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Searches for low-mass new-physics states with the BaBar detector

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We report on the most recent searches for unknown low-mass states performed with the data collected by the BaBar detector at the PEP-II $e+e-$ collider.

The first search is based on a sample corresponding to 53 fb^{-1} of $e+e-$ collision data collected with a special single-photon trigger. We look for events with a single high-energy photon and a large missing momentum and energy, consistent with production of a spin-1 particle A' through the process $e+e- \rightarrow \gamma A'$, $A' \rightarrow \text{invisible}$. Such particles, referred to as “dark photons”, are motivated by theories applying a $U(1)$ gauge symmetry to dark matter. We find no evidence for such processes and set 90% confidence level upper limits on the coupling strength of $A' \rightarrow e+e-$ for a dark photon with a mass lower than 8 GeV. In particular, our limits exclude the values of the A' coupling suggested by the dark-photon interpretation of the muon ($g-2$) anomaly, as well as a broad range of parameters.

Many models of New Physics postulate the existence of new gauge bosons mediating interactions between “dark sectors” and the Standard Model. We present a second search for a dark boson Z' coupling only to the second and third generation of leptons in the reaction $e+e- \rightarrow \mu+\mu-Z'$, $Z' \rightarrow \mu+\mu-$ with the full BaBar dataset. No significant signal is observed and limits improving upon bounds derived from neutrino experiments are set.

Experimental Collaboration

BABAR

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