

**Interdisciplinary and Interagency  
Cooperation  
in  
High Energy Physics**

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# Perspectives on HEP

- **The Structure of the Field**
  - Accelerators remain the most important tool to achieve the HEP science goals ... “the energy frontier”
  - HEP is dominantly “large science”, involving lots of resources (human and technical)
  - HEP experiments and the enabling tools are typically developed and implemented through international collaborations

# Perspective on HEP

- **The National Laboratories**
  - Two large national laboratories – Fermilab and SLAC; plus ANL, BNL, LBNL and **Cornell (NSF)**.
  - Most of the resources in the field (>80%) are concentrated in the big DoE laboratories
  - They provide major accelerator and detector facilities and provide much of the field's technical infrastructure
  - They enable the development of future accelerators and detectors.

***In the future, the national laboratories will continue to be at the center of particle physics, but the scope of their activities is expanding to include more interdisciplinary activities.***

# Perspective on HEP

- **The Universities**
  - HEP in the U.S. is built around a strong university-based community.
  - University faculty, graduate students and postdocs make up more than 80% of the scientists in the field.
  - University scientists provide training for our undergraduate and graduate students and renewal of the field

***A healthy balance between universities and national laboratories is key to the success of the program.***

# Perspective on HEP

- **Style of the agencies is different**
  - DoE is laboratory and facility oriented
  - NSF is individual investigator oriented
  - NASA is mission oriented
- **Close cooperation between DoE & NSF in HEP**
  - HEPAP now reports jointly to NSF and DoE
  - LHC is an excellent model for agency cooperation on a complex (international) project
- **Recent cooperation between DoE and NASA**
  - GLAST is the largest cooperative project

# The Field of Particle Physics



International Union of Pure and Applied Physics

Commission on Particles and Fields  
C11 Commission (1957)

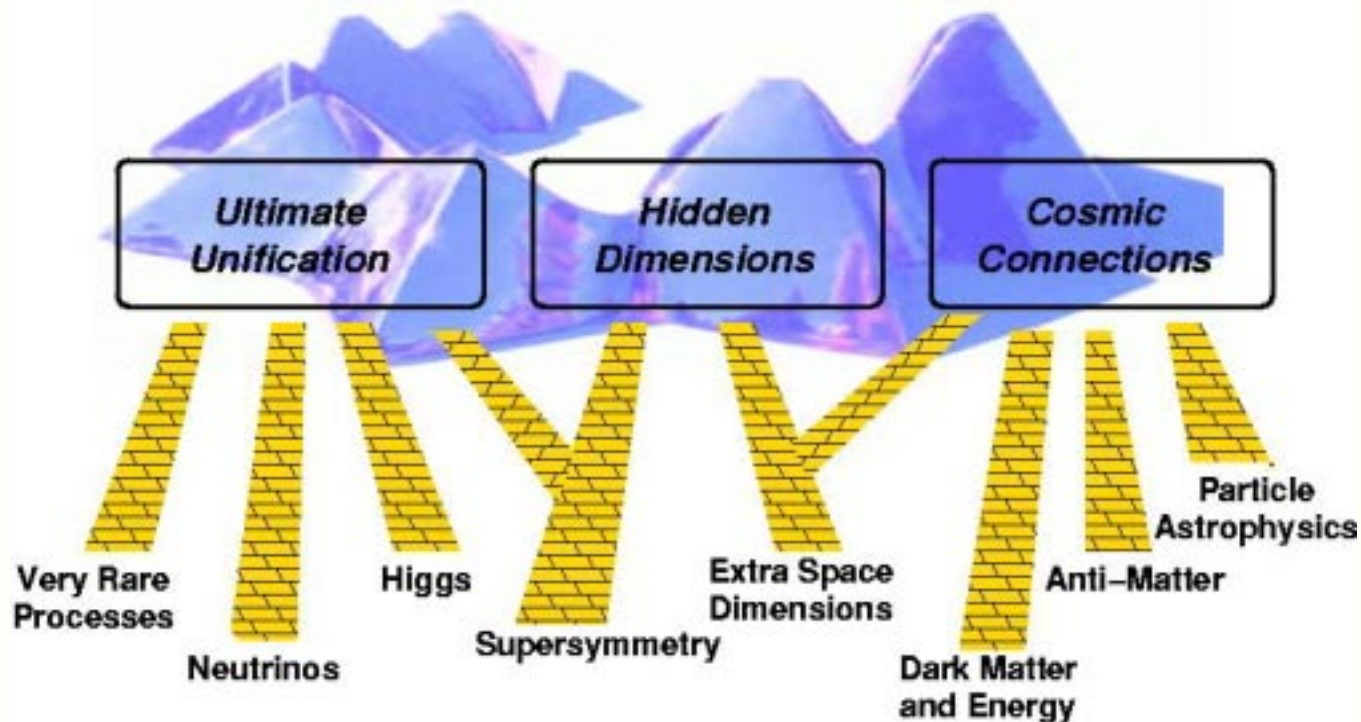
## The Mandate for C11:

“... the theory and experiment concerned with the nature and properties of the fundamental constituents of matter and the forces acting between these constituents”

***But, this definition is now too narrow. Particle physics has broadened its scope and is becoming more interdisciplinary !***

# The New Definition

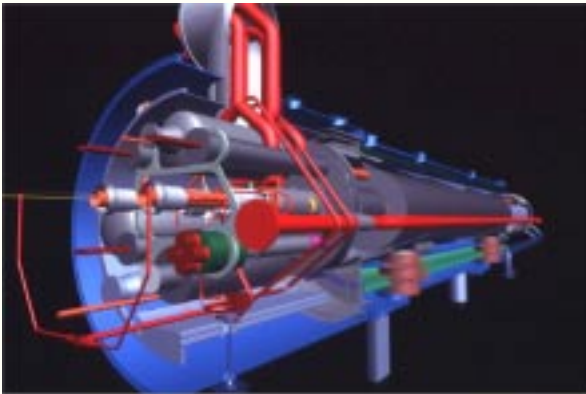
“The Science of Matter, Energy, Space and Time”



## The Paths and Goals of Particle Physics

# The Breadth of Particle Physics

- We have many tools at our disposal from **forefront accelerators** to **satellites in space** to **experiments deep underground**.



Accelerator  
LHC Magnet



Space



The Soudan Mine  
MINOS

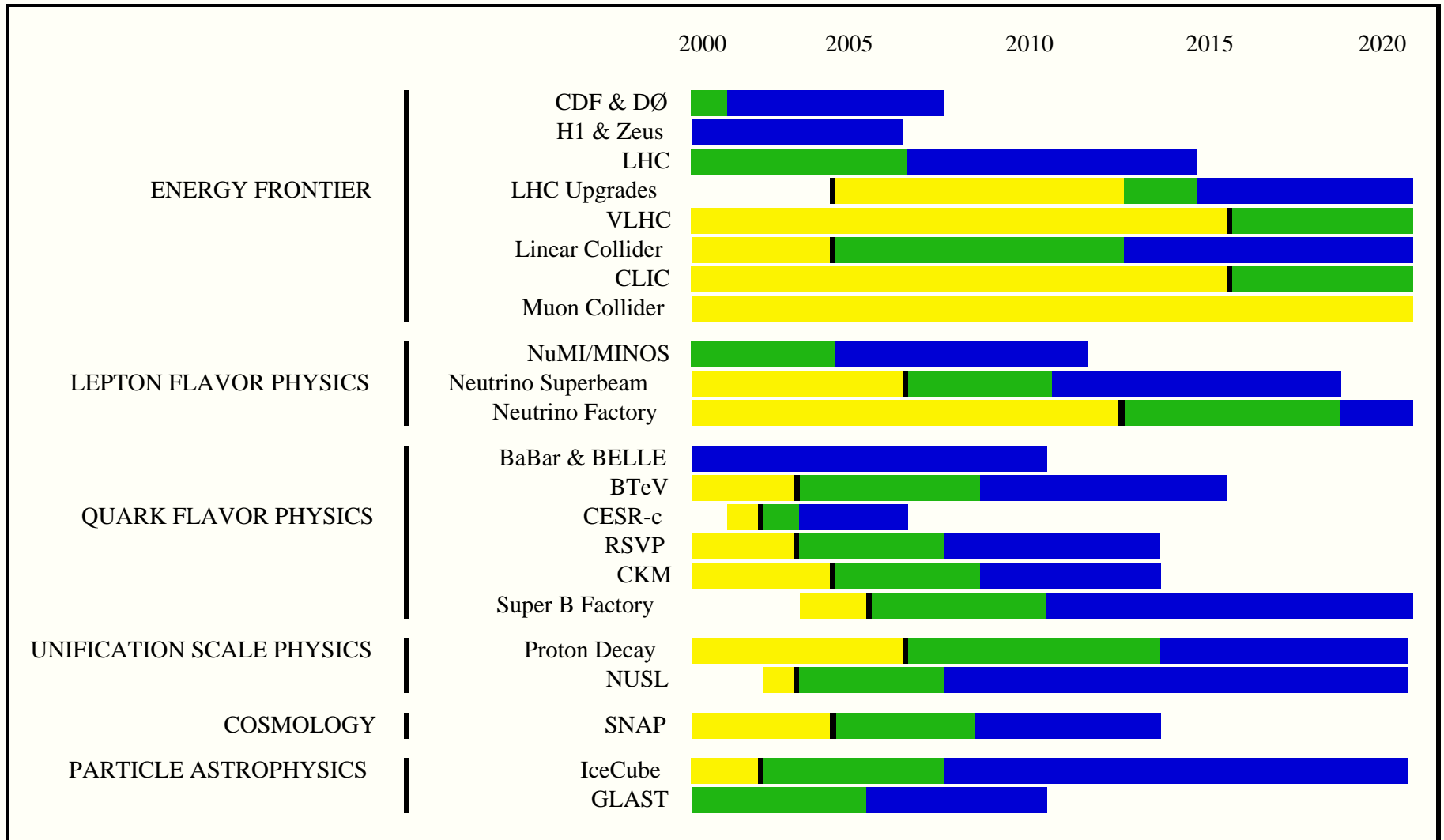
***The science requires forefront accelerators at the energy and luminosity frontiers. But, it also requires innovative experiments in space, underground, and away from accelerators.***

# Particle Physics Project Prioritization Panel (P5)

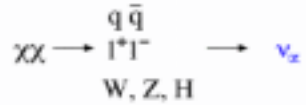
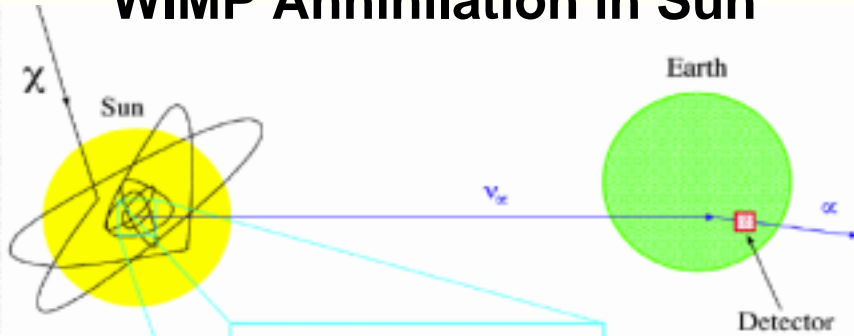
- Prioritization is central to carrying out a diverse, aggressive program of particle physics with limited resources
- P5 is being created to monitor, set priorities and make choices for midsized projects (~ \$50M to \$500M), whether on accelerators or in space.

***This was one of the primary recommendations from the recent long range plan for HEP. It is just being implemented.***

# The Particle Physics Roadmap



# WIMP Annihilation in Sun

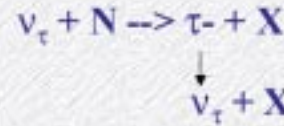


Sensitivity similar to Genius

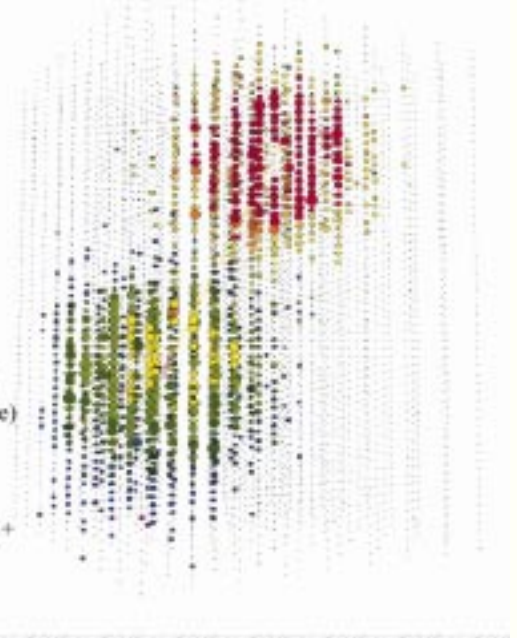
# Astrophysics and Particle Physics

*IceCube*

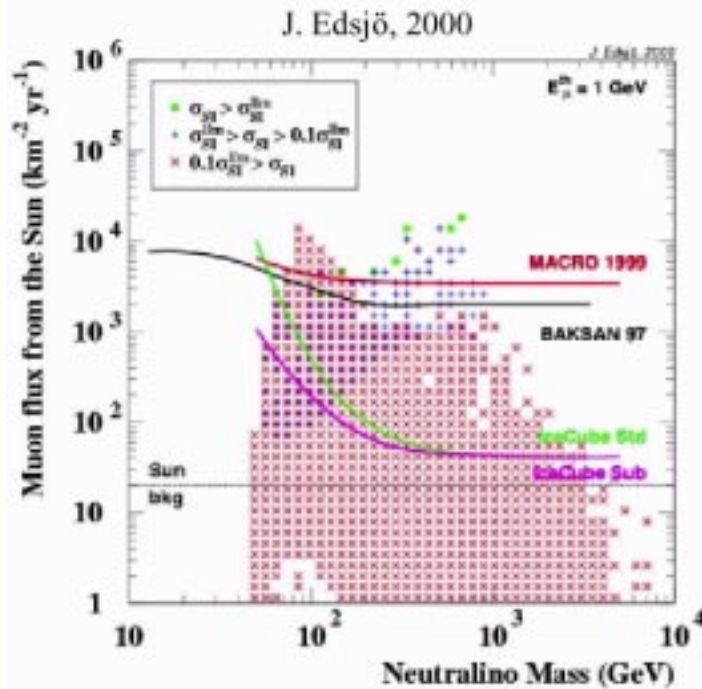
## Double Bang



- $E \ll 1$  PeV: Single cascade (2 cascades coincide)
- $E = 1$  PeV: Double bang
- $E \gg 1$  PeV: Second cascade + tau track

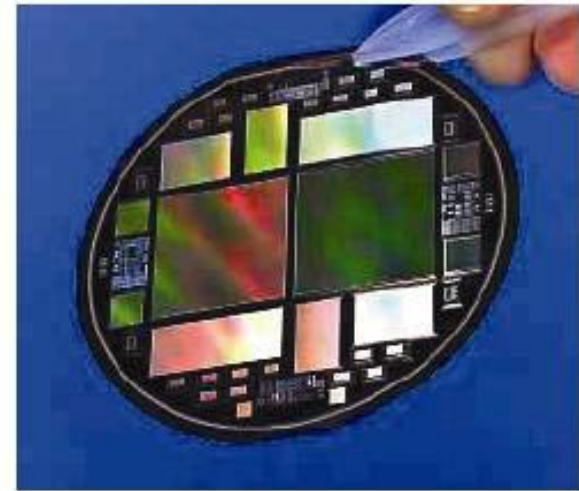
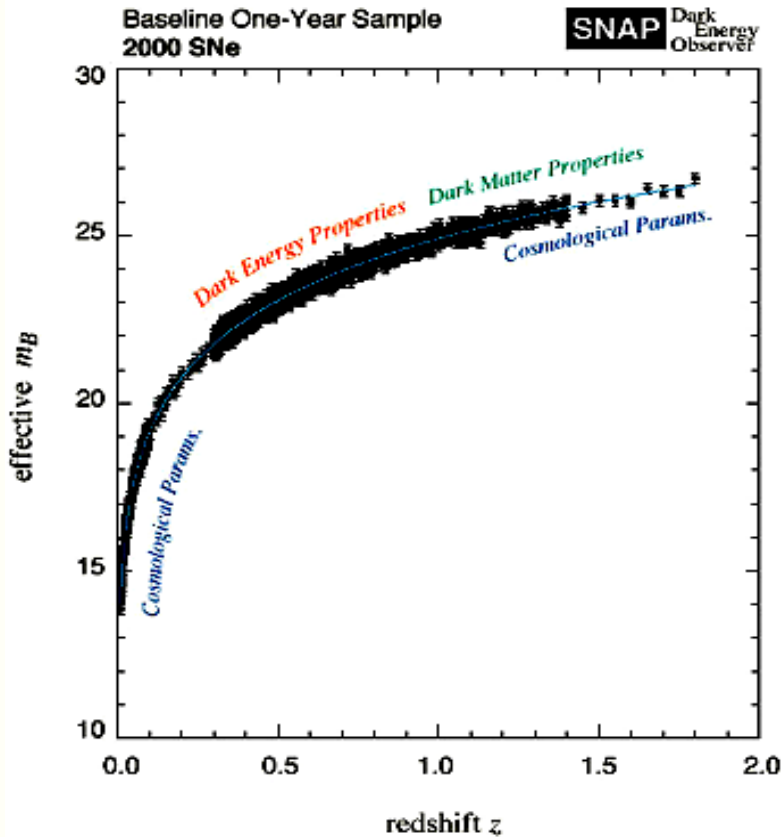
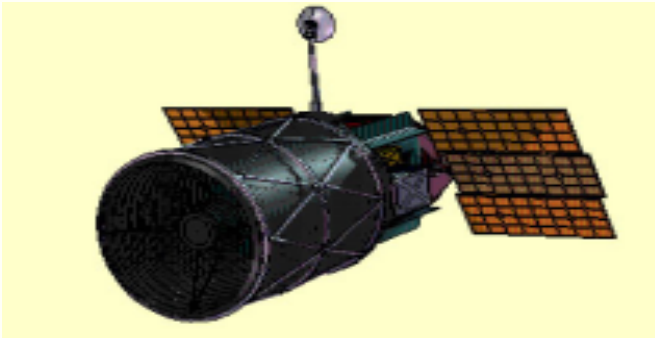


Characteristic signature for  $\nu_\tau$  interactions



# Cosmology and Particle Physics

## *Dark Energy*



The SNAP Dark Energy Detector. SNAP requires R&D to develop a detector with one billion CCD's.

# Conclusions

- **As the scope of HEP broadens, projects that involve major commitments of multiple agencies are becoming more common.**
  - **Need to develop consistent methods for setting priorities, reporting, monitoring, oversight, etc.**
- **HEP is a truly international field.**
  - **Major U.S. based projects typically involve significant international collaboration and resources. Major projects outside the U.S. typically have significant U.S.collaboration and resources.**
  - **Need to develop systems of planning, budgeting and reporting that will be satisfactory both our agencies and to our foreign partners.**