BABAR Constrains Dark-Matter Photon and Higgs

The majority of matter in the universe is “dark matter” that does not interact with light. Since it cannot be seen directly, its existence is inferred from its gravitational impact on normal matter objects, such as stars. Without direct detection of dark matter, we lack an understanding of the particles it is composed of. There may be only one type of dark-matter particle, or an entire “dark sector” of particles with a rich phenomenology.

In a variety of new-physics models motivated by recent astrophysical measurements, this phenomenology includes a “dark photon” and a “dark Higgs”. In the dark sector, these particles have similar roles to those played in the normal sector by the standard-model photon and Higgs. In addition, the dark photon has a small probability for mixing with a normal photon, providing a window through which the dark sector can be probed experimentally. The mass of the dark photon is constrained by astrophysical measurements to be at most a few GeV/c^2. As pointed out by SLAC and Stanford theorists in Phys. Rev. D80, 015003, this makes the dark photon ideally suited for study at *BABAR*, which uses electron-positron collisions with center-of-mass energy of about 10 GeV produced by the SLAC *B* factory between 2000 and 2008.

The *BABAR* collaboration reports new constraints on the parameters of these dark-sector particles in an article (http://arxiv.org/abs/1202.1313) submitted recently to the journal Physical Review Letters. In this study, Caltech postdoctoral researcher Bertrand Echenard searched for simultaneous production of a dark photon and a dark Higgs, where the Higgs decays into two dark photons, and each of the three final-state dark photons decays into standard-model particles. For dark-photon and dark-Higgs masses of several GeV/c^2, the search tightens the limit on the mixing strength between the dark and normal photons by up to two orders of magnitude.

In the figure, grey-shaded regions show values of the dark-photon mass (m_A) and the mixing strength (α'/α) that have been ruled out by previous measurements, including those from *BABAR*. The green, blue, and cyan curves show *BABAR*’s new upper bounds on the mixing strength for various values of the dark-Higgs and dark-photon masses.