- *The only thing you can do with a physics degree is research in physics. Right?*
- *Physics is all theory, engineering is where you do REAL things*

# Common Myths cont...

## More common myths

### 3. *Money:*

- *The salaries for people with physics degrees aren't good*

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

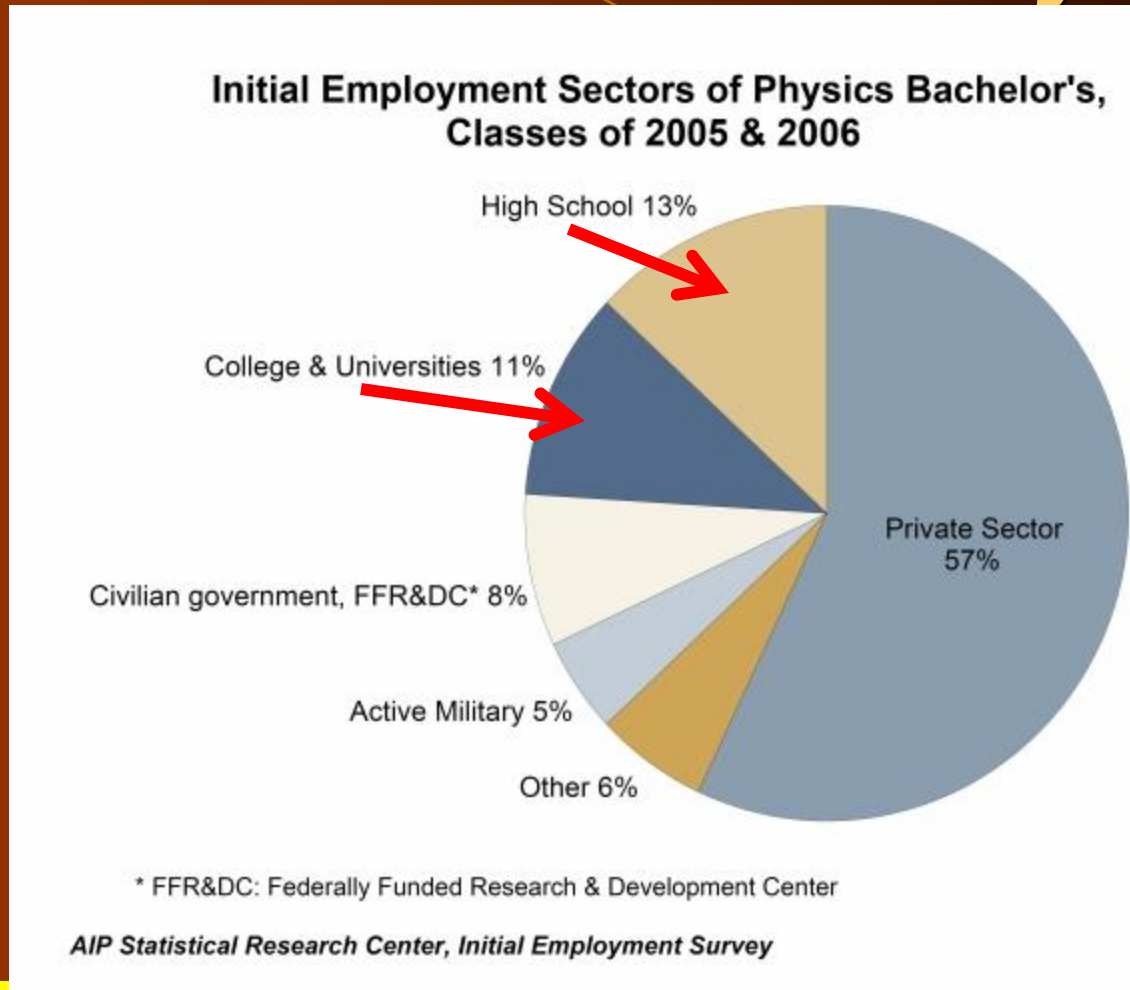
- *What do professors DO anyway?*
- *I've heard about some cool physics things but they aren't relevant to the "real world"*
- *The cool stuff isn't covered in any of the classes*
- *What are the research areas?*

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

Let's talk *Jobs* and *Money* first since, frankly, I think that is what most of you would need to hear about anyway before we get to any of the other stuff...

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

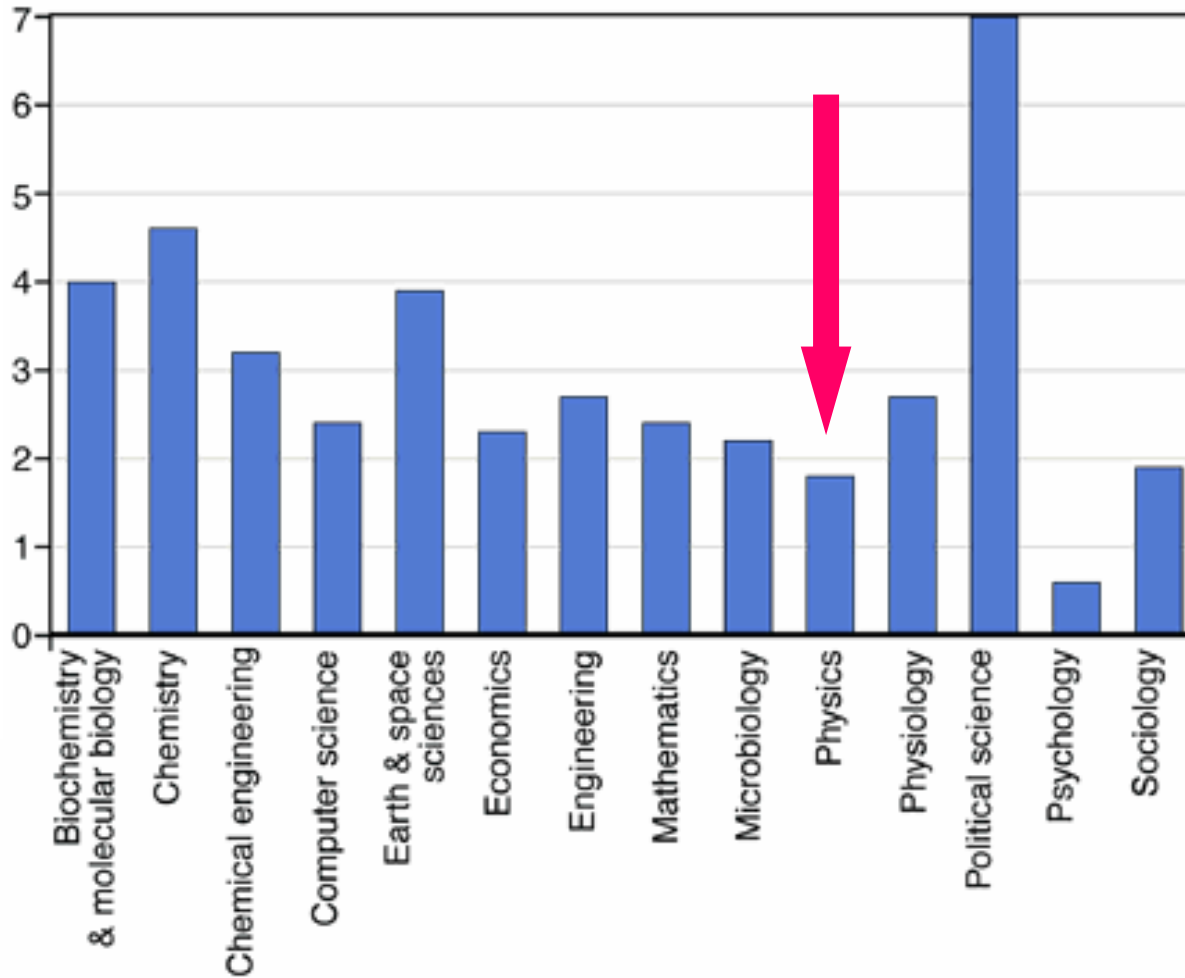
# High School Teacher or a Professor only? No!



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

# No jobs? Fact or Fiction?

Unemployment rate in Percent



*Ok... what kind  
of job?*

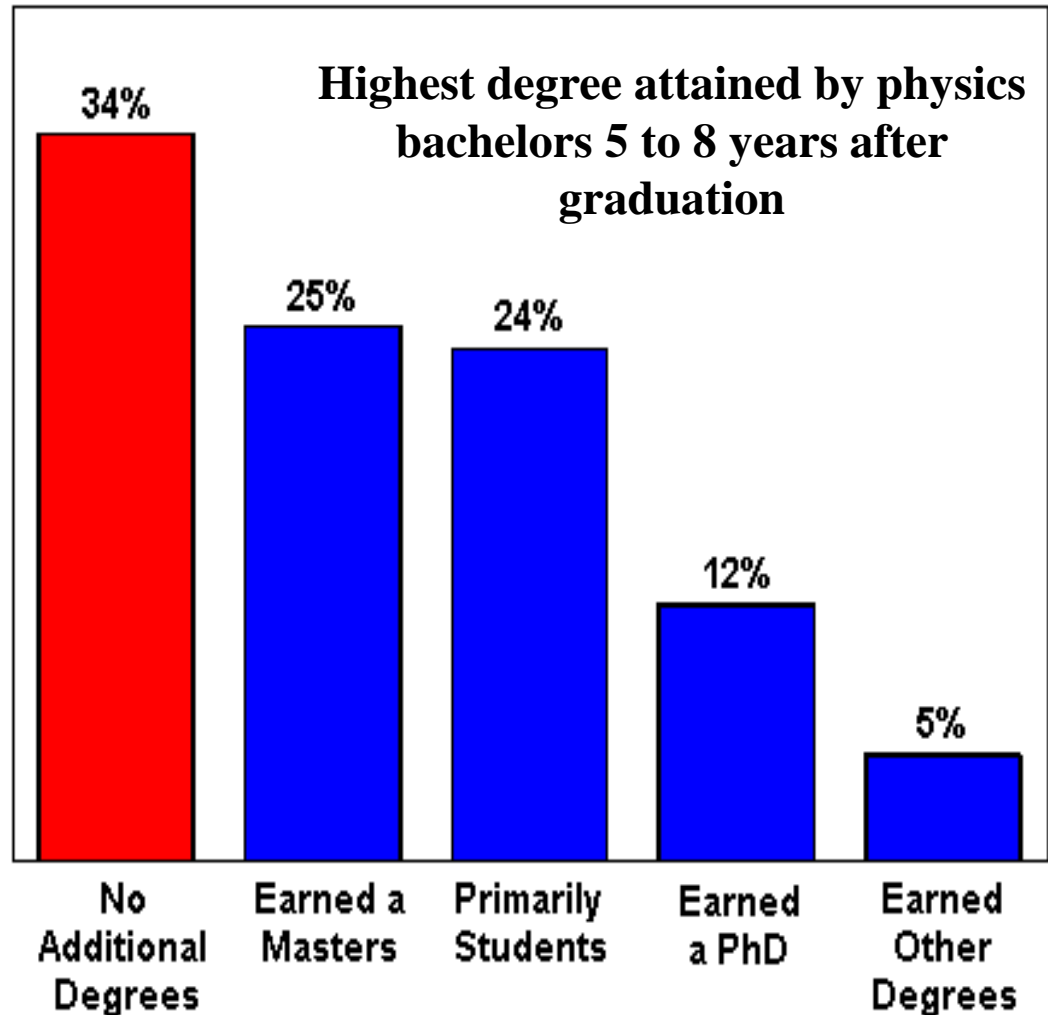
**Depends on what kind of  
degree you get... let's do them  
one at a time:**

- Bachelors**
- Ph.D.**



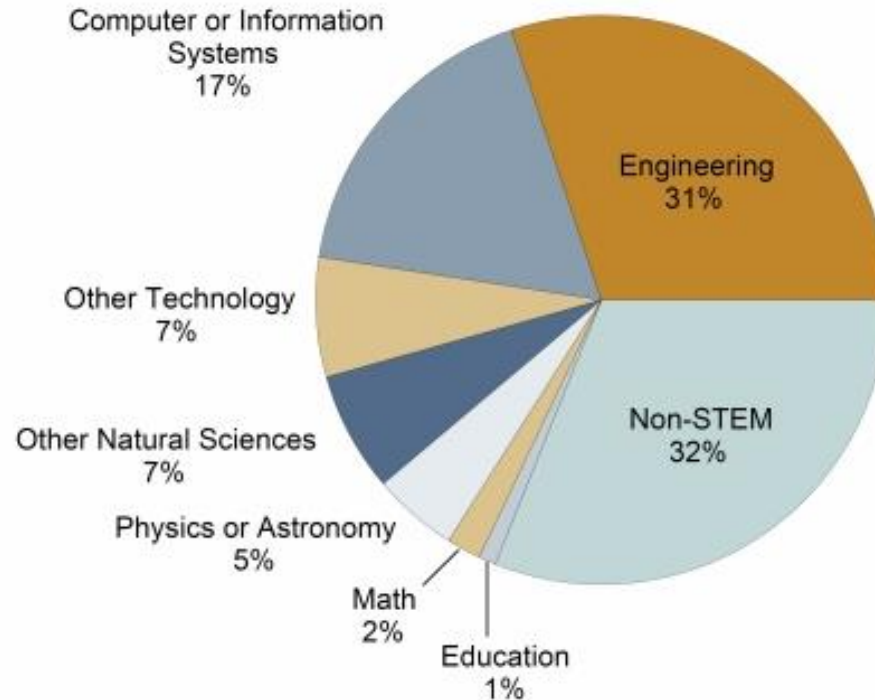
*Ok... Lets say I get a bachelors... then what?*

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



*Ok... What can you do with a bachelors degree?*

## 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*

# 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.**

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**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 things I might do?*

*A: Yup!!!*

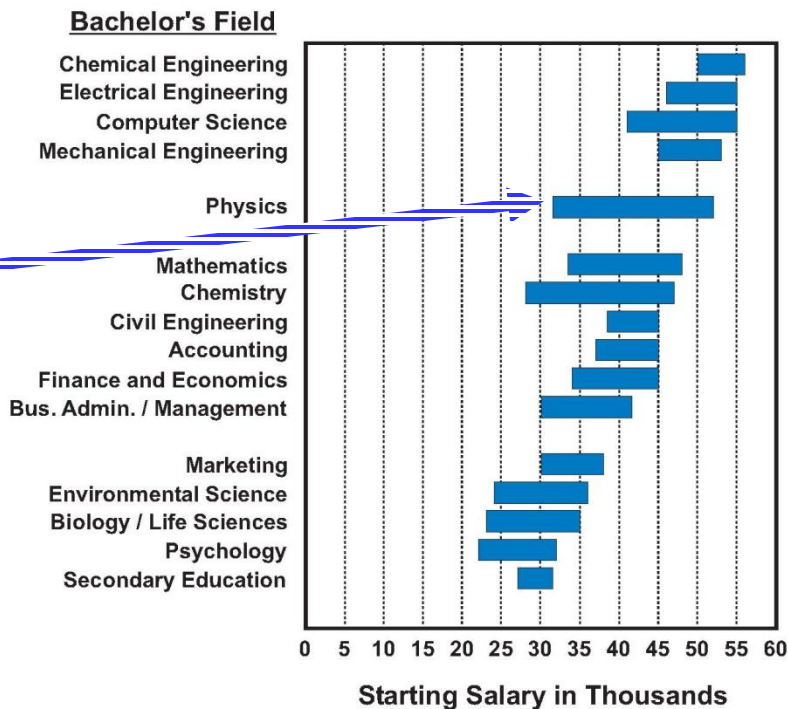
# PHYSICS TRENDS

Contact: Patrick J. Mulvey  
pmulvey@aip.org

Fall 2003

## What's a Bachelor's Degree Worth?

Typical Salaries Offered by Campus Recruiters, 2002-2003



Typical salaries are the middle 50%, i.e. between the 25th and 75th percentiles.

Reprinted from the Fall 2003 Salary Survey, with permission of the National Association of Colleges and Employers, copyright holder.

**AMERICAN  
INSTITUTE  
OF PHYSICS**

**Statistical Research Center**

[www.aip.org/statistics](http://www.aip.org/statistics)

*What about  
a couple of  
years down  
the road?  
What will I  
be doing  
then?*

**Table 1. Type of Employment of Physics Bachelors  
5 to 8 Years After Graduation**

Type of Job	Percent
Software	24
Engineering	19
Science & Lab Technician	9
Management, Owner & Finance	20
Education	12
Active Military	6
Service and Other Non-Technical	10

Based on physics bachelors with no additional degrees who are not primarily students.

AIP Statistical Research Center, 1998-99 Bachelors Plus Five Study.

# 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!!!**  
You can do  
physics or  
applied  
physics

## 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

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OF PHYSICS**

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



*If I get a PhD  
what kind of  
money will I  
end up  
making long  
term?*

**VERY Good  
money  
whether you  
stay in the  
field or not!**

**Typical salaries and median age for major employment sectors, PhDs 2006. (a)**

<b>Academic sector</b>	<b>Typical salaries (in thousands \$)</b>	<b>Median Age</b>
<b>University</b>		
9-10 month salary	64 to 100	49
11-12 month salary	64 to 115	48
<b>4-Year college</b>		
9-10 month salary	51 to 75	47
<b>Non-Academic sector</b>		
Hospital, medical services	105 to 170	49
Government	100 to 135	50
FFR&DC (b)	92 to 135	53
Industry, self-employed	93 to 136	49
UARI (b)	70 to 120	49
Nonprofit	65 to 117	47

(a) Employed U.S. resident members only. Postdoctorates excluded.

(b) FFR&DC=Federally-Funded Research and Development Center

UARI=University-Affiliated Research Institute or Observatory

# 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 PAID a salary to take classes and do research!

Compare to law-school which is 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
- 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>19</sup>

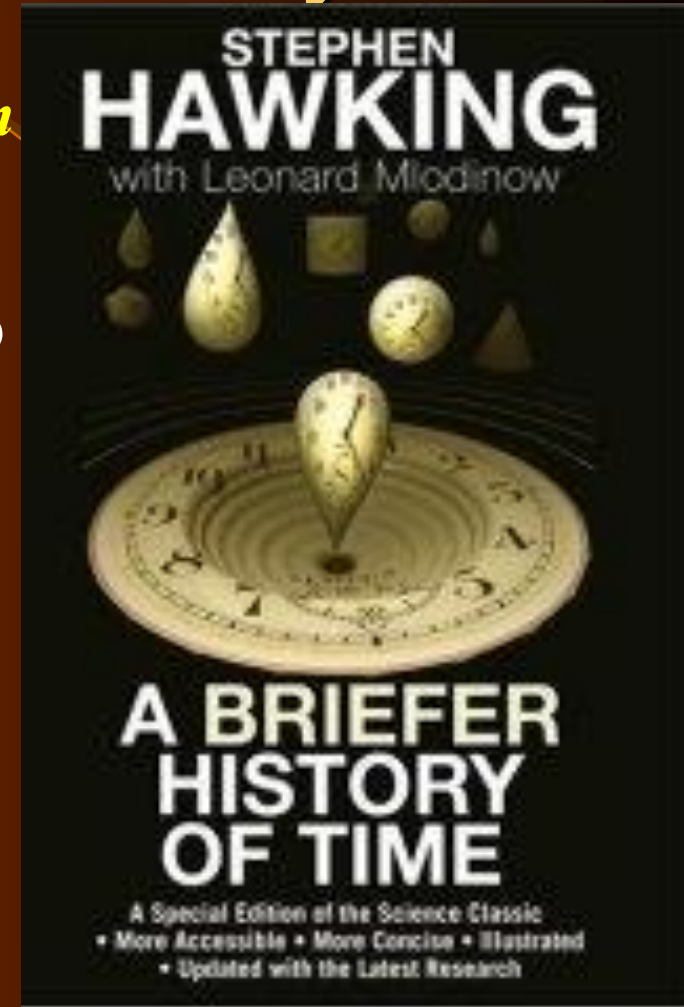
# What are the interesting physics areas?

- **Current Research areas:**
  - **Astronomy, Astrophysics and Cosmology (relativity and the study of the 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?)**
    - **All of these use 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, No Math*”**

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



<http://faculty.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. Sandi Smith 979-845-7738,  
smiths@tamu.edu**

**Good Luck on  
your finals!**



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

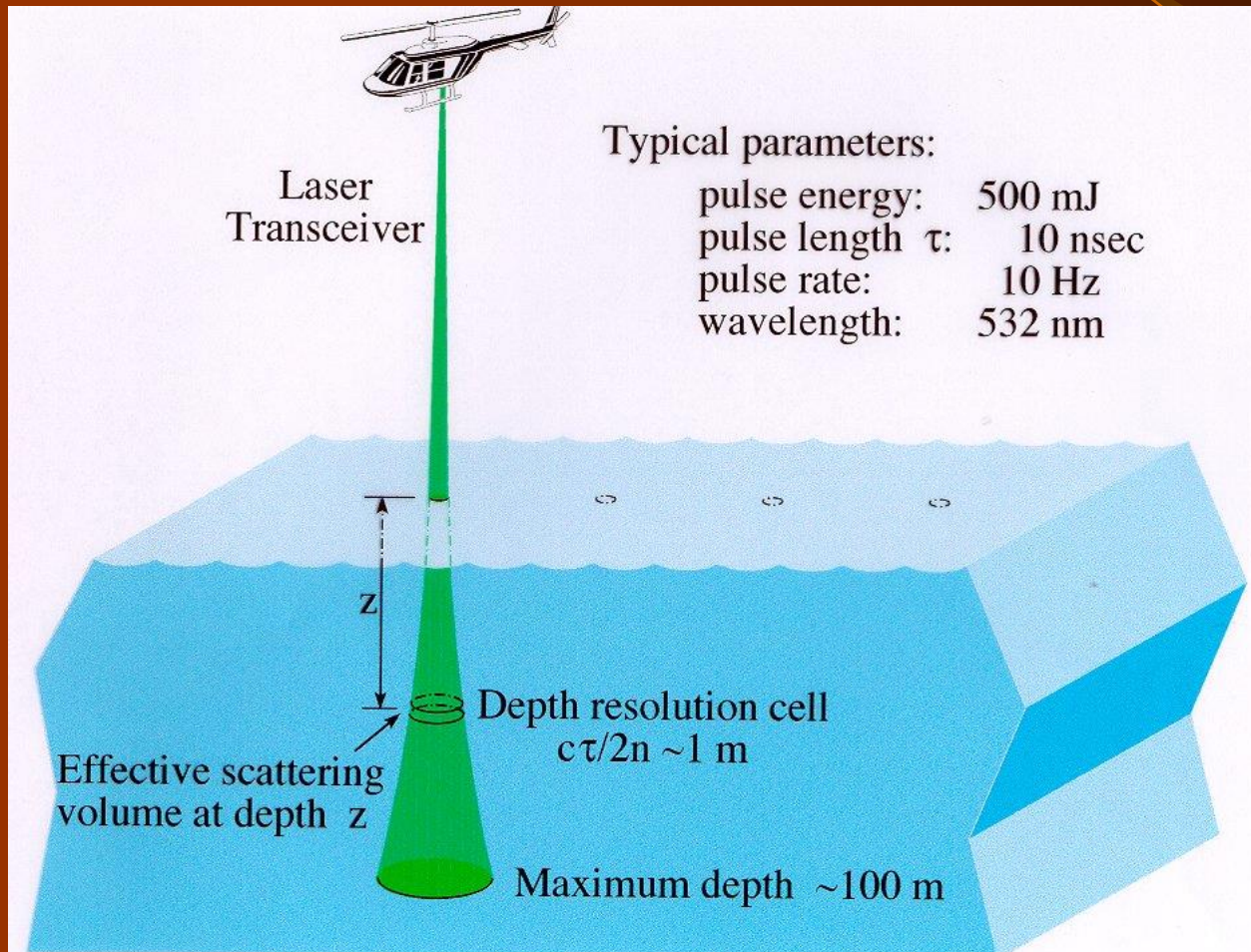
# A “Theory of Everything”

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



# Ocean Temperature Profile

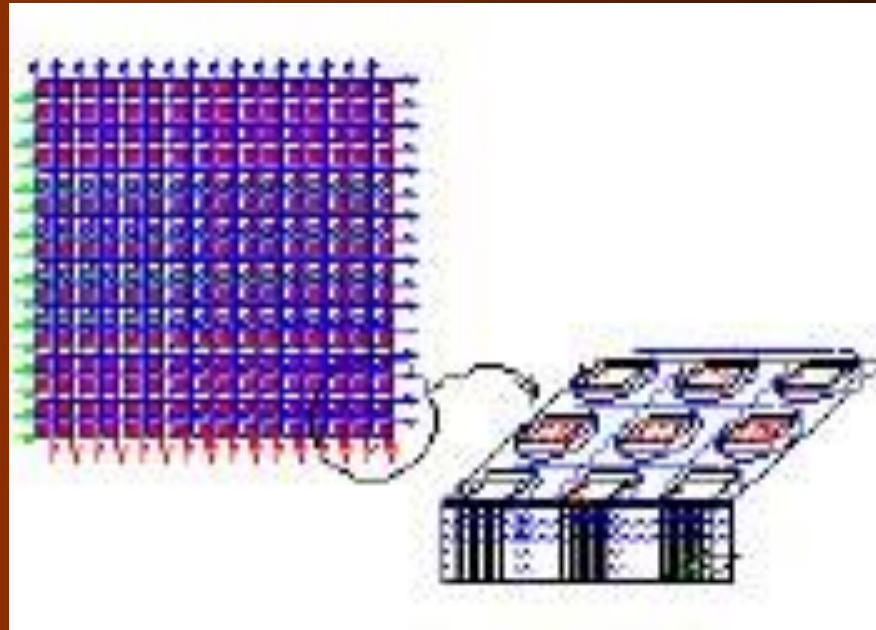
## Remote Laser Sensing



# DNA Sequencing

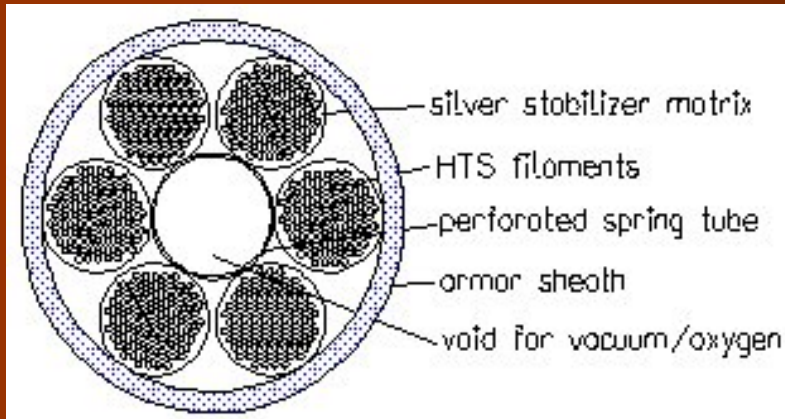


lab-on-a-chip using  
nanotechnology



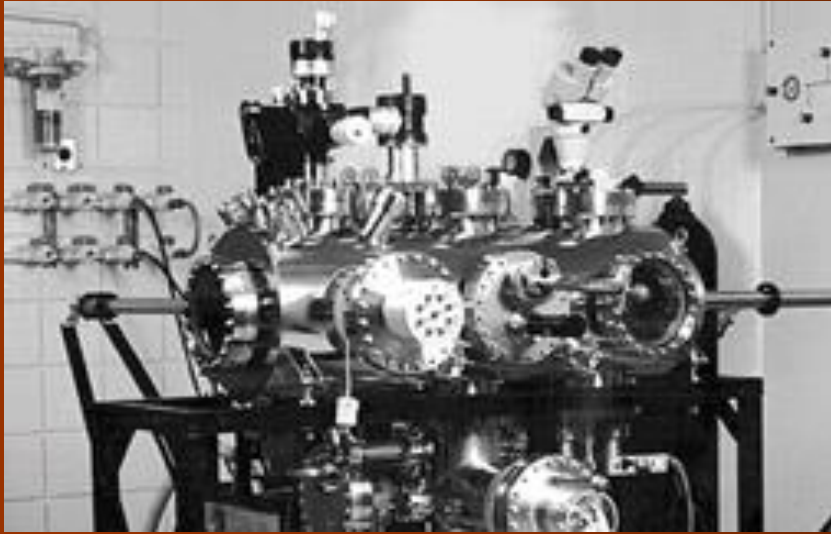


# High $T_c$ Superconductors

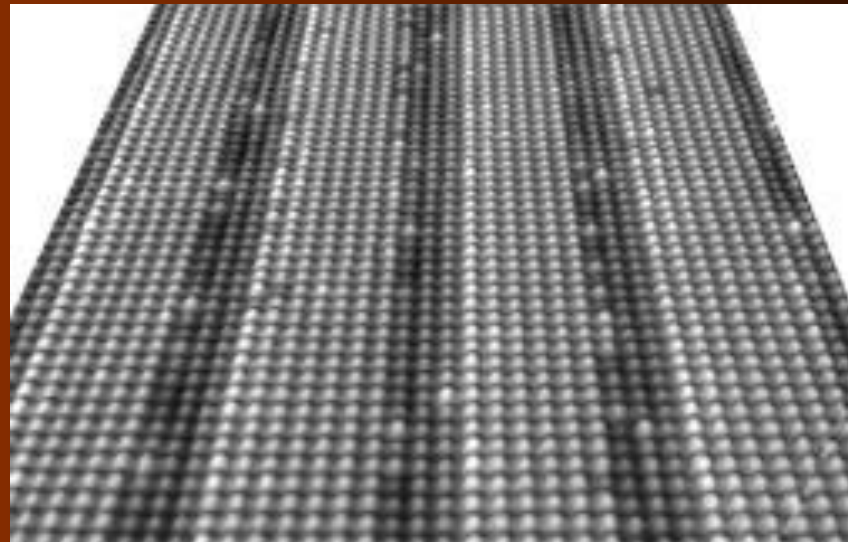


structured 1,000 A  
cable for Bi-2212

# Characterization at the Nanoscale



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



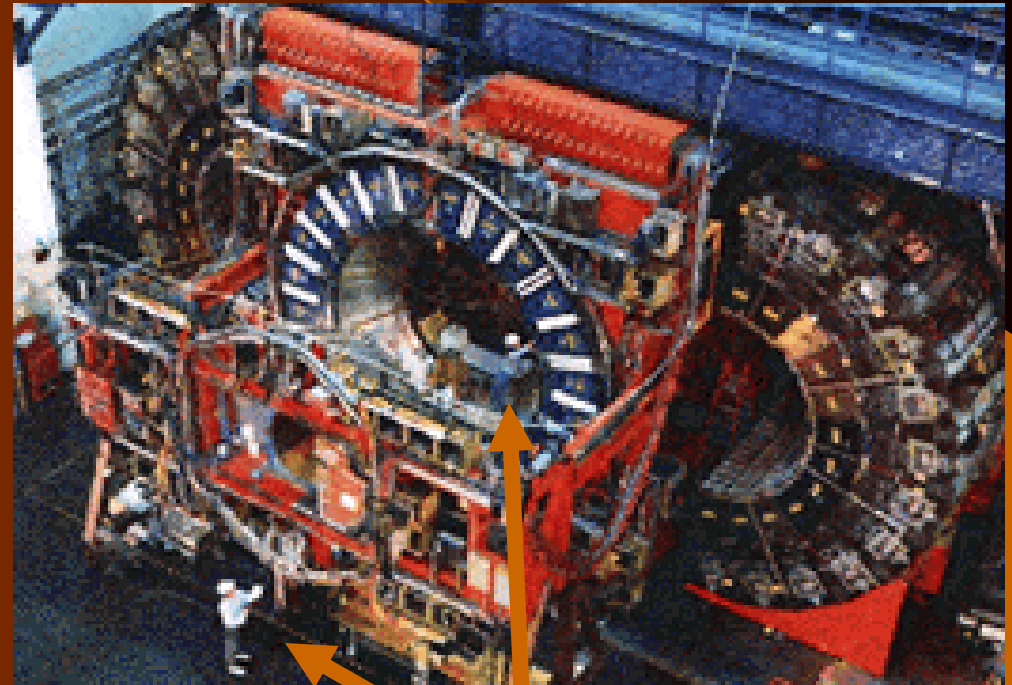
# Supersymmetry Experiments



- 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



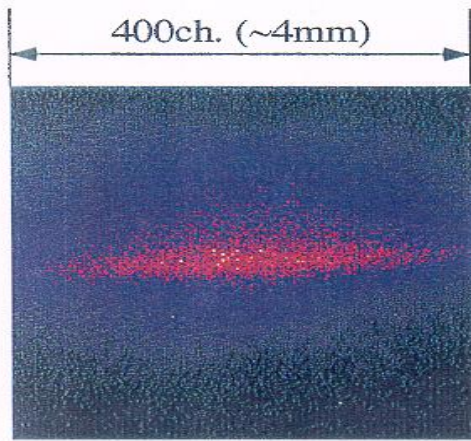
Yes that's a person!

# Applied Physics at Texas A&M

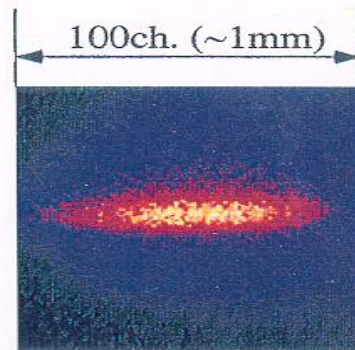
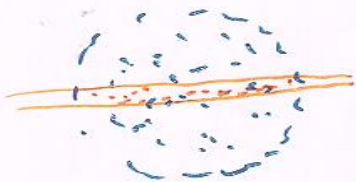
- Physics is crucial to many important advances
  - Computing (classical and quantum)
  - DNA sequencing and other biotech areas
  - Laser Remote Sensing
  - Magnetic Devices and Data Storage
  - Nanotechnology and Sensing
  - Optical Technology
  - Superconductivity (low  $T_c$  and high  $T_c$ )



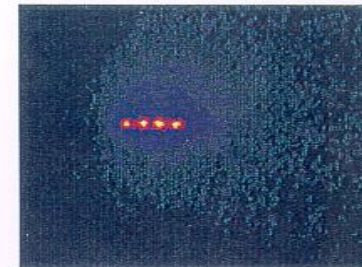
# Fluorescence from laser cooled ions



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

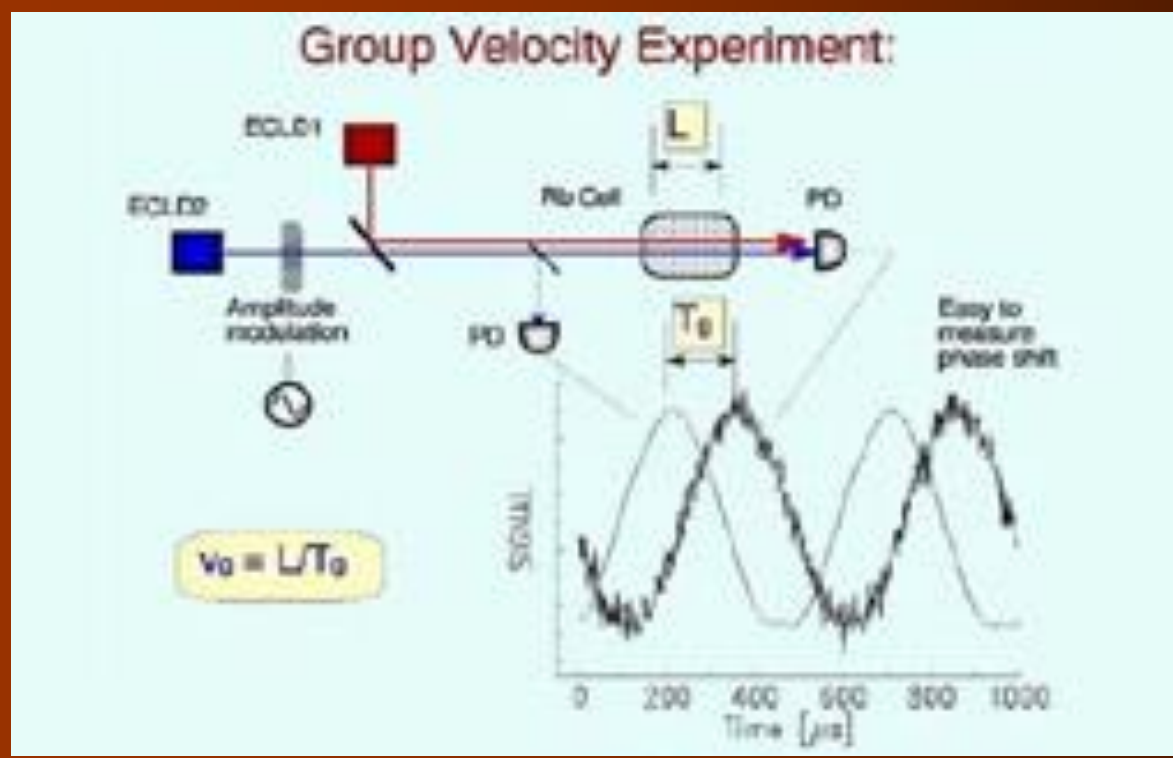


One of two  
University based  
Cyclotrons in  
the US



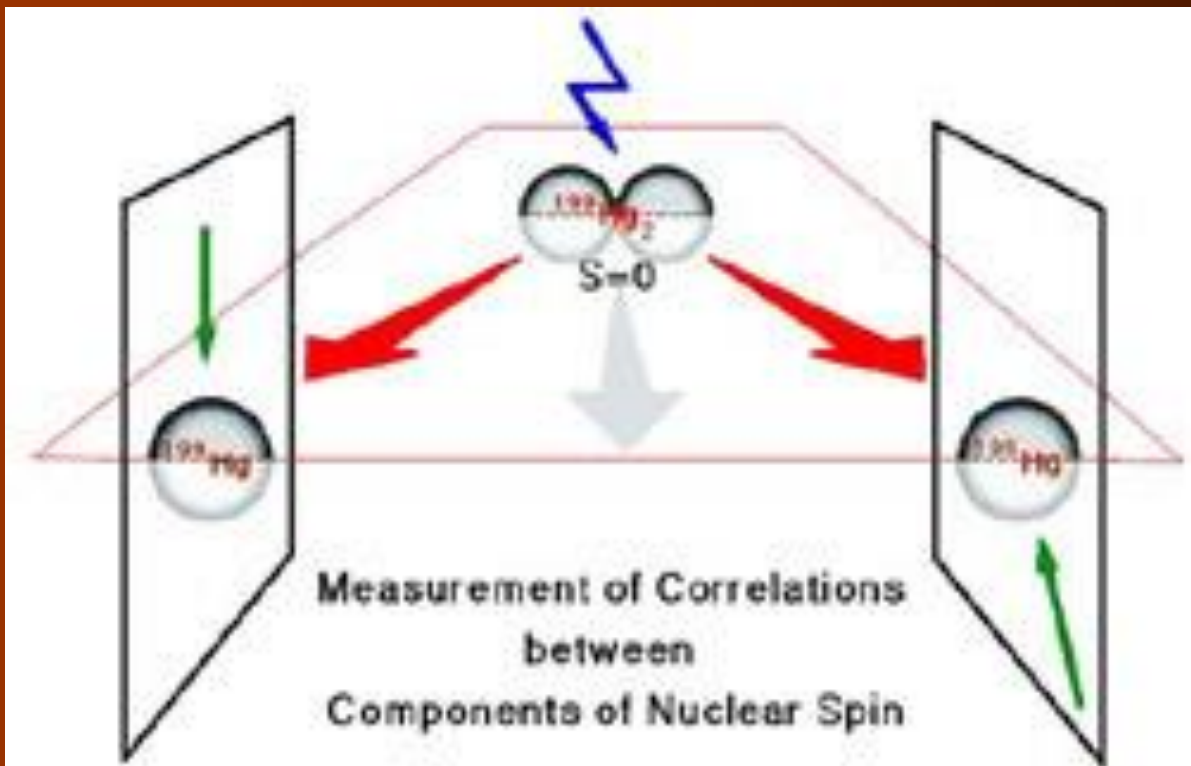
# “Slow Light”

Welch: Group Velocity of Light can be reduced



# Quantum Mechanical Foundations

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

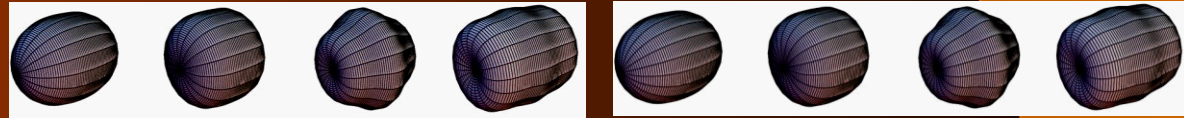




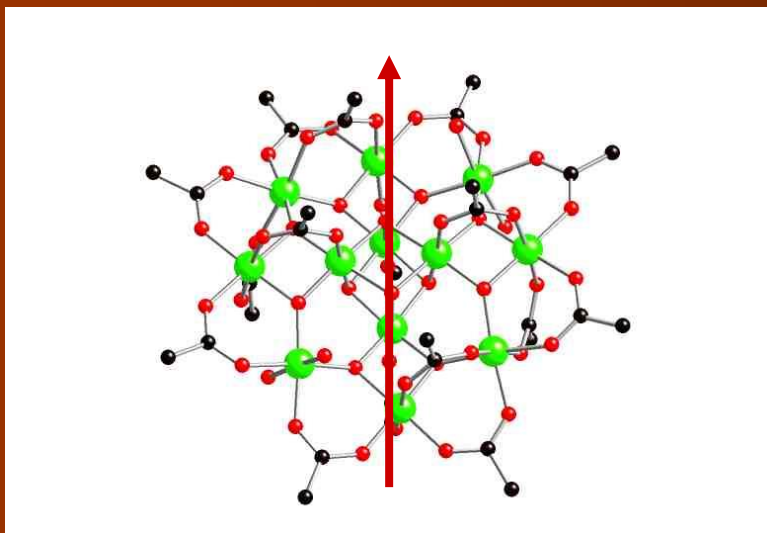
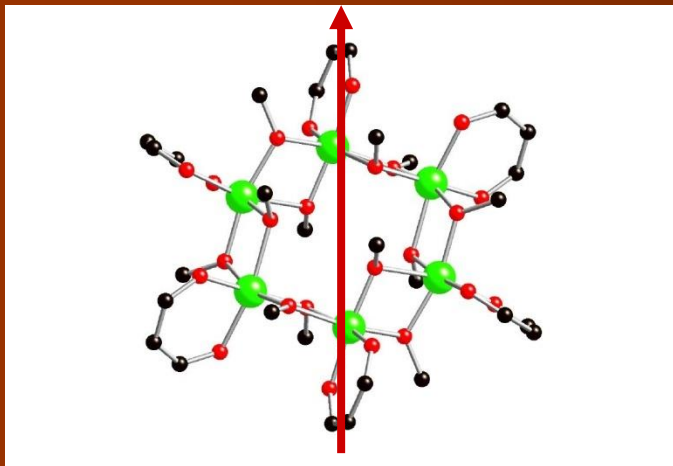
# Collinear Raman Generator



- 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

