Office of High Energy Physics
Report to BPA

April 29, 2011

Glen Crawford
Director, Research and Technology R&D
Office of High Energy Physics
Office of Science, U.S. Department of Energy
HEP Strategic Plan


Progress in achieving the goals of particle physics requires advancements at the

- **Energy**, **Intensity** and **Cosmic** Frontiers
- The U.S. should have a strong, integrated research program at all three frontiers.
- At lower funding levels, cannot maintain leadership at all 3 frontiers

**HEP at its core is an accelerator-based experimental science.**

- Support accelerator and detector R&D to develop new technologies
  - that are needed by the field
  - that benefit the nation
STATUS OF THE FY 2011 BUDGET
FY 2011 Continuing Resolution

We were operating under a CR for over 6 full months.
- We were below the FY 2010 level, since the CFO held back the funds for engineering design for Mu2e and LBNE. They are considered new starts.

Final distribution of FY2011 funding for Office of Science not yet determined
- To be submitted to Congress next week
- Expect final FY11 HEP budget to be very close to FY11 CR level
- "No new starts" held in FY11 Appropriation

*Does not include reductions for 0.2% rescission, $16M contractor pay freeze, and unobligated Prior Year funds

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HEP</td>
<td>810,483</td>
<td>829,000</td>
<td>799,500</td>
<td>(tbd)</td>
</tr>
<tr>
<td>SC</td>
<td>4,789,288</td>
<td>5,129,574</td>
<td>4,826,000</td>
<td>4,884,000*</td>
</tr>
</tbody>
</table>
Working under the CR

- HEP formulated a plan for the $799,500,000.
  - We made a financial plan for the laboratories much like a normal year.
  - Attempted to avoid any dire impacts until the FY11 Appropriation was known
- HEP is holding minimal reserves at this point.
  - Very limited ability to respond to problems or supplemental requests
- Several Intensity Frontier projects (MicroBooNE, Mu2e, and LBNE) are considered new starts and are not receiving any equipment funding, including engineering design
  - Mu2e was instructed by HEP to slow work to avoid a gap in funding.
  - LBNE has been slowed down due to dealing with the DUSEL situation (more on this later)
  - We are working to try to mitigate impacts of the extended CR but these projects will inevitably experience some delays.
  - These delays will be exacerbated if there is another CR in FY2012.
- Now pushing to get remaining FY11 funding out as soon as possible.
The High Energy Physics Budget Request

<table>
<thead>
<tr>
<th>Description</th>
<th>FY 2010</th>
<th>FY 2011 Request</th>
<th>FY 2011 March</th>
<th>FY 2012 Request</th>
<th>FY12 vs FY10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proton Accelerator-Based Physics</td>
<td>438,369</td>
<td>439,262</td>
<td>439,462</td>
<td>412,707</td>
<td>-25,662</td>
</tr>
<tr>
<td>Electron Accelerator-Based Physics</td>
<td>30,212</td>
<td>24,707</td>
<td>20,805</td>
<td>22,319</td>
<td>-7,893</td>
</tr>
<tr>
<td>Non-Accelerator Physics</td>
<td>97,469</td>
<td>88,539</td>
<td>88,539</td>
<td>81,852</td>
<td>-15,617</td>
</tr>
<tr>
<td>Theoretical Physics</td>
<td>68,414</td>
<td>69,524</td>
<td>68,024</td>
<td>68,914</td>
<td>500</td>
</tr>
<tr>
<td>Advanced Technology R&amp;D</td>
<td>156,347</td>
<td>189,968</td>
<td>173,346</td>
<td>171,908</td>
<td>15,561</td>
</tr>
<tr>
<td>Construction</td>
<td>0</td>
<td>17,000</td>
<td>0</td>
<td>39,500</td>
<td>39,500</td>
</tr>
<tr>
<td>Total, High Energy Physics</td>
<td>790,811</td>
<td>829,000</td>
<td>794,078</td>
<td>797,200</td>
<td>6,389</td>
</tr>
</tbody>
</table>

FY 2010 appropriation including SBIR/STTR was $810 million, so the FY 2012 request is a reduction of $13 million from FY 2010.
Funding Trends

HEP is now between the HEPAP/P5 “A” and “B” scenarios.

• Funding FY 2009-2011: Program workforce and scope largely preserved – implementation slow
• Funding FY 2012 Target: Workforce will be downsized and the program de-scoped; cannot maintain leadership program at all 3 frontiers
SC and HEP Funding Trends
• In the late 90’s the fraction devoted to projects was about 20%.
• This fraction reached a minimum around 2006.
• The projects started since then are coming to completion.
• The HEP Committee of Visitors recommended projects should be ~20% of the budget.
HEP Major Changes in 2012

- The Tevatron will not run in FY 2012. The proton accelerator complex will run for 6 months to support the neutrino program.
  - Funding goes from $126 million in FY 2010 to $103 million in FY 2012.
  - The complex will then shutdown to install the accelerator upgrade components of NOvA.
    - Beam power will go from 400kW to 700kW.

- The NOvA Project is now in the ramp down portion of its profile.
  - From $59 M in FY 10 to $41 M in FY 12.
  - First detector modules will be installed in FY 2012. Completion is expected in 2013.

- Future Complex R&D is increased to support the development of new ideas to improve the complex.
  - The accelerator complex is over 40 years old and the portion of the complex that accelerates protons to 8 GeV is mostly the original equipment.
    - From $6.6M in FY 10 to $15M in FY 12 for R&D on a superconducting proton linac.

- LHC support is decreased by $6.8 M as the LHC Accelerator Upgrade project is completed.

- There is $10 M in the other facilities category to support the Homestake mine, while decisions are made on whether DOE can use the mine for the SC program.
**Energy Frontier: Transitioning**

**Tevatron Program**
- Operation of the Tevatron completes in FY 2011.
  - The machine is running the best that it ever has.
- P5 evaluated a proposal for 3 more years of ops; recommended only extending the run if new funding could be found.
- FY 2012 Request supports completion of the analyses with the full data sets.
  - Computing operations at Fermilab and universities.
  - Support of researchers
- Planning the disassembly of the detectors and Tevatron ring.
  - Look for opportunities to reuse components elsewhere.

**LHC Program**
- Performance in 2010 improved dramatically.
  - 5 orders of magnitude improvement; Peak luminosity about a factor of 10 lower than the Tevatron.
  - First SUSY limits already better than the Tevatron limits.
- The LHC will run through 2012, then 18 month shutdown
  - Expect another factor of 10 improvement in luminosity.

**At the threshold of discovery (?)**
- Already 3\(\sigma\) evidence for new physics (CDF)...and rumors of more to come
The Fermilab accelerator complex will run in FY 2012 for 6 months to support the neutrino program.

- MINOS and MiniBooNE will be following up on antineutrino results that unexpectedly disagree with neutrino results.
  - Additional data is needed to reduce the statistical errors on the antineutrino data.
  - MINOS has proposed to run in the NOvA era.
  - MINERvA will be continuing its program of neutrino cross-section studies.

The NOvA project will install the first detector modules and the required accelerator upgrades in FY 2012.

- Completion is expected in FY 2013.
The Daya Bay Reactor Neutrino Experiment is second only to the LHC as a major US HEP offshore investment.

- The scientific result is critical to the future of the Intensity Frontier program
- First antineutrino detectors completed (above left) and being installed now
- China contributes about 50% of detectors and all of civil construction
- Initial commissioning in 2011 and full operations in 2012
DOE and NSF had developed a partnership model for the physics program at the deep Underground Science and Engineering Lab (DUSEL), which would be in the Homestake Mine in Lead, South Dakota.

- DOE HEP would steward the Long Baseline Neutrino Experiment while NSF stewarded the DUSEL Facility.
  - DOE HEP would lead the construction of the neutrino beam, near detector, far detector, and the underground cavern for the far detector.
  - NSF would contribute a fixed dollar amount to the far detector and the underground cavern for the far detector.
  - NSF would provide the non-detector specific infrastructure such as the shafts, water pumping, ventilation, etc.
- NSF would steward the dark matter experiments and DOE HEP would partner.

- DOE NP would steward neutrinoless double beta decay and NSF would partner.
- The National Science Board rejected this arrangement and declined to fund the DUSEL project any further.
  - NSB suggested that this was more appropriate for DOE to build the facility.
The Office of Science has an interest in three experiments that had been planned for DUSEL.
- Long Baseline Neutrino Experiment
- Dark Matter
- Neutrinoless Double Beta Decay

The Office of Science has started a review process to determine if any of these can be carried out in a cost effective manner at the Homestake Mine.
- Stakeholders were informed of the review process at the end of February.
- First meeting of the review committee was held at SLAC April 13-15
- Report to DOE/SC management expected in late May

The FY 2012 request includes $15 million to keep the Homestake Mine viable while decisions are made. (HEP $10 M, NP $5 M)

Review process will inform the FY 2013 request.
Fully Exploiting B-Factory Data

• HEP has supported the completion of the analysis of the data.

• There have been over 100 publications since the shutdown in 2008
Future B-Factories?

- In one of the mid-range funding scenarios (Scenario B), P5 called for modest U.S. participation in an overseas “Super-B factory,” that will significantly extend the search for new physics and complement the domestic Intensity Frontier program centered at Fermilab
  - Two US proposals (Japan, Italy) were submitted to respond to this recommendation
  - Note that we are currently somewhat below this funding scenario
- Subsequent to the P5 Report, DOE also received a revised proposal to re-mount the muon g-2 experiment at Fermilab which would require about the same level of investment as US participation in the Super-B projects
- All three proposals were sent out for mail review, but the results were inconclusive, as all three proposals rated highly on scientific merit and reviewers recommended proceeding with them
- To help decide between these competing proposals HEP convened a comparative review panel (Aug 10-12 2010) to prioritize the three proposals.
- **The clear recommendation from the panel was to fund both g-2 and U.S. participation in the Japanese Super-B proposal if possible. The Italian Super-B proposal was not recommended for funding.**
- We will try our best to accommodate these projects in our out-year planning
Cosmic Frontier: The Future is Now

- AMS-02 Launches **today** from Kennedy Space Center
  - The next “HEP detector in space” (a la Fermi/GLAST)
  - Large international collaboration led by the U.S.
  - Will open up new vistas in high energy particle astrophysics

- The Dark Energy Survey project is nearing completion and will begin operations in 2012
  - DOE built camera for NSF telescope in Chile
  - The next phase in ground-based dark energy investigations
Cosmic Frontier : Next Steps

- The Particle Astrophysics Scientific Assessment Group (HEPAP subpanel) made several recommendations, including:
  - Fund the High Altitude Cerenkov Array (HAWC) in all funding scenarios.
    - Will be done in partnership with NSF.
    - FY 2012 request includes an MIE start of $1.5 million of a total $3 million.
  - Pursue R&D on at least two technologies for direct searches for Dark Matter.
    - Dark matter searches are very sensitive to backgrounds.
    - Need to demonstrate excellent background rejection before choosing a technology.
    - FY 2012 request includes $3 million for R&D on the technologies.

- NRC Astronomy and Astrophysics Decadal Survey laid out a coordinated science plan for Dark Energy
  - Ground-based : Mission Need Statement signed by the Director of the Office of Science for a “Stage IV” experiment.
    - Working to coordinate LSST project planning with NSF.
  - Space-based : JDEM R&D will be closed out this year.
    - NASA has the lead on WFIRST. We continue to talk with them.
Accelerator R&D Significant Changes

- The FACET Project to build a beam driven wakefield acceleration test facility completes this year.
  - Held a workshop to inform experimenters of its capabilities.
  - FY 2012 budget request includes $6 million to operate it.
- The ILC R&D program is reduced by $12.5 million from FY 2010.
  - There have been notable accomplishments in the program, but the time scale for starting an ILC continues to recede.
    - Advanced Energy Systems (Medford, NY) working with Thomas Jefferson National Accelerator Facility produced superconducting RF cavities that exceed 35 MeV/m gradient 90% of the time in 2010.
      - The overall program achieved 50% of the time in 2009.
    - Information from the LHC needed to make a decision may not be available until 2014 or 2015.
      - ART has prioritized the remaining R&D that was planned for the ILC Global Design Effort to maximize its impact.
- Progress on developing an accelerator stewardship program has been delayed due to a lack of personnel. We are actively recruiting IPAs, detailees to help.
HEP OFFICE NEWS
Personnel Changes

- Dennis Kovar retired at the end of 2010.
  - Mike Procario been acting as Associate Director for HEP since January.
  - A search for a new AD is in progress.

- Positions filled:
  - New program managers in Computational HEP, Theory, LHC Operations (2 Feds, 1 IPA)
  - We have also hired a new financial analyst.
  - Moving paperwork for an additional IPA

- Departures:
  - Experienced managers in Computational HEP, Theory, LHC Operations (1 IPA, 1 detaiilee)

- We were unable to fill a federal position for a program manager in accelerator science. We are re-advertising soon.

- We are still seeking another IPA or detaiilee to work in accelerator science and on the accelerator R&D strategic plan.

- HEP Committee of Visitors (2010) reiterated the need for additional program staff
Search for a New Associate Director

- The search is being headed by Patricia Dehmer, Deputy Director for Programs, Office of Science.
- Nominations were solicited from the field.
  - Those nominated have been contacted by Dr. Dehmer and asked to apply.
- The posting for the position opened March 10th and will be open until May 10th.
  - The HEP website has a link.
  - Interested individuals must apply electronically through that link.
- A panel of three SES members from inside and outside the Office of Science will review all of the applications, and this panel will put forward the top candidates. Typically 4 to 8 candidates are put forward.
- There will be interviews with a team from HEP and Feds from outside HEP. The interview process may also include a presentation by each candidate to the HEP (as well as others in SC) staff.
- Dr. Brinkman will approve the selection.
- According to the rules set down by the Office of Personnel Management, a decision must be made within 90 days of the close of the posting – or about Aug 9th.
  - Still needs several levels of approval after SC decision
BUDGET DETAILS (BACKUP)
Cross cuts

By function
- EPP Research
- Technology Research
- Facilities
- MIE
- Construction
- SBIR/STTR

By program
- Proton
- Electron
- Non-accelerator
- Theory
- Advanced Tech
### Intensity Frontier: Construction Status

<table>
<thead>
<tr>
<th>Description</th>
<th>FY 2010</th>
<th>FY 2011 Request</th>
<th>FY 2011 Feb</th>
<th>FY 2012</th>
<th>FY12 vs FY10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>0</td>
<td>17,000</td>
<td>0</td>
<td>39,000</td>
<td>22,000</td>
</tr>
<tr>
<td>Mu2e (PED)</td>
<td>0</td>
<td>5,000</td>
<td>0</td>
<td>22,500</td>
<td>17,500</td>
</tr>
<tr>
<td>Mu2e (OPC)</td>
<td>4,777</td>
<td>5,000</td>
<td>6,467</td>
<td>7,500</td>
<td>4,777</td>
</tr>
<tr>
<td>Long Baseline Neutrino Experiment (PED)</td>
<td>0</td>
<td>12,000</td>
<td>0</td>
<td>17,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Long Baseline Neutrino Experiment (OPC)</td>
<td>14,178</td>
<td>0</td>
<td>2,750</td>
<td>7,000</td>
<td>-7,178</td>
</tr>
</tbody>
</table>

- Both projects had their first request for PED funds in FY 2011. No funds have been approved in FY 2011.

- **Work on both projects has been slowed to prevent a gap in funding.**
  - Experience in FY 2008 when the NOvA project lost funding has shown that it takes 6 to 9 months to rebuild a project team after dispersing them.
    - It is better to slow work and keep a core team together.
  - The FY 2012 request includes OPC funding for both projects to prevent a funding gap in case there is a CR at the beginning of FY 2012.
### Proton Accelerator Based Research

<table>
<thead>
<tr>
<th>Description</th>
<th>FY 2010</th>
<th>FY 2011 Request</th>
<th>FY 2011 Feb</th>
<th>FY 2012</th>
<th>FY12 vs FY10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proton Accelerator Based Physics</td>
<td>438,369</td>
<td>439,262</td>
<td>441,823</td>
<td>412,707</td>
<td>-25,662</td>
</tr>
<tr>
<td>Research</td>
<td>125,743</td>
<td>130,299</td>
<td>130,419</td>
<td>127,696</td>
<td>1,953</td>
</tr>
<tr>
<td>Facilities</td>
<td>312,626</td>
<td>308,963</td>
<td>311,404</td>
<td>285,011</td>
<td>-27,615</td>
</tr>
<tr>
<td>Proton Accelerator Complex Operations</td>
<td>125,945</td>
<td>123,215</td>
<td>135,830</td>
<td>103,374</td>
<td>-22,571</td>
</tr>
<tr>
<td>Proton Accelerator Complex Support</td>
<td>13,001</td>
<td>16,617</td>
<td>11,760</td>
<td>12,462</td>
<td>-539</td>
</tr>
<tr>
<td>Proton Accelerator Facility Projects</td>
<td>86,591</td>
<td>74,463</td>
<td>73,137</td>
<td>76,740</td>
<td>-9,851</td>
</tr>
<tr>
<td>Current Facility Projects</td>
<td>79,998</td>
<td>59,220</td>
<td>63,437</td>
<td>61,740</td>
<td>-18,258</td>
</tr>
<tr>
<td>NOvA</td>
<td>59,000</td>
<td>46,220</td>
<td>46,220</td>
<td>41,240</td>
<td>-17,760</td>
</tr>
<tr>
<td>MicroBooNE</td>
<td>2,043</td>
<td>8,000</td>
<td>8,000</td>
<td>6,000</td>
<td>3,957</td>
</tr>
<tr>
<td>Mu2e</td>
<td>4,777</td>
<td>5,000</td>
<td>6,467</td>
<td>7,500</td>
<td>2,723</td>
</tr>
<tr>
<td>LBNE</td>
<td>14,178</td>
<td>0</td>
<td>2,750</td>
<td>7,000</td>
<td>-7,178</td>
</tr>
<tr>
<td>Future Facility R&amp;D</td>
<td>6,593</td>
<td>15,243</td>
<td>9,700</td>
<td>15,000</td>
<td>8,407</td>
</tr>
<tr>
<td>Large Hadron Collider Support</td>
<td>79,511</td>
<td>84,033</td>
<td>78,818</td>
<td>72,761</td>
<td>-6,750</td>
</tr>
<tr>
<td>Other Facilities</td>
<td>7,578</td>
<td>10,635</td>
<td>11,859</td>
<td>19,674</td>
<td>12,096</td>
</tr>
</tbody>
</table>
Electron Accelerator-based Physics

- The SLAC B-factory shutdown in 2008.
- Funding for support for researchers and computing continues to ramp down.
- Funding is provided to disassemble the Babar detector and PEP-II accelerator.
  - HEP is investigating giving accelerator components to Italy for their use.
    - This would be less expensive than disposing of them.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Electron Accelerator-Based Physics</td>
<td>30,212</td>
<td>24,707</td>
<td>24,707</td>
<td>22,319</td>
<td>-7,893</td>
</tr>
<tr>
<td>Research</td>
<td>15,263</td>
<td>14,927</td>
<td>14,927</td>
<td>13,069</td>
<td>-2,194</td>
</tr>
<tr>
<td>Grants Research</td>
<td>5,959</td>
<td>6,337</td>
<td>6,692</td>
<td>5,192</td>
<td>-767</td>
</tr>
<tr>
<td>National Laboratory Research</td>
<td>9,278</td>
<td>8,565</td>
<td>8,235</td>
<td>7,877</td>
<td>-1,401</td>
</tr>
<tr>
<td>University Service Accounts</td>
<td>26</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>-26</td>
</tr>
<tr>
<td>Facilities</td>
<td>14,949</td>
<td>9,780</td>
<td>9,780</td>
<td>9,250</td>
<td>-5,699</td>
</tr>
<tr>
<td>Electron Accelerator Complex Operations</td>
<td>12,019</td>
<td>8,880</td>
<td>8,880</td>
<td>8,350</td>
<td>-3,669</td>
</tr>
<tr>
<td>Electron Accelerator Complex Support</td>
<td>2,930</td>
<td>900</td>
<td>900</td>
<td>900</td>
<td>-2,030</td>
</tr>
</tbody>
</table>
## Non-accelerator Physics

<table>
<thead>
<tr>
<th></th>
<th>FY 2010</th>
<th>FY 2011 Request</th>
<th>FY 2011 Feb</th>
<th>FY 2012 Request</th>
<th>FY 12 – FY 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Accelerator Physics</td>
<td>97,469</td>
<td>88,539</td>
<td>88,539</td>
<td>81,852</td>
<td>-15,617</td>
</tr>
<tr>
<td>Research</td>
<td>97,469</td>
<td>88,539</td>
<td>88,539</td>
<td>81,852</td>
<td>-15,617</td>
</tr>
<tr>
<td>Grants Research</td>
<td>21,708</td>
<td>22,556</td>
<td>19,853</td>
<td>21,417</td>
<td>-291</td>
</tr>
<tr>
<td>National Laboratory Research</td>
<td>44,933</td>
<td>43,923</td>
<td>47,826</td>
<td>46,435</td>
<td>1,502</td>
</tr>
<tr>
<td>Projects</td>
<td>30,828</td>
<td>22,060</td>
<td>20,860</td>
<td>14,000</td>
<td>-16,828</td>
</tr>
<tr>
<td>Current Projects</td>
<td>21,110</td>
<td>6,060</td>
<td>6,060</td>
<td>2,000</td>
<td>-19,110</td>
</tr>
<tr>
<td>DES</td>
<td>8,610</td>
<td>4,000</td>
<td>4,000</td>
<td>0</td>
<td>-8,610</td>
</tr>
<tr>
<td>SuperCDMS</td>
<td>1,500</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-1,500</td>
</tr>
<tr>
<td>Daya Bay</td>
<td>11,000</td>
<td>2,060</td>
<td>2,060</td>
<td>500</td>
<td>-10,500</td>
</tr>
<tr>
<td>HAWC</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1,500</td>
<td>1,500</td>
</tr>
<tr>
<td>Future Projects R&amp;D</td>
<td>9,718</td>
<td>16,000</td>
<td>14,800</td>
<td>12,000</td>
<td>2,282</td>
</tr>
</tbody>
</table>

- There is a $17 million decrease in projects as Daya Bay, DES, and SuperCDMS complete.
- LSST and dark matter experiments are in an R&D phase before starting MIEs.
### Theoretical Physics Research

<table>
<thead>
<tr>
<th>Description</th>
<th>FY 2010</th>
<th>FY 2011 Request</th>
<th>FY 2011 Feb</th>
<th>FY 2012</th>
<th>FY12 vs FY10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theoretical Physics Research</td>
<td>68,414</td>
<td>69,524</td>
<td>68,024</td>
<td>68,914</td>
<td>500</td>
</tr>
<tr>
<td>Research</td>
<td>68,414</td>
<td>69,524</td>
<td>68,024</td>
<td>68,914</td>
<td>500</td>
</tr>
<tr>
<td>Grants Research</td>
<td>27,415</td>
<td>27,555</td>
<td>28,055</td>
<td>27,415</td>
<td>0</td>
</tr>
<tr>
<td>National Laboratory Research</td>
<td>25,838</td>
<td>26,290</td>
<td>25,303</td>
<td>26,074</td>
<td>236</td>
</tr>
<tr>
<td>Computational HEP</td>
<td>11,476</td>
<td>10,400</td>
<td>10,400</td>
<td>11,076</td>
<td>-400</td>
</tr>
<tr>
<td>SciDAC</td>
<td>6,000</td>
<td>5,600</td>
<td>5,600</td>
<td>5,600</td>
<td>-400</td>
</tr>
<tr>
<td>Computational QCD and Network Support</td>
<td>5,476</td>
<td>4,800</td>
<td>4,800</td>
<td>5,476</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>3,685</td>
<td>5,279</td>
<td>4,266</td>
<td>4,349</td>
<td>664</td>
</tr>
</tbody>
</table>

Other is dominated by the Particle Data Group.
## Advanced Technology R&D*

<table>
<thead>
<tr>
<th>Description</th>
<th>FY 2010</th>
<th>FY 2011 Request</th>
<th>FY 2011 Feb</th>
<th>FY 2012</th>
<th>FY12 vs FY10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Technology R&amp;D</td>
<td>156,347</td>
<td>169,941</td>
<td>161,941</td>
<td>152,744</td>
<td>-3,604</td>
</tr>
<tr>
<td>Accelerator Science</td>
<td>36,933</td>
<td>48,580</td>
<td>41,444</td>
<td>45,167</td>
<td>8,234</td>
</tr>
<tr>
<td>Grants Research</td>
<td>8,146</td>
<td>9,080</td>
<td>9,880</td>
<td>10,150</td>
<td>2,004</td>
</tr>
<tr>
<td>National Laboratory Research</td>
<td>28,787</td>
<td>39,500</td>
<td>31,564</td>
<td>35,017</td>
<td>6,230</td>
</tr>
<tr>
<td>Accelerator Development</td>
<td>94,206</td>
<td>95,166</td>
<td>94,302</td>
<td>82,096</td>
<td>-12,110</td>
</tr>
<tr>
<td>General Accelerator Development</td>
<td>31,721</td>
<td>34,171</td>
<td>28,021</td>
<td>33,146</td>
<td>1,425</td>
</tr>
<tr>
<td>Superconducting RF R&amp;D</td>
<td>22,000</td>
<td>19,240</td>
<td>22,390</td>
<td>17,500</td>
<td>-4,500</td>
</tr>
<tr>
<td>Electron Beam Welder</td>
<td>0</td>
<td>3,200</td>
<td>3,200</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Muon Accelerator Program</td>
<td>5,494</td>
<td>3,555</td>
<td>10,691</td>
<td>8,950</td>
<td>3,456</td>
</tr>
<tr>
<td>International Linear Collider R&amp;D</td>
<td>34,991</td>
<td>35,000</td>
<td>30,000</td>
<td>22,500</td>
<td>-12,491</td>
</tr>
<tr>
<td>Other Technology R&amp;D</td>
<td>25,208</td>
<td>46,222</td>
<td>46,222</td>
<td>44,645</td>
<td>19,437</td>
</tr>
<tr>
<td>Detector Development, Grants Research</td>
<td>3,679</td>
<td>3,688</td>
<td>2,906</td>
<td>3,952</td>
<td>273</td>
</tr>
<tr>
<td>Detector Development, National Laboratory</td>
<td>21,529</td>
<td>22,507</td>
<td>23,289</td>
<td>21,529</td>
<td>0</td>
</tr>
</tbody>
</table>

*excluding SBIR/STTR