US Particle Physics: Scientific Opportunities

A Strategic Plan for the Next Ten Years

Report of the
Particle Physics Project Prioritization Panel

May 29, 2008

Charge to the Panel

- In November of 2007 the DOE and the NSF asked HEPAP to reconvene the P5 panel
- Charge to the Panel: Develop a 10 year plan for US Particle Physics under various DOE funding scenarios:
  - A. Constant effort at the FY2008 level(688 FY08 M$ DOE)
  - B. Constant effort at the FY2007 level(752 FY07 M$ DOE)
  - C. Doubling of budget over 10 years starting with FY2007
  - D. Additional funding above the previous level, associated with specific activities needed to mount a leadership program

  The Panel was also briefed on the status of NSF fiscal planning. The plan described here assumes approval of the DUSEL MREFC proposal and continued funding of the NSF university program.

The Three Frontiers of Particle Physics

Addressing the central questions of the field requires a broad program of research using a variety of tools and techniques that we broadly classify into three interrelated frontiers:

- The Energy Frontier, using high-energy colliders to discover new particles and directly probe the properties of nature.
- The Intensity Frontier, using intense beams to uncover the elusive properties of neutrinos and observe rare processes that probe physics beyond the Standard Model.
- The Cosmic Frontier, revealing the natures of dark matter and dark energy and using high-energy particles from space to probe the architecture of the universe.

These three frontiers form an interlocking framework that addresses fundamental questions about the laws of nature and the cosmos.

Lepton Colliders

- The international particle physics community has reached consensus that a full understanding of the physics of the Terascale will require a lepton collider as well as the LHC. The panel reiterates the importance of such a collider.
- In the next few years, results from the LHC will indicate the required energy for such a lepton collider.
- If the optimum initial energy proves to be at or below approximately 500 GeV, then the International Linear Collider is the most mature option with a construction start possible in the next decade.
  - The cost and scale of a lepton collider mean that it would be an international project, with the cost shared by many nations.
  - International negotiations will determine the siting; the host will be assured of scientific leadership at the energy frontier.
- A requirement for initial energy much higher than the ILC's 500 GeV will mean considering other collider technologies.
- Whatever the technology of a future lepton collider, and wherever it is located, the US should plan to play a major role.

Lepton Collider R&D Program

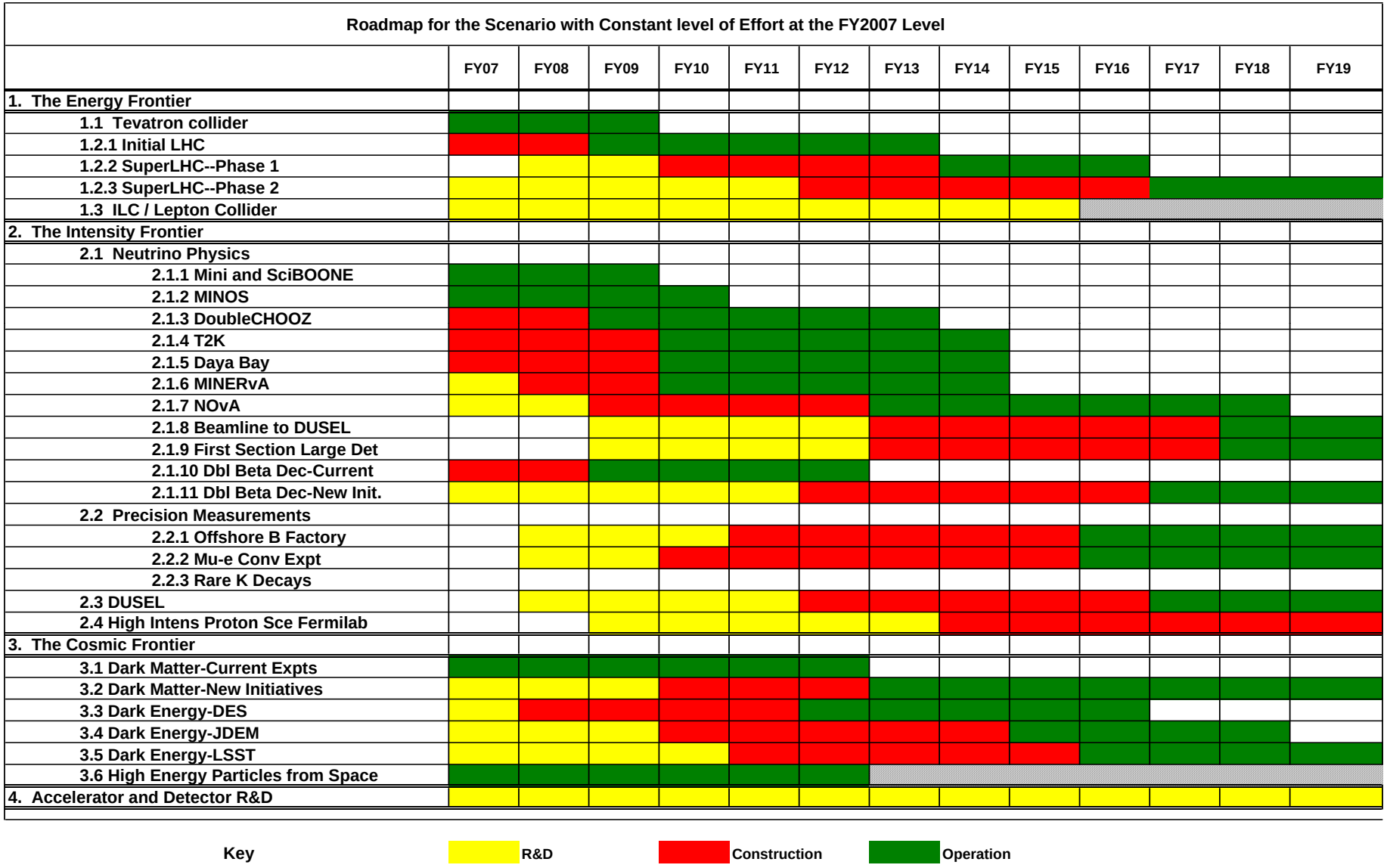
- For the next few years, the US should continue to participate in the international R&D program for the ILC to preserve the option of an important role for the US should the ILC be the choice of the international community. The US should also participate in coordinated R&D for the alternative accelerator technologies that a lepton collider of higher energy would require.
- The panel recommends for the near future a broad accelerator and detector R&D program for lepton colliders that includes continued R&D on ILC at roughly the proposed FY2009 level in support of the international effort. This will ensure a significant role for the US even if the ILC is built overseas. The panel also recommends R&D for alternative accelerator technologies, to permit an informed choice when the lepton collider energy is established.
- The panel also recommends an R&D program for detector technologies to support a major US role in preparing for physics at a lepton collider.

Advanced Accelerator and Detector R&D

- Advances in accelerator and detector R&D are critical for the United States to maintain leadership at the Energy, Intensity and Cosmic Frontiers of particle physics; to allow the possibility of hosting a future energy-frontier accelerator in the United States; and to develop applications for the benefit of society.

The panel recommends support for a program of detector R&D on technologies strategically chosen to enable future experiments to advance the field, as an essential part of the program.

Roadmap for Funding Scenario B



DOE Budget Scenario B FY 2007 to 2018