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Z' Bosons at Colliders: a Bayesian Viewpoint

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We revisit the CDF data on di-muon production to impose constraints on a large class of Z' bosons occurring in a variety of E_6 GUT based models. For this we suggest an alternative statistical analysis method which ultimately allows to straightforwardly (i)~vary the gauge coupling strength, g' , of the underlying $U(1)'$; (ii)~include interference effects with the Z' amplitude (which are especially important for large g'); (iii)~smoothly vary the $U(1)'$ charges; (iv)~combine these data with the electroweak precision constraints, as well as with other observables obtained from colliders such as LEP-2 and the LHC; and (v)~find preferred regions in parameter space once an excess is seen. Our method yields limits generally differing by only a few percent from the CDF ones when we follow their approach.

We also analyze the dependence of these limits on various factors contributing to the production cross-section, showing that currently systematic and theoretical uncertainties play a relatively minor rôle.

One general result is that interference effects are quite relevant if one aims at discriminating between models. We use a Bayesian method to project lower limits on the Z' mass for the Tevatron and for a number of actual and hypothetical reference energies and luminosities for the LHC. Finally, we show the full classification of the E_6 Z' models with integer charges.

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