



# Why Study Physics ?

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**Pl. Visit <http://physics.ucsd.edu>**



# Why Study Physics?

- Physics is the underlying basis of all physical sciences and Engineering
  - “Oldest and the most successful branch of engineering “ !
- Quantitative theory of all facets of nature
  - From subatomic Quarks to the Grand Cosmos
  - Hands on experience, learn practical skill sets applicable universally.
    - Students trained as “problem solvers”
- Science degree that gives students wide career options
  - Research in all Physical Sciences (DNA, 1998 Chemistry Nobel, NeuroScience)
  - Engineering and Materials research (interdisciplinary)
  - Computation and Information Technology : World Wide Web invented by researcher
  - Physicists designed and built the first digital computer (MARK I)
  - Education , Journalism, Medical School, Investment Banking (Wall street), Futures Market modeling etc

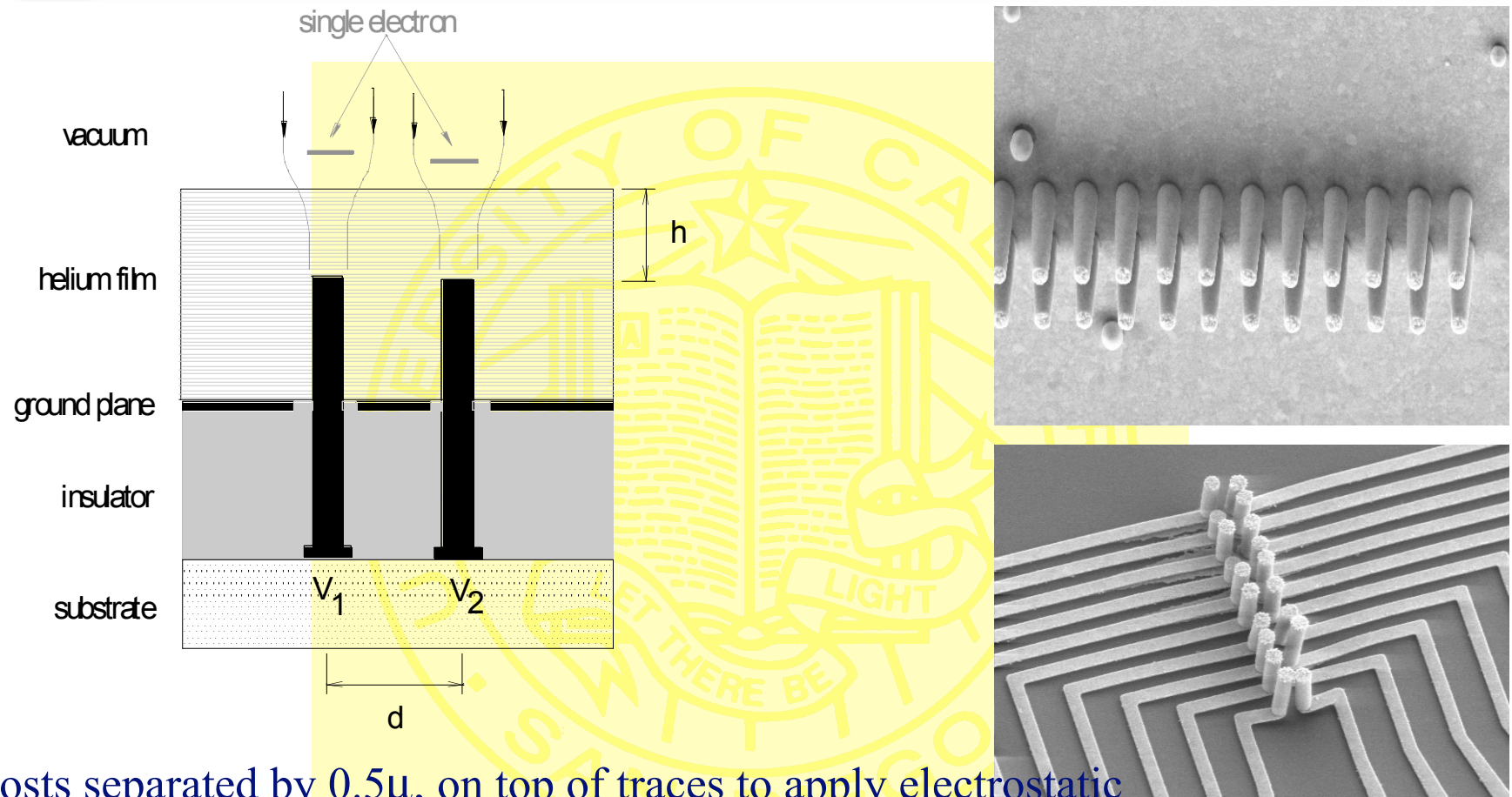


# Physics Impact on Industry & Society

- Many Chief Technology Officers at top industries have physics education & training : Qualcomm, Xerox, Bell Labs etc
  - *“Most desirable employees in industries are physics undergraduates with MS/PhD in Engineering”*
- National Policy: Physicists lead all sciences in contribution to national policy in many national and international issues
  - Albert Einstein, Richard Feynman, Carl Sagan, Herb York etc.
- In an increasingly technological society, physics gives best training for a global inter-disciplinary perspective
  - Example : Quantum Computers (Qbits)



# System to trap and manipulate single electrons

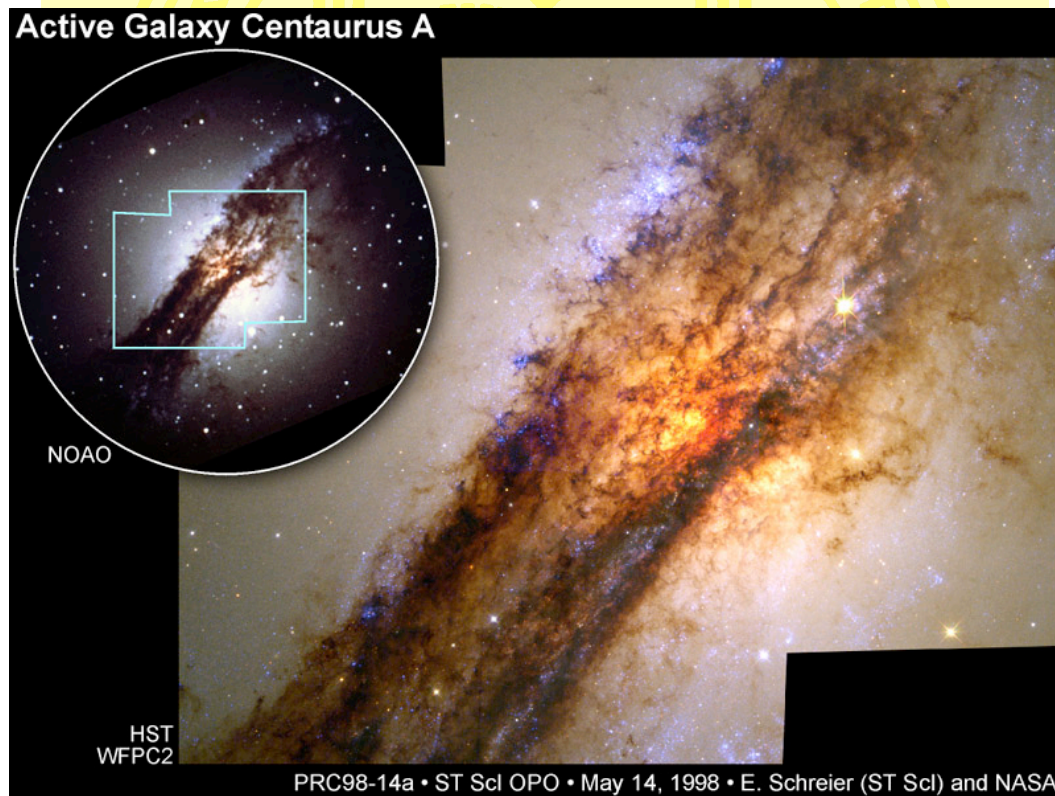


- Posts separated by  $0.5\mu$ , on top of traces to apply electrostatic potentials
- Ground plane to shield the electrons from the field of the traces and to apply uniform field in vertical (z) direction



# Feeding Habits of Black Holes !

- A massive black hole hidden at the center of a nearby giant galaxy feeding on a smaller galaxy in a spectacular collision.
- Such fireworks were common in the early universe, as galaxies formed and evolved





# Physics in Everyday Life

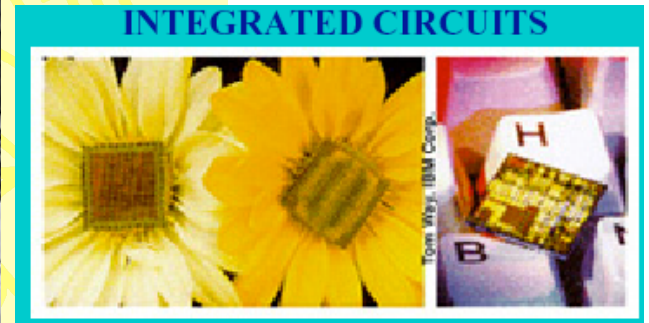
## Eniac (1945) : World's First Computer

17,468 vacuum tubes, 70,000 resistors, 10,000 capacitors,  
1,500 relays, and 6,000 manual switches !

### Magnetic Data Storage



The first hard disk (1956) compared with the newest 3.5 inch 1 gigabyte disk.

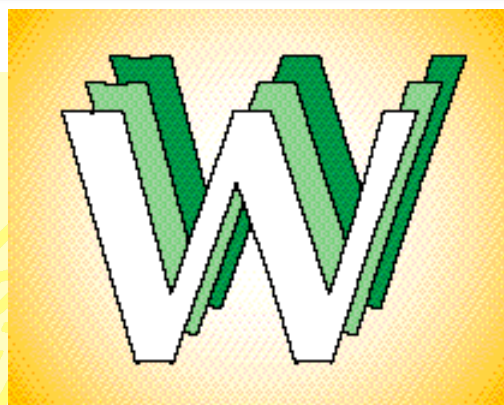


Physics Research in Magnetic Materials, thin films  
and semiconductors led to small affordable computers

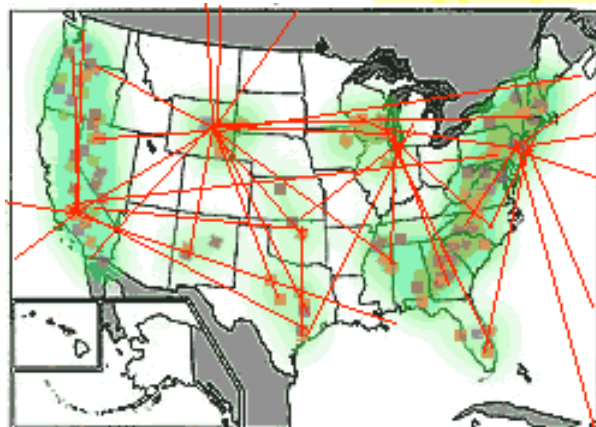




# Physics Revolutionizes Communication



The Internet



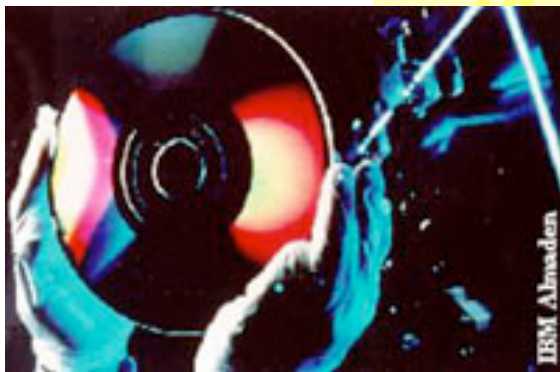
WWW invented purely for Particle Physics Research !



# Physics in Everyday Life : Lasers

Today, lasers make up a multi-billion dollar industry. Our daily lives are enhanced by a basic discovery that was originally thought by some to have no practical uses whatsoever !

Optical Storage: CD



Laser Cutting



Laser Surgery





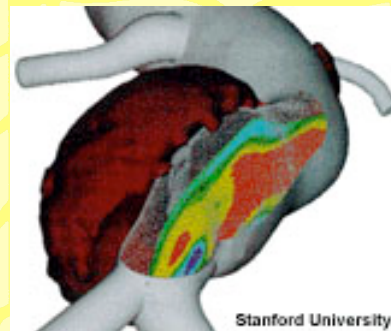


# Physics & Medicine

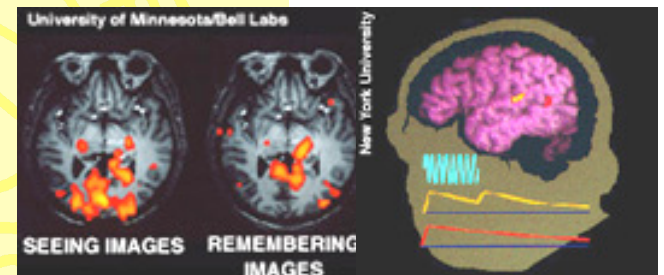
physics research is used to develop new cures for disease and new ways to quickly diagnose health problems.

## THREE-DIMENSIONAL MODELING OF BLOOD FLOW

### ULTRASOUND



### Magnetic Resonance Imaging



(Neutron) Radiation Therapy  
Using Particle Accelerators





## Source Of Satisfaction: Money or Knowledge?

- Need money !
  - For Pizza (now)
  - Putting kids thru school (later !)
- Need Knowledge !
  - and challenge of discovering how nature behaves
  - springs you out of bed in the morning ... A new day may mean a new discovery !
- An education in physics provides you with these twin necessities of life (money and knowledge of the nature of the nature)
- To discover nature's secrets is a thrill no money can ever buy ! This is why some of the smartest people do science.



## Starting Salary ('99) After Bachelor Degree

Field of Bachelor's Degree	Starting Salary (\$)
Chem Engg	46,929
Elec. Engg	45,666
Computer Science	44,649
Information Science	38,902
Physics	40,025
Chemistry	34,111
Mathematics	37,253
Civil Engg	36,076
Biology	29,047
Psychology	26,652
Environmental Science	26,536

Source: Salary Survey 1999-2000, published by National Association of Colleges and Employers.



## Breakdown of Physics Majors' Employment

### Where they go After Bachelor's Degree

Computing	\$ 43,807	23%
Research/Consulting/Tech.	\$ 40,295	36%
Engineering	\$ 42,460	11%
Others	\$ 40,622	19%
Education	\$ 26,300	11%

Others = Sales, design, quality control, management etc



## Starting Salary (1999) After PhD Degree

Electrical Engineering	70,848
Physics	60,288
Chemical Engineering	67,333
Chemistry	56,885
Mathematics	52,908
Civil Engineering	58,571
Psychology	45,679
Biology	45,679

Source: Salary Survey 1998-1999, published by National Association of Colleges and Employers. September 1999



# R&D Magazine Survey of Professions

See online Salary Calculator based on recent R&D survey data

See <http://208.208.73.47/salary00/>

If you are (a) Below 30 years of age (b) live in California (c) have less than 5 years of experience, then by field and highest degree , typical salaries (\$) are:

Field	Bachelor's	Masters	Ph.D
ECE	50,000	57,100	66,300
Physics	49,900	57,000	66,000

If you are (a) about 40 years of age (b) live in California (c) have more than 10 years of experience, then by field and highest degree , typical salaries (\$) are:

Field	Bachelor's	Masters	Ph.D
ECE	60,500	67,600	76,800
Physics	60,400	67,500	76,800

Comparable Salaries in California !



# Why Study Physics at UCSD ?

- World class research program, students taught by top researchers in the field. **You learn the latest from the best !**
- 11 members of National Science Academy, 13 Academy of Arts and Sciences, 2 fellows of Royal Society
- Faculty are Winners of (short selection to make a point) :
  - National Medal of Science
  - Enrico Fermi Prize
  - Maxwell Prize and A.P.S. Sloan Fellowship
  - Cottrell Fellowship (**communicating research to undergrads**)
  - Heinemann Award
  - American Physical Society's Biophysics Award
  - Faculty for the 21st Century (**emphasizes innovative teaching**)



# Why Study Physics at UCSD ?

- Small class size, friendly interactive style of teaching  
→ **Individual attention from world class faculty**
- Education taken very seriously at UCSD
  - **Vice-chair for Education** in Physics department devoted to nurturing excellence in undergraduate teaching and research
- **Broad and flexible** physics program allows students to customize course work and laboratory experience
- **Undergraduate Physics Club** : with office space on campus and computing support, weekly seminars from researchers
- Encourage (one-on-one) **research involvement** by undergrads with faculty and research staff via PHY199 during school and summer research program supported by the NSF
- **Excellent placement to top research universities and industry**





# UCSD Physics Majors Program

- Courses are a combination of core curriculum and electives
  - electives emphasize technological aspects of physics
- Many Physics major streams / specialization :
  - Physics geared towards future in Physics Research
  - Computational Physics: “All of nature can be computed..you just need to know how !”
  - Biophysics : Biology through a Quantitative viewpoint
  - Earth Sciences/ Geophysics
  - Materials physics (BS/MS): Semiconductor Physics, Magnetic Materials, Super Conducting Materials
  - General Physics with emphasis on education: teachers/journalists



# Undergrad Involvement in Research

- Diverse research program at UCSD
  - students encouraged to join physics grads, research staff and faculty in their junior/senior years including internship
- Research Fields include:
  - Physics of the sub-atomic world
    - Elementary Particle Physics, Atomic Physics
  - Physics of the Cosmos
    - Astrophysics, Astronomy and Space Physics
  - Physics of Materials
    - Superconductivity, Thin films, Micro-calorimetry, Novel materials
  - Physics of Biological systems
    - Neuro-physics, energy generation in cells, structure of proteins etc
  - Physics of Non-linear systems and Plasma Physics



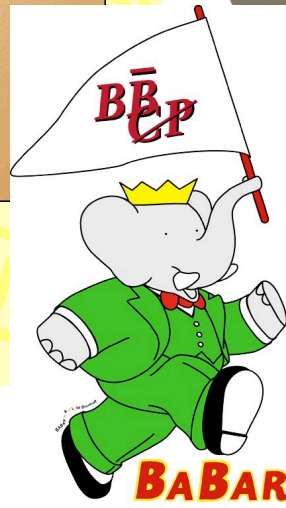
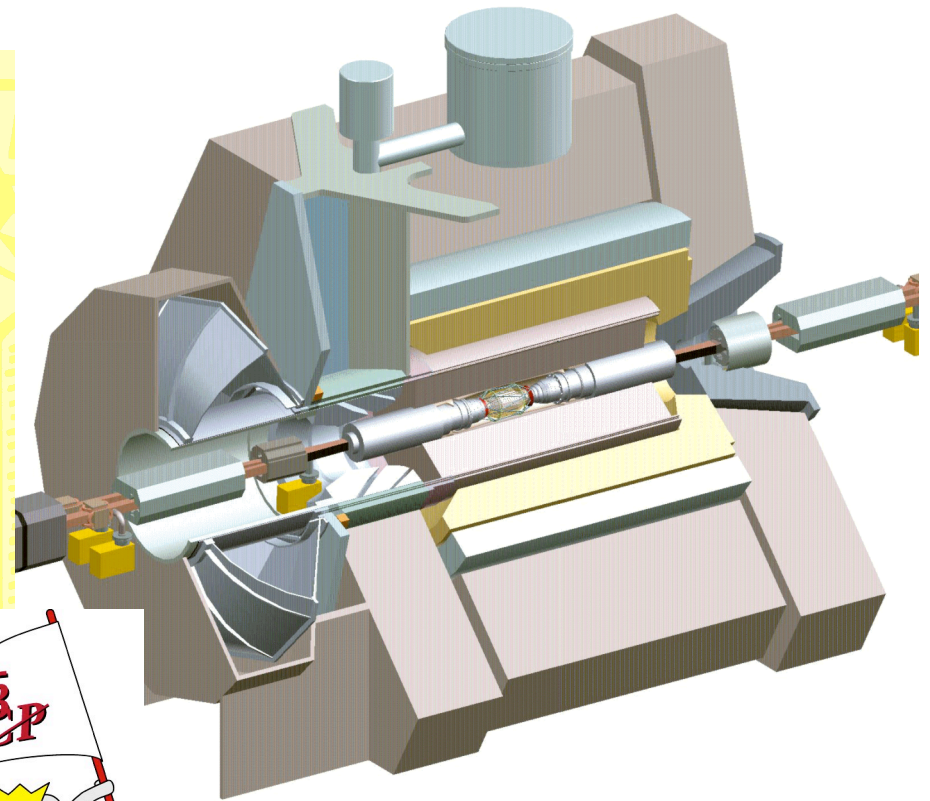
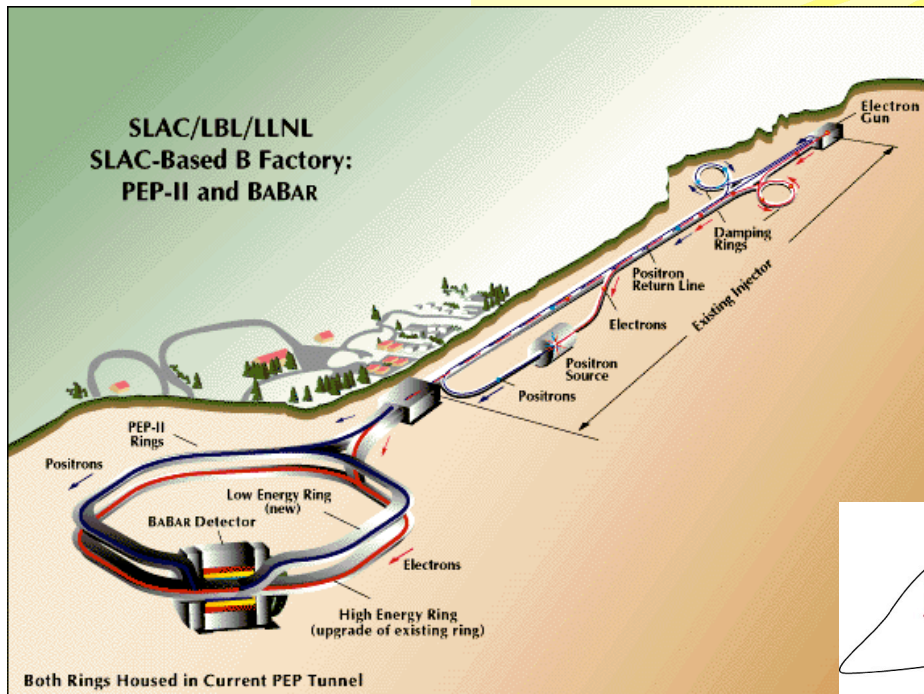
# Example of Student Research

## Anti-matter In the Universe

- How did the Universe get to be as we see it today ? Where is all the anti-matter that came with the “Big-Bang” that created the universe ?
- My group is involved in understanding the **difference between matter and anti-matter**. We collide matter against anti-matter using high energy particle accelerators and reproduce in laboratory what the universe looked like in the very early (fraction of a second) since it was created...baby universes !
- Typically 2-3 undergrads/year involved in this research, contribute to peer-reviewed publications
- Many claim undergrad research was their biggest thrill of their entire undergrad education
- Coveted by top research schools for their PhD program and industry because of their early exposure to cutting-edge research and problem solving ability



# Difference Between Matter and Antimatter





## Summary: Why UCSD Physics ?

- Physics teaches problem-solving skills coveted universally
- UCSD Physics  $\Rightarrow$  World class physics faculty and research teams
- Committed to **excellence in physics education**
- Emphasizes broad and flexible curriculum
  - General physics, Astrophysics, Biophysics, Materials physics, Earth science, Computational physics
- Encourage undergrad involvement in cutting-edge research
  - during school year (199 courses) & summer internship
    - (National Science Foundation's REU program)
- Excellent record of students moving on to top research Universities & Industries
- For more info please visit **<http://physics.ucsd.edu>**