Brief update on status of dark photons

Rouven Essig

APEX phone meeting, 3/14/2014
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

\[ m_{A'} \text{ [GeV]} \]

- $e^+ e^-$
- $\mu^+ \mu^-$
- hadrons
Status ~2008

A' → Standard Model

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

A' → Standard Model

(only showing strongest constraints)
Re-interpretation by theorists of a BaBar analysis looking for pseudo-scalar decaying to $\mu^+\mu^-$.
Use rare meson decays

\[ \phi \rightarrow \eta A' \]
\[ A' \rightarrow e^+ e^- \]
\[ \eta \rightarrow \pi^+ \pi^- \pi^0 \]
\[ \eta \rightarrow \pi^0 \pi^0 \pi^0 \]
WASA detector at COSY

\[ \pi^0 \rightarrow \gamma A' \quad A' \rightarrow e^+ e^- \]

\[ 5 \times 10^5 \, \gamma e^+ e^- \text{ events} \]
APEX/MAMI

based on test runs

$A' \to \text{Standard Model}$

$\epsilon^2$ vs $m_{A'}$ (GeV)

APEX/MAMI Proof of Principle
PHENIX@RHIC (BNL) 2013/14

(unpublished, presented in a talk)

A$^\prime$ → Standard Model

$\pi^0 \rightarrow \gamma A'$

$A' \rightarrow e^+ e^-$
Existing data; analyses almost complete

BaBar
(full dataset, other final states)

MAMI
(more run settings)

projections are rough; final results may differ!!!
HPS's 2015 run in Hall B

Run Plan still being determined i.e. curves may change!

Status ~2015?

WASA projected run

HPS's 2015 run in Hall B

Run Plan still being determined i.e. curves may change!
APEX

APEX’s projected full run

Will have significant new reach
Unclear: more Phenix data?
What are final MAMI and BaBar reach?
CERN-SPS?

clear: more results expected of course in 2016 and beyond
Field very active
APEX has important role to play