Future Directions for APEX

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By the way... arXiv:1404.5502v1.pdf

Search for light massive gauge bosons as an explanation of the $(g - 2)_{\mu}$ anomaly at MAMI

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(A1 Collaboration)





- [Near Term] Optimizing the APEX Run Plan
- Vertex searches?
- Muon and pion final states
- Wider angle and higher energy

APEX in context: Dec 2010 (PAC37)



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A good sign— Vibrant field!

A lot of progress on (the easy half) of our region of interest.

Would modified run plan explore more new ground?

e.g.
– shift settings
– more time at fewer settings

APEX Run Plan



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e.g.

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We need to re-evaluate APEX reach & run plan in light of new info. since PAC 37 proposal

- Detailed model of APEX septum acceptance (from John LeRose)
- Non-uniform efficiency in VDC
- Full modeling of QED backgrounds for PAC37: (no-interference)*(constant rescaling)
- Should improve pion yield & rejection estimates and resulting bandwidth limits

This is underway – led by James Beacham but with very limited time

Prerequisite for making good decisions about run plan 8

- [Short Term] Optimizing the APEX Run Plan
- Vertex searches?
- Muon and pion final states
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Can we do vertexing?





How clean is two-track vertex resolution?

2-track vertex (HPS, M. Graham)

Can we do vertexing?

APEX production target



Fill e.g. every 3rd holder – thermal studies would need to be revisited



 – compromises bump-hunt sensitivity (but maybe not as much as we think)

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Branching ratios



μ+μ- could double statistics on high-energy runs, has somewhat different mass coverage and somewhat independent search π + π - could help make APEX competitive at higher energies (see next)

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Questions



Need trigger strategy to keep $\pi^+\pi^-$ and $\mu^+\mu^-$ but reject π^+e^- Background rates for $\pi^+\pi^-$ less known • [Short Term] Optimizing the APEX Run Plan

• Vertex searches? *positive findings could impact run plan*

• Muon and pion final states *positive findings could impact run plan*

• Wider angle and higher energy *more futuristic*



- LIMIT: B field saturation in the septum even reaching 7.5° bend angle for 2.2 GeV electron/positron was
- Same field integral at 3.3 GeV would only bend by 5°
 ...so we can think about 7° opening angle
- Would require dedicated wider-angle septum, but appears achievable (perhaps can cannibalize APEX septum?)

Step 1: would such a setup have interesting reach? e.g. 4.4 and 6.6 GeV settings cover m_{A'}~400-700 MeV and 600-1000 MeV respectively, but to what coupling? Higher-Mass A' at APEX?

Step 1: would such a setup have interesting reach? e.g. with 7.5° opening angle, 4.4 and 6.6 GeV settings cover $m_{A'}$ ~400-700 MeV and 600-1000 MeV respectively, but to what coupling?

Ingredients:

- detect e+e– only, or also μ and π ?
- pion backgrounds? e.g. WISER
- EM backgrounds? e.g. MadGraph

Progress on muon pairs for other physics (e.g. asymmetry) may make this more interesting.