Welcome & Introduction

APEX phone meeting, 10/17/2014

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Today’s meeting

• Introduction (10’)
  (Dark Photon Status + APEX overview)

• Summary of Outstanding Tasks (20’)

• Discussion of Outstanding Tasks (20’)

• Discussion of draft authorship rules (10’)

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Dark Photons & Current Status
A’ couples to Quarks and charged Leptons

allows production of A’ in $e^+e^-$ colliders, electron & proton beam dumps, meson decays etc.

consider only A’ masses $>$ 1 MeV
A' decays

APEX region

$\text{Br}(A' \rightarrow \text{SM})$

$e^+ e^-$

hadrons

$\mu^+ \mu^-$

$m_{A'}$ [GeV]
Status ~2008

A' → Standard Model

dark photons considered well before 2008, but constraints never discussed in detail
Status ~Today (published results)
APEX vs The World

\[ \epsilon^2 \quad m_{A'} \text{ [GeV]} \]

- APEX
- The World

\( a_{\mu, \pm 2 \sigma} \)

favored

DarkLight

HPS

Orsay

U70

HADS

KLOE

PHENIX

A1

BaBar

KLOE

Mu3e

NA48/2

E774

E141

a_e

APEX vs The World
How does APEX work?
Electron-beam Fixed-Target Concept

Detector

Target
(e.g. tungsten)

Detectors
APEX Goal and Strategy

Goal: find an $A'$ resonance!

Challenge: find it over large, but smooth, background

Requires large statistics & excellent mass resolution!

Sensitivity controlled by $S/\sqrt{B}$ in mass window $\Delta m$,

$$ \frac{S}{\sqrt{B}} \sim \frac{\epsilon^2}{\alpha} \sqrt{N_{QED} \left( \frac{m_{A'}}{\Delta m} \right)} $$
Experimental Setup

- Electron, $P = \frac{E_0}{2}$
- Positron, $P = \frac{E_0}{2}$
- Septum
- Beam $E_0$
- tungsten target
- $A' - e^-$
- $e^+$
- high-resolution spectrometer (HRS-left)
- high-resolution spectrometer (HRS-right)
APEX is designed and optimized for $A'$ resonance search with large statistics and excellent mass resolution:

- JLab Hall A: **High-current CW beam & high-resolution spectrometers (HRS’s)**
- Spectrometer configuration with septum **maximizes signal acceptance** while reducing background
- HRS detectors & DAQ allow for high singles rate operation
- Minimize contributions to angular resolution from spectrometer optics reconstruction and multiple-scattering in target
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