

JLab Report

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Overview

- The 6 GeV program continues to produce outstanding science
- The 12 GeV Upgrade is progressing beautifully toward 2015 project completion
 - “On cost, ahead of schedule” and “ready to start construction” per Lehman Review
 - Anticipate CD-3 September 3rd
- The 6 GeV program between now and the 2013 shutdown (running at ~80% utilization) presents outstanding opportunities
- Budgets and an impending Continuing Resolution are making life harder than we’d like!

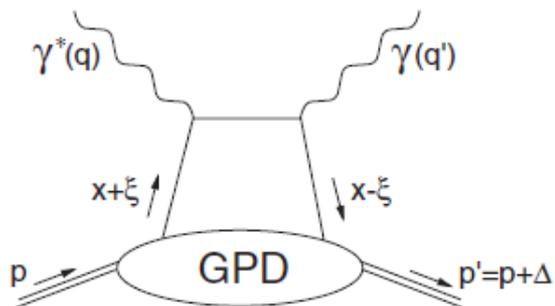
JLab: Recent Results

Recent Results: Nucleon Structure

Ji Sum Rule and DVCS Provide Access to Quark Angular Momentum

$$J_q = \frac{1}{2} \Delta \Sigma_q + L_q$$

$$= \frac{1}{2} \int_{-1}^{+1} dx x [H_q(x, \xi, t=0) + E_q(x, \xi, t=0)]$$

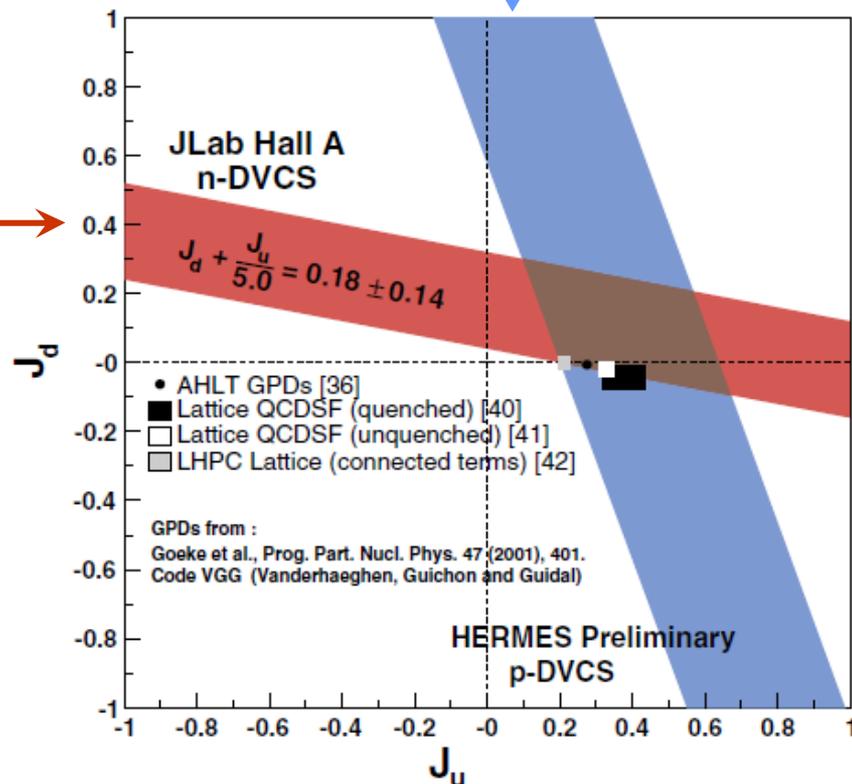


With a more limited data set, we can make a **model-dependent** determination of the quark angular momenta

$$\chi^2 = \sum_{i=1}^7 \frac{(\Im[C_n^I(t_i)]^{\text{exp}} - \Im[C_n^I(t_i)]_{J_u, J_d}^{\text{VGG}})^2}{(\delta_{\text{stat}}^{\text{exp}})^2 + (\delta_{\text{sys}}^{\text{exp}})^2}$$

Neutron measurements are mostly sensitive to J_d (d quark in the neutron)

Proton Measurements are mostly sensitive to J_u (u quark in the proton)

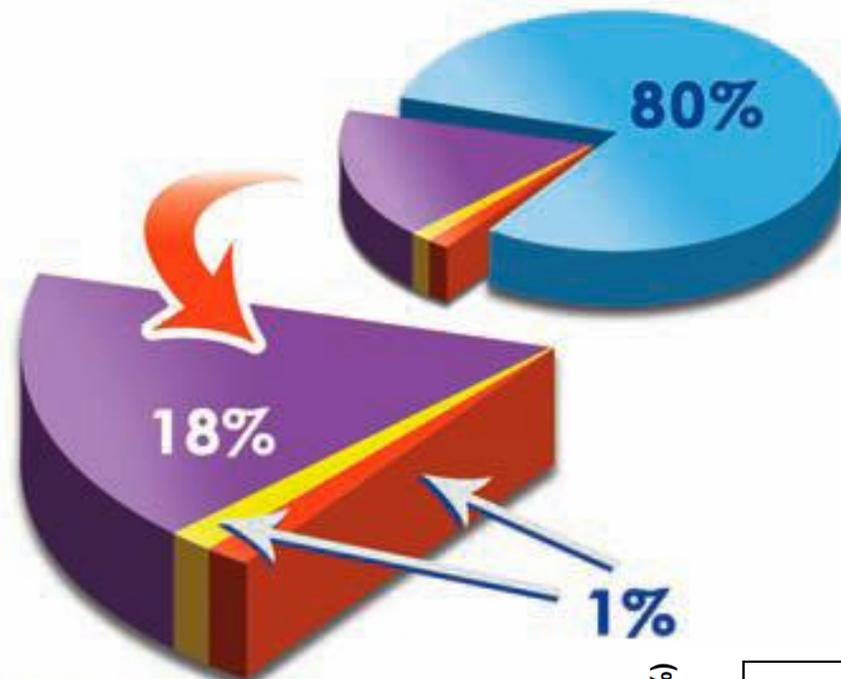
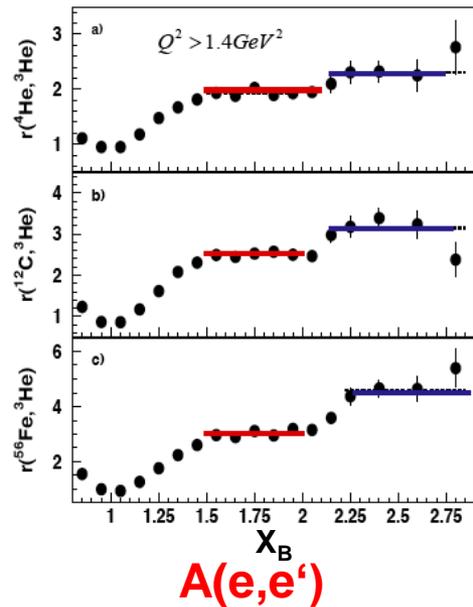


M. Mazouz et al., PRL 99 (2007) 242501

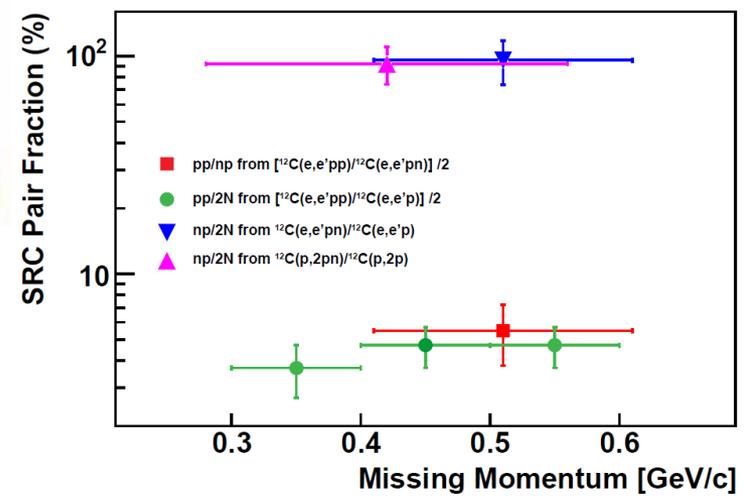
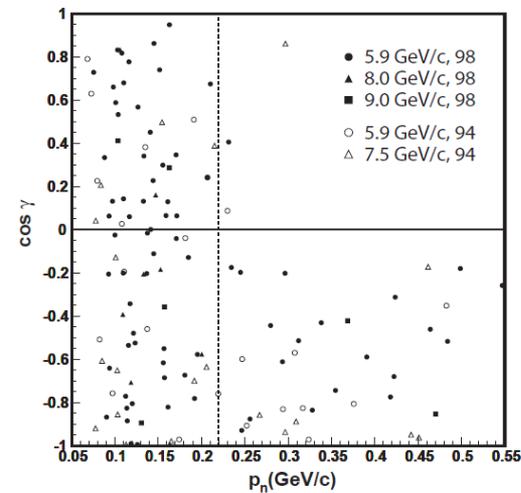
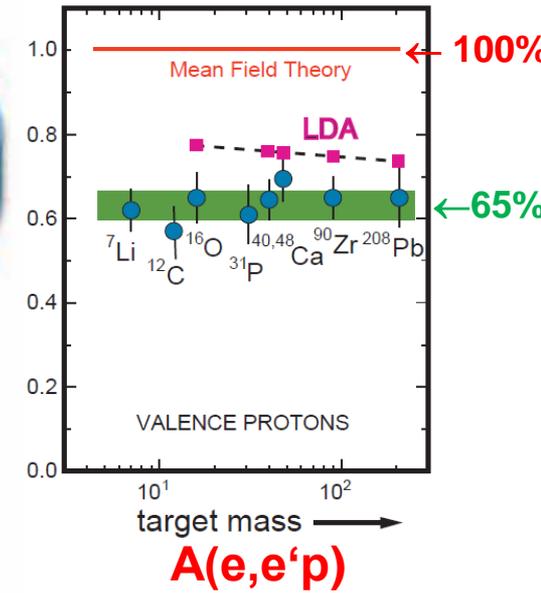
These experiments:

- Are establishing the validity of the GPDs and factorization,
- Demonstrate the complementarity of neutron and proton data
- Establish neutron measurements as essential in the hunt for quark orbital momentum

Recent Results: Structure of ^{12}C



NIKHEF



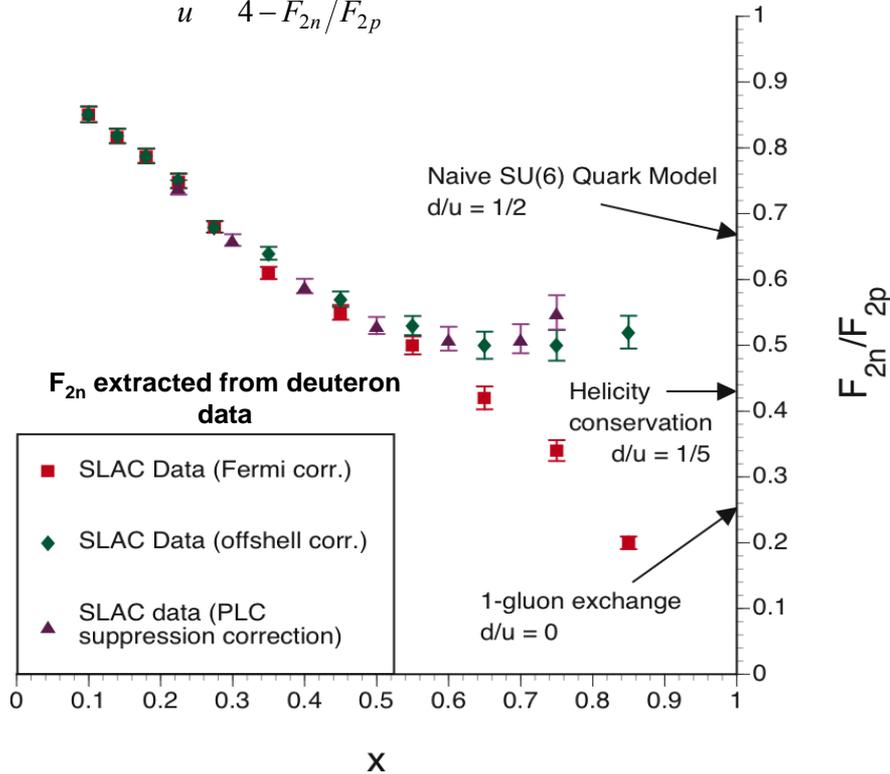
$^{12}\text{C}(p, 2pn)$

$^{12}\text{C}(e, e'pN)$

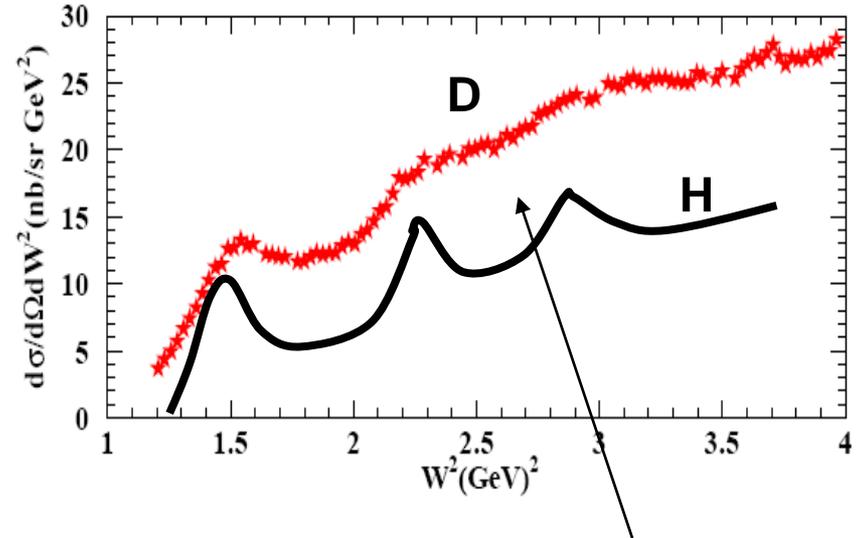
Recent Results: Neutron Structure Functions

The Problem: nuclear binding uncertainties prevent us from knowing F_{2n} and $d/u(x \rightarrow 1)$

$$\frac{d}{u} \approx \frac{4F_{2n}/F_{2p} - 1}{4 - F_{2n}/F_{2p}}$$



Inclusive electron scattering off hydrogen and deuterium $Q^2=1.5 \text{ GeV}^2$

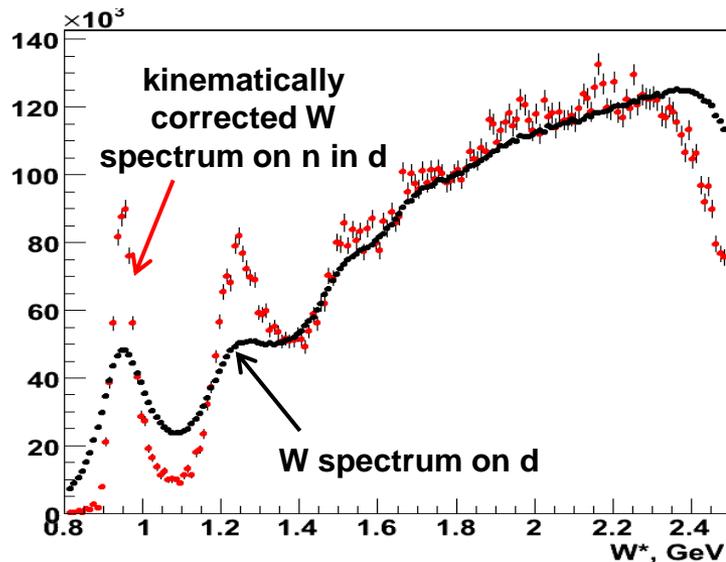


Neutron inferred from the difference (w/ corrections for Fermi motion, binding, etc....)

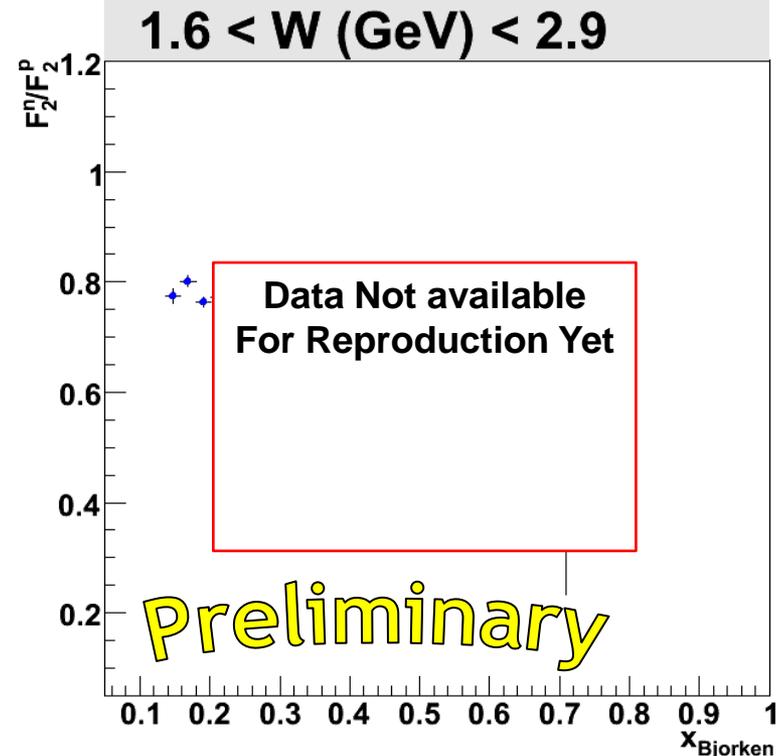
Recent Results: Neutron Structure Functions

The Solution: Spectator proton tagging to select the low-momentum part of the d wave function and tag the motion of the struck neutron

How? The **BoNuS** Experiment w/ CLAS uses a slow proton recoil detector (radial TPC)



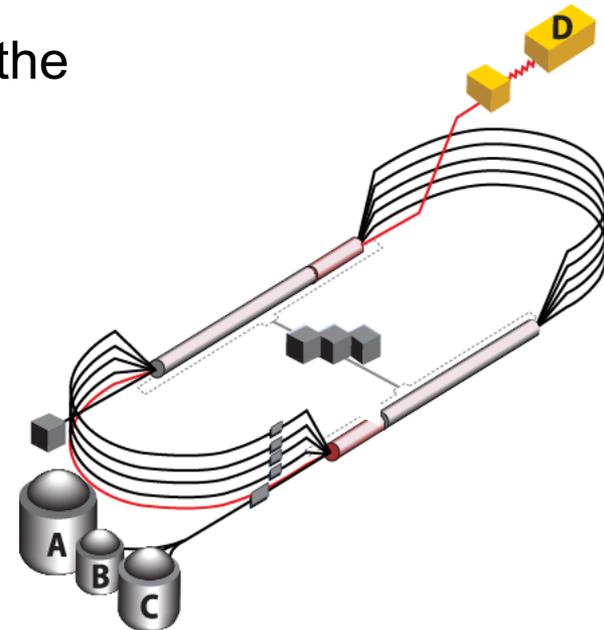
Analysis underway... results in early 2009



JLab: The 12 GeV Upgrade

12 GeV Upgrade Project Status

- **Successful DOE SC OPA Independent Project Review (Lehman Review) preparatory to CD-3:**
 - Project On Cost and Ahead of Schedule, No significant issues
 - Key R&D and PED Completed
 - Construction start recommended
- **Full CD-3 approval anticipated for 9/3/08 (DOE Board Mtg.)**
- **The 12 GeV Science program continues to evolve**
 - 2 PACs to date, with 3rd this January
 - 18 experiments approved as “appropriate for the first 5 years of 12 GeV operations”
 - 7 more experiments conditionally approved
 - Parity program proposals developing nicely
- **Concerns:**
 - Prolonged Continuing Resolution in FY09
 - Likely completion delay of 6 months
 - Likely cost increase of ~\$6M
 - Volatility in commodity prices, dollar decline



12 GeV Experimental Physics Progress

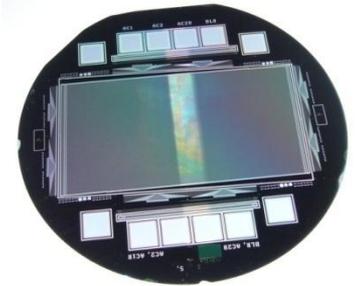
Hall A

- ARC Energy Measurement Upgrade simplified



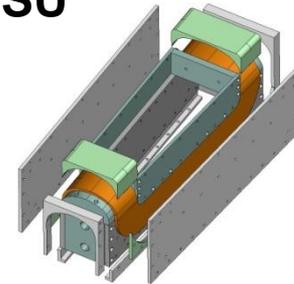
Hall B

- Many components prototypes, e.g. Central TOF
- SVT prototype tested, performed better than expected



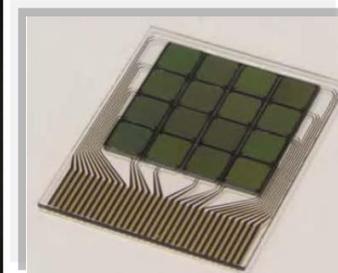
Hall C

- Solicitation issued for first large SC magnet, Horiz. Bend Magnet R&D: coil trial wind ongoing @ MSU
- Detector package finalized, mostly funded through non-DOE sources (NSF/MRI, Hermes Pb glass).
- MOUs for construction in development



Hall D

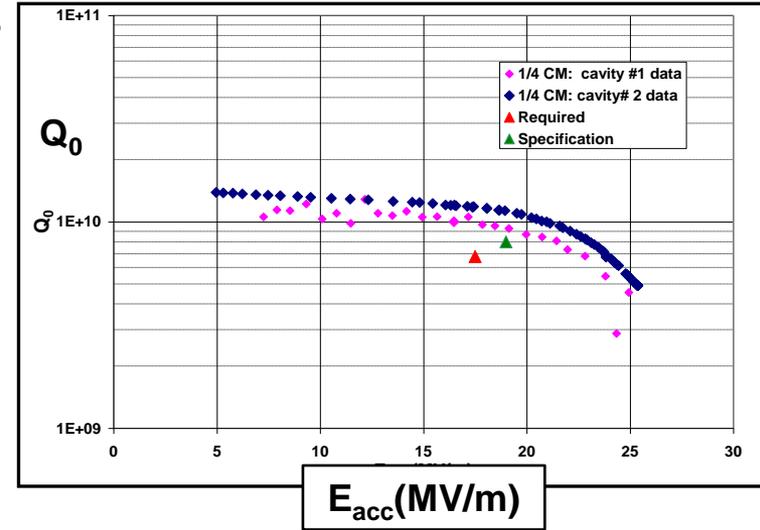
- Fast electronics/DAQ modules in evaluation phase
- Silicon PMT evaluation (3 x 3 mm²) progressing well, emphasis on quality assurance
- All detector components copies or prototyped



12 GeV Accelerator R&D Activities

Cryomodules: “1/4 cryomodule” tests

- Cavity gradient-vs-Q performance in a 1/4 cryomodule demonstrated to exceed spec.
- Damping of higher-order modes exceeds spec.
- All other components performed successfully (mechanical & piezo-electric tuners, waveguides, windows, etc).

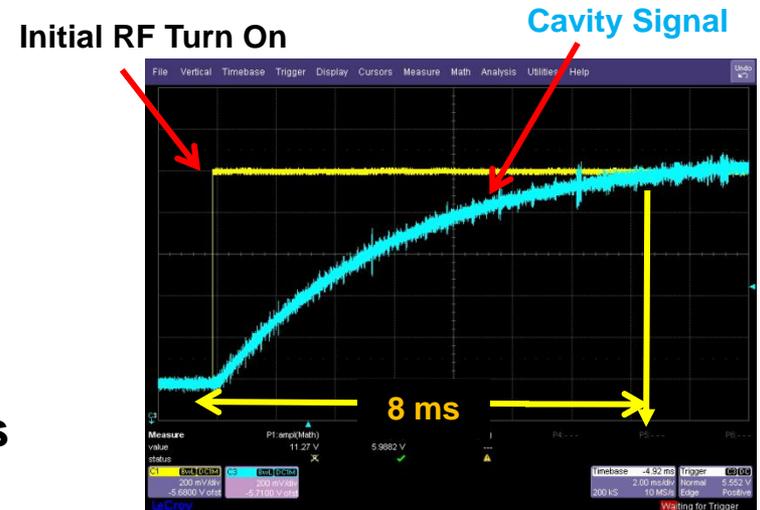


RF field control: Controlling actual 12 GeV cavities

- Digital controls bettered specification for phase and amplitude control
- World's first digital “self-excited loop” controls energize an off-resonance cavity in only 8 msec

Beamline magnets:

- Prototypes of the 2 new quadrupole designs have been tested successfully.



Cavity Gradient ~ 15 MV/m

JLab: Completion of the 6 GeV Program

Completion of the 6 GeV Program

- **The research program planned for the remainder of the “6 GeV Era” includes first-class opportunities to advance our understanding of hadronic matter, with major experiments on:**
 - The structure of the nuclear building blocks
 - The structure of nuclei
 - Fundamental Symmetries
- **As discussed at the Long Range Plan, we want to operate CEBAF at ~80% of optimum during 12 GeV construction as a balance between fulfilling commitments to the present program and redirecting funding toward the Upgrade**

Completion of the 6 GeV Program as Presented to LRP

- **Completion of data-taking for milestone-related physics**
 - Baryon spectroscopy (FROzen Spin Target and HDIce target data)
 - DVCS (CLAS Phase II and Hall A separation of BHxDVCS and DVCS²)
 - Structure function moments (SANE, d_2^n)
 -
- **Important new data on:**
 - Nucleon EM form factors (G_E^p to higher Q^2 and High Precision at low Q^2)
 - Strange quark distributions (HAPPEX III)
 - Hypernuclear spectroscopy (HKS)
 - Correlations (Coulomb Sum Rule and $^4\text{He}(e,e'pN)$ data extended)
 - Dispersive effects in electron scattering [(e^+,e^+) , and polarization transfer tests]
 - Transversity
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- **Unique new experimental directions:**
 - PREx (rms radius of neutron dist. for nuclear structure, astrophysics, and atomic PV Standard Model tests)
 - Q_{Weak} (Weak charge of the proton for a Standard Model Test)
- **Measurements in new areas of research that will be a focus of science with the 12 GeV Upgrade, such as:**
 - Single spin asymmetries
 - DVCS w/ Longitudinally polarized target
 - Hadronization
 - Hybrid Meson Searches
 -

Progress Toward the Completion of the 6 GeV Program

- **Completion of data-taking for milestone-related physics**
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[2008 Completed Experiments in Blue](#)

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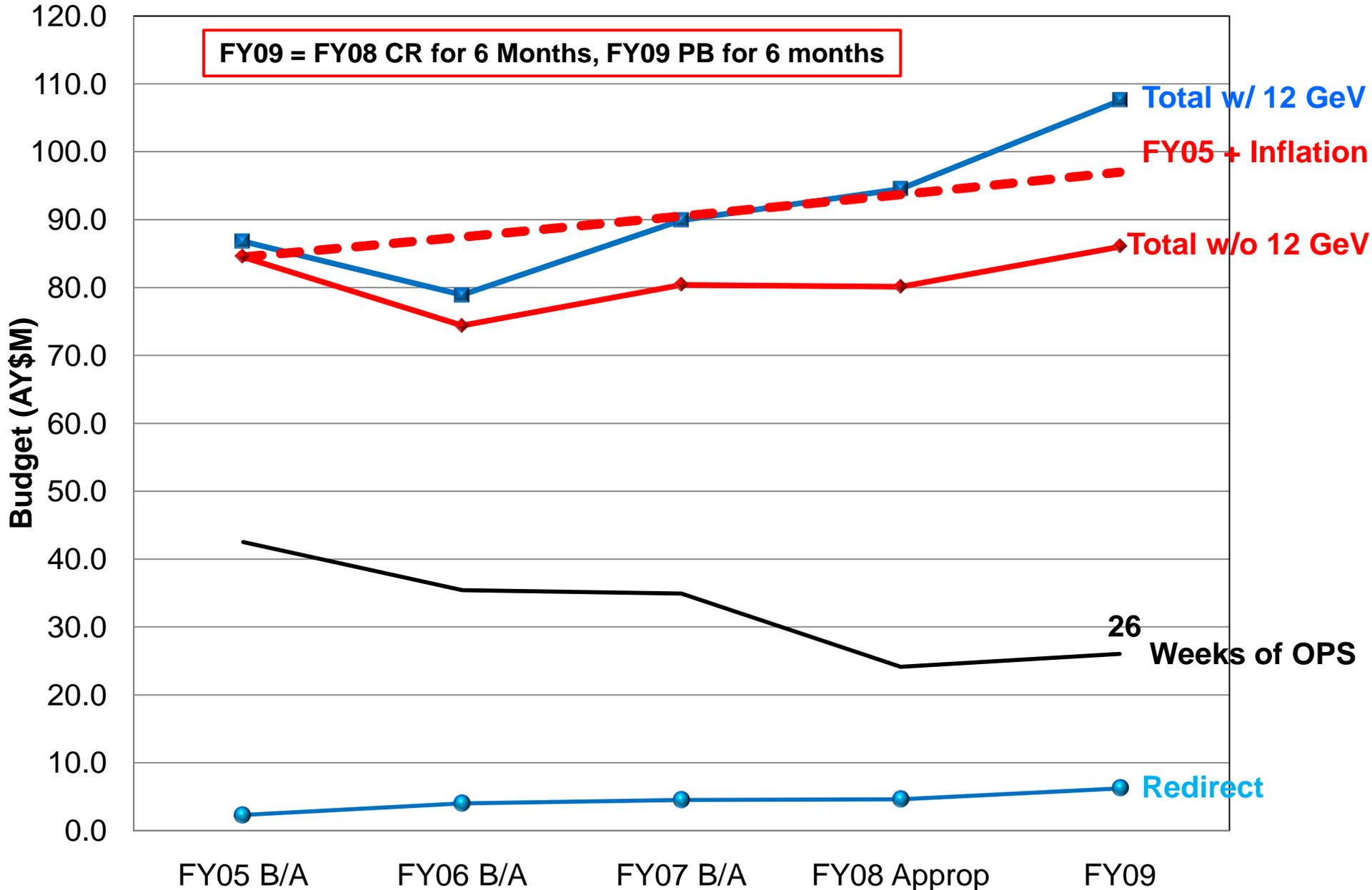
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- [2008 Completed Experiments in Blue](#)
[2009 Planned Experiments in Red](#)

Budgets Put Major Elements of the 6 GeV Program at Risk

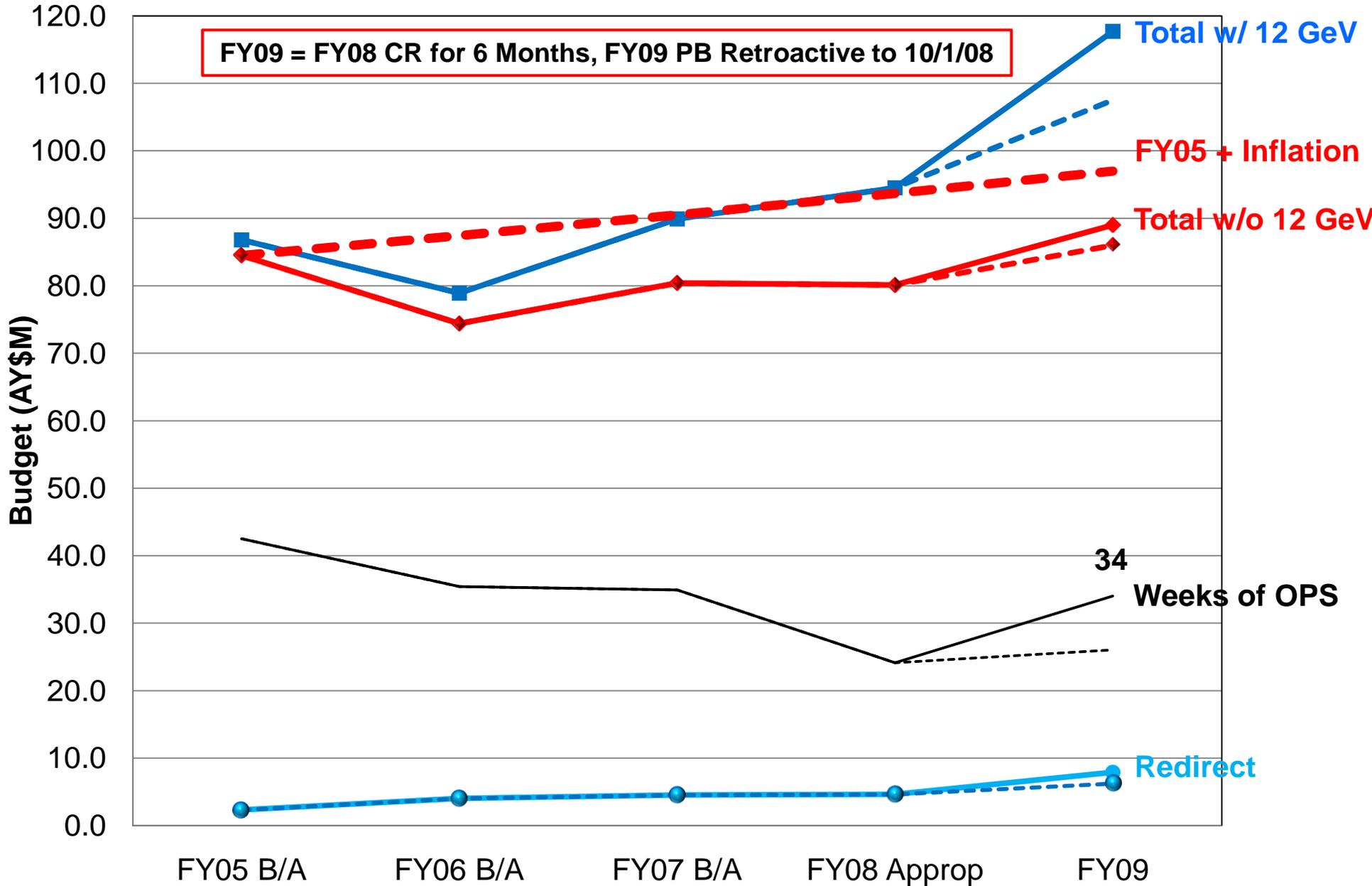
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 -
- FY09 At Risk; FY10-12 At Risk**
[2008 Experiments in Blue](#)
[2009 Planned Experiments in Red](#)

JLab: Budgets and the Continuing Resolution

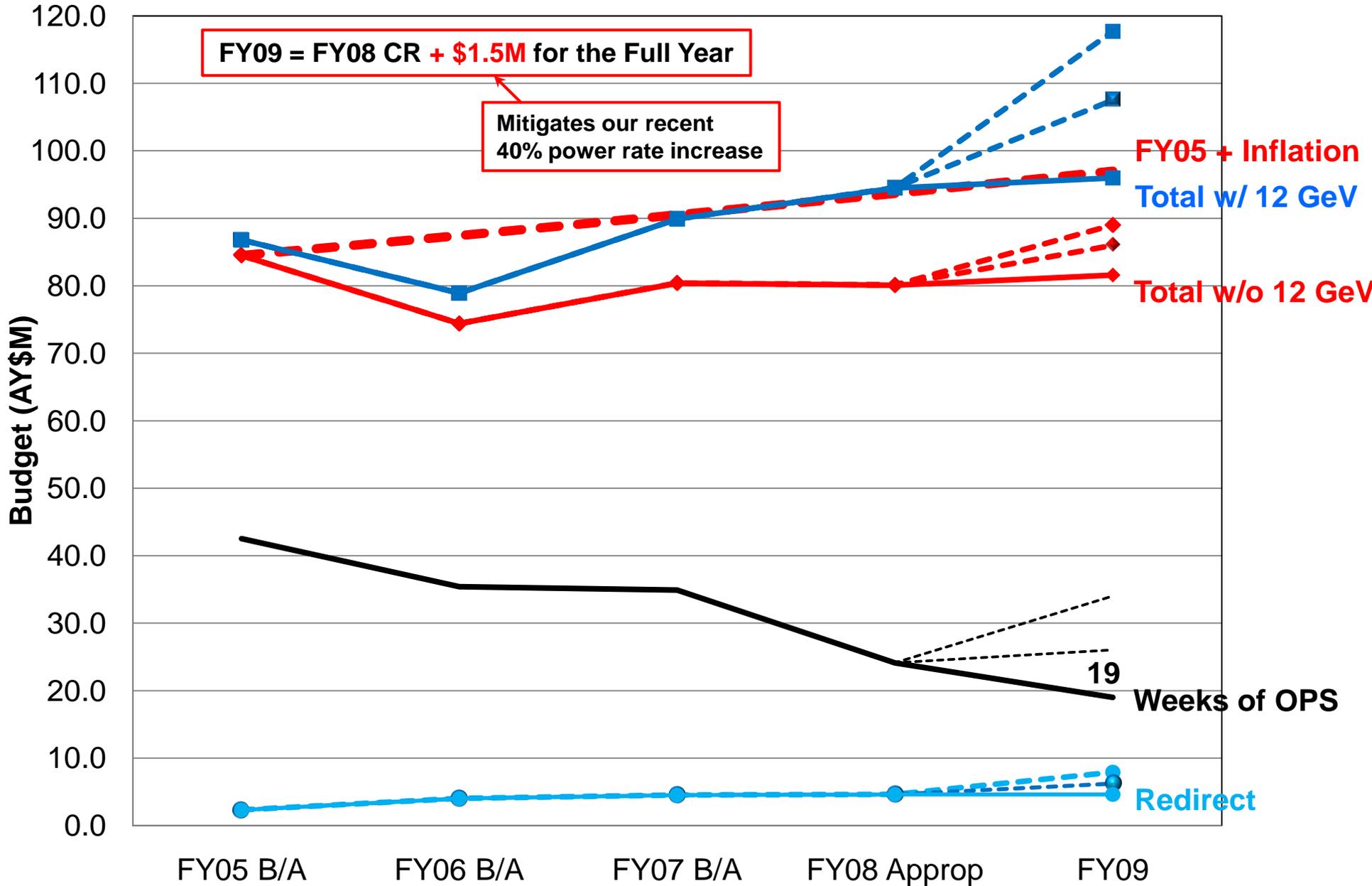
Budget History and Outlook – Base Scenario



Budget History and Outlook – Scenario 2



Budget History and Outlook – Scenario 3



Budget Issues and Concerns

Continuing Resolution Impacts:

- **12 GeV Construction Funding Not Available During FY09 CR**
 - ⇒ Likely Schedule Slip and Increased Total Project Cost (6 Months / \$6M)
- **Annual Carryover Essentially Gone**
 - \$7.7M in FY05 → ~\$0.5M in FY09; Helped Offset FY06-FY08 Budget Deficit
 - Extended Continuing Resolution in FY09 creates cash flow problem

Overall Budget Impacts:

- **Budget Levels Not Keeping Up with Cost of Living Increases:**
 - ⇒ Unable to Sustain Current Workforce Level without Assistance from DOE
 - ⇒ Absorbing Significant Power Rate Increases without Increase in Budget
 - ~50% Rate Increase in 5 Years (38% in FY08! – mitigated by \$1.5M addition to budget)
 - \$5.1M in FY05, \$6.3M Likely in FY09 w/ 16 Fewer Weeks of Running
 - ⇒ Decreased Ability to Procure Materials and Supplies
 - Down 14%: \$27.1M in FY05, \$23.3M Likely in FY09
 - ⇒ Difficult to Maintain/Attract Personnel with Minimal to No Salary Increases
- **Infrastructure Investments Increasing ⇒ Fewer \$\$\$ for Science**
 - FY05 GPP = \$0.8M; FY09 Likely GPP = \$1.4M → Committed to \$2M Annually
- **Increased EH&S and cybersecurity requirements ⇒ Fewer \$\$\$ for Science**
 - ~ 8.5 FTEs and \$1.5M/year Increase from FY05

Conclusions

- The 6 GeV program continues to produce outstanding science
- The 12 GeV Upgrade is progressing beautifully toward 2015 project completion
 - “On cost, ahead of schedule” and “ready to start construction” per Lehman Review
 - Anticipate CD-3 September 3rd
- The 6 GeV program between now and the 2013 shutdown (running at ~80% utilization) presents outstanding opportunities, **but budget limitations may keep us from realizing its potential**
- Budgets and an impending Continuing Resolution are making life harder than we’d like!
 - CR may delay 12 GeV 6 months and add \$6M to cost
 - Budget levels, increased infrastructure investments, and increased EH&S and cybersecurity requirements are reducing \$\$\$ available for science