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Mass scale of vectorlike matter and superpartners from IR fixed point predictions of gauge and top Yukawa couplings

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We use the IR fixed point predictions for gauge couplings and the top Yukawa coupling in the MSSM extended with vectorlike families to infer the scale of vectorlike matter and superpartners. We present results in detail for the MSSM extended with one complete vectorlike family. We find that for a unified gauge coupling $\alpha_G > 0.3$ vectorlike matter or superpartners are expected within 1.7 TeV (2.5 TeV) based on all three gauge couplings being simultaneously within 1.5% (5%) from observed values. This range extends to about 4 TeV for $\alpha_G > 0.2$. We also find that in the scenario with two additional large Yukawa couplings of vectorlike quarks the IR fixed point value of the top Yukawa coupling independently points to a multi-TeV range for vectorlike matter and superpartners. Assuming a universal value for all large Yukawa couplings at the GUT scale, the measured top quark mass can be obtained from the IR fixed point for $\tan\beta \approx 4$. The range expands to any $\tan\beta > 3$ for significant departures from the universality assumption of the Yukawa couplings.

Summary

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