## NOTE ON LIGHT GLUINO

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It is controversial if a light gluino of mass below 5 GeV is phenomenologically allowed. Below we list some of the most important and least controversial constraints which need to be met for a light gluino to be viable. For reviews on the subject, see, e.g., Ref. 1.

- 1. Either  $m_{\tilde{g}} \lesssim 1.5$  GeV or  $m_{\tilde{g}} \gtrsim 3.5$  GeV to avoid the CAKIR 94 limit. See also Ref. 2 for similar quarkonium constraints on lighter masses.
- 2. The lifetime of the gluino or the ground state gluinocontaining hadron (typically,  $g\tilde{g}$ ) must be  $\gtrsim 10^{-10}$  s in order to evade beam-dump and missing energy limits [1,2].
- 3. Charged gluino-containing hadrons  $(e.g. \ \tilde{g}ud)$  must decay into neutral ones  $(e.g. \ R^0(\tilde{g}g)\pi^+ \text{ or } (\tilde{g}u\bar{u})e^-\bar{\nu}_e)$ with a lifetime shorter than about  $10^{-7}$  s to avoid the AKERS 95R limit. Older limits for lower masses and shorter lifetimes are summarized in Ref. 1.
- 4. The lifetime of  $R^0 \to \rho^0 \tilde{\gamma}$ , if allowed, must be outside the ADAMS 97B range. The  $R_p^+(\tilde{g}uud)$  state, which is believed to decay weakly into  $S^0(\tilde{g}uds)\pi^{\pm}$ (FARRAR 96), must be heavier than 2 GeV or have lifetime  $\tau_{R_p} \gtrsim 1$  ns or  $\tau_{R_p} \lesssim 50$  ps (*e.g.* if the strong decay into  $S^0 K^{\pm}$  is allowed), or its production cross sections must be at least a factor of 5 smaller than those of hyperons, to avoid ALBUQUERQUE 97 limit.
- 5.  $m_{\tilde{g}} \geq 6.8 \text{ GeV} (95\% \text{ CL})$  if the "experimental optimization" method of fixing the renormalization scale is valid and if the hadronization and resummation uncertainties are as estimated in BARATE 97L, from the  $D_2$  event shape observable in  $Z^0$  decay. The 4-jet angular distribution is less sensitive to renormalization scale ambiguities and yields a 90%CL exclusion of a light gluino (DEGOU-VEA 97). A combined LEP analysis based on all

the  $Z^0$  data and using the recent NLO calculations [3] is warranted.

6. Constraints from the effect of light gluinos on the running of  $\alpha_s$  apply independently of the gluino lifetime and are insensitive to renormalization scale. They disfavor a light gluino at 70% CL (CSIKOR 97), which improves to more than 99% with jet analysis.

## References

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