Status of the APEX experiment

The A’ Experiment (APEX)
Searching for a new Vector Bosons $A'$ Decaying to $e^+e^-$
Jefferson Laboratory

G.B. Franklin (Carnegie Mellon University)
for the APEX Collaboration

Spokespeople: R. Essig, P. Schuster, N. Toro, B. Wojtsekhowski
APEX Collaboration List Goes Here
APEX Dark Photon Production and Detection

$e^- \rightarrow A' \rightarrow \llap{\sim} \left( \frac{m_A}{E} \right)^{3/2} \text{(narrow)} \rightarrow l^- \llap{\sim} \frac{m_A}{E} \rightarrow l^+$

$E_{A'} \approx E_{\text{beam}} - m_{A'}$

$E_{e^-} \approx m_{A'}$

Energy = $E$

Electron, $P = E0/2$

Positron, $P = E0/2$
The APEX $A'$ Signal

**A' Production**

$e^- e' = \varepsilon e^-$

$A'$

$e^-$

Nucleus

$\sigma \sim \alpha'/m^2 = \varepsilon^2 \alpha/m^2$

**QED Backgrounds**

$\gamma^* \rightarrow e^+ e^-$

$d\sigma \sim \alpha^2/m^3 \, dm$

- Narrow peak on broad background
- Region of sensitivity: $\alpha'/\alpha > 9 \times 10^{-8}$
  
  $65 \, \text{MeV} \leq m_{A'} \leq 525 \, \text{MeV}$
- Requires missing mass resolution $\delta m = 0.5\%$
- APEX achieves this using:
  1) JLab’s twin High Resolution Spectrometers
  2) Novel tungsten-ribbon target
Coverage Achieved With 4 Kinematic Settings

65 MeV \leq m_{A'} \leq 525 MeV

1 Month Beam Time

A) 6 days @ 2.3 GeV
B) 12 days @ 4.5 GeV
C) 6 days @ 1.1 GeV
D) 6 days @ 3.3 GeV
Status: The APEX Test Run

- Test run performed in Hall A, July 2010
- Verified all key aspects of apparatus performance
- 700k good trident events

JHEP 1102:009,2011, arxiv:1001.2557
Status: The APEX Septum Magnet

- $e^+e^-$ pairs at $\sim\pm 5^\circ$
- Septum magnet required
- Completed Aug. 2014
- Ready for checkout
- Field map measurements

Funding was provided by five universities: NCCU, CMU, CSULA, SBU, UW(Ca)
Status: Tungsten-Ribbon Target

Large Z target
Accepted $e^+e^-$ pairs miss downstream foils
Holders compensate for temperature increases

SLAC-designed target at JLab
• Ongoing Preparations
• Motion interface
• Heat-load analysis
• Procure target holders
Status: SciFi Detectors

- “Active sieve-slit” – enables optics calibration without switching beam energy & $e^+$ arm polarity
  - For low-current optics calibration runs only; will be removed during production runs

- Two hodoscopes assembled 2012 & 2013
- New readout electronics (FADC) being installed
- Testing this summer
- Need commissioning and incorporating in optics fit
Status: Other Ongoing Projects

- Vacuum chamber & corrector magnet design
- **Radiation** study & shielding
- **Analysis**: High-rate VDC reconstruction, online software
- Update reach & QED background model
Conclusion

• Ready to run Spring 2015

• WHAT ELSE DO WE WANT TO SAY?