US National Laboratories and Fermilab

Young-Kee Kim

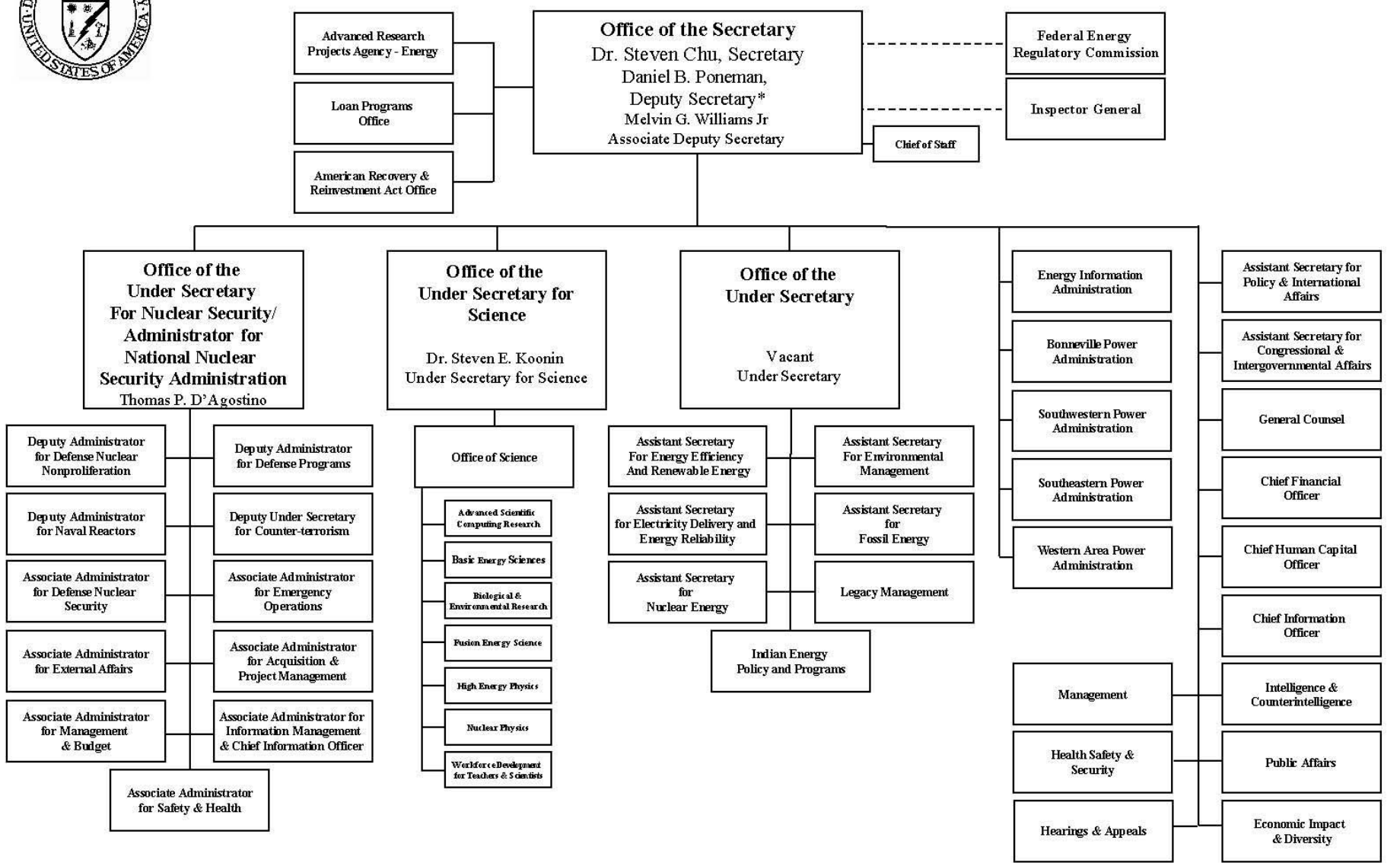
May 19, 2011

U.S. National Laboratories

Most of National Laboratories for Science and Technology are under the Department of Energy (DOE).

DEPARTMENT OF ENERGY

DOE Annual budget ~$30B



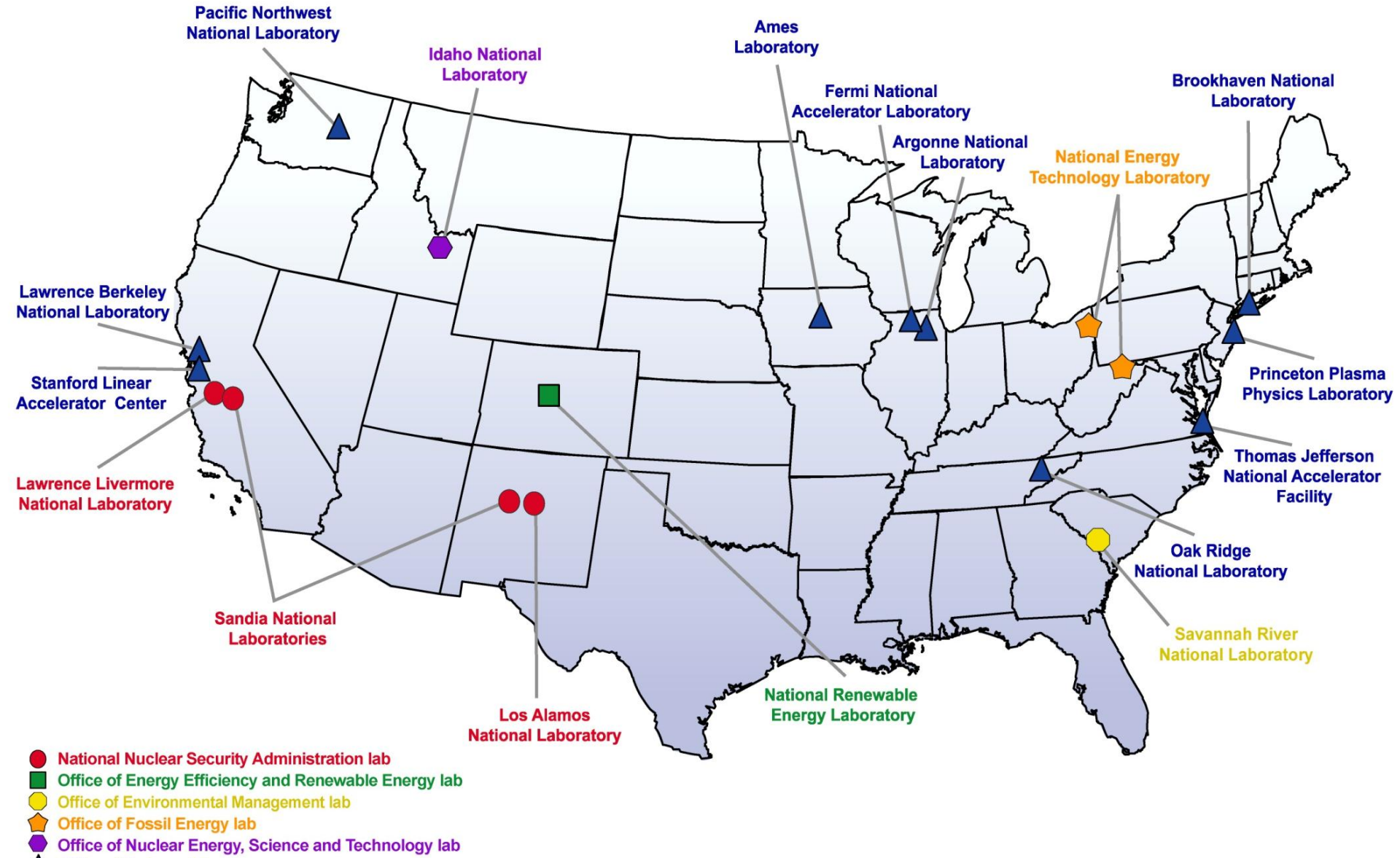
* The Deputy Secretary also serves as the Chief Operating Officer

3 May 2011

DOE: National Laboratories

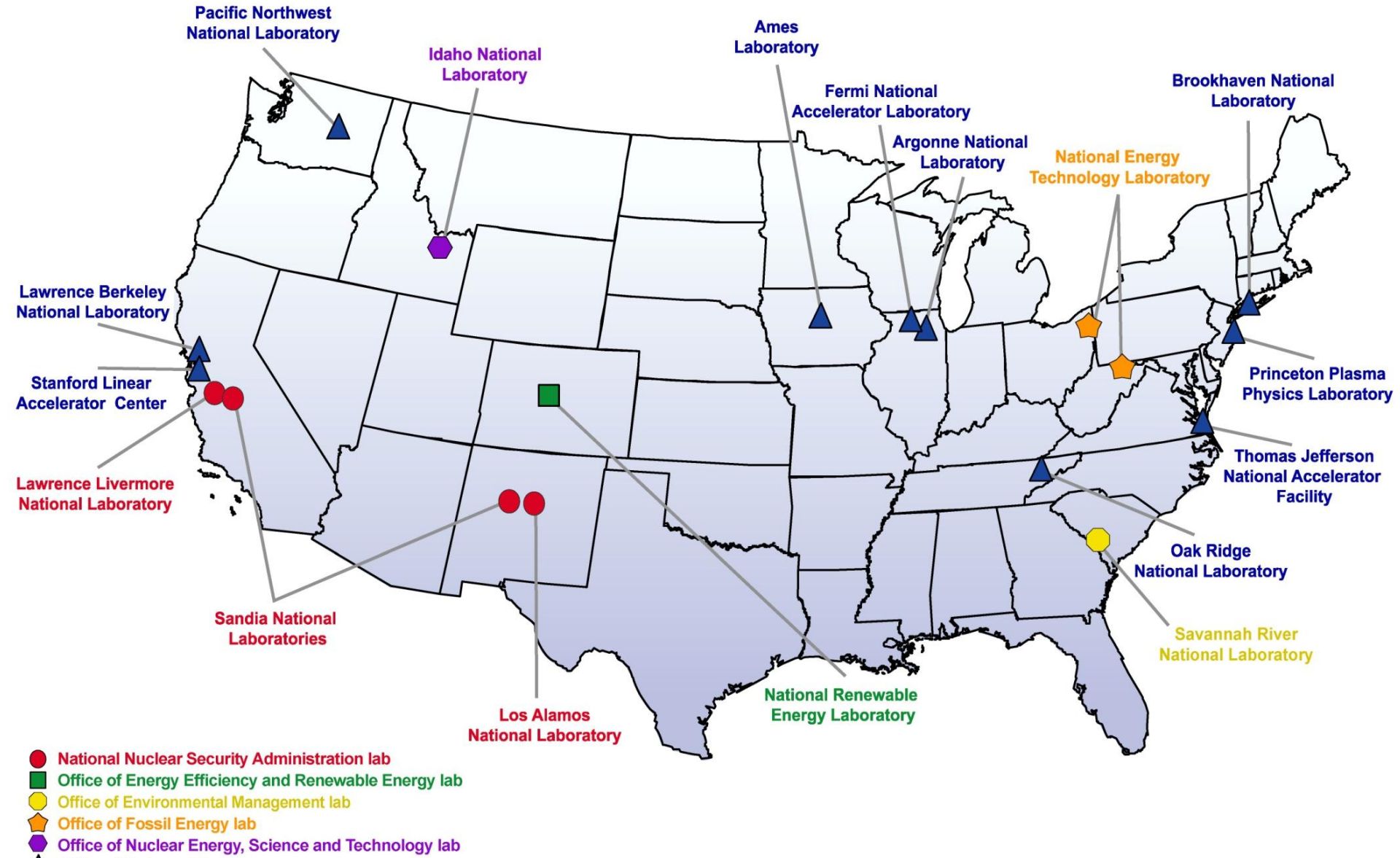
- Together, the 17 DOE laboratories comprise a preeminent federal research system, providing the Nation with strategic scientific and technological capabilities. The laboratories:
  - Execute long-term government scientific and technological missions, often with complex security, safety, project management, or other operational challenges;
  - Develop unique, often multidisciplinary, scientific capabilities beyond the scope of academic and industrial institutions, to benefit the Nation's researchers and national strategic priorities; and
  - Develop and sustain critical scientific and technical capabilities to which the government requires assured access.

Department of Energy: National Laboratories



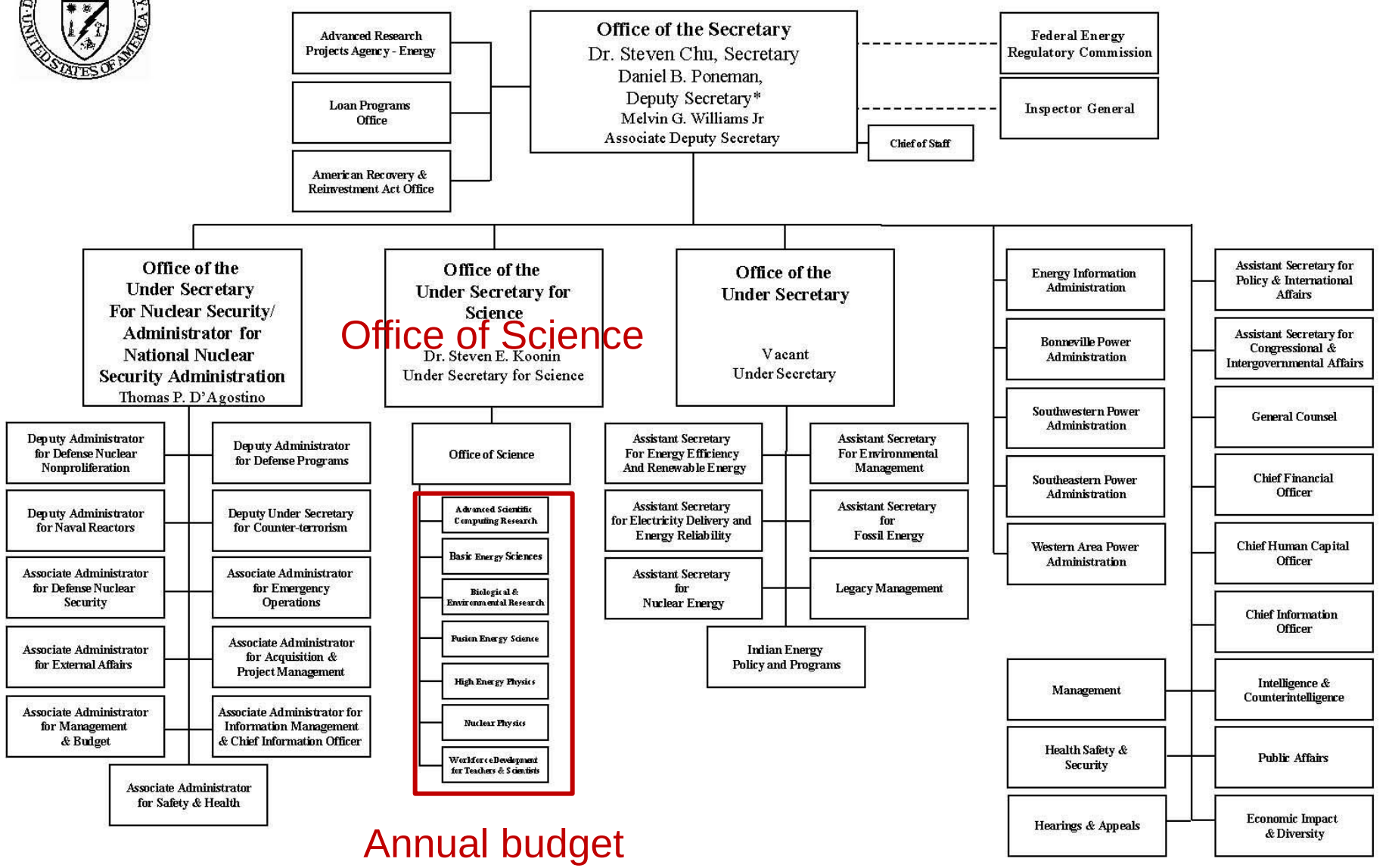
Department of Energy: National Laboratories

Office of Science Laboratories ▲



DEPARTMENT OF ENERGY

DOE Annual budget ~$30B



Office of Science

Annual budget ~$4.8B

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3 May 2011

DOE: Office of Science

- Total annual budget ~$4.8B funds
  - High Energy Physics (particle physics)
  - Nuclear Physics
  - Fusion
  - Materials and Chemical Sciences
  - Computational Sciences
  - Biological and Environmental Research
  - 10 national laboratories
  - Universities

DOE: Office of Science

- User facilities at 10 national laboratories provide researchers with the most advanced tools of modern science including
  - Accelerators
    - Colliders
    - Neutrino beams
    - Light sources
    - Neutron sources
  - Facilities for studying the nanoworld, the environment, and the atmosphere
- In 2010, over 26,000 researchers from academia, industry, and government laboratories, utilized these unique facilities to perform new science

Office of Science Labs: Characteristics

Laboratory	History	Characteristics	Area (acres)	Accelerators
Ames	1947	Single-program	10	
ANL	1947	Multi-program	1,500	X
BNL	1947	Multi-program	5,320	X
FNAL	1967	Single-program	6,800	X
LBNL	1931	Multi-program	202	X
ORNL	1943	Multi-program	4,470	X
PNNL	1965	Multi-program	350	
PPPL	1951	Single-program	89	
SLAC	1962	Multi-program	426	X
TJNAF	1995	Single-program	169	X

GOCO: Government owned / contractor operated

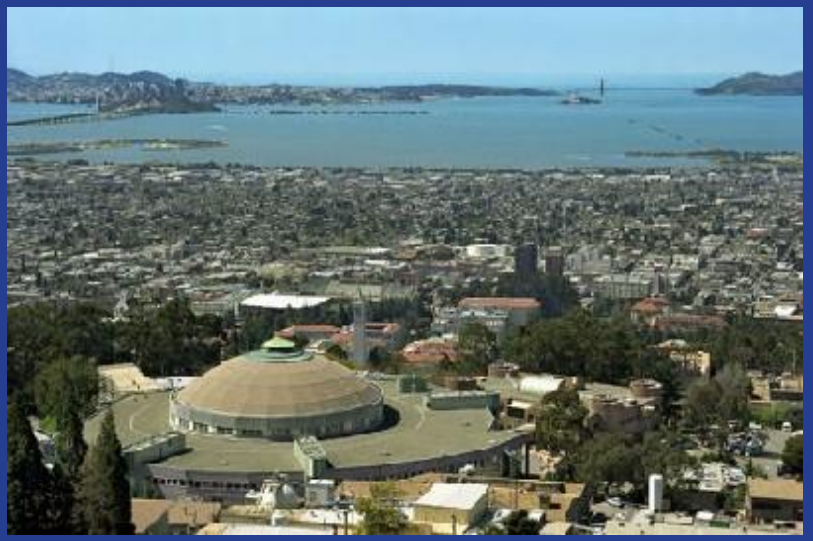
- Originated during the Manhattan Project
- National laboratories designated as Federally Funded Research and Development Centers (FFRDCs)
  - Owned by the U.S. government
  - Managed and operated by contractors (typically industrial, academic,, or nonprofit organizations)
- GOCO model established to enable contractors:
  - To recruit the nation's best scientists and engineers
  - To apply private-sector personnel and research management practices
- Management and operation (M&O) contracts set terms of partnership

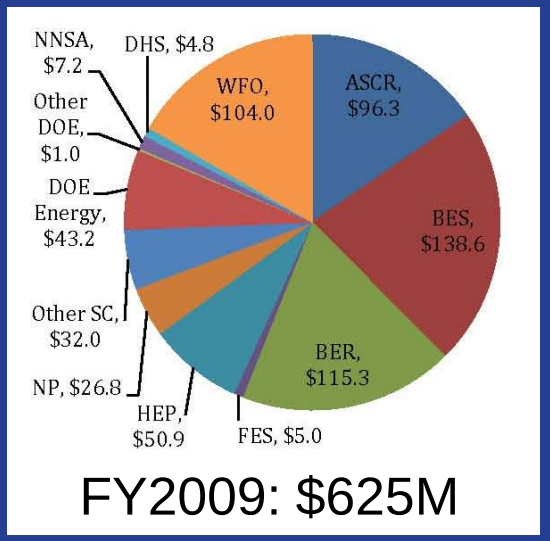
Office of Science Labs and Contractors

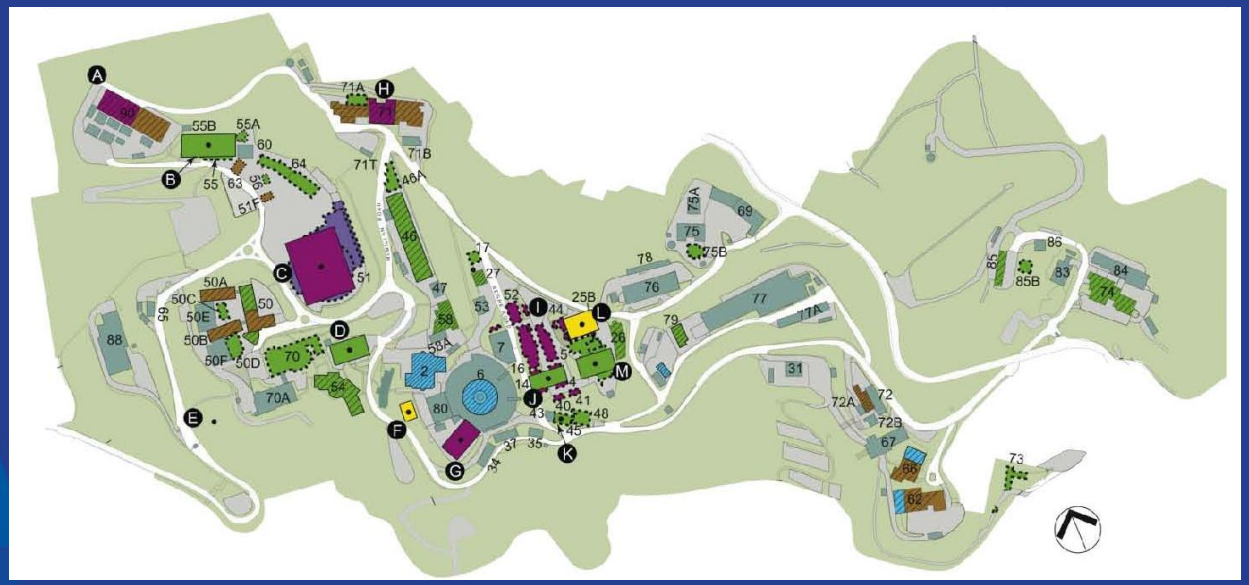
Laboratory	M&O Contractor
Ames	Iowa State University
ANL	University of Chicago
BNL	SUNY – Battelle
FNAL	U. of Chicago – URA(Universities Research Association)
LBNL	University of California
ORNL	University of Tennessee – Battelle
PNNL	Battelle
PPPL	Princeton University
SLAC	Stanford University
TJNAF	SURA (Southeastern Universities Research Association) – CSC (Technology Company)

Lawrence Berkeley National Laboratory

Multi-program laboratory







Fermilab

UT-Battelle has managed ORNL since 2000

The University of Tennessee

- An ORNL partner since 1946
- State-funded Science Alliance started in 1982, to build programs with ORNL
- Shared research and joint appointments
- Joint institutes in advanced materials, biological sciences, computational sciences, neutron sciences, nuclear physics

UT-BATTELLE

Battelle Memorial Institute

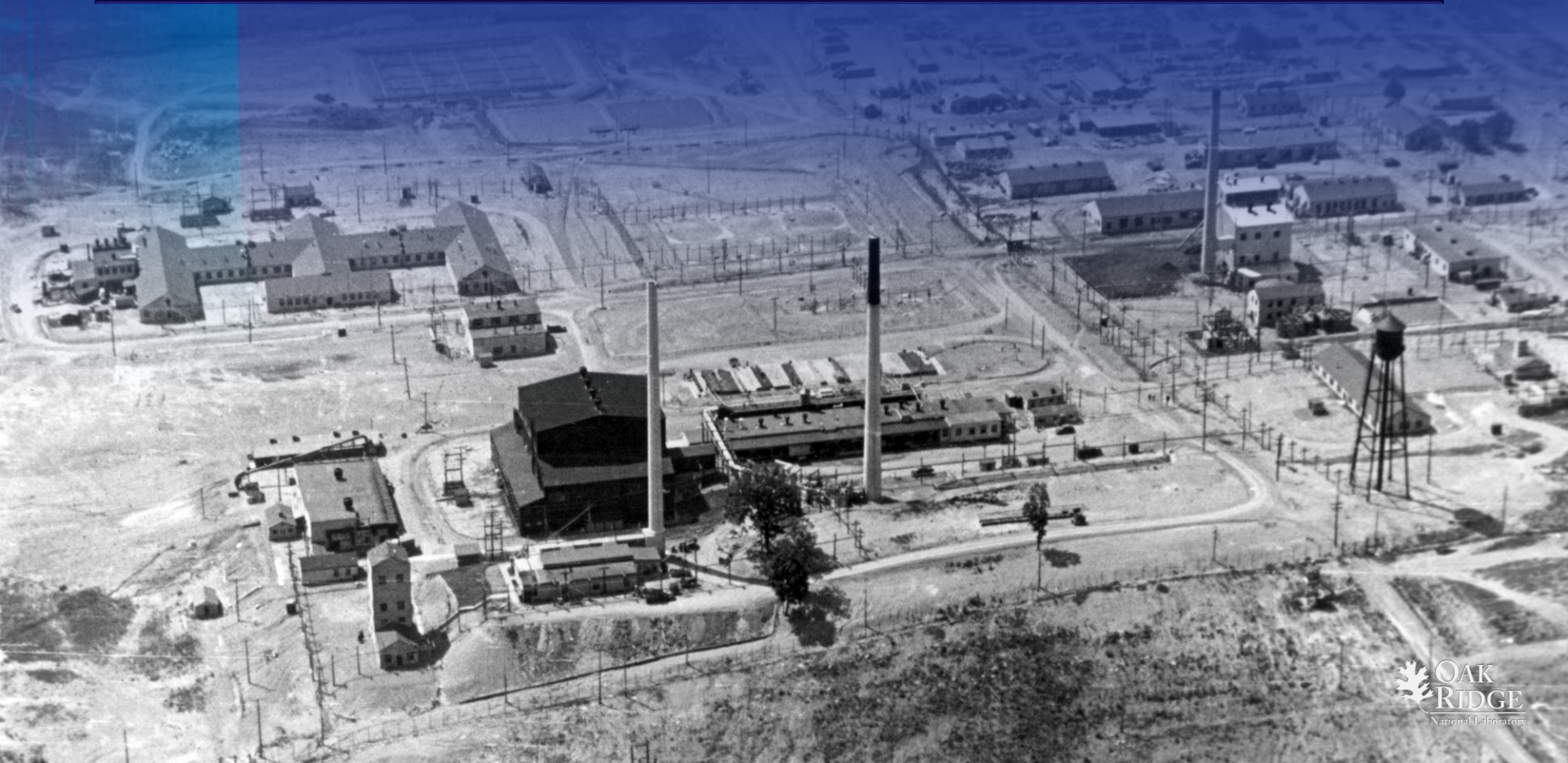
- A 65-year relationship with DOE
- Develops and deploys technology worldwide
- Manages or co-manages 6 DOE national laboratories: ORNL (with UT), Brookhaven (with SUNY-Stony Brook), Idaho, Lawrence Livermore (with UC and Bechtel), NREL (with MRI), Pacific Northwest

OAK RIDGE National Laboratory
Fermilab

Oak Ridge National Laboratory evolved from the Manhattan Project

ORNL in 1943

The Clinton Pile was the world's first continuously operated nuclear reactor



ORNL is DOE's largest science and energy laboratory

Multi-program laboratory

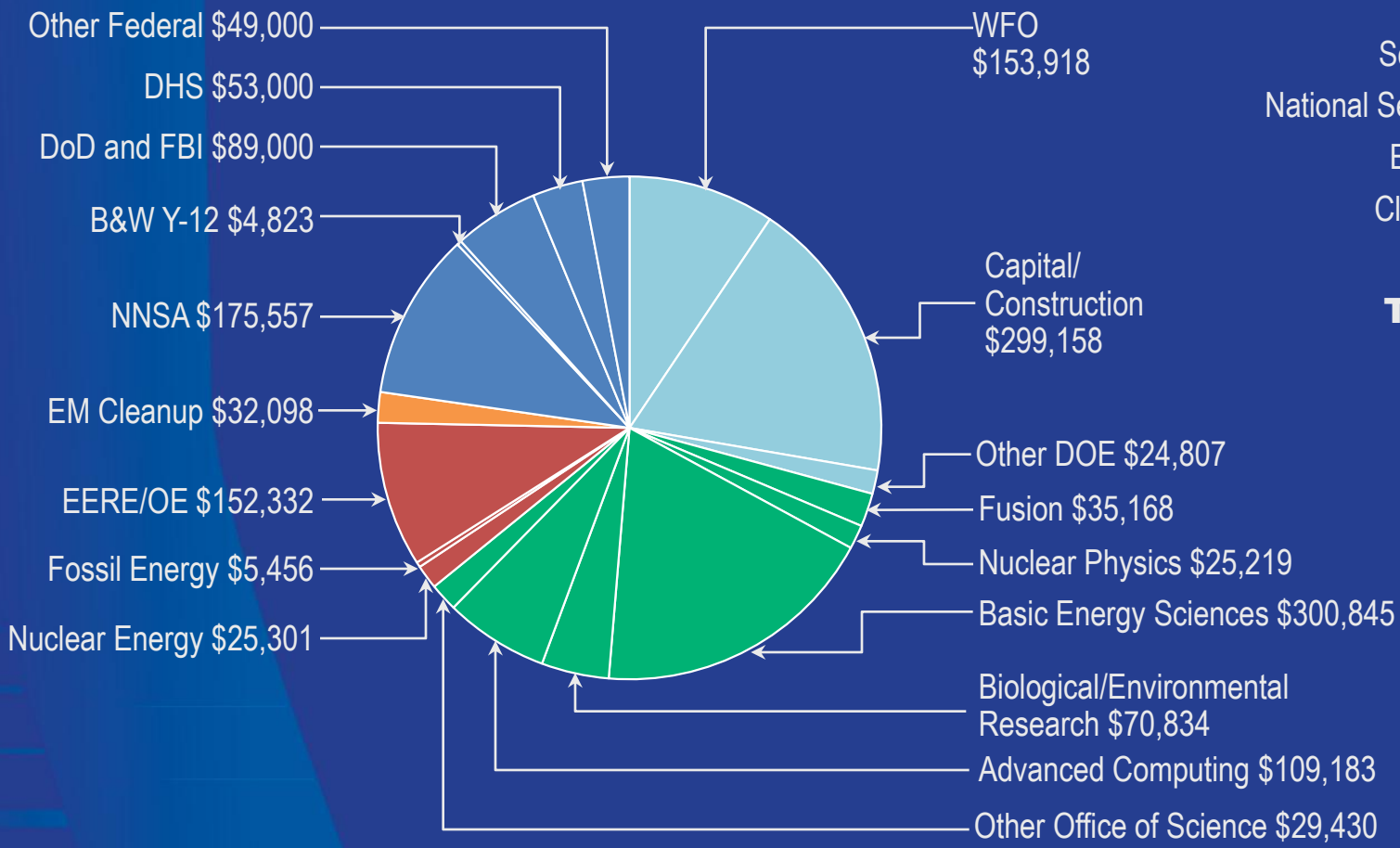
- $1.65B budget
- 4,500 employees
- 4,000 research guests annually
- $500 million invested in modernization

- Nation's largest concentration of open source materials research
- World's most intense pulsed neutron source and a world-class research reactor

- World's most powerful open scientific computing facility
- Nation's most diverse energy portfolio
- Managing the billion-dollar U.S. ITER project

OAK RIDGE National Laboratory

ORNL business volume (FY10 projected, $k)



Science	$571M
National Security	$371M
Energy	$201M
Cleanup	$32M
Other	$478M
Total	**$1.65B**

(includes ~$170M of ARRA funding)

OAK RIDGE National Laboratory
Fermilab

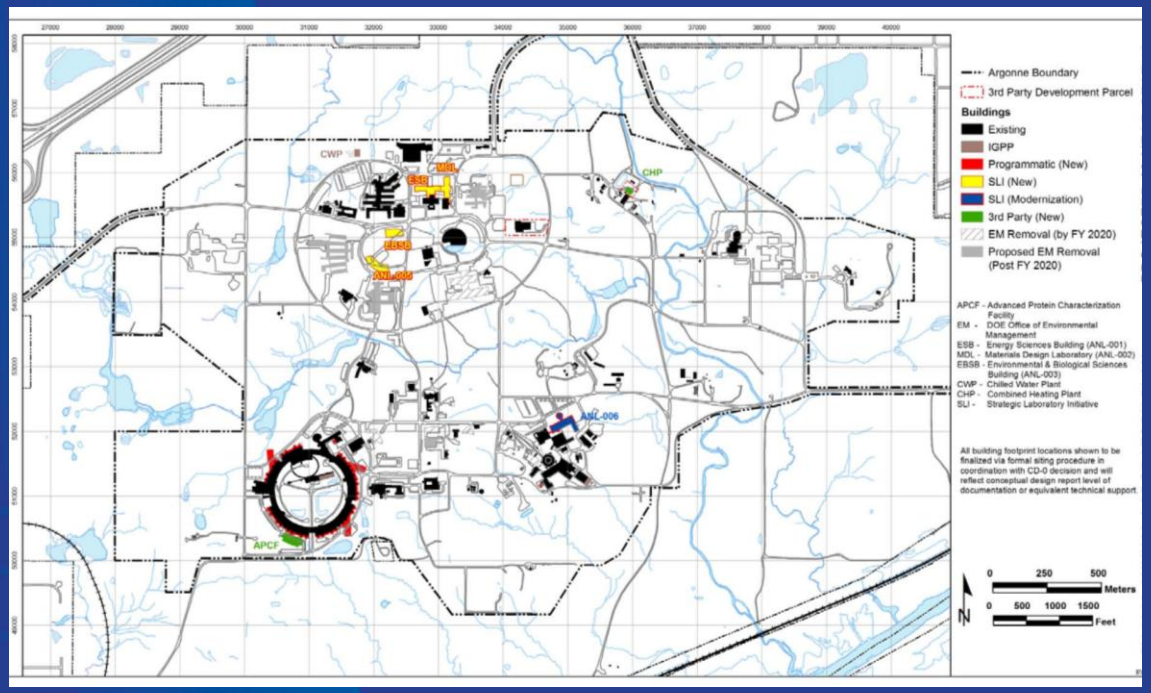
Argonne and Fermilab Connection

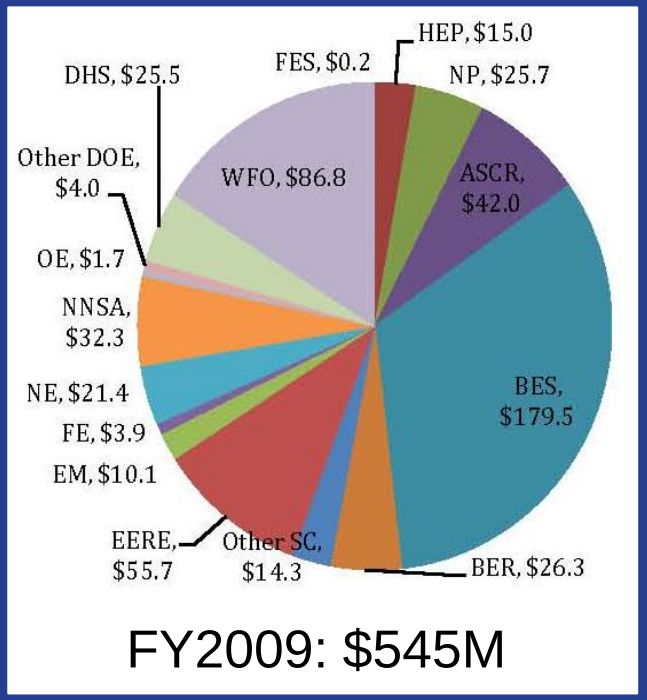
University of Chicago manages Argonne National Laboratory
University of Chicago + URA manages Fermi National Accelerator Lab.

UChicago Strategic Collaborative Initiatives Programs
Research collaboration
Joint appointments
Joint lecture / discussion series: S&T – Humanity
……

Argonne National Laboratory

Multi-program laboratory





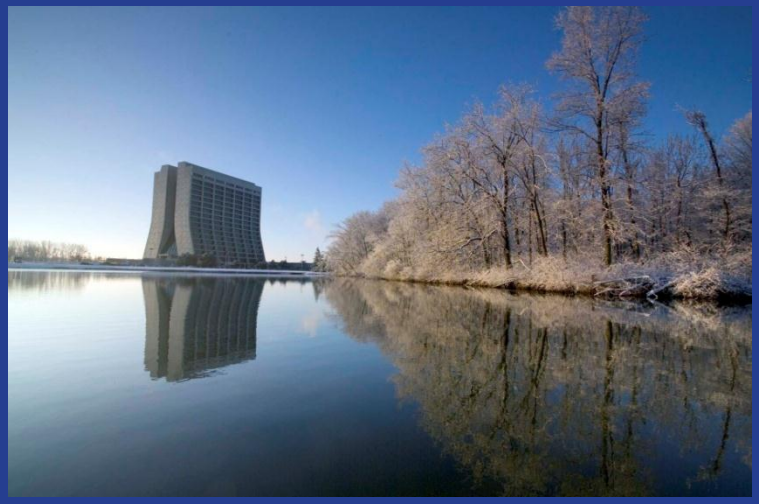
Fermilab

Fermi National Accelerator Laboratory

Particle Physics Lab

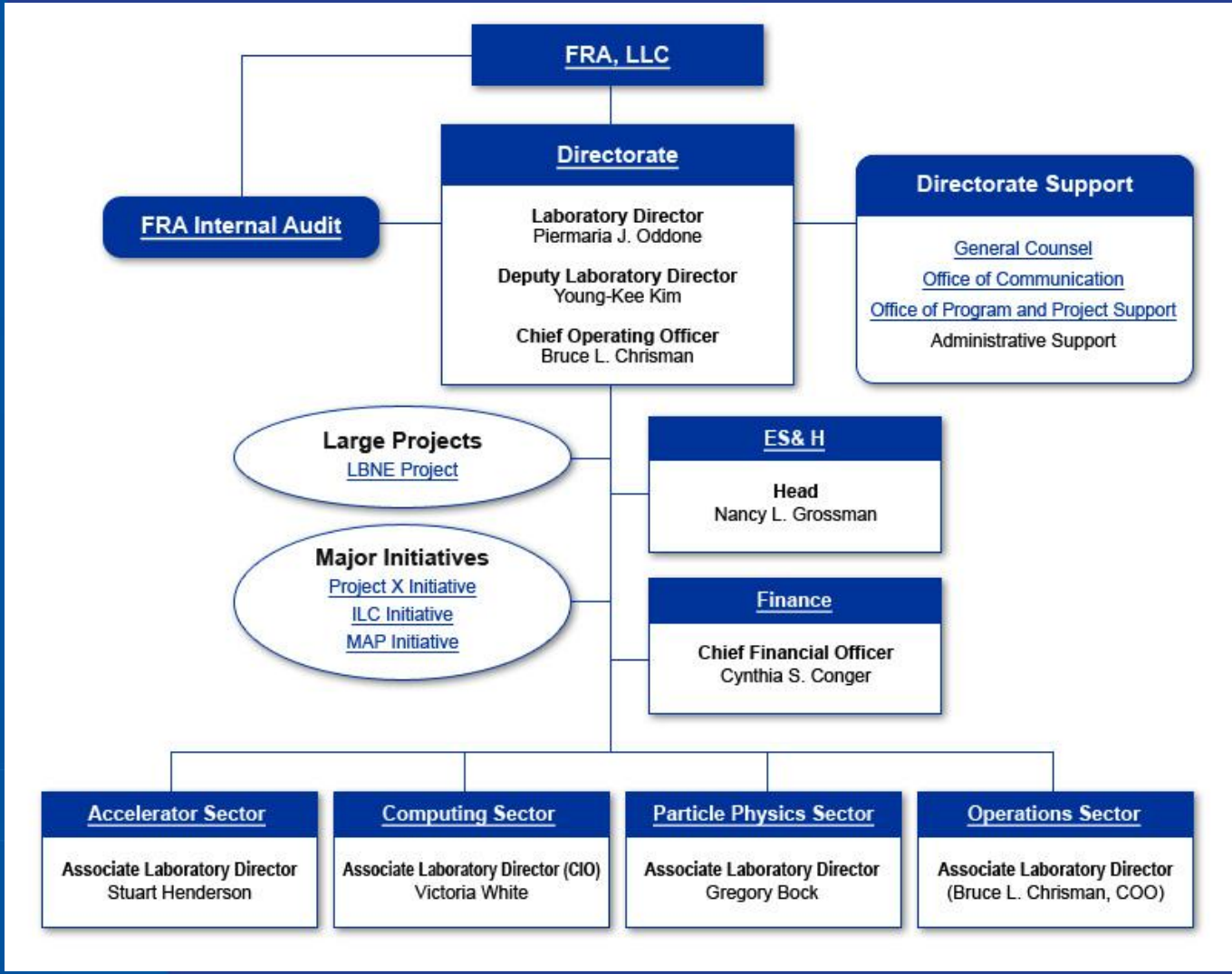
DOE's largest single-program lab

- 1950 employees; $400 M
- 2300 users
  - ~130 Ph.D.s / year
- 6800 acres, park-like site



- Tevatron: 2 TeV proton – antiproton collider
- Highest intensity neutrino beams (low and high energy)
- World class particle astro projects, particle and particle astro theory, computation programs
- Advanced detector, accelerator, computer technology

Fermilab Organization



U.Chicago - URA has managed FNAL since 2007

Fermi Research Alliance (FRA)

Robert Zimmer, President

Steve Beering, Executive Chairman, URA Board of Trustees

Robert Zimmer, Chair
Steve Beering, Vice-Chair
Pier Oddone, President

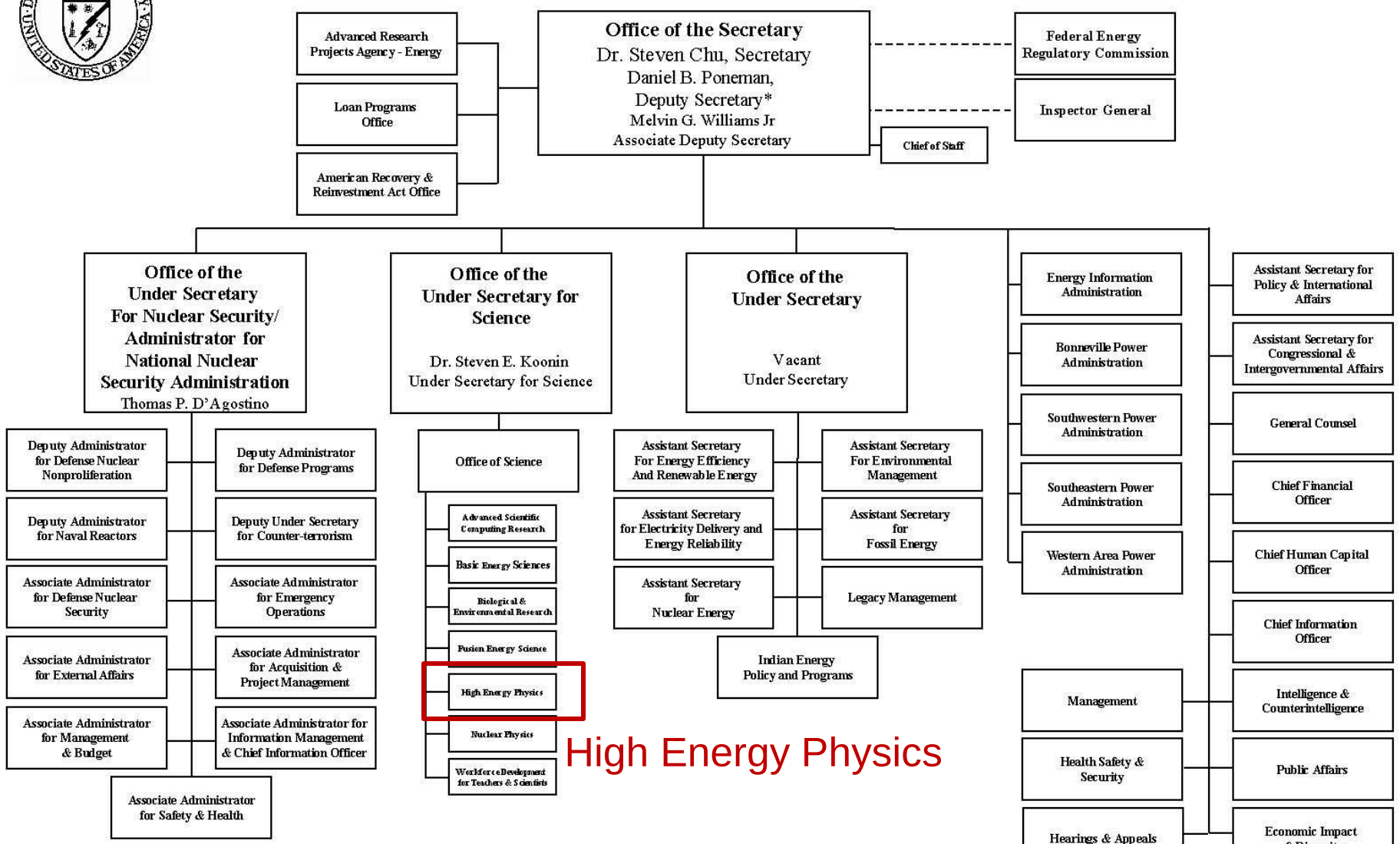
FRA: A Board of Directors

- URA's Broad Membership base
  - 90 US universities engaged in guiding the future of FNAL.
- The University of Chicago Representatives
  - leadership, scientific resources, reachback, and expanded collaborations with ANL.
- Illinois University Representatives
  - strengthens local and state support, and intellectual reachback through joint appointment.
- Industry
  - best practices to deliver the most science per dollar
- The National Laboratory Community
  - benchmarking and collaboration within the National Laboratory System.
- International Representatives
  - connection for performing research within the new international paradigm for particle physics.

FRA

- A Board of Directors:
  - Board meetings: 3 per year
  - Visiting committee meetings: 1 for physics, 1 for admin
- FRA initiatives
  - UChicago Strategic Collaborative Initiatives Programs
  - URA Visiting Scholars Programs
  - Support various conferences / workshops
  - Share joint research programs
  - Share joint faculty appointments
  - ….

DEPARTMENT OF ENERGY



High Energy Physics

- Particle Physics
- Accelerator Research & Development

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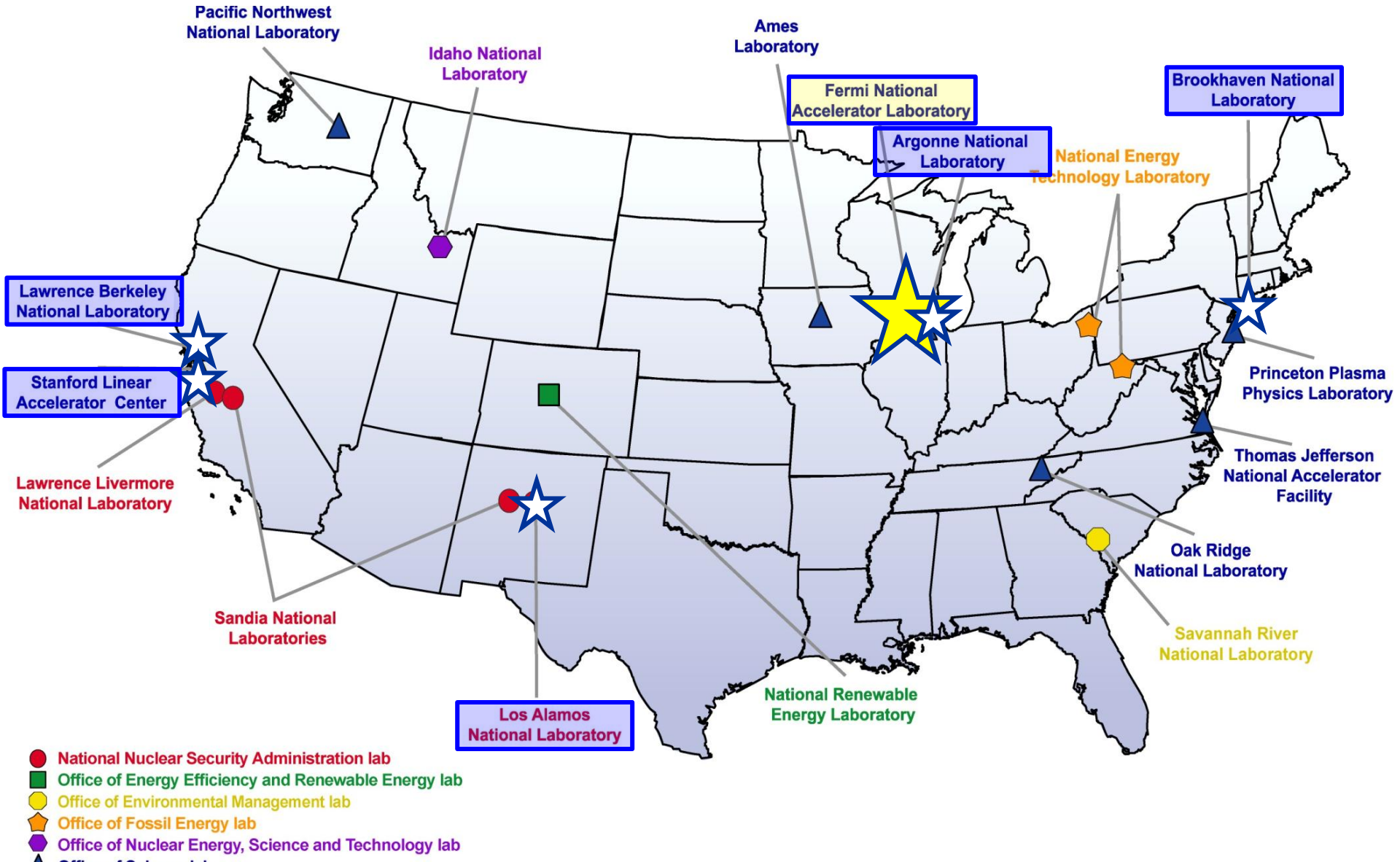
Department of Energy: National Laboratories

Labs Involved in Particle Physics



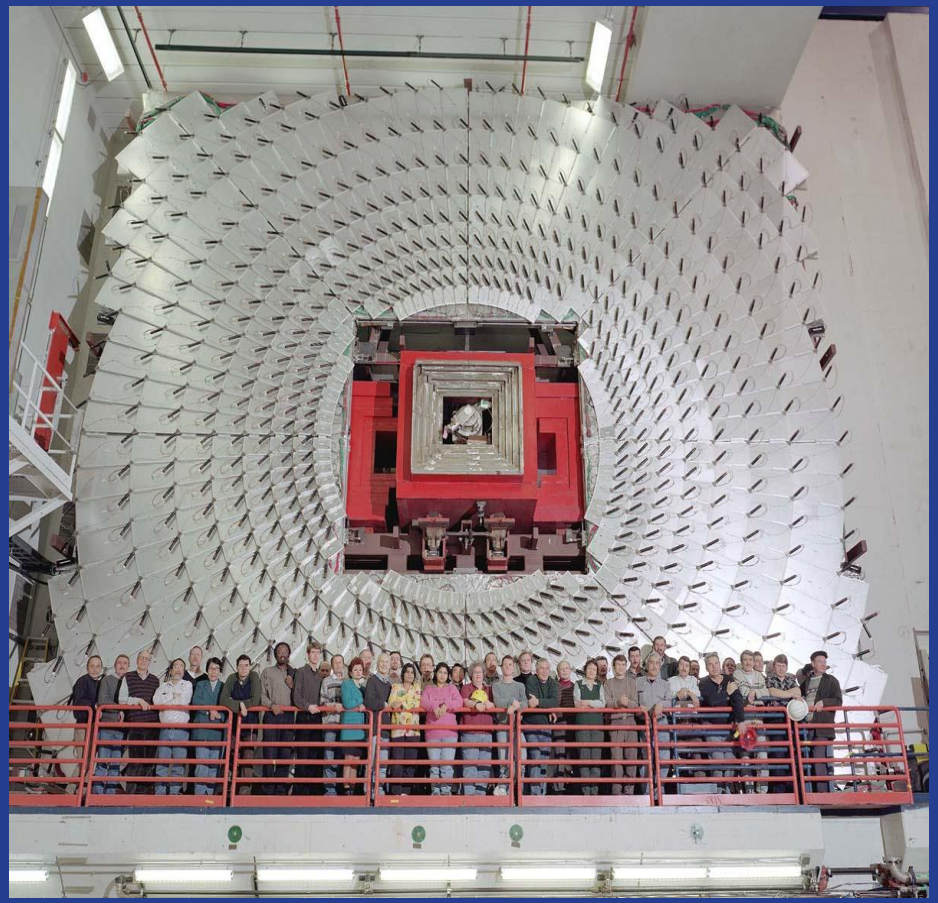
DOE Office of High Energy Physics

- ~$800M total
  - 50%: ~$400M to Fermilab
  - 25%: ~$200M to other national laboratories
  - 25%: ~$200M to universities

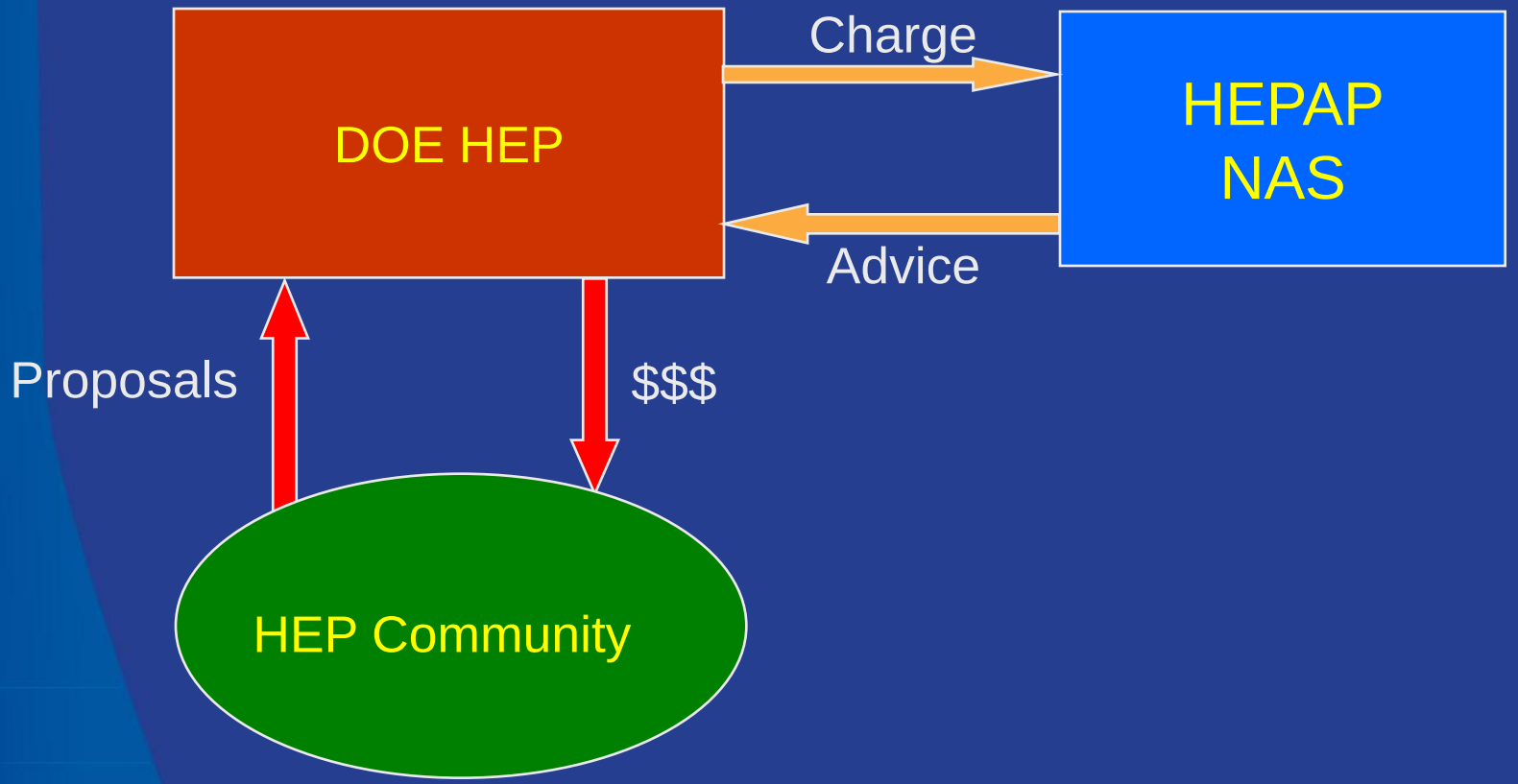
Note: NSF ~$50M for Particle Physics

Fermilab Mission: the national particle physics lab

- Enable the US community to tackle the most fundamental physics questions of our era
- Interdependence: integrate the universities and other laboratories fully into national and international programs



Strategic Planning for Particle Physics

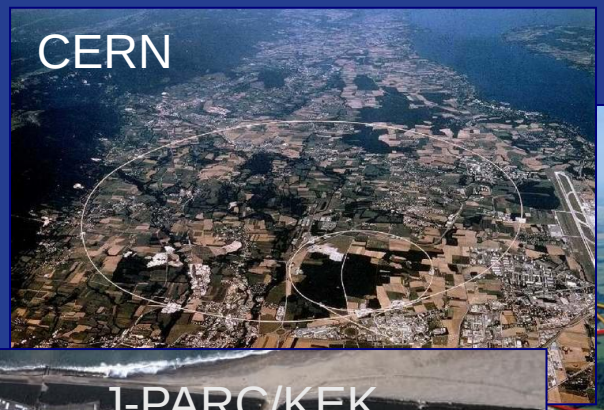


Fermilab Strategic Plan

Many generations of particle accelerators:
each generation built on the accomplishments of the previous ones
raising the level of technology ever higher

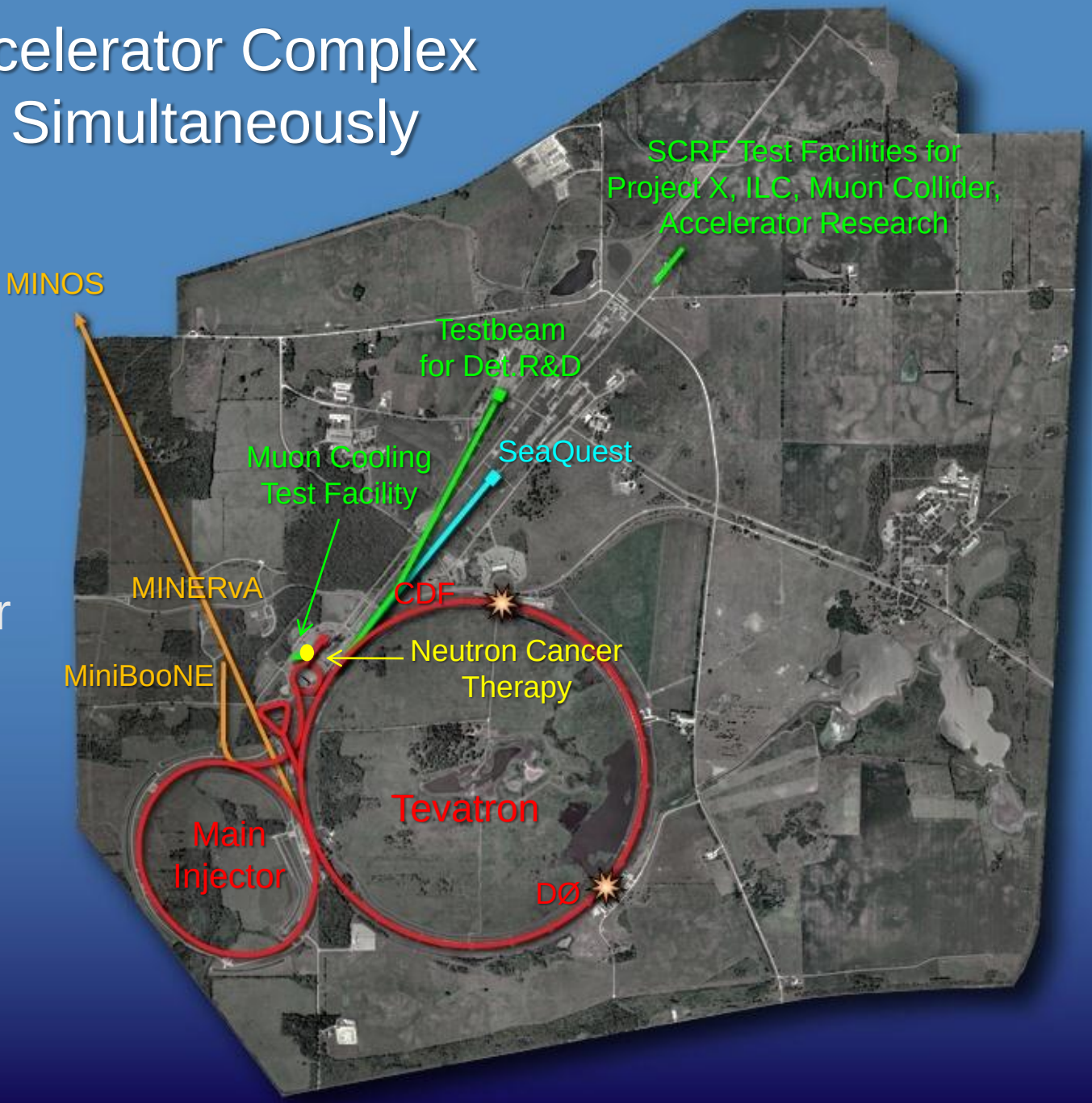
Accelerator physics as science

high energy physics
(particle physics)

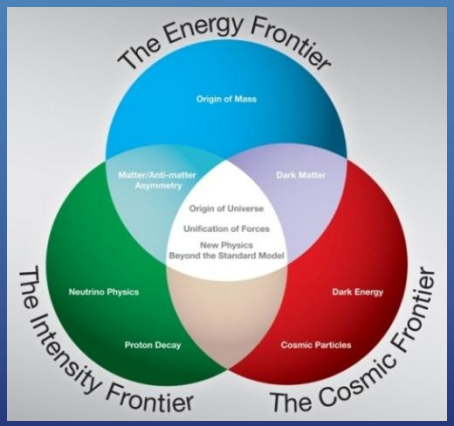


- Historically many applications in society through development of accelerator, detector and computational technology, and construction of facilities

Fermilab Accelerator Complex Operating Simultaneously



Energy Frontier
Intensity Frontier

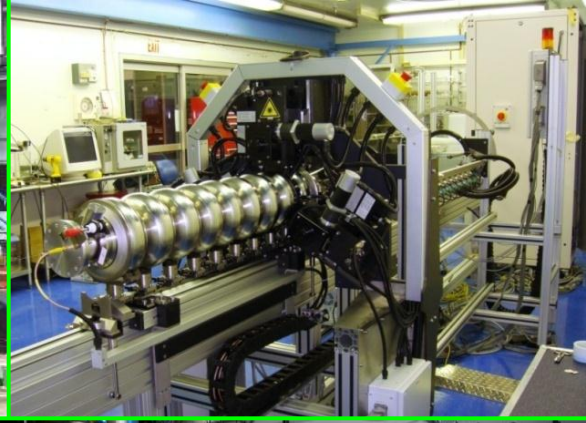


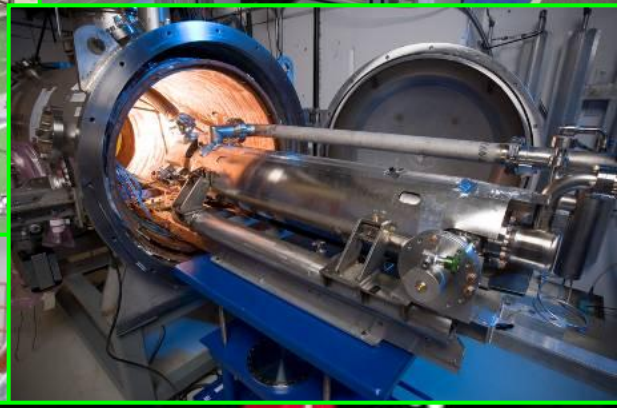
Fermilab

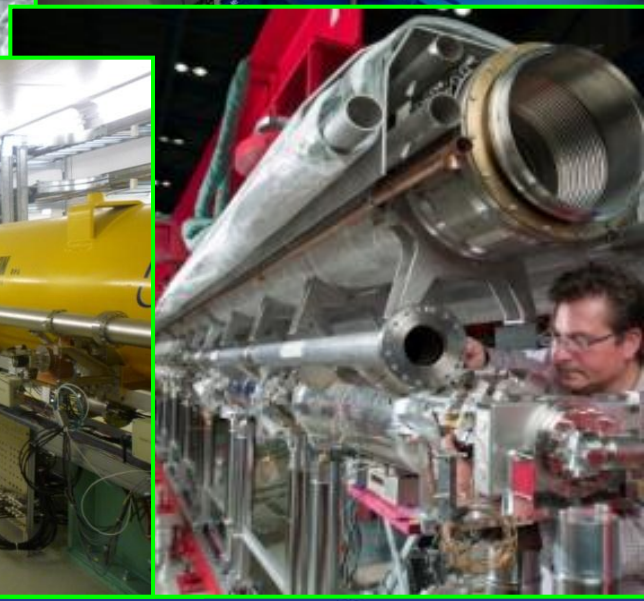
Super conducting RF technology:

Future projects: ILC, Project X, Muon Collider

Accelerator Research / Science







IARC (Illinois Accelerator Research Center)

Fermilab

Design chosen
Construction: 2011-2012

- Elements: Office, Education and Technical building, High Bay Space (existing CDF building), Additional parking lots
- Close proximity to the industrial area of the lab.

- Accelerator: Research (S&T), education, partnerships with industry

Current Experimental Programs at Fermilab
(Collaborative Efforts)

Energy Frontier: 27 countries

Intensity Frontier:
17 countries

Cosmic Frontier:
24 countries

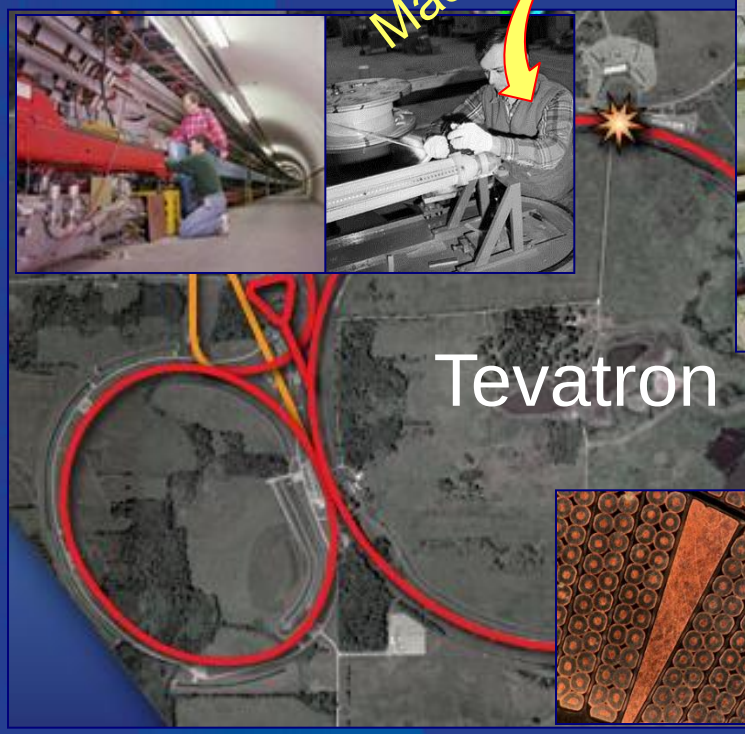

Detector
Computing
Large International Collaboration
(unite people from different countries and different cultures)
Invention of WWW !!

Education (K-12, undergrads, public) at Fermilab

http://www.fnal.gov/pub/education/k-12_programs.html

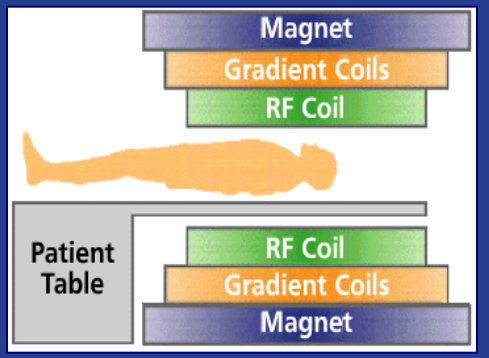
- NSF, DOE, Fermilab Friends, Fee-based cost recovery
- CY2009: 45,390 teachers, students, general public
  - Regular teacher workshop: 98
  - Summer interns: 55
  - Summer teachers: 22
  - Students field trip: 8,693
  - Science adventure classes: 1,655
  - Visitors to science center: 3,011
  - Tours: 3,357 students;127 teachers;7,760 public
  - Classroom presentation: 14,689
  - Science Chicago Fest: 6,000
  - …..

Fermilab Tevaton superconducting wire → MRI



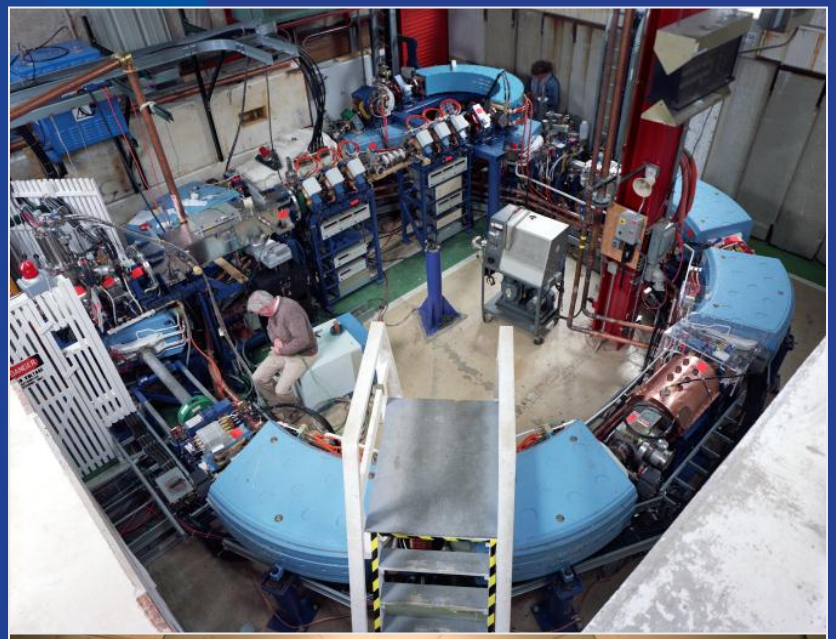
Industry

MRI (Magnetic Resonance Imaging



Proton Cancer Therapy

Fermilab designed and built world's 1st proton accelerator specifically for proton therapy



Loma Linda Proton Therapy and Treatment Center

Designed and built at Fermilab
Has treated > 8,000 patients

Technology Demonstration → Industry

Today there are ~25 proton therapy centers in operating or under construction worldwide

Today, ~30,000 accelerators are in operation around world

- Discovery science
- Materials research / manufacturing
- National security
- Energy and the environment
- Medical sciences, Medicine

PET (Positron Emission Tomography) Scan