

# DOE – Office of Science Office of High Energy and Nuclear Physics

Joint DOE/NASA/NSF Meeting at DOE

HENP's response to the April 2002  
Recommendations of the National Research  
Council's Committee on Physics of the  
Universe (Professor Michael Turner, chair)

# Office of High Energy and Nuclear Physics

## Our Mission:

To understand the nature of matter at its most fundamental level and explore the evolution of the universe through the fundamental interactions of matter, energy, space & time.

# Office of High Energy and Nuclear Physics

We support about 90% of the U.S. basic research on fundamental particles and forces and nuclear matter.

We construct and operate major accelerator research facilities and support about 3,000 scientists and 1,000 graduate students from more than 130 universities and 10 national laboratories.

Where we do our experiments:

- Particle Accelerators

“Atom Smashers”  $\pm$  create particles and interactions

- The Universe

Detectors underground, on the ground, and in space to study fundamental particles and forces

# Division of High Energy Physics (John O'Fallon, Director)

## **Program Direction is provided by:**

The High Energy Physics Advisory Panel (HEPAP) & its subpanels are our community based advisory committees that provide official advice & recommendations on the direction of the field.

**It reports jointly to DOE & NSF!**

# Division of High Energy Physics

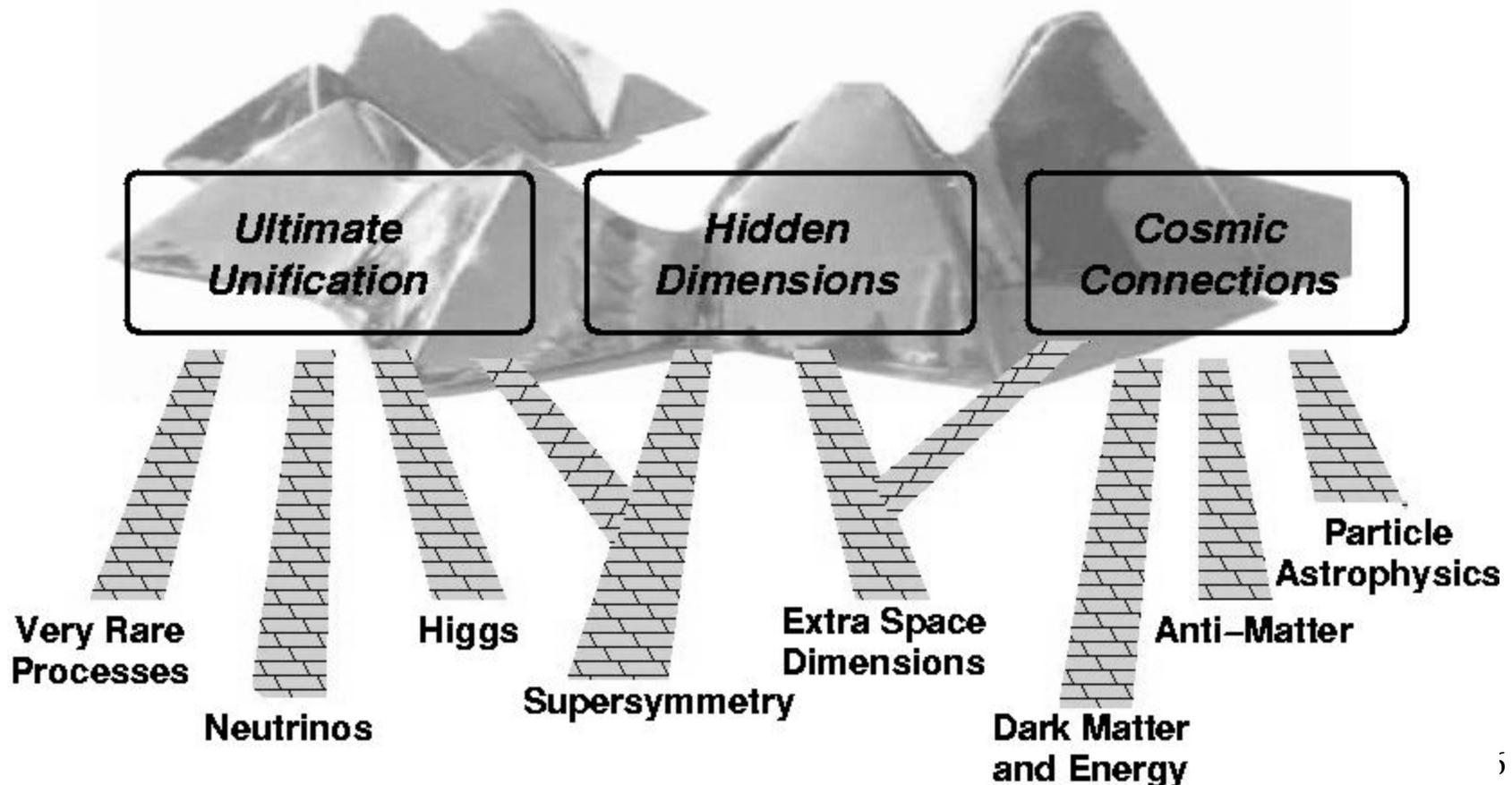
## HEPAP 2001 Long Range Planning Subpanel

### Program Goals:

- **Ultimate Unification:** understand how the disparate forces & particles of the universe merge into a single coherent picture
- **Hidden Dimensions:** seek new dimensions of space-time
- **Cosmic Connections:** seek the mysterious particles and forces that have created indelible imprints on our universe

# Division of High Energy Physics

HEPAP 2001 Long Range Planning Subpanel <sup>®</sup> Our Program Goals



# Division of High Energy Physics

**To achieve these goals, we study**

- **Lepton flavor physics,**
- **Quark flavor physics, and**
- **We Travel along the Energy Frontier**

**Our experiments all have NSF and/or Foreign partners:**

→ **CDF & DZero at the Fermilab Tevatron**

→ **BaBar at SLAC**

→ **ATLAS & CMS at LHC at CERN**

→ **NUMI/MINOS, MiniBOONE at Fermilab (with NP)**

→ **Formulation of science & technology for future  
Linear Collider (world community)**

**® For Future: Detector & Accelerator Research**

# Division of High Energy Physics

## To achieve goals, we also do:

- **Unification-Scale physics**
- **Cosmology & Particle Astrophysics**

- **Super-Kamiokande & K2K – proton decay & neutrinos (Japan)**
- **Sloan Digital Sky Survey (SDSS) (with NSF & Sloan Foundation)**
- **Supernova Cosmology Project (SCP) and Nearby Supernova Factory (using NSF and NASA telescopes + foreign)**
  
- **CDMS-II (with NSF), Pierre Auger (with NSF, foreign)**
- **Large Area Telescope for GLAST Mission (with NASA, foreign)**
  
- **VERITAS (with NSF, foreign)**
- **Supernova Acceleration Probe (SNAP) (with NASA?!)**

# Division of Nuclear Physics (Dennis Kovar, Director)

## **Program Direction is provided by:**

The Nuclear Science Advisory Committee (NSAC) is our community based advisory committee that provides official advice on the national program for basic nuclear science research.

**It reports jointly to DOE and NSF!**

# Division of Nuclear Physics

## NSAC 2002 Long Range Plan

### Program Goals:

- % What is the structure of the nucleon?
- % What are the properties of hot nuclear matter?
- % What is the structure of nucleonic matter?
- % What is the nuclear microphysics of the universe?
- % What is the new Standard Model?

# Division of Nuclear Physics

## To achieve these goals, we study

- Quark and gluon structure of the nucleon,
- Hot nuclear matter in relativistic heavy ion collisions,
- Nuclei at the limits of isospin and angular momentum,
- Nuclear reactions important for nucleosynthesis,
- Fundamental symmetry properties of neutron and neutrino

## Our experiments all have NSF and/or Foreign partners:

- JLAB and MIT/Bates experiments
- BRAHMS, PHENIX, PHOBOS, STAR at RHIC at BNL  
(with NSF, RIKEN-Japan)
- Experiments with ATLAS, HRIBF, 88" Cyclotron accelerators
- Cold/Ultracold neutrons at LANSCE & SNS
- SNO, KamLAND, MiniBOONE at Fermilab
- R&D for Rare Isotope Accelerator, JLAB Upgrade

# Turner Panel Recommendations

Panel made 7 recommendations & contains:

- Recommendations for New Initiatives
- Support for projects identified by Astronomy Decadal Survey on the basis of their ability to address the 11 questions posed by the Panel
- Interagency initiative for joint planning/funding

# Turner Panel Recommendations

## 1. Understanding the Birth of the Universe

- ★ **Measuring the polarization of the CMB to detect the gravity-wave signature of inflation**

**(Panel recommends: New DOE/NASA/NSF Initiative)**

### DOE-HENP Involvement:

We are providing support for small group of scientists at universities and labs doing simulations, software algorithms, theoretical studies, hardware R&D and participating in CMB experimental collaborations:

MAXIPOL(NASA,DOE,NSF)

Planck Surveyor (NASA,ESA)

PolarBear(DOE,NSF)

# Turner Panel Recommendations

## 2. Understanding the Destiny of the Universe

- ★ **Large Synoptic Survey Telescope (LSST) – has promise for shedding light on dark energy (Support of Decadal Survey)**
- ★ **Construct a wide field telescope in space to use supernovae to fully probe the expansion history & the nature of the dark energy (New DOE/NASA Initiative)**

### DOE-HENP Involvement:

(using NASA, NSF, foreign telescopes + partial funding)

#### Ⓜ **Supernova Cosmology Project (SCP) at LBNL**

– continue using ground-based & Hubble space telescope

#### → **Nearby Supernova Factory (SNFactory) at LBNL**

– started recently for ground-based local supernova measurements

#### Ⓜ **SNAP (partner w/NASA!)**

– at LBNL, doing R&D now

# Turner Panel Recommendations

- ## **3. Explore Unification of Forces from Underground**
- ★ **New generation of experiments for neutrinos, dark matter, & proton lifetime (New DOE/NSF Initiative)**
  - ★ **Recommend that an underground lab w/sufficient depth and infrastructure should be built to house the experiments**

### **Dark Matter:**

- **CDMS-II in Minnesota (with NSF) – dark matter**
- **SDSS – dark matter (with NSF, Sloan Foundation)**

### **Neutrinos/proton lifetime:**

- **SuperK, K2K, KamLAND (Japan) – (HEP, NP & NSF)**
- **MiniBoone (Fermilab) – (HEP, NP & NSF)**
- **SNO (Canada) – (NP)**
- **NUMI/MINOS (Fermilab/Minnesota)**
- **scientific studies for future experiments:**

**JHFnu, Superbeams, UNO or HyperK, Solar Neutrinos**

# Turner Panel Recommendations

- ## **4. Explore Basic Laws of Physics from Space**
- ★ **Support for Constellation-X (Con-X) to probe event horizon of black holes (Support of Decadal Survey)**
  - ★ **Support for Laser Interferometer Space Antenna (LISA) to detect gravity waves from colliding massive black holes (Support of Decadal Survey)**

# Turner Panel Recommendations

## **5. Understanding Nature's Highest Energy Particles**

**☆ Support for current program in measurements of high energy gamma rays, cosmic rays & neutrinos – ensure completion & operation of Southern Auger array**

**→ GLAST/LAT – (with NASA, foreign)**

**→ Pierre Auger (southern) – (with NSF, foreign)**

**→ VERITAS – (with NSF, foreign)**

**→ possible future: Pierre Auger (northern)**

# Turner Panel Recommendations

## **6. Physics Under Extreme Conditions in the Lab**

- ★ **Devise & perform experiments in high energy-density physics to discern the physics that can be scaled up to understand extreme astronomical sources – agencies should work to bring different scientific communities together**

→ **BRAHMS, PHOBOS, PHENIX, STAR experiments at Relativistic Heavy Ion Collider (RHIC) at BNL (with NSF, RIKEN-Japan, Foreign)**

→ **RHIC upgrade**

→ **Rare Isotope Accelerator**

# Turner Panel Recommendations

## **7. Interagency Initiative on the Physics of the Universe**

- ★ **Joint planning & implementation of cross-agency projects to realize the scientific opportunities at the intersection of physics and astronomy (Interagency Initiative)**

**Current scientific partnerships are going well.**

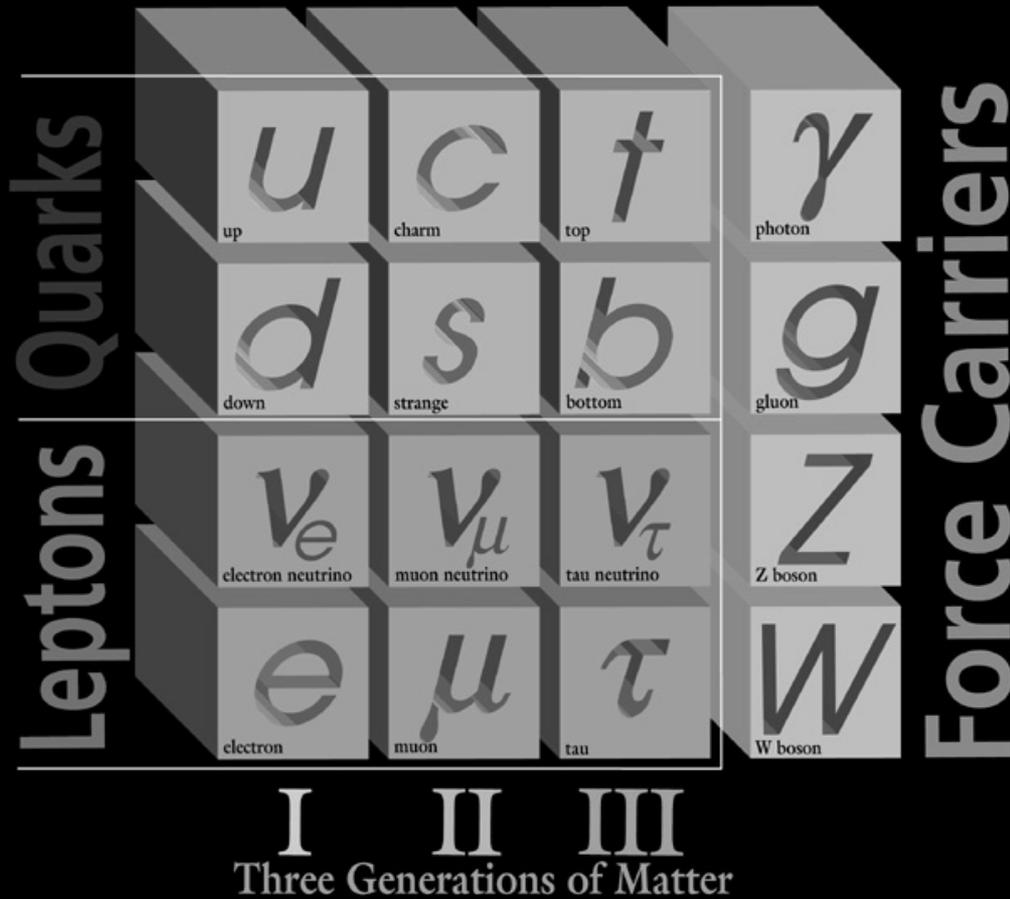
**We are stronger because of our current partnerships.**

**We are excited about future possibilities!**

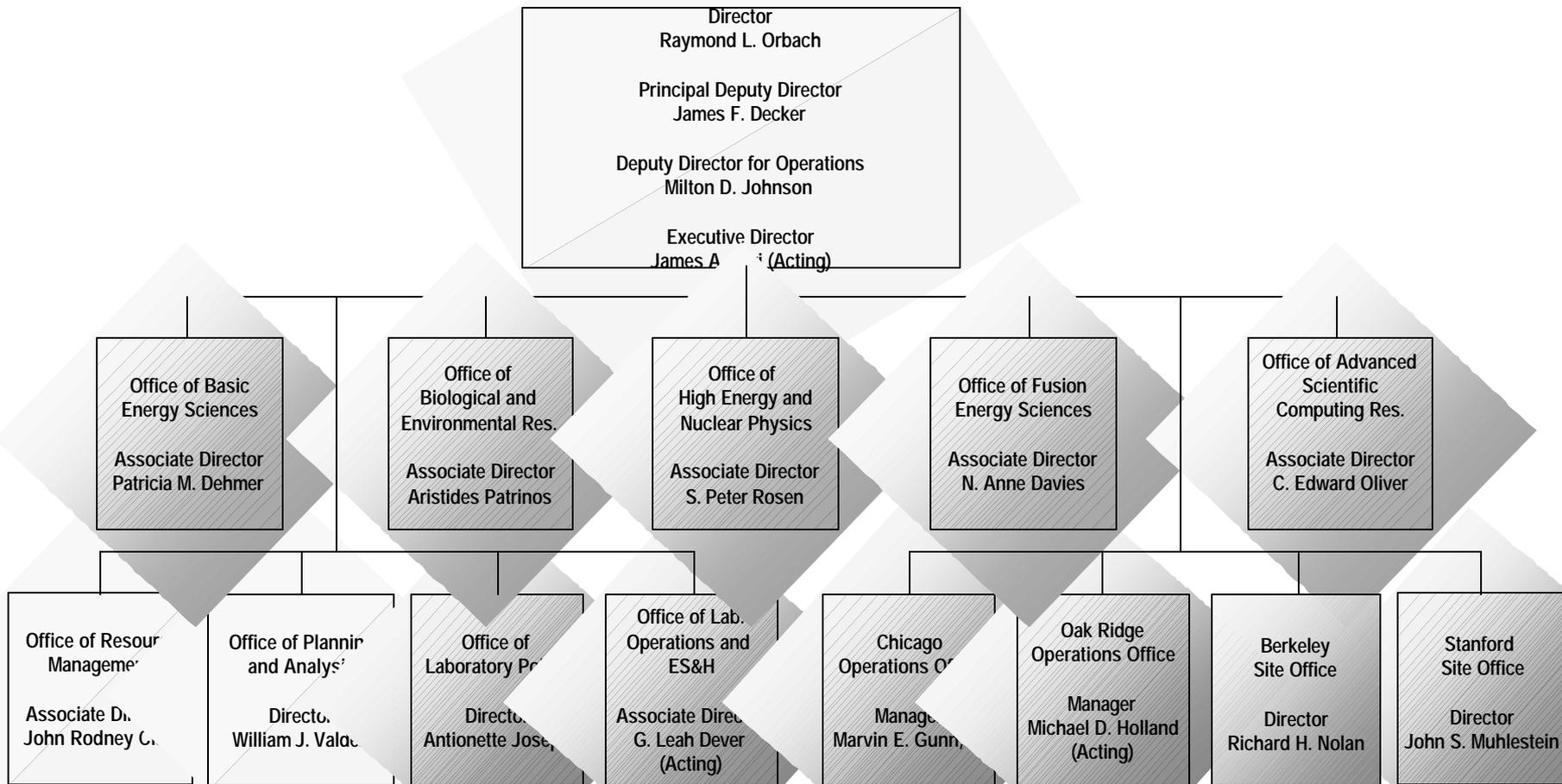
**We will work at all levels to continue to seek partnerships.**

# Backup/Extra Slides

# ELEMENTARY PARTICLES



# Office of Science



NOTE: Director of Science equivalent to Assistant Secretary position and filled by Presidential Appointment (Senate confirmed); Principal Deputy Director equivalent to Principal Deputy Assistant Secretary; Associate Directors equivalent to Deputy Assistant Secretaries.

Approved: \_\_\_\_\_  
Raymond L. Orbach  
Director  
Office of Science