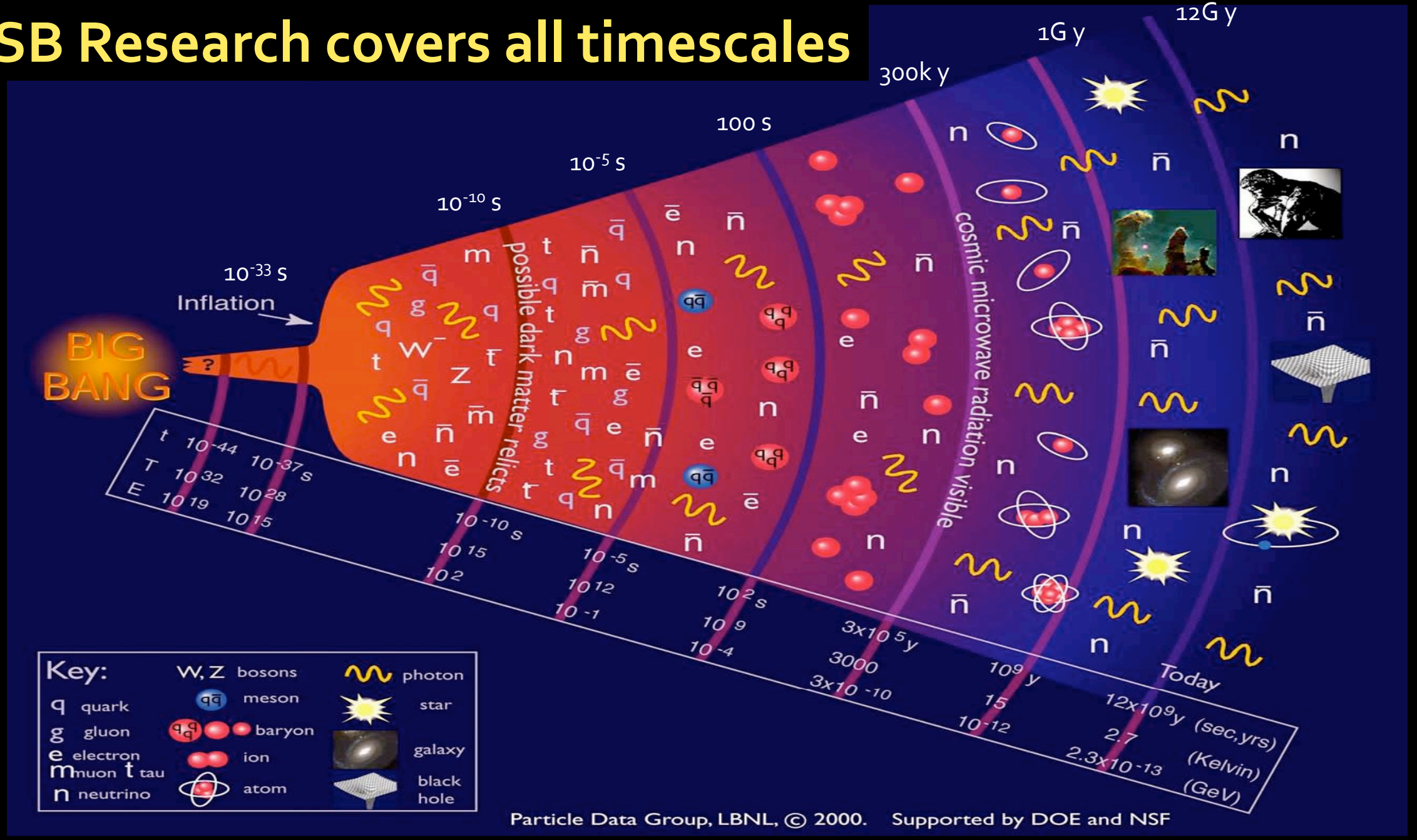
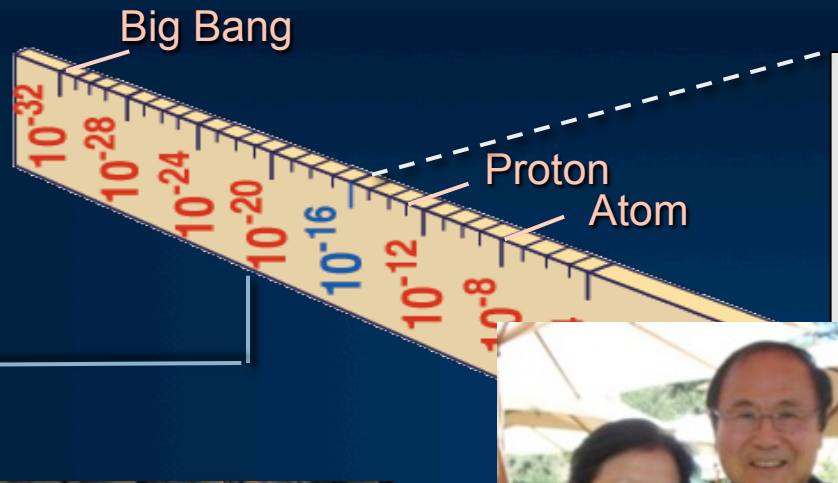
Research@UCSB

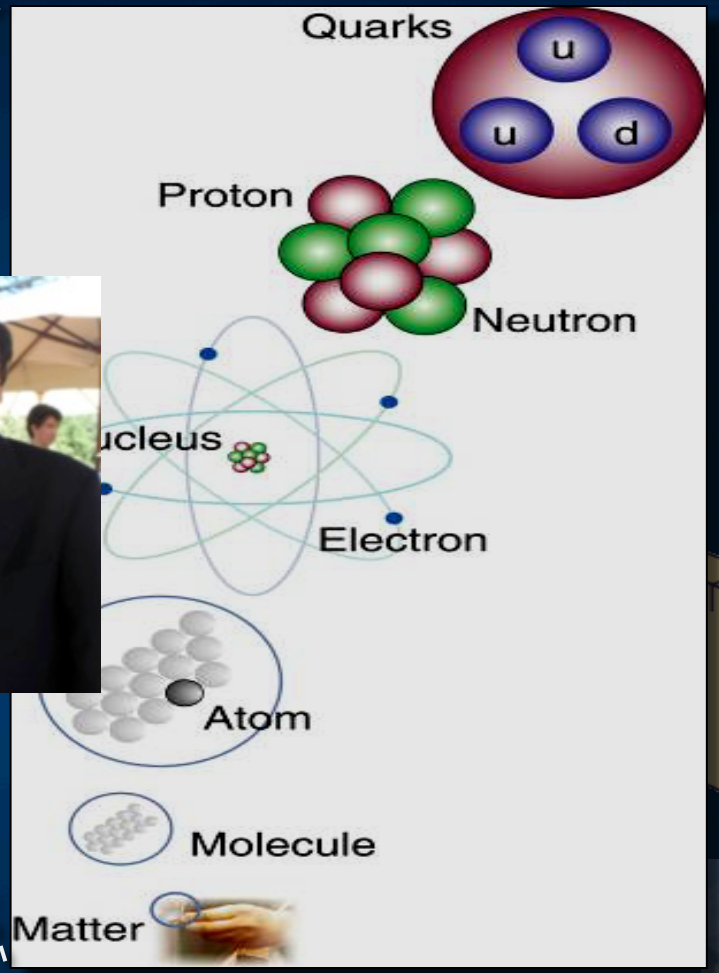
Joe Incandela
Vice Chancellor for Research
Joe and Pat Yzurdiaga Chair in Experimental Science

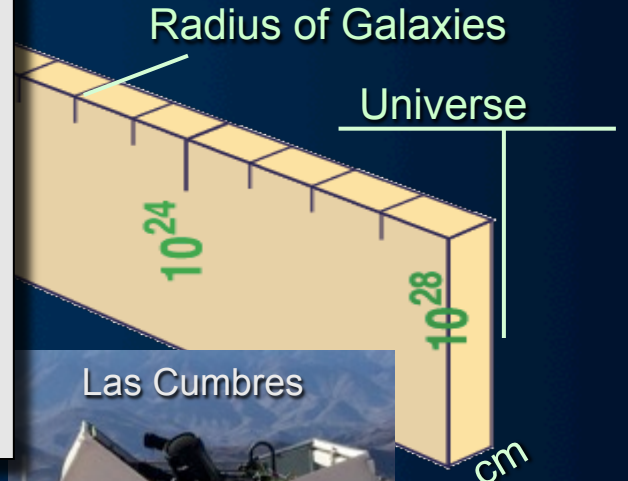
UCSB Research covers all timescales



UCSB Research covers all distance scales

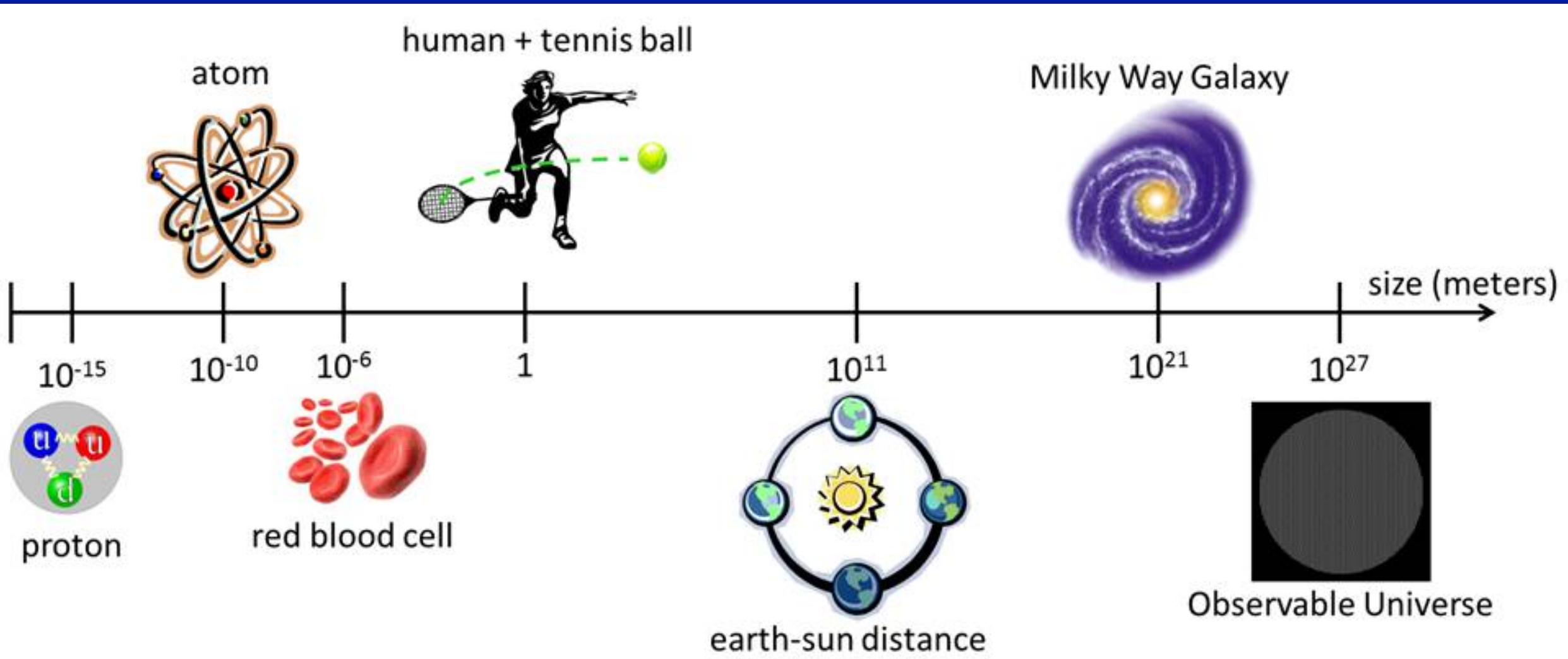






Research at UCSB spans all scales

Not all of it has a direct applications…



But it all has impacts … impacts that are often unexpected …

154

Solid State Lighting and Energy Efficiency Center (SSLEEC)

154 patents since 2011
> 430 papers since 2007 cited 14,000 times
< 195k$ per disclosure for a potential new patent

One of the most unique and successful collaboration models for universities & industry

Impacts of a new technology

Historic Rice Fields, Washima, Ishikawa, Japan: 21,000 LEDS

From a presentation by Prof. Kim Yusada - UCSB Art dept.

Closer to home, LEDS illuminate the Pardall tunnel

From presentation by Prof. Kim Yusada - UCSB Art dept.


LED Plant Factory: Feeding the World
Growth rate is 2.5 times (latest: 5 times) higher
Water usage is 1% of standard farms

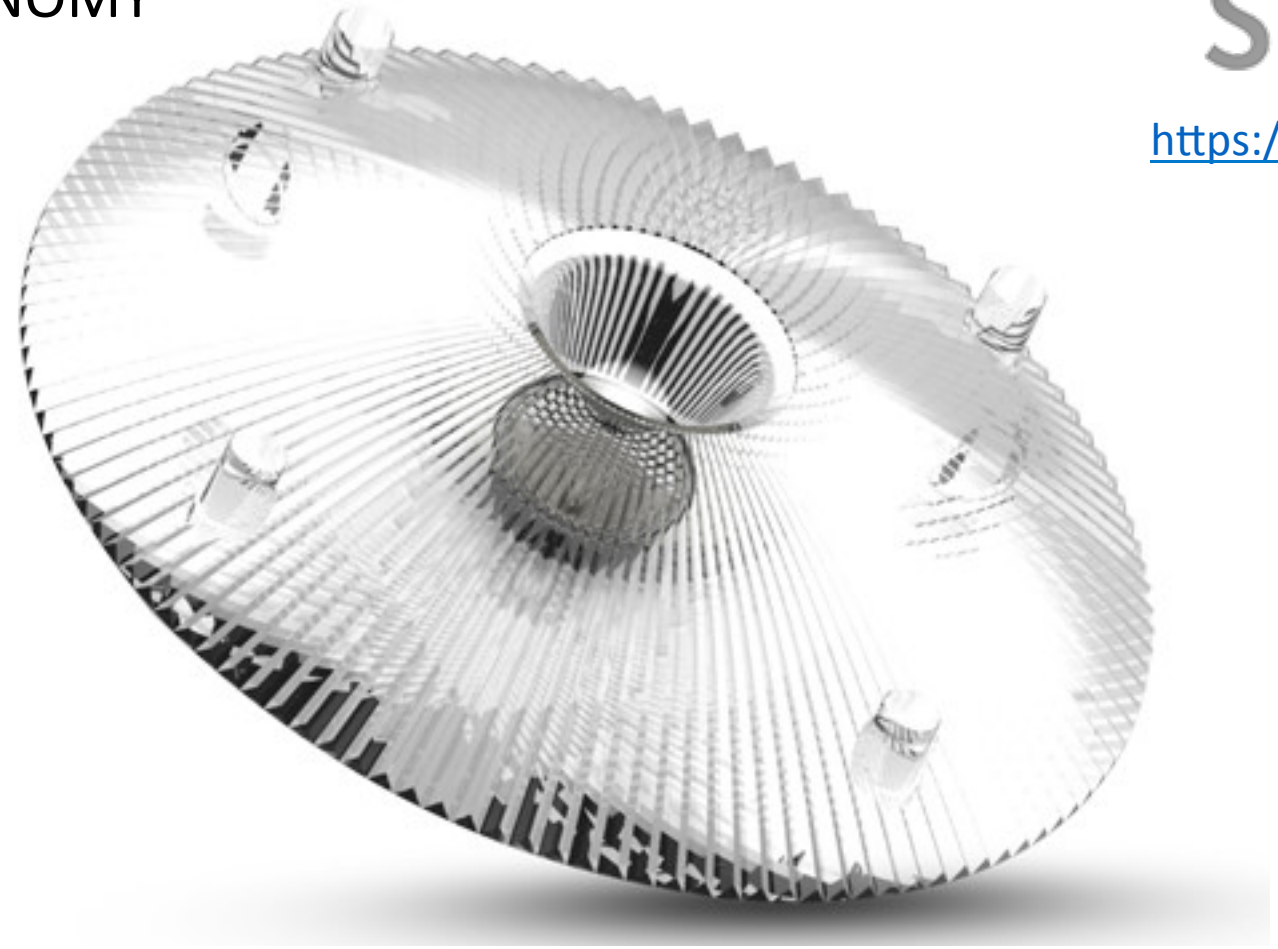
Unite to Light http://unitetolight.org

30% Increase in Graduation Rates
Over 73K lights distributed to 65 countries

IMPACT ON THE ECONOMY

SORAA®

https://www.soraa.com/about



Grow GaN on GaN: perfect crystal structure with
1000x fewer defects and 5x more light per unit area.

IMPACT ON THE ECONOMY

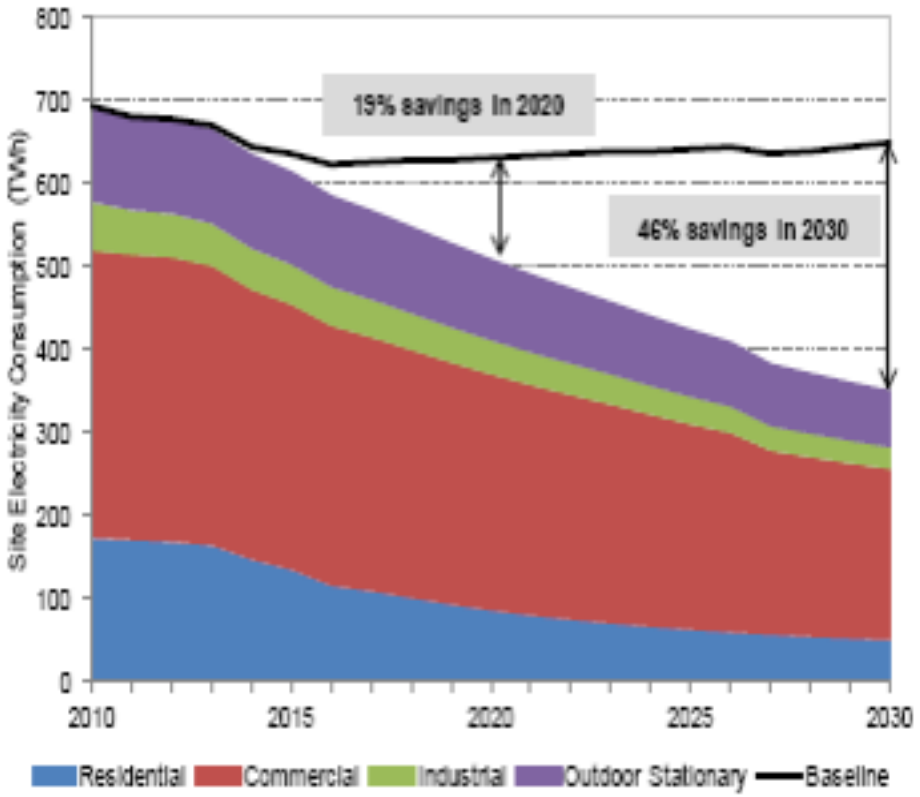


Figure ES. 1 Forecasted U.S. Lighting Energy Consumption and Savings, 2010 to 2030

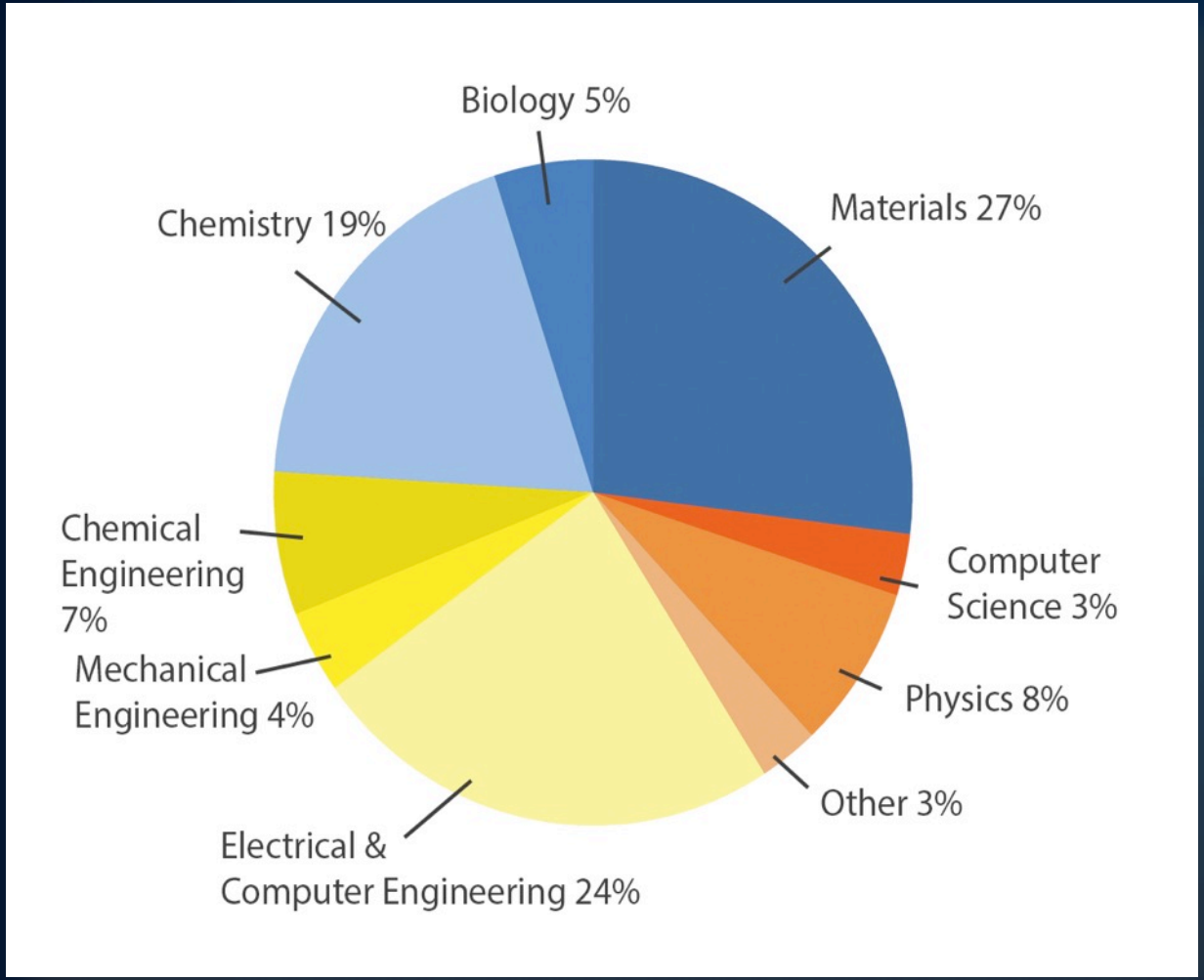
- In 2030 46% reduction in energy needed for lighting in U.S.
- Cumulative savings of $250Billion from 2010-2030

*Source: DOE Fact Sheet; SSL Program, Jan 2012

Equal to fifty 1000MW power plants in the US alone!

Slide courtesy Steven Denbaars

UCSB Patent Portfolio



- **626 Total active technologies**
  - **51% under licensing arrangement**
  - **90 New Disclosure per year**
- **4-6 startups per year**
  - **80 startups formed to date**
  - **80% are still active or have merged**

Many new technologies – Many Impacts

Impacts of Data, Analysis, and Synthesis

Negative Impact on the planet per Pound of Protein

Slide from Prof. Ben Halpern (NCEAS Director)

Thought Experiment

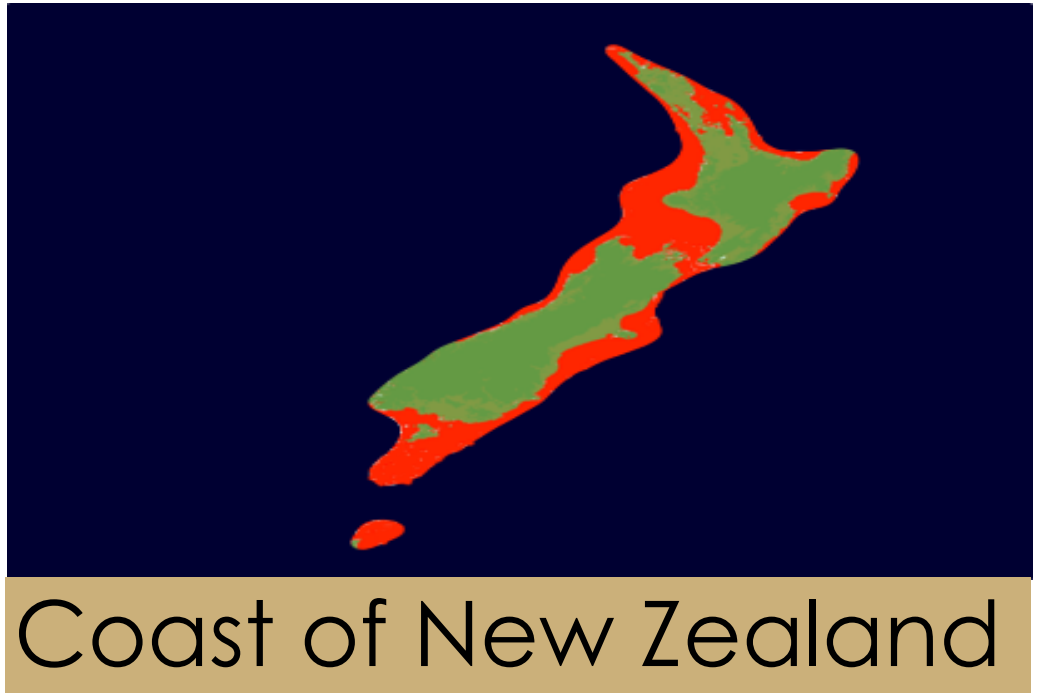
Versus

Surface area needed by 2050?

Slide from Prof. Ben Halpern (NCEAS Director)

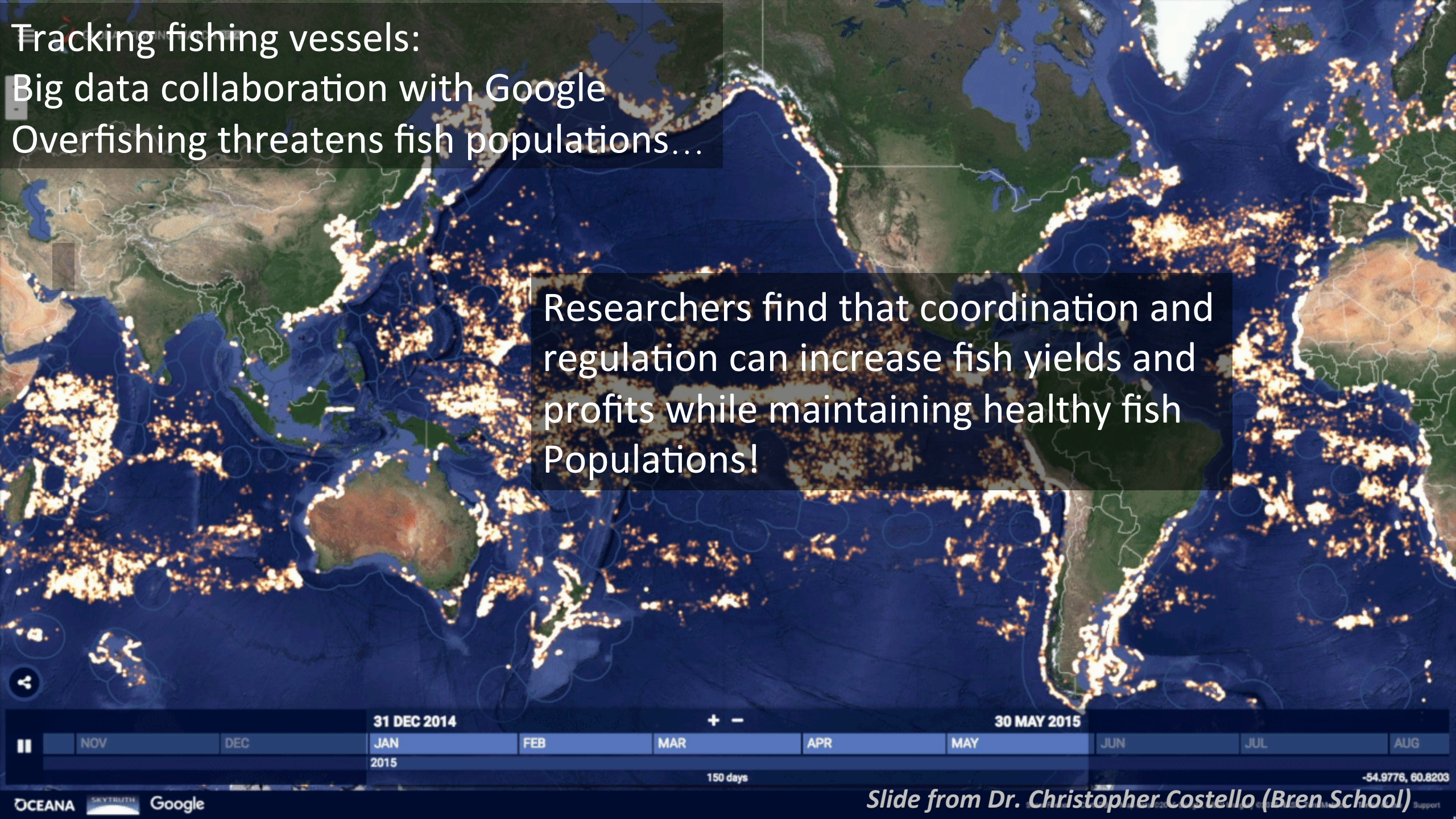
Thought Experiment

Versus



Surface area needed by 2050?

Slide from Prof. Ben Halpern (NCEAS Director)



Slide from Dr. Christopher Costello (Bren School)

Impactful Communication

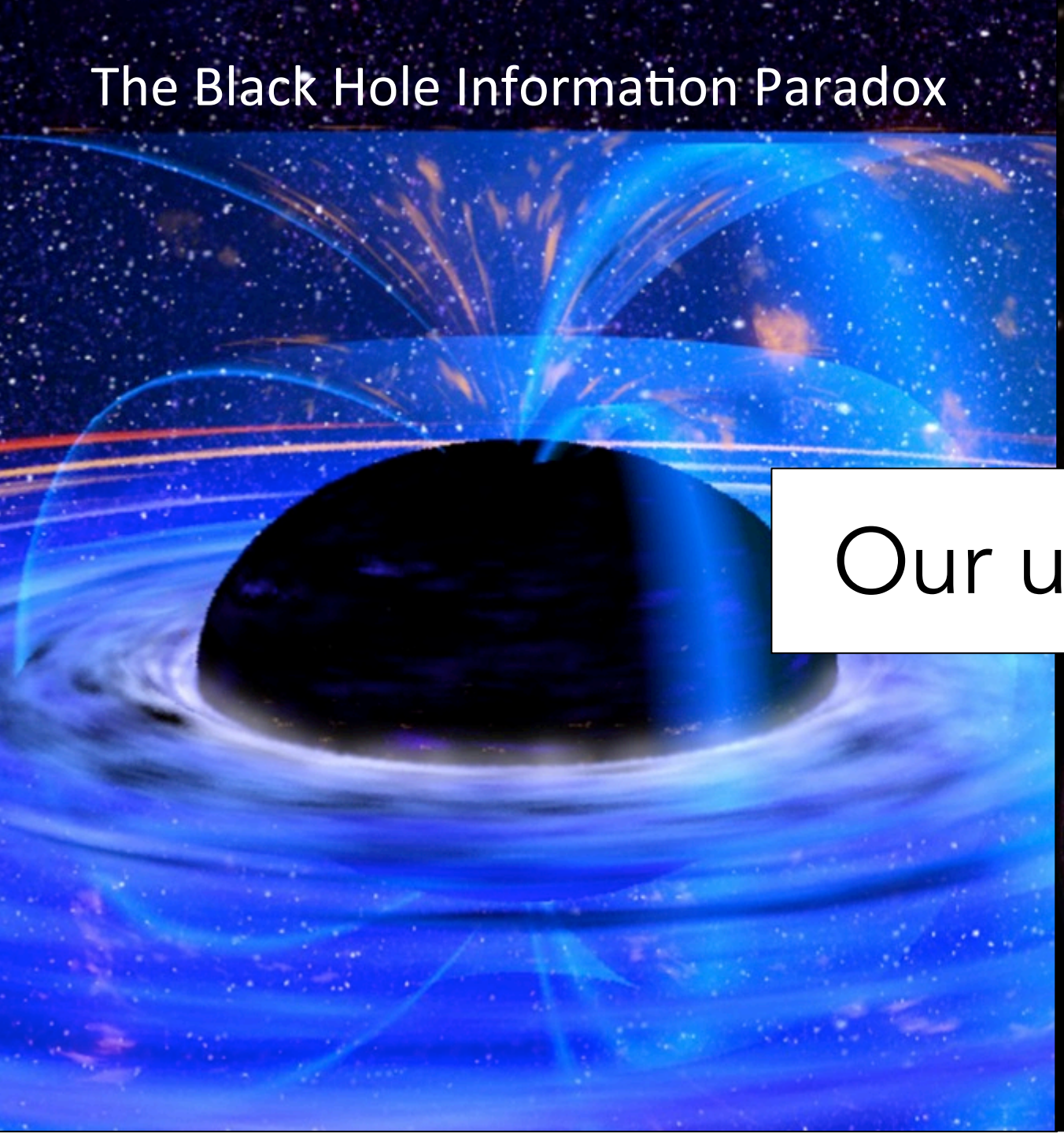
Blue Horizons Summer Program for Environmental Media teaches students how to communicate vital stories about the ocean through media.
(In its 12th year)

Breadth of Research

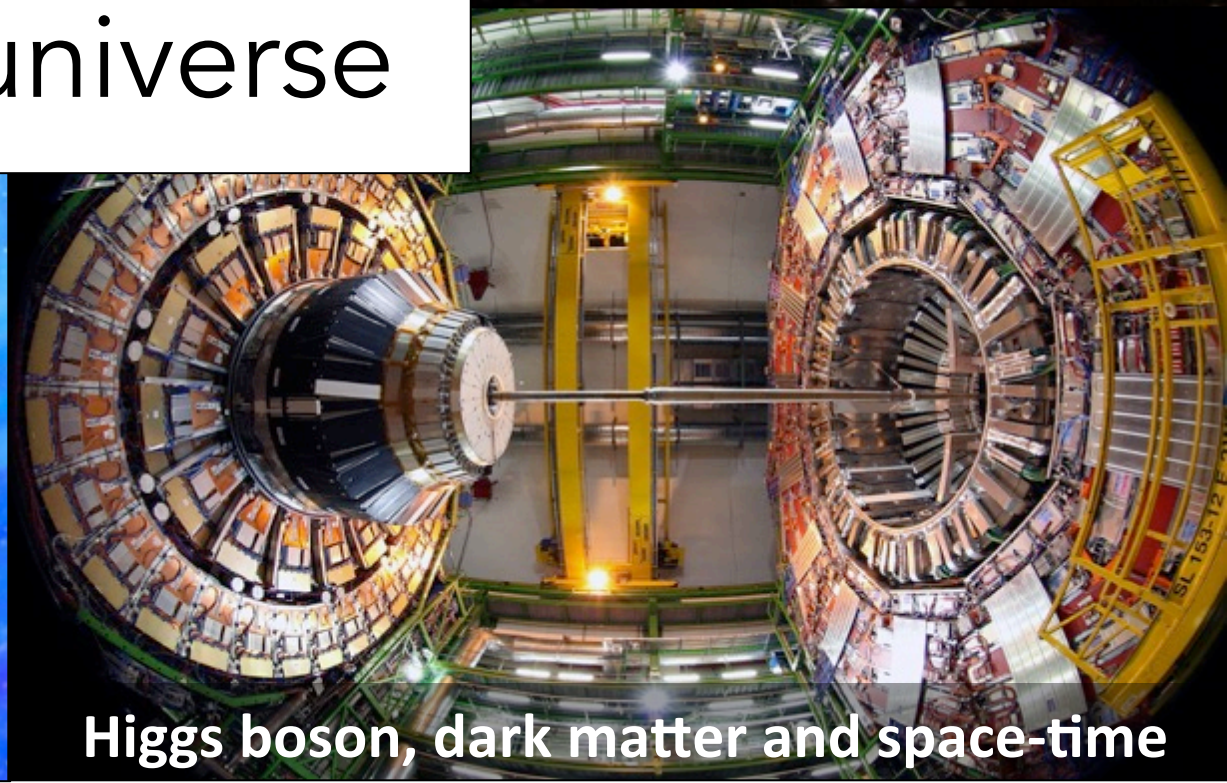
A small sampling of UCSB research in 5 broad categories

Many can be found reported in the UCSB Current Online
http://www.news.ucsb.edu

The Black Hole Information Paradox



Our universe



Higgs boson, dark matter and space-time

Prevalence of ghosts in Japanese culture

An ancient Mayan's Venus Tables

Our culture

Mexican Casta painting and racial hierarchy

Quantifying belief system dynamics

Our World

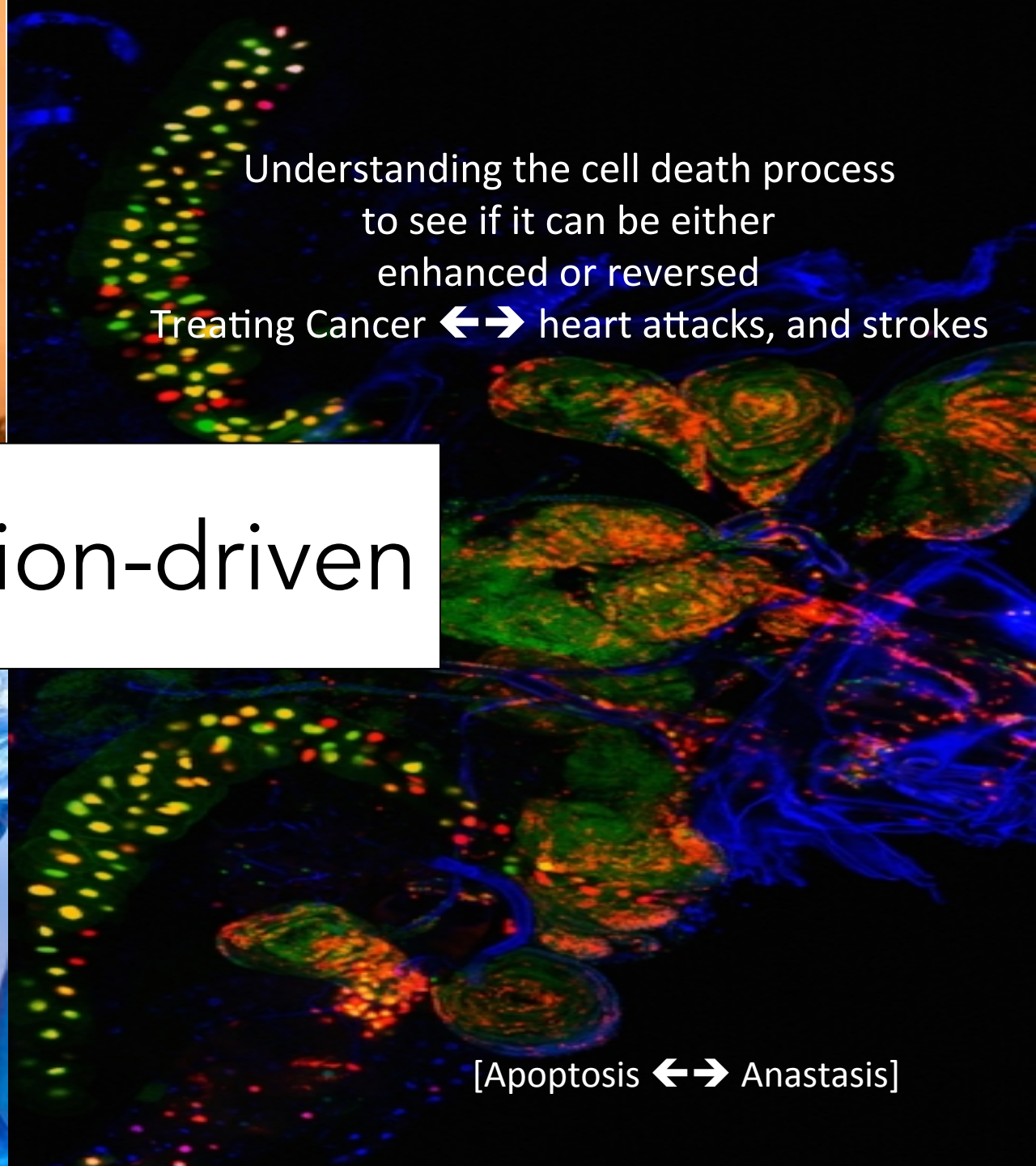
Santa Cruz Island Reserve and California's ecological past

How blood vessels shrink

History repeats: polarization in the 19th century

Class and gender implications of the silk trade in medieval Paris

Urban wildfire patterns and reslience strategies

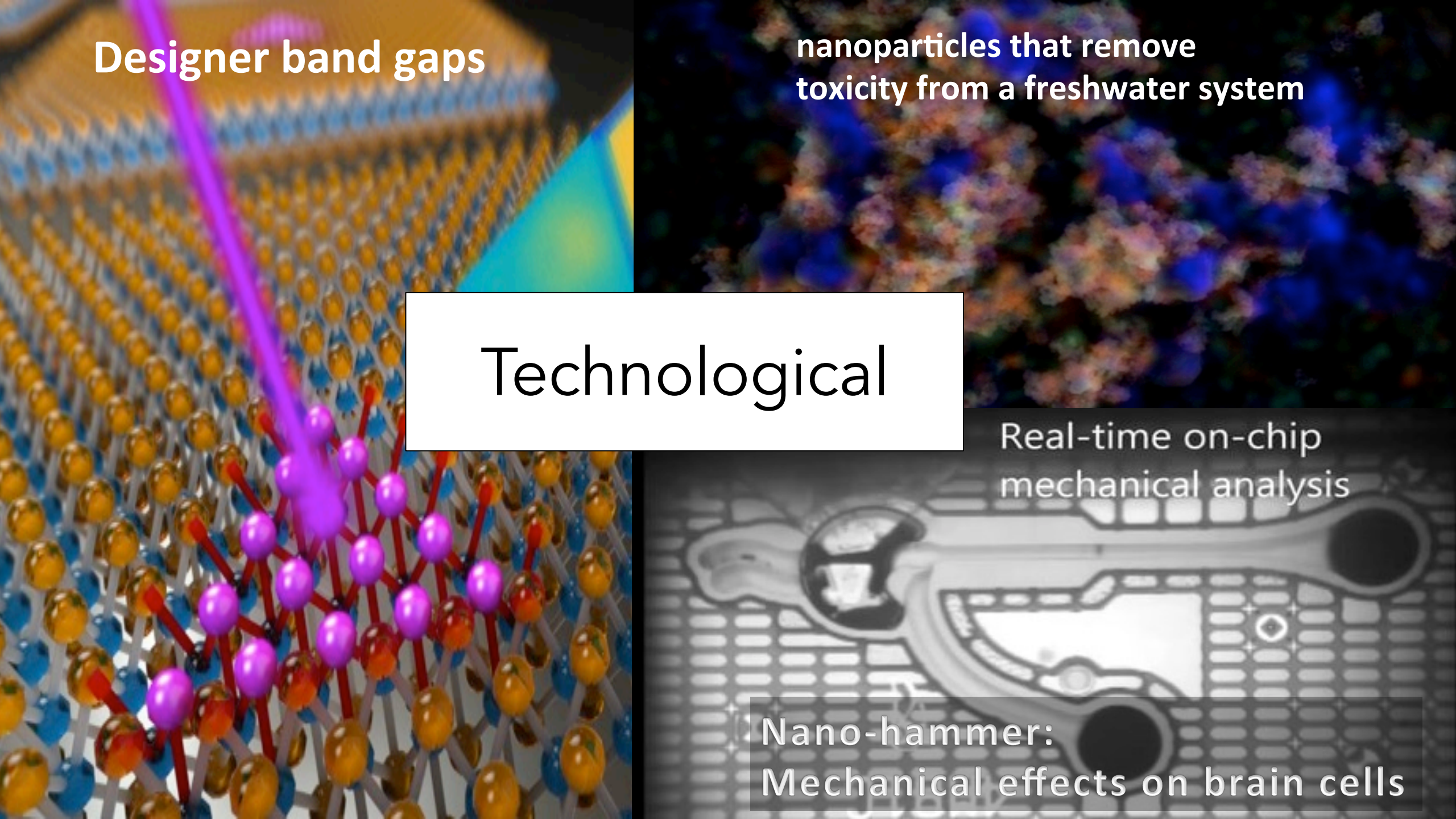


Understanding the cell death process
to see if it can be either
enhanced or reversed
Treating Cancer ←→ heart attacks, and strokes

Application-driven

The production, use and fate of all plastics

[Apoptosis ←→ Anastasis]


Designer band gaps
nanoparticles that remove
toxicity from a freshwater system
Technological
Real-time on-chip
mechanical analysis
Nano-hammer:
Mechanical effects on brain cells

What makes UCSB research really special?

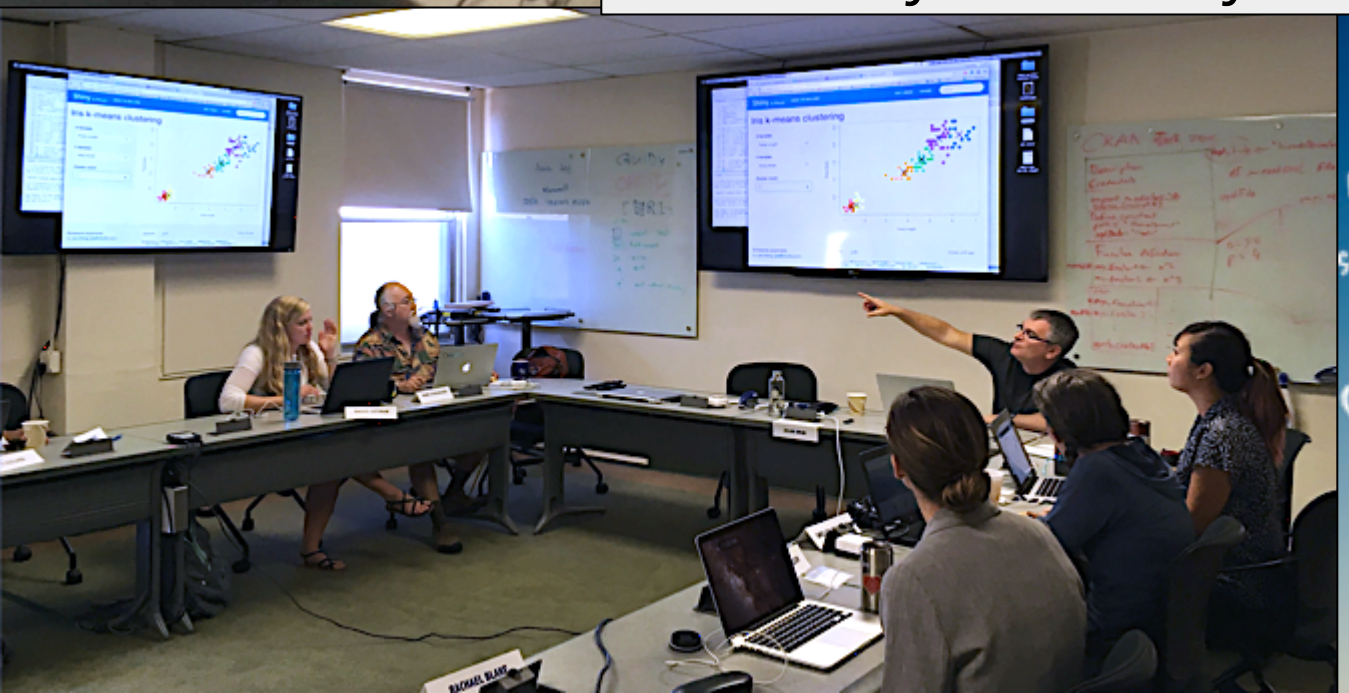
Openness to collaboration and a remarkable knack for knowing how to bring great minds together from all over the world

The following are examples of what some researchers call:

“The Santa Barbara Effect”

- Top 1% in ecology worldwide
- 2400 pubs: Top 10 have 27,000 citations
- 20,000 researchers involved thus far
  - 130 post-doc fellows
- Copied by 22 centers around the world

National center for ecological analysis and synthesis



Kavli Institute for Theoretical Physics

Science

- **Programs that Transform Research**
  - 12 Programs + 8 Conferences - 70 Visitors all day every day
  - Nurture new frontiers – A gateway to new a field
  - 50% of Visitors are from outside the U.S..
  - KITP Online watched 24/7

Education

- **Development of Young Scientists**
  - Postdoctoral Program, Graduate Fellows, Affiliates

Outreach

- **Respond to Challenges Facing Physics**
  - Underrepresented groups in Physics, High School Teachers, Outreach…

Charles T. Munger Physics Residence now in full operation

- **5 Faculty, 12 Postdocs and 1000 Visitors/year**
  - Averaging one paper/day

Material Research Laboratory

#1 In NRC Rankings of PhD Programs

Interdisciplinary:

- Physics, chemistry, life sciences, engineering,

Purpose:

- Understand how small-scale structure influences function and performance
- Develop new materials and methods of fabrication

Impact

- **Since 2011, 35 Patents and >1,000 publications with >15,000 citation**

Outreach

- *75* undergrad interns *per* year.
- *115 UCSB graduate students and postdoctoral fellows participate*

UCSB BRAIN INITIATIVE

LET THERE BE LIGHT

Slide courtesy of Dr. Bridget Queenan

LIGHT

FORCE

TIME

ACTION

Psychological & Brain Sciences

Media, Arts & Technology

Chemistry & Biochemistry

Economics

Chemical Engineering

Ecology, Evolution & Marine Biology

Sociology

Biomolecular Science & Engineering

Communications

Physics

Materials

Electrical & Computer Engineering

History

Philosophy

Mechanical Engineering

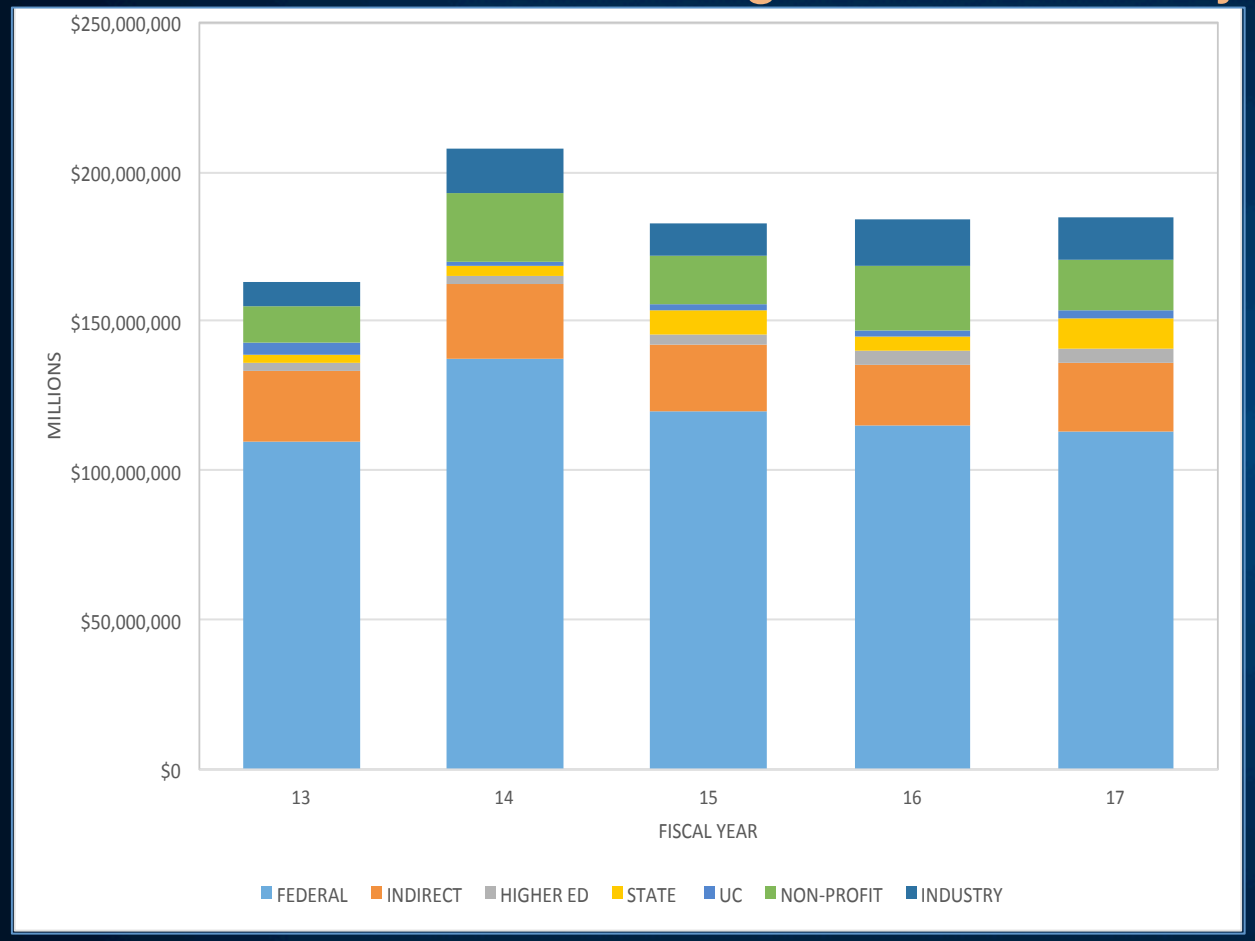
Molecular, Cellular & Developmental Biology

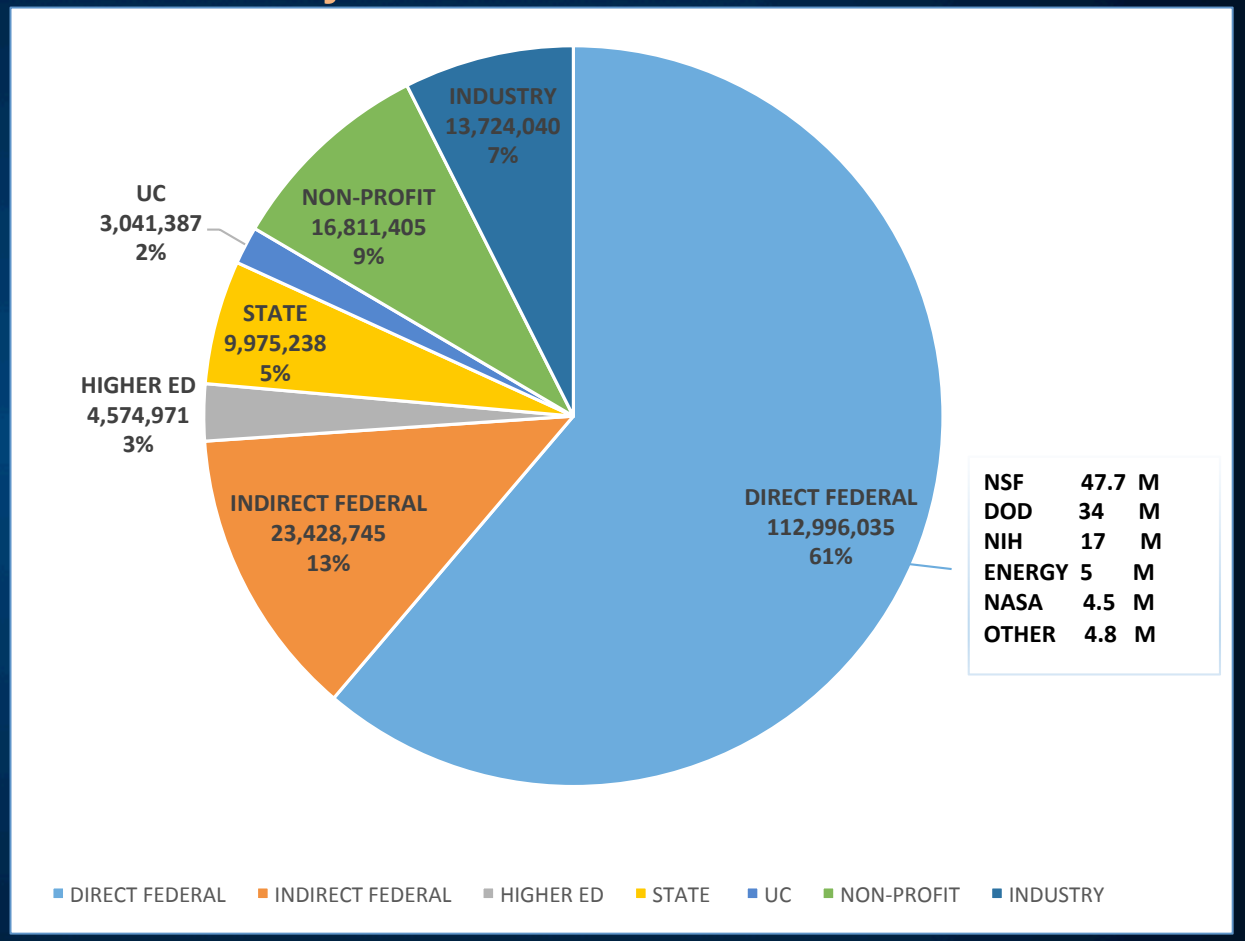
Computer Science

Slide courtesy of Dr. Bridget Queenan

UCSB Research funding history and sources

Funding has held steady at ~185M$/year*





*Most is Federal:
NSF – DOD – NIH – DOE - NASA…

Competition

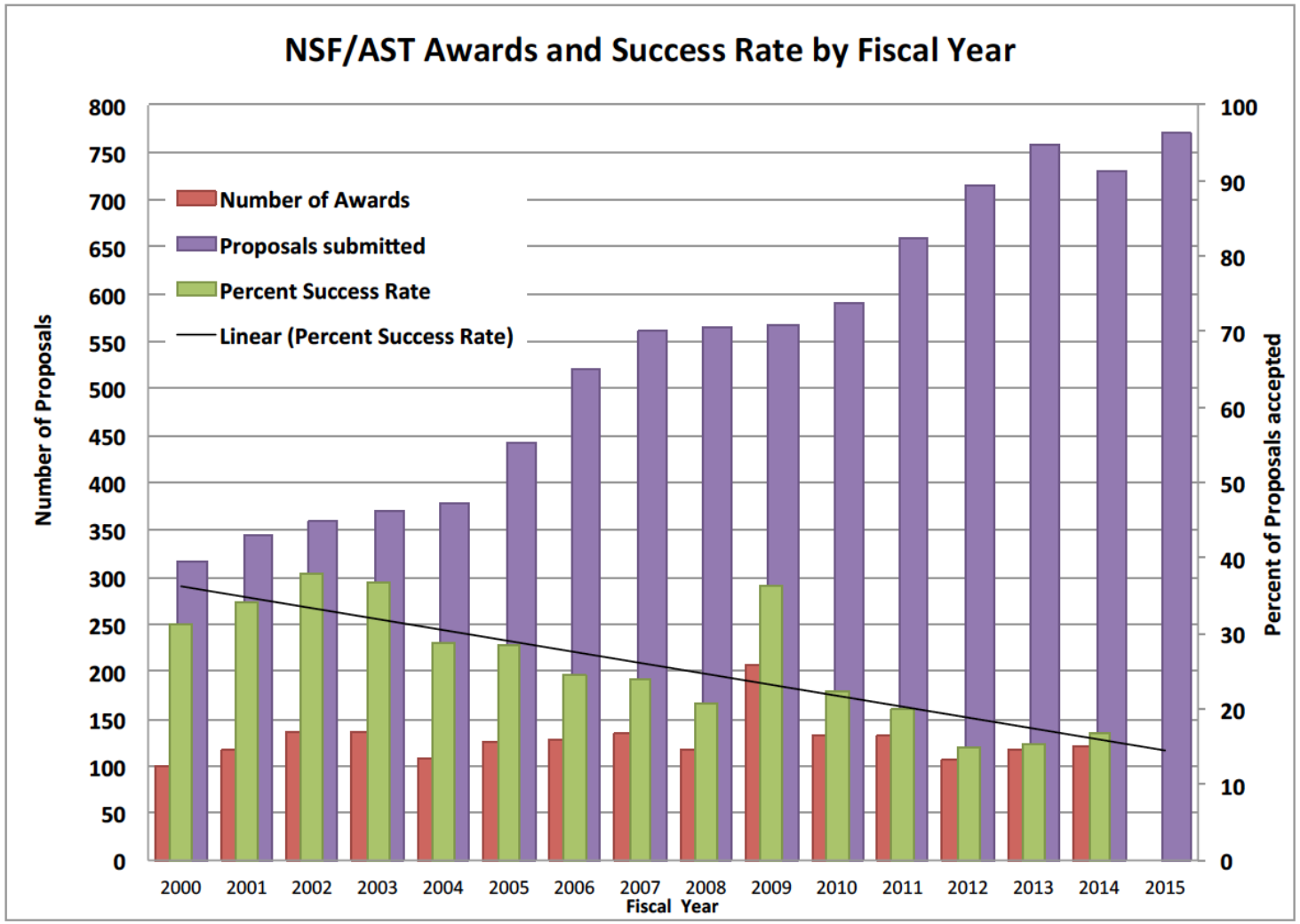
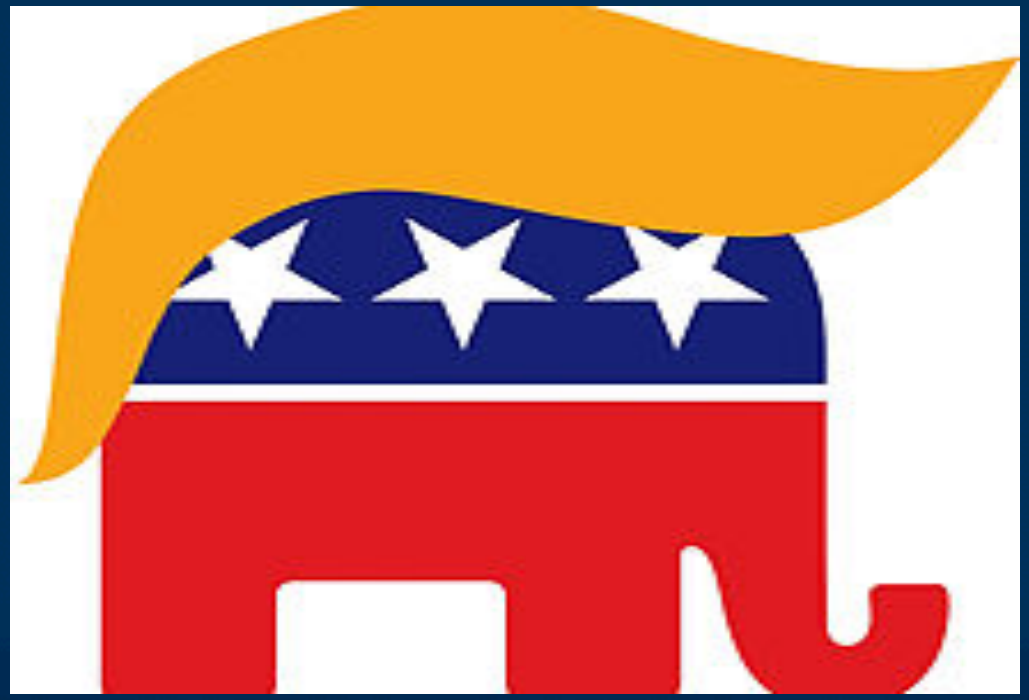


Figure 1. *Historical NSF/AST (AAG) proposal success rate[6] through 2014. The anomalous spike in FY09 is due to the one-time stimulus provided by the American Recovery and Reinvestment Act.*

Future of Federal Funding?

Priorities are shifting!



In conclusion: UCSB Research is far-reaching

Many great topics could not be covered, including

Many examples where faculty members pair up for greater impacts

The importance of students to research and research to students, which cannot be overstated

UCSB has extraordinary untapped potential

Imagine where UCSB research could go next!