Future of the Energy Frontier (DOE Perspective)

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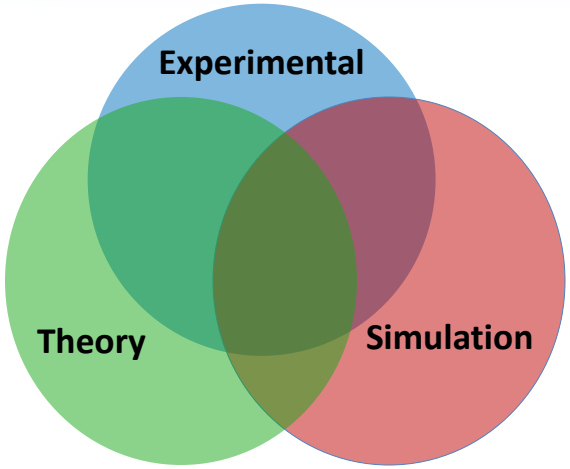
SiD Detector Workshop

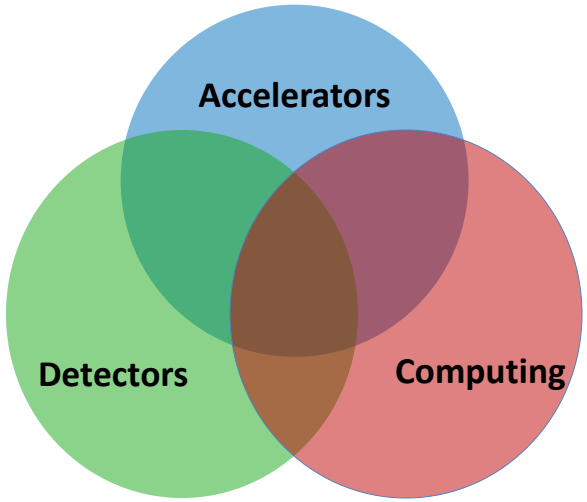
August 23 2012

SLAC

HEP Physics and Technology



Along Three Paths



Enabled by
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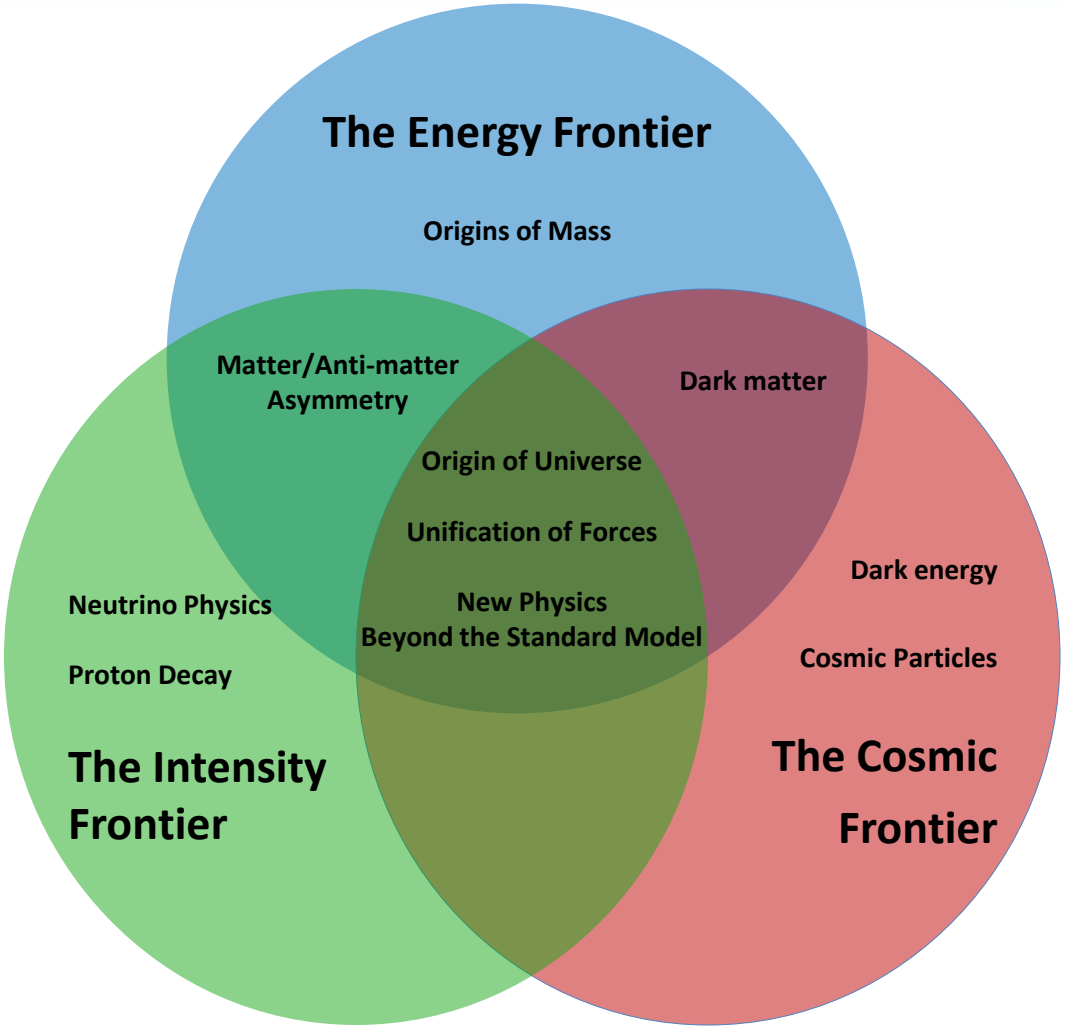
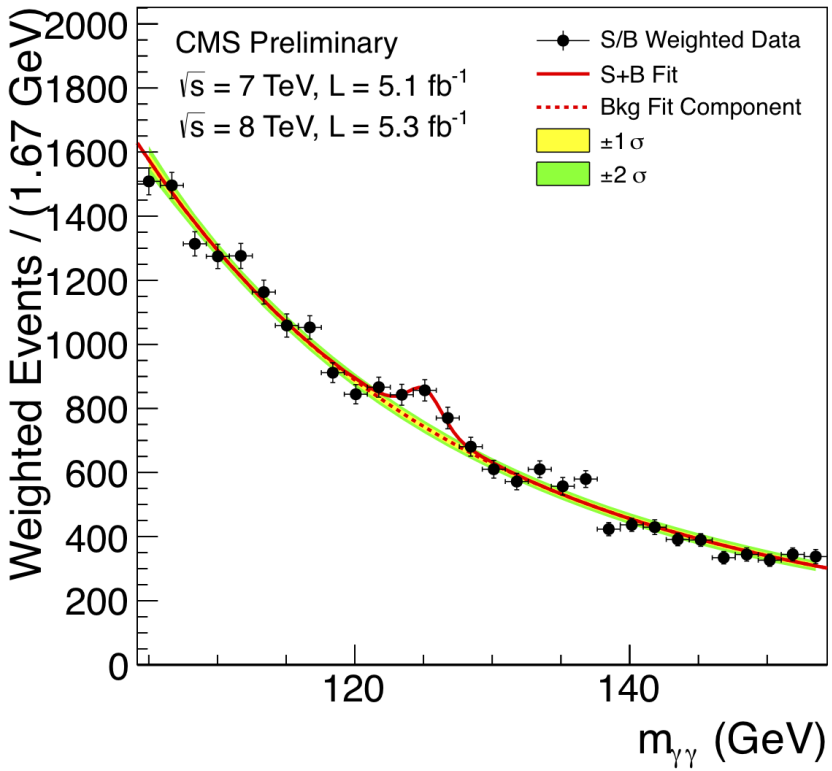
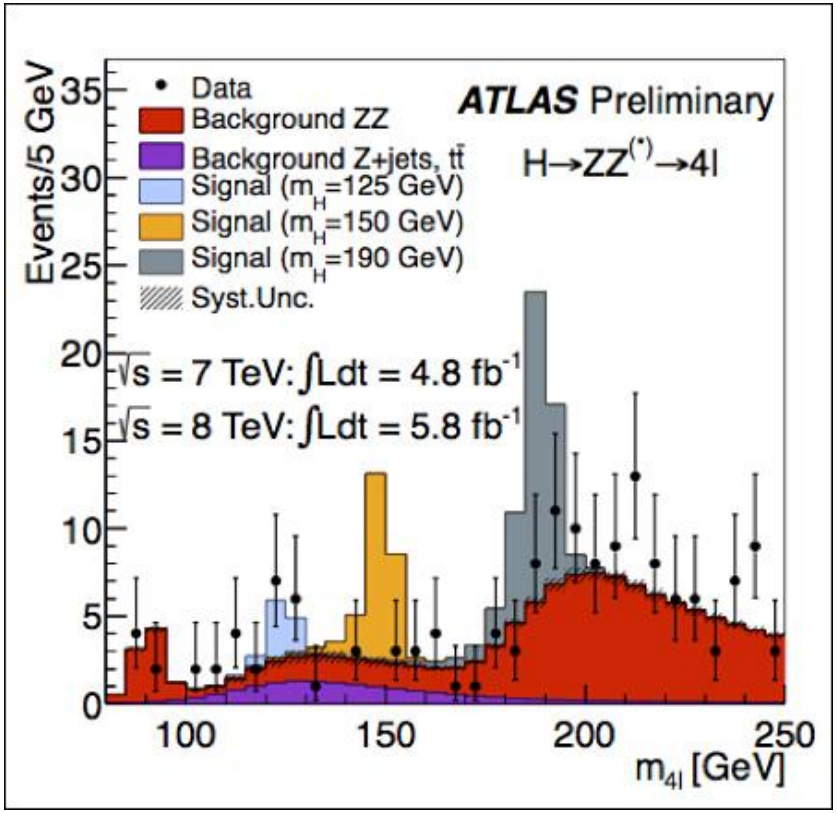


Physics Frontiers

The Wait is Over!





Energy Frontier Plan

- **Science goals**
  - Explore the TeV scale. Is there anything there but a SM Higgs?
- **Recent results**
  - There is a Higgs-like boson at 125 GeV
    - There are many predictions to test to see if it is the “real McCoy”.
- **Near term**
  - Continued LHC running though 2012.
  - Repair splices in LHC magnets in 2013/2014.
  - Resume running at ~14 TeV in 2014.
- **No new facilities under construction at this time**
- **Planned program of major projects:**
  - **LHC Detector Upgrades**: (2017-8) to cope with increased data rates
  - Participate in the LHC-High Luminosity upgrade with installation ~ 2022.

CERN's LHC Accelerator Upgrade Timeline

2009 — Start of LHC

Run 1: 7 TeV center of mass energy, luminosity ramping up to ~30% of nominal; 5.7 fb^{-1} delivered, expect 10-15fb^{-1} in 2012

2013/14 — LHC shut-down to prepare machine for design energy and nominal luminosity

Run 2: Ramp up luminosity to nominal; 14 TeV CM energy; 156 fb^{-1}

2017 or 18 — Injector and LHC Phase-I upgrades to go to ultimate luminosity

Run 3: Ramp up luminosity to 2.2 x nominal, reaching ~100 fb^{-1} / year accumulate 400 hundred fb^{-1}

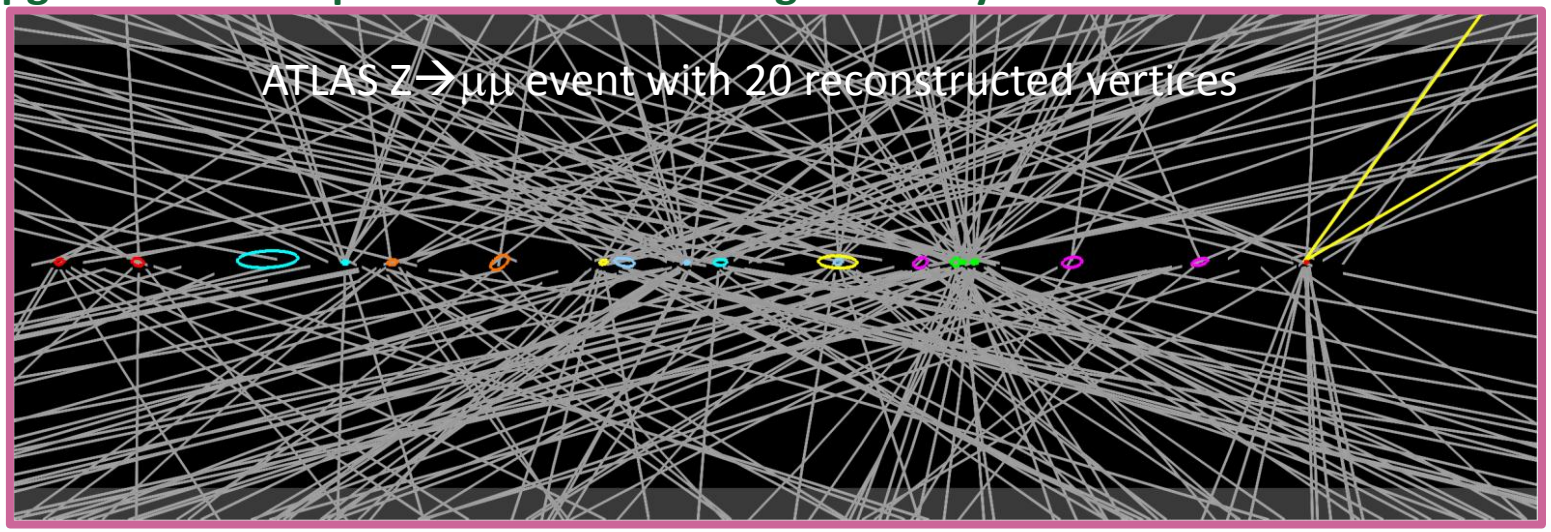
~2021/22 — Phase-II: High-luminosity LHC. New focussing magnets and CRAB cavities for very high luminosity with levelling

Run 4: Collect data until > 3000 fb^{-1}

2030

Developing a Mission Need Statement

- **HEP will work with the collaborations and CERN to understand the impact of the CERN LHC upgrades on detectors:**
  - What are the critical needs for detector upgrades?
  - What responsibilities does CERN want the US to take on?
  - In what technical areas does the US possess leading or unique capabilities?
- **Analyze the schedule needed to deliver upgraded detector components.**
- **Develop a cost estimate and plan to have the funding available in the HEP budget.**
- **Goal is to complete a Mission Need Statement in FY 2012 for the near-term upgrades that keep the detectors running smoothly**



Next Steps : Energy Frontier

- **Discussions with CERN about follow-on to LHC Agreement proceeding**
  - Necessary precursor to planning for "Phase-II" upgrades
  - DOE and NSF agree on framework principles
- **Energy Frontier science plan will require high-energy LHC running**
  - What is the real physics of the TeV scale?
  - This will likely take a few years to sort itself out
  - US "Snowmass" process is an important element, along with European and Japanese HEP strategies
- **Significant collaborations with other regions on future colliders will require a high-level approach between governments**
  - As we noted at FALC. See also following slides.
  - Modest ground-level efforts can continue as funding allows

Past Performance in Planning

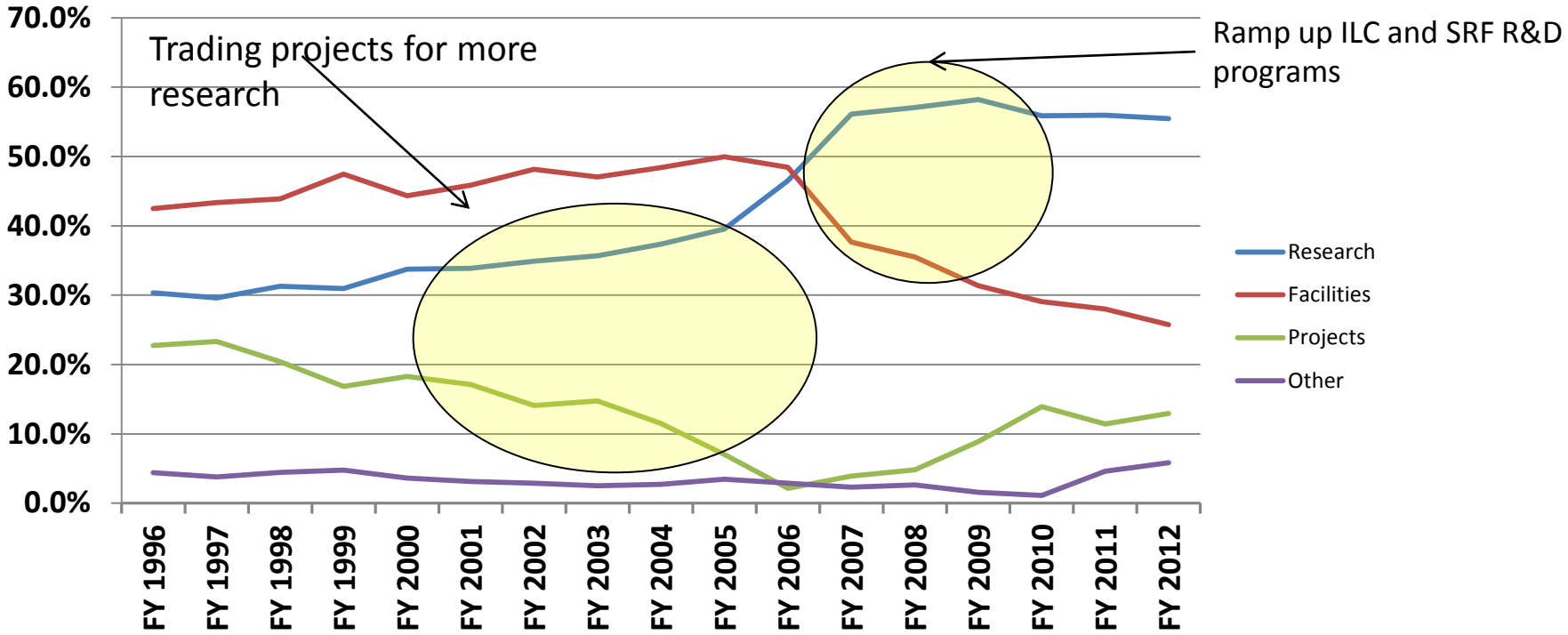
- **P5 Plan and Impact**
  - Diverse scientific portfolio embraced by stakeholders
  - Clear priorities set
  - Realistic budgets, although we are at/below the lower limit by now
  - Very, very positive impact

- **Broader Impacts**
  - Accelerator stewardship plans moving forward. Targeted workshops in planning stages. Hope to begin program in FY14

- **Need to lay the foundation to update P5 plan as the next step. Need more details.** 'You guys have great questions, but what about answers?'

- **Look at what other parts of Office of Science have done** – e.g., Basic Energy Sciences (BES)
  - Very successful, but ~$200M/yr for projects is the empirical limit.

Funding Trends



- In the late 90's the fraction of the budget devoted to projects was about 20%.
- Progress in many fields require new investments to produce new capabilities.
- The projects started in 2006 are coming to completion.
- New investments are needed to continue US leadership in well defined research areas.
- Possibilities for future funding growth are weak. Must make do with what we have.

Implementing the Priorities

- **Research funding will decrease at ~2% a year for the next several years.**
  - Program priorities and comparative reviews will be used to implement the cuts.
  - Both the universities and the laboratories will be affected.
    - Comparative lab reviews in Energy Frontier and detector R&D this year
    - Cosmic and Intensity Frontiers next year; Accelerator Science TBD
- **Operations funding approximately flat-flat**
- **Seeking approval of CD-0 for mid-scale dark matter, dark energy; ATLAS and CMS upgrades; and muon g-2 this fall.**
  - Investing in cosmic, energy, and intensity frontiers.
  - CD-1 approved for LSST, Mu2e; CD-1 review for LBNE in Oct
- **Embarking on a community planning process.**
  - APS Division of Particle and Fields is organizing it.
  - Working groups meeting now.
  - Major meeting next summer.

Context: FY2013 Budget Issues

- **ILC R&D efforts zeroed out**
  - 5 year R&D plan successfully completed; no project on near horizon
  - Plan to continue involvement with international planning **at very low level**
    - Physics case needs to be re-examined in light of LHC results
    - Be prepared if foreign gov't comes with high-level request for partnership
  - Working with HEP labs to minimize damage to accelerator core competencies
    - The importance of SRF to DOE/SC futures has not been missed
- **Detector R&D can continue, but…**
  - Needs to be generic (see e.g. CDRD reviews)
  - No new funding opportunities for CDRD or similar proposals anticipated in FY13
  - For universities: ADR or Comparative Review proposals may be appropriate, depending on details of what is proposed
  - For labs: just reviewed lab detector R&D efforts in July. Awaiting a few supplemental lab proposals
  - We are trying to boost funding level for this area, but very challenging budget landscape

FY 2013 High Energy Physics Budget Request

(Dollars In Thousands)	FY 2012	FY 2013 Request	FY 2013 vs. FY 2012
Proton Accelerator-Based Physics	421,594	411,532	-10,062
Electron Accelerator-Based Physics	23,025	29,146	+6,121
Non-Accelerator Physics	84,062	97,425	+13,363
Theoretical Physics	66,850	68,522	+1,672
Advanced Technology R&D	167,329	149,896	-17,433
Subtotal, Research and Operations	762,860	756,521	-6,339
Construction	28,000	20,000	-8,000
Total, High Energy Physics	790,860*	776,521	-14,339

*The FY 2012 appropriation is reduced by $840,000 for the High Energy Physics share of the DOE-wide $73,300,000 rescission for contractor pay freeze savings. The FY 2013 budget request reflects the FY 2013 impact of the contractor pay freeze.

Future Plans for Portfolio Development

- **DPF Planning process – frontier oriented**
  - In partnership with DOE/NSF, supported by all the labs
  - Must develop more project ideas than we can afford + more affordable ideas

- **SCIENCE CASE FIRST!**
  - Then worry about experiments. Remember we need continuous science output
  - Snowmass is NOT a shootout. It is not a love fest either. We must be critical about science goals & think out of the box
  - Worthy science goals married to implausible assumptions do not advance the discussion

- **Consider novel ideas for packaging our programs (BES used EFRC's, Hubs, etc.)**
  - Will a critical mass of program elements, industrial participation, computing, materials, technologies, etc. make a difference to how fast we can move on our science or in broader impacts?
- **Compelling ideas have the potential to raise the budget and expand our scope and impact if we have the patience and skill to develop them!**

Program Planning Goals

- **The HEP program will have a coherent program plan for each of our frontiers: Cosmic, Energy, and Intensity – plus accelerator research, theory, etc. Then it needs to be integrated into 1 overall, coherent, coordinated plan, and prioritized.**
  - Eg Snowmass → Update HEPAP/P5 plan → DOE/NSF implementation

- **The plan doesn't need to be a consensus; rather it can show the range of options available.**

- **The plan will show the current science reach and potential future science reach that can be achieved by experiments in the HEP program to make significant advances in the coming years.**

- **The plan should exhibit compelling science as well as technical and fiscal realism**

What You Can Do

- **Coherent science case from and by the community**
  - Keep to high standards and maintain diversified approach
  - Explanations have to be carefully thought out and eventually oversimplified
  - Must layout timeline for when answers to our questions are likely. 'We are doing experiments to see what we find' not adequate
  - Emphasize unity of our field in the process
  - Emphasize broader impacts – real impacts and opportunities for impacts
- **Community service from individuals**
  - Contemplate broader impacts and pursue them.
  - Collaborate outside HEP
  - Be broadly informed on HEP science and technical issues
  - Participate in community planning exercises. Bring your colleagues.