Search for an invisibly decaying Z boson at Belle II in e⁺e⁻(e±) plus missing energy final states

Abstract: Theories beyond the standard model often predict the existence of an additional neutral boson, the Z'. Using data collected by the Belle II experiment during 2018 at the SuperKEKB collider, we perform the first searches for the invisible decay of a Z in the process e⁺e⁻ Z' and of a lepton-flavor-violating Z in e⁺e⁻ e±Z'. We do not find any excess of events and set 90% credibility level upper limits on the cross sections of these processes. We translate the former, in the framework of an L - L theory, into upper limits on the Z coupling constant at the level of $5 \times 10^{-2} > 1$ for $M_{Z'} > 6$ GeV/$c^2$.

A simulated event in which a Z' boson is produced in association with two muons (blue tracks with green hits) and decays into invisible particles that detection and are shown in yellow.
90% CL upper limits on coupling constant $g$. Dark blue filled areas show the exclusion regions for $g$ at 90% CL, assuming the LL predicted BF for $Z\text{ invisible}$; light blue areas are for BF($Z\text{ invisible}$) = 1. The solid and dashed lines are the expected sensitivities in the two hypotheses. The red band shows the region that could explain the muon anomalous magnetic moment $(g-2)\pm 2$.

*Belle II 2018*

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\int Ldt = 276\text{ pb}^{-1}
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