HEP Budget for Physicists

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HEPAP

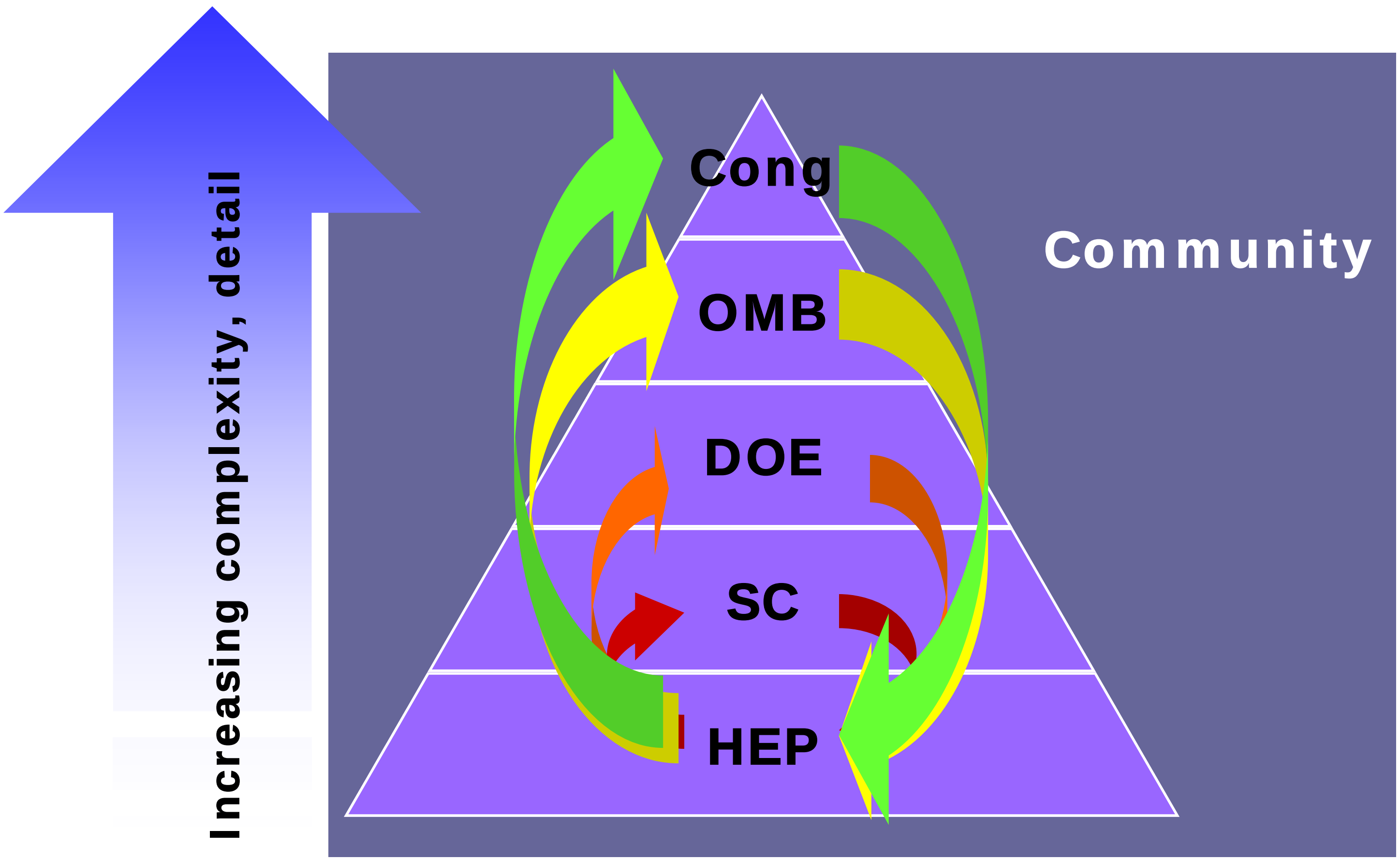
Nov 29 2007

DOE Budget Process (Historical)

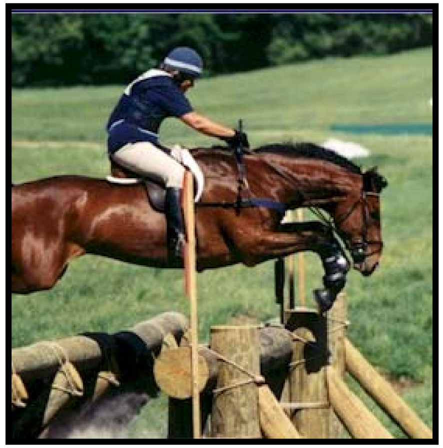
"This meeting was called in order to discuss the meat. It has been pointed out that there is no more meat. A motion has been made to fight over the bones."

George Booth, The New Yorker April 28, 1980

Budget Planning Cycle



There are Four Big Hurdles in SC Budget Formulation



#1 – Inside SC
(Feb. – April FY 200N)

- Each AD-ship determines program priorities within constraints of the funding guidance provided by the Director of SC.
- Each AD presents program priorities to Director of SC.
- The Director of SC determines program priorities within constraints of the funding guidance provided by DOE.

#2 – Inside DOE
(April – July FY 200N)

- The Director of SC and the DOE Assistant Secretaries present their program priorities to DOE.
- DOE determines overall agency priorities.
- SC prepares President's Budget. Each SC AD responsible for preparation of AD-ship budget.

#3 – OMB
(Aug. – Dec. FY 200N)

- DOE budget submitted to OMB.
- Each AD defends program budget at OMB hearing in early September.
- OMB provides "Passback" guidance to DOE in late November.
- Discussions between DOE and OMB refine final budget numbers.
- SC prepares President's Budget. Each SC AD responsible for preparation of AD-ship budget.

#4 – Congress
[February FY 200(N+1)]

- President's Budget presented to Congress.

[Mar. – Sept. FY 200(N+1)]

- Agencies present their budgets to Congress in formal hearings.
- Congress appropriates funding for 13 appropriations bills for FY 200(N+2), using the "President's Budget as a starting point for the Congressional Budget and appropriations."

From the comments of Ellen Burns, Office of Congressman Vern Ehlers, May 2004

HEP Budget Internal “Products”

Budget Cycle	Excel Docs	Versions	Word Docs	Versions
SC	18	35	6	15
DOE	9	17	11	32
OMB	20	35	18	25
Congress	16	41	18	51
Total	63	128	53	123

- Data from FY2006 budget cycle
- Some double-counting of docs in list, since many of the docs recur from cycle to cycle
- But versions are probably undercounted

Budget Formulation (Future Plan)

- Budget formulation is not simple
  - Multi-dimensional
    - **(Operations/Construction/R&D; labs/universities;…)**
  - Dynamic
  - Strongly coupled
  - With significant boundary conditions

- We try to proceed using a few basic guidelines
  - Project-like activities on planned profiles
  - Facility operations and core research at level of effort

DOE Budget Process

- In recent years, more emphasis on budget integration, planning and transparency
  - Motivated in part by focus on good project management practice throughout DOE
  - Baselined construction projects are "protected" in budget planning
  - All significant (>$2M) projects must be identified and approved internally **at least 1 year** before $$ flows
  - Not well-matched to basic research

Publicly Visible HEP Product

High Energy Physics

Funding Profile by Subprogram

(dollars in thousands)

	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
High Energy Physics			
Proton Accelerator-Based Physics	362,157	376,536	389,672
Electron Accelerator-Based Physics	112,291	117,460	79,763
Non-Accelerator Physics	54,205	59,271	72,430
Theoretical Physics	47,984	52,056	56,909
Advanced Technology R&D	121,601	159,476	183,464
Subtotal, High Energy Physics	698,238	764,799	782,238
Construction	—	10,300	—
Total, High Energy Physics	698,238[a]	775,099	782,238
Stanford Linear Accelerator Center (SLAC) Linac Operations (non-add)[b]	(56,100)	(52,100)	(32,500)
High Energy Physics, excluding SLAC Linac Operations (non-add)[b]	(642,138)	(722,999)	(749,738)

Public Law Authorizations:
Public Law 95-91, "Department of Energy Organization Act", 1977
Public Law 103-62, "Government Performance and Results Act of 1993"
Public Law 109-58, "Energy Policy Act of 2005"

Mission

The mission of the High Energy Physics (HEP) program is to understand how our universe works at its most fundamental level. We do this by discovering the most elementary constituents of matter and energy, exploring the basic nature of space and time itself, and probing the interactions between them. These fundamental ideas are at the heart of physics and hence all of the physical sciences. To enable these discoveries, HEP supports theoretical and experimental research in both elementary particle physics and fundamental accelerator science and technology. HEP underpins and advances the DOE missions and objectives through this research, and by the development of key technologies and trained manpower needed to work at the cutting edge of science.

- Overview of the program for interested layman, NOT intended to be
  - **Comprehensive**
  - **Prescriptive**
  - **Highly detailed**
- Main goal is to be a description of the program which is
  - **Compelling**
  - **Consistent**
  - **Reflecting research priorities**

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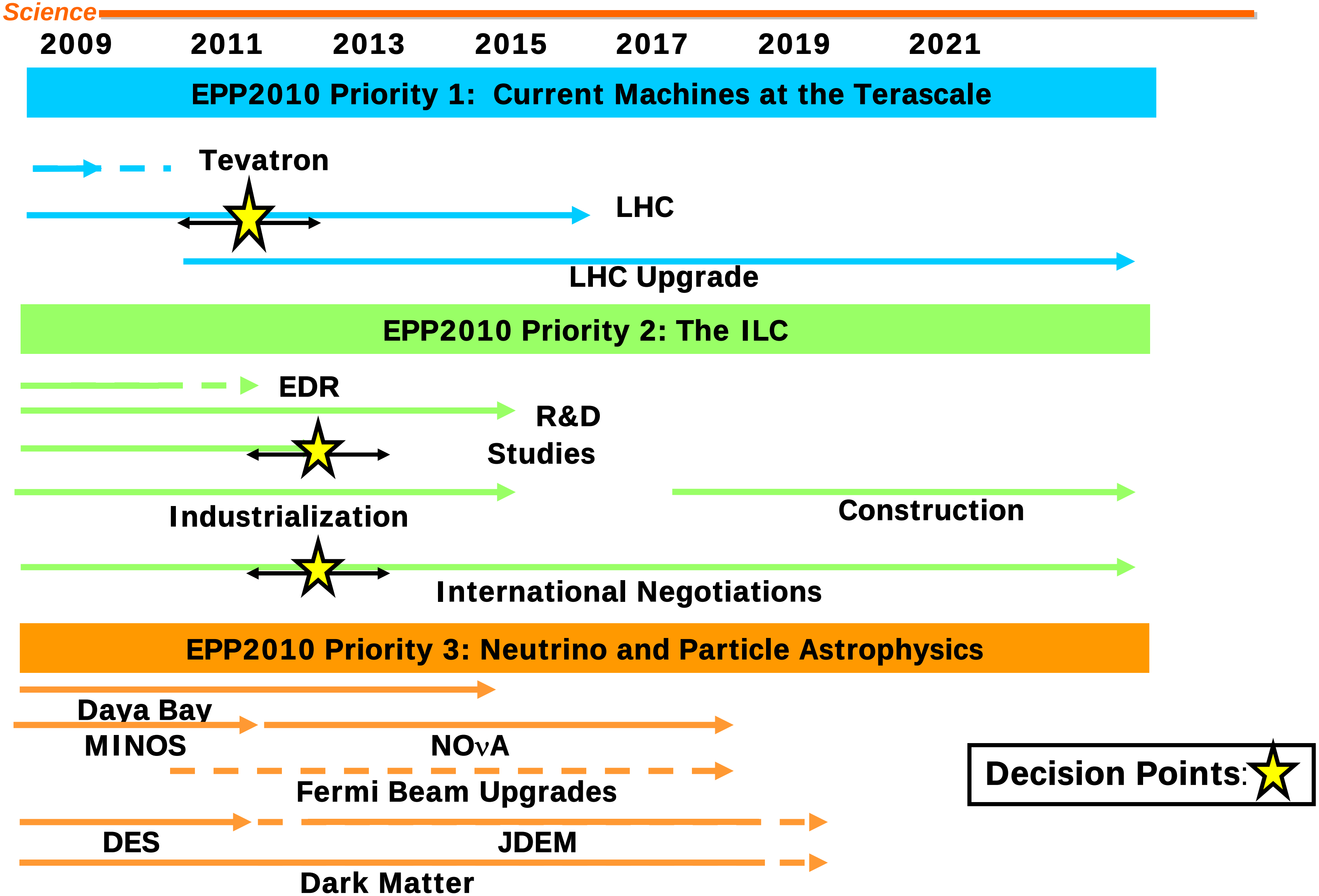
HEP Program Scenarios (a la EPP 2010)



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FY2008 HEP Budget

(Dollars in Thousands)	FY 2007 Actual	FY 2008 Request	FY 2008 House Mark	FY 2008 Senate Mark
High Energy Physics				
Proton Accelerator-Based Physics	343,633	389,672	389,672	389,672
Electron Accelerator-Based Physics	101,284	79,763	79,763	79,763
Non-Accelerator Physics	60,655	72,430	72,430	79,430
Theoretical Physics	59,955	56,909	56,909	56,909
Advanced Technology R&D	166,907	183,464	183,464	183,464
Total, High Energy Physics	**732,434**	**782,238**	**782,238**	**789,238**
Stanford Linear Accelerator Center (SLAC) Linac Operations (non-add)	(51,300)	(32,500)	(32,500)	(32,500)

The SLAC linear accelerator (linac) supports operations of the B-factory (funded by HEP) and will also support operations of the Linac Coherent Light Source (currently under construction and funded by Basic Energy Sciences (BES)). With the completion of B-factory operations in FY 2008, SC has been transitioning funding of the SLAC linac from HEP to BES, with FY 2008 representing the third and final year of joint funding with BES.

HEP Budget Narrative

- Some examples of recent HEP budgets on our website:
  http://www.science.doe.gov/hep/budget/HEPBudgetpage.shtm
- Narrative format set by DOE CFO, OMB, Congress
- HEP Budget categories are a compromise between a “physics” basis and a “functional” basis:
  - **Proton/electron accelerator-based research**
  - **Non-accelerator-based research**
  - **Theory**
  - **Advanced Technology R&D**
- Mapping of budget functions onto OHEP office structure is not necessarily intuitive

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Budget Execution (Current FY)

- Write financial plans (labs) and grants (universities, others) based on appropriated (or expected) budget
- Initial plan usually based on “worst case” of House or Senate mark. DOE CFO sets overall funding level.
  - **In addition, program may hold back funds for pending decisions, possible rescissions, contingency**
- Subsequent plans can rearrange funding distribution or priorities
  - **In case of Continuing Resolutions, can get stuck in holding pattern, making execution difficult**
  - **In FY2007, this was the case. FY2008…?**
- **Generally try to implement “big picture” priorities**

FY2008 HEP Big Picture

- We are both operating current facilities and preparing for the next decade's activities.
  - **Conversion of Capital to Operating of the past decade is over. Re-converting Operating to Capital has begun. Not an easy step.**
- New (M&S-intensive) HEP construction projects will be ramping up.
  - **NOvA (NUMI Off Axis Neutrino Appearance Experiment)**
  - **MINERVA neutrino cross section measurements**
  - **Daya Bay neutrino experiment w/China**
  - **Dark Energy Survey (DES) w/NSF**
- ILC R&D is ramping up to a $60M request for FY2008, up from $42M in FY2007
  - **SCRF infrastructure initiative continues, aligned with ILC R&D**
- Tevatron, B Factory, and NUMI running full steam.

FY2008 Budget Status

- Full House passed Energy and Water bill in July
- Senate committee passed Energy and Water bill in June (no full Senate vote)
  - Currently on Continuing Resolution through Dec 14
- White House has stated it will veto the bill if it comes in at the Congressional spending level
- House and Senate are trying to work out a compromise in Conference
  - Conference seems likely to split the difference between President's Request and Congressional markups
  - Whether this will become law is anyone's guess
  - The impact on Office of Science is also uncertain

Projects and Budgets

- Managed according to approved baselines by designated Project Manager. Extent of oversight tailored to total project cost (TPC)
  - Decision process in R&D phase still ill-defined for smaller projects (PAC? → P5? → DOE)
  - New rules and guidelines for how to report costs both pre- and post-baseline
    - **Available on request**
  - Complex dance between project and budget requirements/timelines (see following slide)

Budget vs Project Process

Budget Process

- Externally driven by Congress and Office of Management and Budget

- Cares about
  - How much $$ do you want to spend? When? Why?
  - What color is the $$? (operating, equipment, other)

- Construction projects automatically get higher visibility due to extra reporting requirements and financial controls

DOE Project Management Process

- Internally driven by DOE Office of Engineering and Construction Management (OECM) and SC Office of Project Assessment (Lehman)
- Cares about
  - What Phase is the project in?
  - Is it ready to go to the next Phase? (Critical Decisions or CD's, e.g. CD-0)
  - Cost, schedule, technical readiness
- Larger projects automatically get higher visibility in DOE due to layered approval levels

DOE Budget Requests REQUIRE appropriate CD's are passed before requesting/spending $$

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Current MIE Projects

Department of Energy
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(EQU costs ONLY; Dollars in Thousands)

		Total Project Cost (TPC)	Total Estimated Cost (TEC)	Prior Year Appro-priations	FY 2006	FY 2007	FY 2008	Completion Date
LHC	Large Hadron Collider–ATLAS Detector, CERN	102,950	54,703	53,105	1,598	—	—	FY 2007
LHC	Large Hadron Collider–CMS Detector, CERN	147,050	71,789	67,639	2,900	1,250	—	FY 2007
Neutrinos	NuMI Off-axis Neutrino Appearance (NOvA) Detector, Fermilab	260,000	TBD	—	—	1,000	4,900	FY 2013
Neutrinos	Main Injector Experiment v-A (MINERvA), Fermilab	16,800	10,700	—	—	—	5,000	FY 2010
Neutrinos	Reactor Neutrino Detector, Daya Bay, China	32,000 - 34,000	TBD	—	—	500	3,000	FY 2012
Neutrinos	Tokai-to-Kamioka (T2K) Near Detector, Tokai, Japan	4,700	3,000	—	—	—	2,000	FY 2009
Particle-Astro	Very Energetic Radiation Imaging Telescope Array System (VERITAS), Amado, Arizona	7,399	4,799	3,650	1,149	—	—	FY 2006
Particle-Astro	Dark Energy Survey, Cerro-Tololo Inter-American Observatory, Chile	24,100 - 26,700	TBD	—	—	3,610	7,500	FY 2011
Accel	BaBar Instrumented Flux Return (IFR) Upgrade, SLAC	4,900	4,900	4,200	700	—	—	FY 2006

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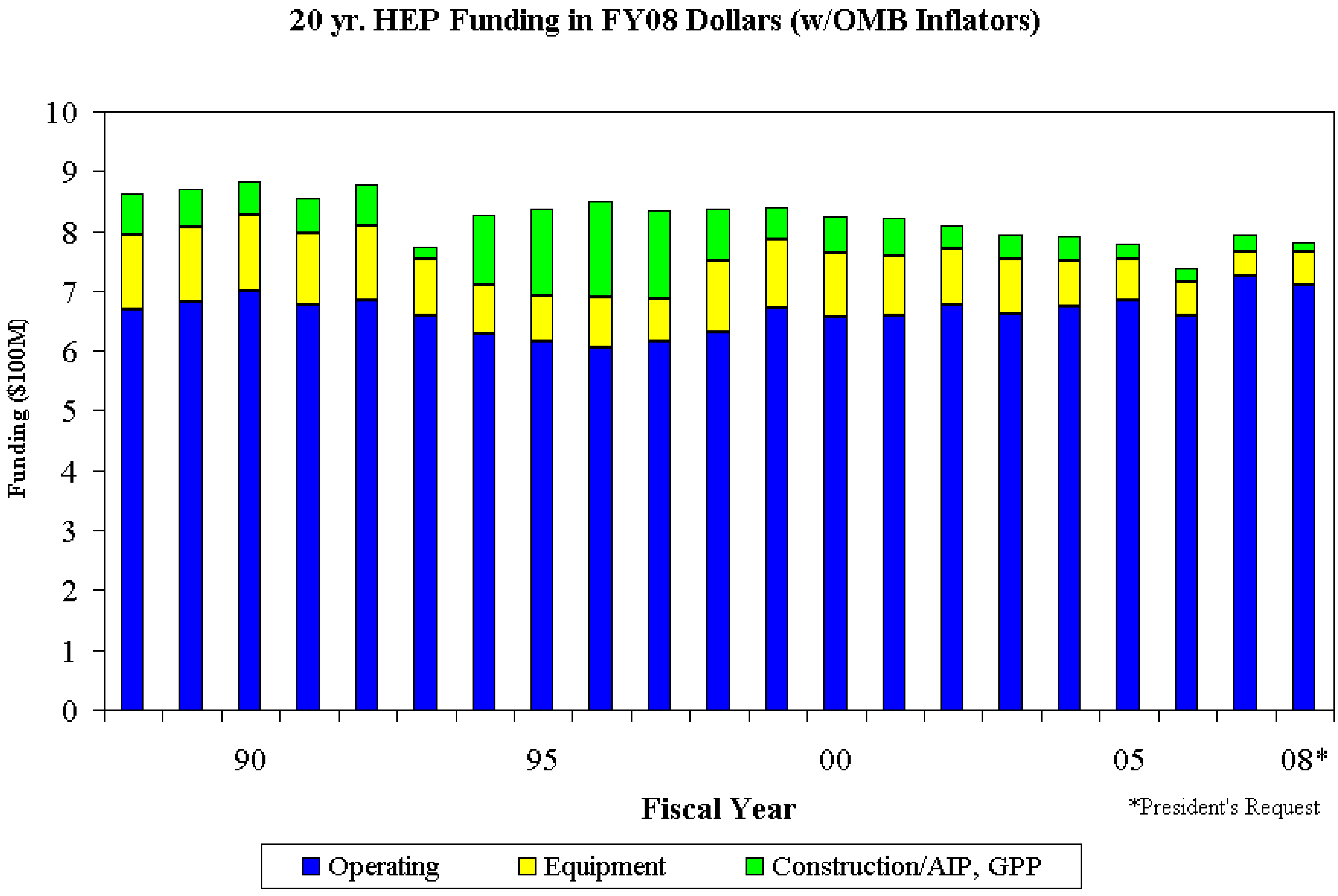
Summary (my perspective)

- HEP is a complex and multiply-connected program
  - Budget, management, programmatic
- Current budget structure seems to work well with main customers (OMB, Hill)
  - However, some important cross-cuts not very transparent
  - Significant learning curve to understand in detail
    - Serious students welcome!

Backup Slides

HEP Historic w/ Inflation

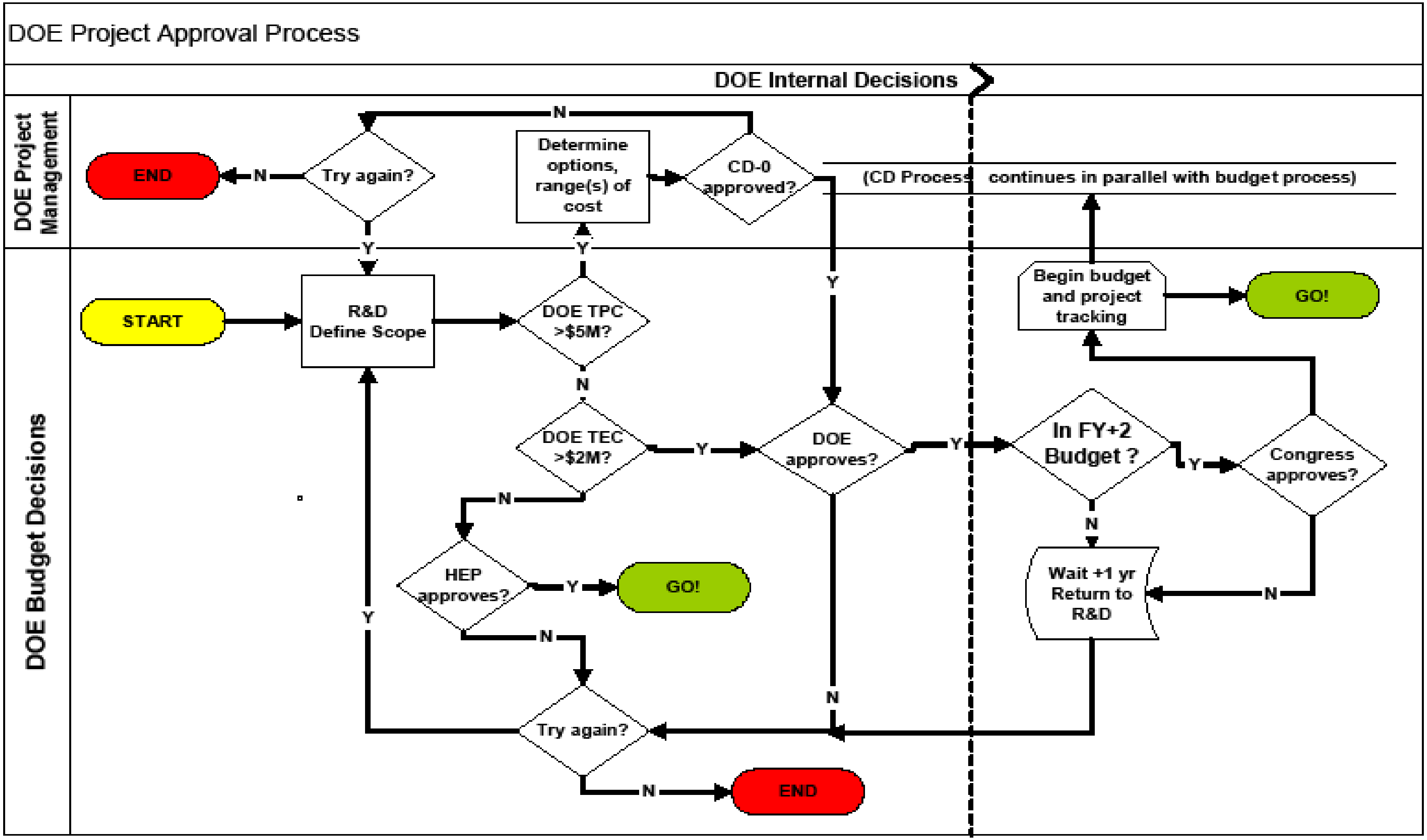


Strata of DOE Projects

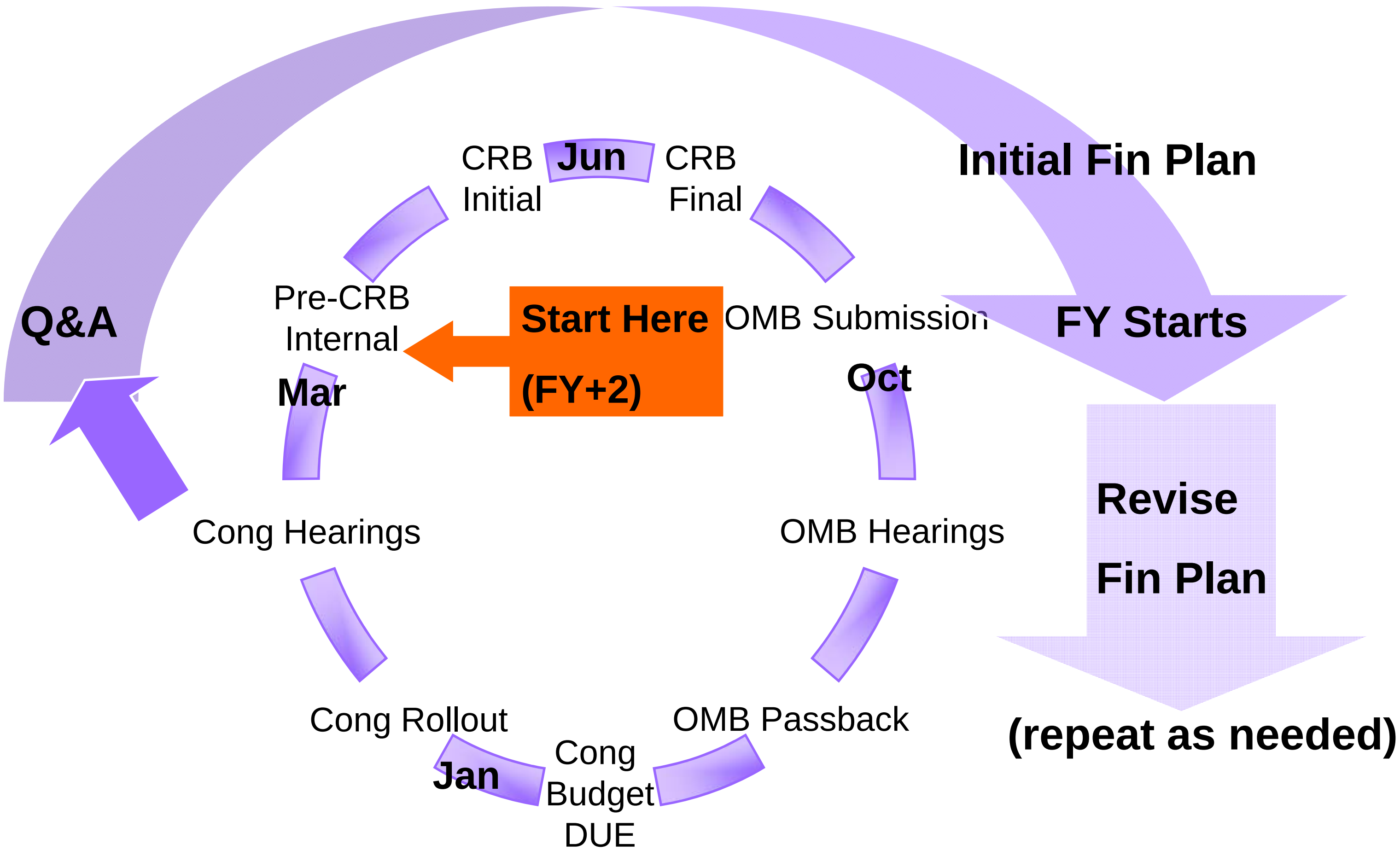
Threshold	Triggers	DOE Jargon	Decision Maker	Consequences	Recent Examples

Civil Construction:
➢$5M OR
➢20% of TPC
	Extensive Budget Reporting	Line Item Const.	if TPC >$400M:
			Dep. Sec.
			if TPC >$100M:
			Director, Office of Science
				Budget Reporting and Tracking;
				Congressional visibility; OMB apportionment
					NuMI

Total Project Cost (TPC) >$20M	Extensive Project Reporting	MIE	if TPC >$20M: *Assoc. Dir.*	Earned Value Management; DOE project reporting (PARS); OMB performance tracking (PART)	U.S. LHC NOvA Daya Bay DES
Total Project Cost (TPC) >$5M	DOE Project Management System	MIE	AD's delegate	DOE Project Management (CD-process, reviews)	Run II Detector Upgrades Minerva
Total Estimated Cost (TEC) >$2M	Budget Reporting	Major Item of Equip. (MIE)	HEP program manager	MIE tracking; Request in FY+2 budget	VERITAS Babar IFR Upgrade T2K


DOE Project Approval Process
DOE Internal Decisions
DOE Project Management
DOE Budget Decisions
END
N
Try again?
Determine options, range(s) of cost
CD-0 approved?
(CD Process continues in parallel with budget process)
Y
START
R&D Define Scope
DOE TPC >$5M?
DOE TEC >$2M?
DOE approves?
In FY+2 Budget ?
Congress approves?
Begin budget and project tracking
GO!
HEP approves?
Wait +1 yr Return to R&D
Try again?
END

The Nominal Process



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A Strategic Plan for US-based High Energy Physics

"Today, our nation faces some decisions about its future role in particle physics. The US can choose to sacrifice its historical leadership in particle physics. Or we can make a strong commitment to current and future global efforts. The United States has an unprecedented opportunity, as a leader of nations, to undertake this profound scientific challenge."

– H. Shapiro, EPP 2010 Chair

- The particle physics program for the next 10-15 years will focus on:
  - LHC discoveries at the Terascale
  - ILC and Superconducting RF (SCRF) R&D leading to
    - A) a construction decision with an international agreement for a US-based ILC
    - B) If not ILC, an alternative world-leading US facility
  - Dark Energy, Dark Matter detection, Neutrinos, particle astrophysics