FIG. 8: Likelihood maps of mSUGRA parameter space allowing for non thermal-neutralino contributions to the dark matter relic density. The graphs show the likelihood distributions sampled from 7d parameter space and marginalised down to two. The likelihood (relative to the likelihood in the highest bin) is displayed by reference to the bar on the right hand side of each plot.
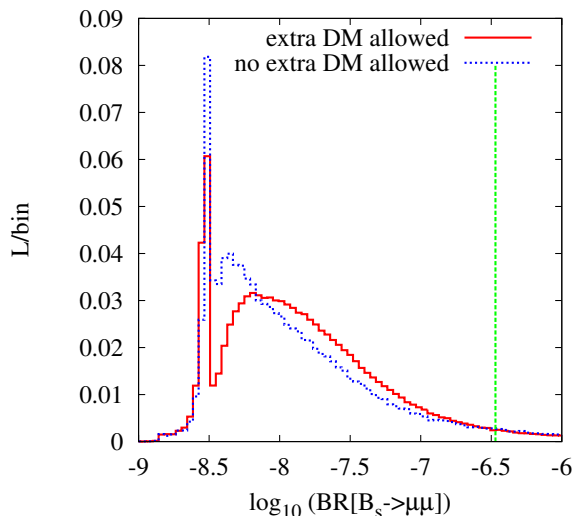

FIG. 9: Investigation on the effects of allowing for a non thermal-neutralino component of dark matter in the branching ratios for the decay $B_s \to \mu^+\mu^-$ in mSUGRA. The current Tevatron upper limit is displayed by a vertical line.

VI. CONCLUSIONS

Previous studies of mSUGRA in the context of dark matter and particle physics constraints have tended to not use the full dimensionality of the parameter space, and to have put hard 95% (C.L.) limits on predictions. Here, in the full dimensionality of parameter space, we include all of the information in a likelihood fit, so that violating one constraint slightly might be traded against fitting another one better in a consistent manner. Although there is plenty of qualitative information about possible dark matter annihilation regions in mSUGRA in the literature, this paper gives a quantitative calculation of the likelihood distributions in the full dimensionality of the parameter space. However, the most important contribution of this paper lies in the implications of the results to particle physics.

We have successfully employed an MCMC algorithm to provide likelihood maps of the full 7d input parameter space of mSUGRA. By using a statistical test, we have shown that the likelihood distributions have achieved good convergence before a total of 9×10^6 samplings of the likelihood. We have presented the likelihood marginalised down to each 2d mSUGRA parameter pair. Such plots provide the totality of the current information we have about the model given the experimental constraints and are quantitative results. Theoretical uncertainties in the sparticle spectrum calculation broaden a couple of the distributions a little but do not change them radically.

The main new contribution of this paper is to our knowledge of what current constraints on mSUGRA mean for particle physics in a quantitative sense.

the fit. The A^0-pole region has higher $\tan\beta$, and therefore higher values for the branching ratio. The estimated amount of likelihood that could be covered by Tevatron measurements with 8 fb^{-1} of integrated luminosity increases by 6% to 35% of the currently allowed density due to the presence of non thermal-neutralino dark matter contributions.