Simplest example of additional U(1) model

(Holdom 1986)

$$\mathcal{L} = -\frac{1}{4}V_{\mu\nu}^2 - \frac{\kappa}{2}V_{\mu\nu}F^{\mu\nu} + |D_\mu\phi|^2 - V(\phi),$$

This Lagrangian describes an extra U(1)' group (**dark force, hidden photon, secluded gauge boson etc, also known as U-boson, V-boson, A-prime, gamma-prime etc**), attached to the SM via a vector portal (kinetic mixing). Mixing angle κ (also known as ϵ, η, χ) controls the coupling to the SM.

For the purpose of this talk, I will consider broken U(1)', with the scale of the breaking in a window from MeV-to-GeV. Mixing angle and mass m_V are the only parameters – the model is very minimal.

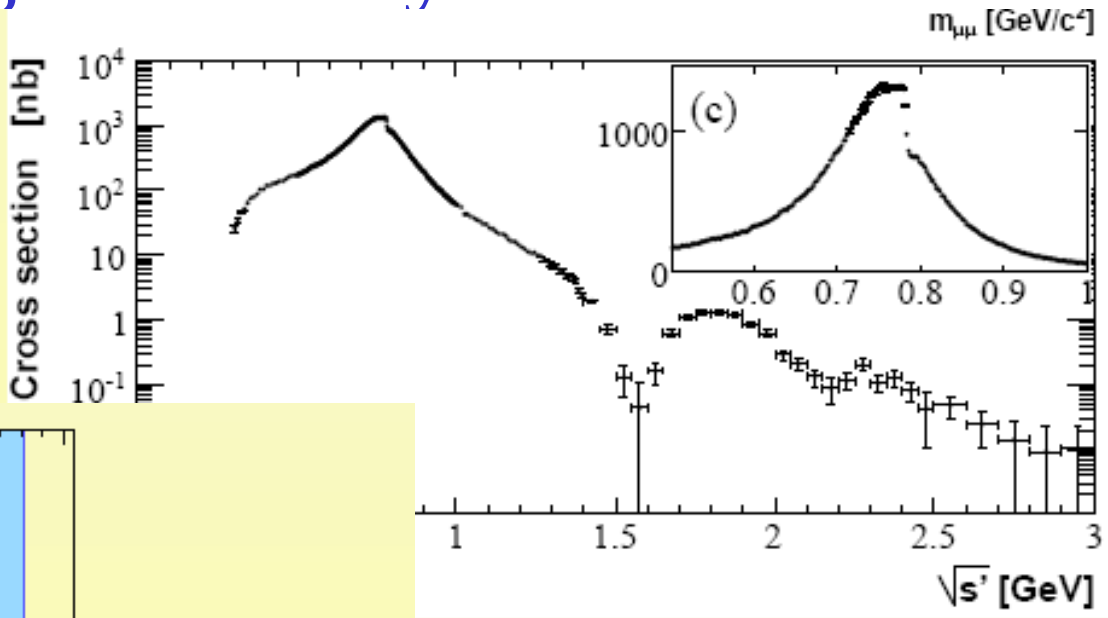
A much broader scan can be found in the review of J.Jaeckel, A.Ringwald, **arXiv:1002.0329**

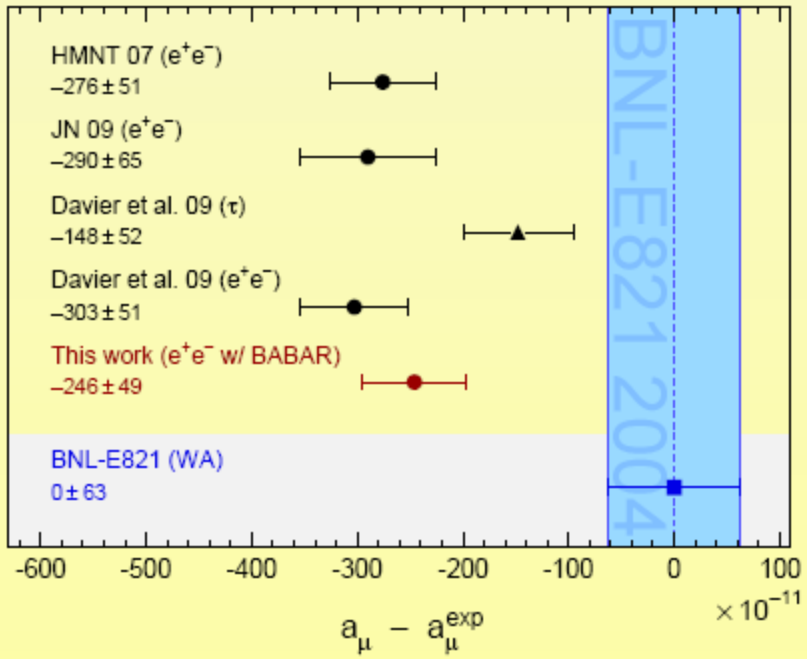
Why searching for new gauge boson(s) at low and medium energies is important

1. Standard Model is built on SU(3)xSU(2)xU(1) interactions. *Testing for existence of additional gauge groups is needed.*
2. Hints for new sub-GeV gauge bosons might be given to us by *several particle physics anomalies*, most importantly g-2 of the muon.
3. New U(1) groups can serve as mediators of connection between SM and particle dark matter. *Speculative but interesting*.
4. Additional U(1) with kinetic mixing to photons is a very "natural" possibility of new light physics. *It is very simple – even elegant – and extremely predictive.*
5. Significant advances can be achieved using fixed target setups. Only a very small subset of experiments done at low energy can be sensitive to physics beyond SM. Therefore, *it should be done, given a potentially enormous reward in case of a positive result.*

Precision frontier:
Anomaly in g-2 anomaly of muon

Recent BaBar data





The discrepancy of 300×10^{-11} (theoretical value is smaller) is 3.1 sigma away from the measured value. First signs of new physics ?

✱ Davier et al. arXiv:0906-5443

Summary of proposed experiments

DarkLight

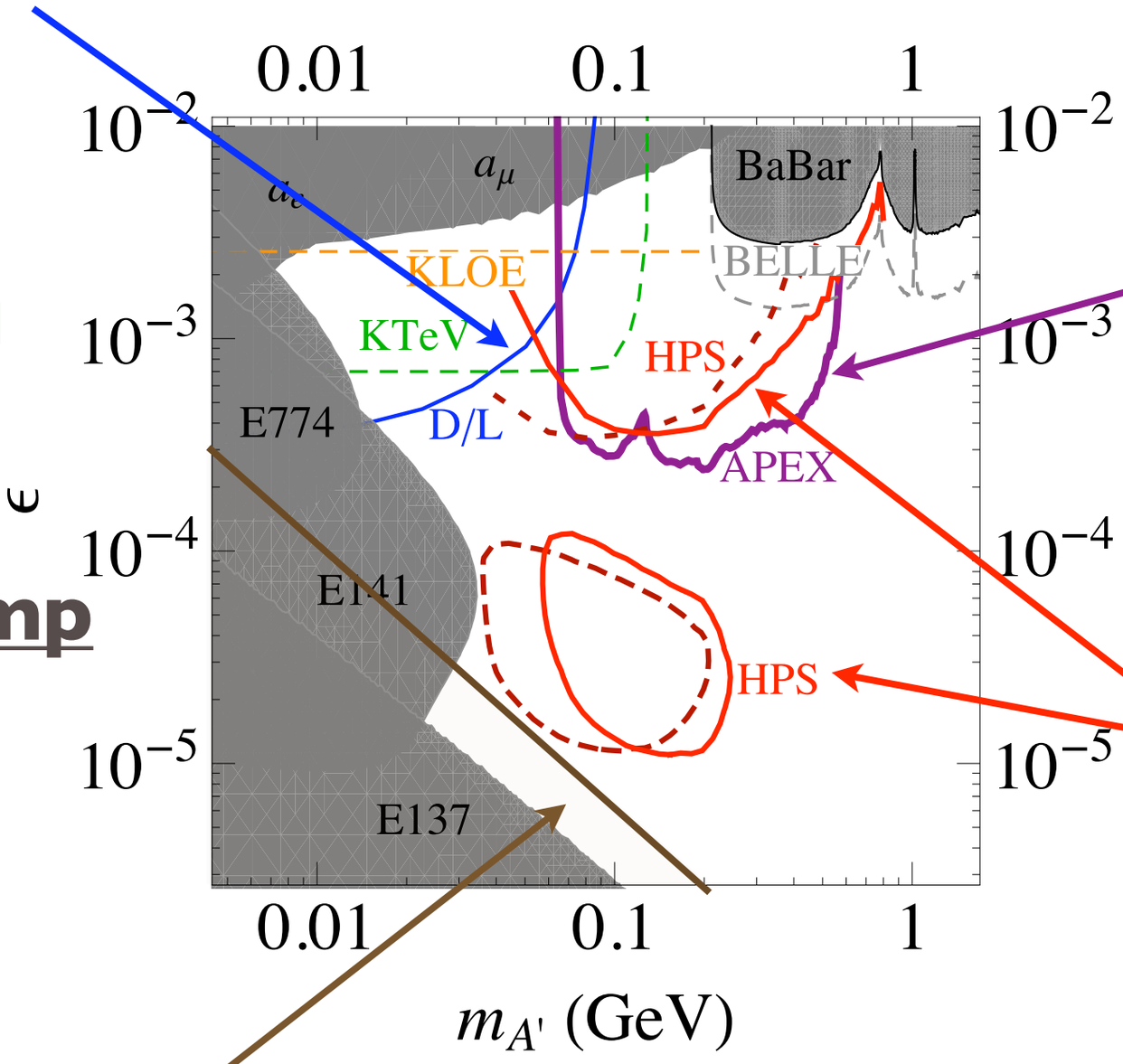
[reach from Freytsis, Ovanesyan, Thaler, arXiv:0909.2862]

See talks at this workshop

+ **Mainz**

(similar proposed reach to APEX)

+ **beam dump at JLab**
+ **PrimEx**



APEX

Heavy Photon Search

HIPS @ DESY

Andreas Ringwald is at workshop

Perspective

- Outstanding science opportunity
  - capitalizes on world class experimental facilities
  - enhances the existing scientific program
  - brings in a new community of users
- Realization
  - cost scale seems reasonable
  - timescale: ≈ decade long program
- JLab should develop the optimized program to undertake the most effective search in its energy range for the U(1)' group beyond the Standard Model.