Hadron Physics Summer School 2014

Working Group # 7:

Dark Photon

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In one of the simplest scenarios of the physics beyond the Standard Model (SM), dark matter particles belonging to an additional abelian gauge symmetry are added to the SM. The associated gauge boson, the so-called U boson, can communicate with the SM through a mixing in the kinetic term of the QED Lagrangian with a small parameter ϵ. Because of this mixing the U boson – despite its Higgs-generated non-vanishing mass – is often called *dark photon* [1–3].

Phenomenological arguments suggest that the mixing parameter must be of the order of 10^{-4} to 10^{-2}, while the U boson mass is between 4 MeV and 2 GeV [1,2]. This estimate is also supported by the astrophysical observations (such as the positron and/or electron excesses observed by ATIC [4], H.E.S.S. [5], and PAMELA [6], as well as the narrow 0.511 MeV γ ray emission from the galactic bulge observed by INTEGRAL [7]) and the constraints imposed by precision measurements such as the anomalous magnetic moments $(g-2)$ of of muon and electron [8]. In turn, the *light dark matter* hypothesis might also explain the present mismatch between theory and experiment for the anomalous magnetic moment of the muon [9, 10].

Such a light U boson might be observed via a direct production in particle accelerators or as a narrow structure in the invariant mass spectrum of a lepton-antilepton pair in the decay channel of some suitable vector or pseudoscalar meson.

Our task is to suggest an experiment which is sensitive to a short-lived U-boson. If the proposed experiment finds a corresponding signal, we will have clear evidence for physics beyond the SM and learn for the first time about the nature of dark matter. If not, we will put a further constraint on possible extensions of the SM of particle physics.

Key References

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Further Reading

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