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Experimental signatures of Kalb-Ramond-like particles

We analyse phenomenological signatures of Kalb-Ramond-like particles, described by an antisymmetric rank-2 tensor, when coupled to fermionic matter. The latter is modelled by a tensor current coupled directly to the Kalb-Ramond field or by a pseudovector current coupled to the rank-1 dual of the field-strength tensor. We obtain limits on the coupling constants to fermions and mass of the Kalb-Ramond-like particles by investigating their impact on the hyperfine splittings of hydrogen, the tree-level unitarity of the S matrix for $e^- + e^+ \to \ell^- + \ell^+$ scattering with $\ell \neq e$ and the differential cross section for Bhabha scattering. Assuming that the couplings to fermions are independent of the fermion species, the strongest 95\%-CL bounds we find are from LEP data at $\sqrt{s} = 136.23$~GeV, namely $g_{\rm PV}/\Lambda$
$lesssim 6.3 \times 10^{-13}\,\mathrm{eV}^{-1}$ and $g_{\rm T}$
$lesssim 1.3 \times 10^{-12}\,(m/\mathrm{eV})$, both for $m \ll \sqrt{s}$ (here Λ is a characteristic energy scale). These limits can be improved in upcoming lepton colliders due to enhanced precision, as well as higher energies.

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