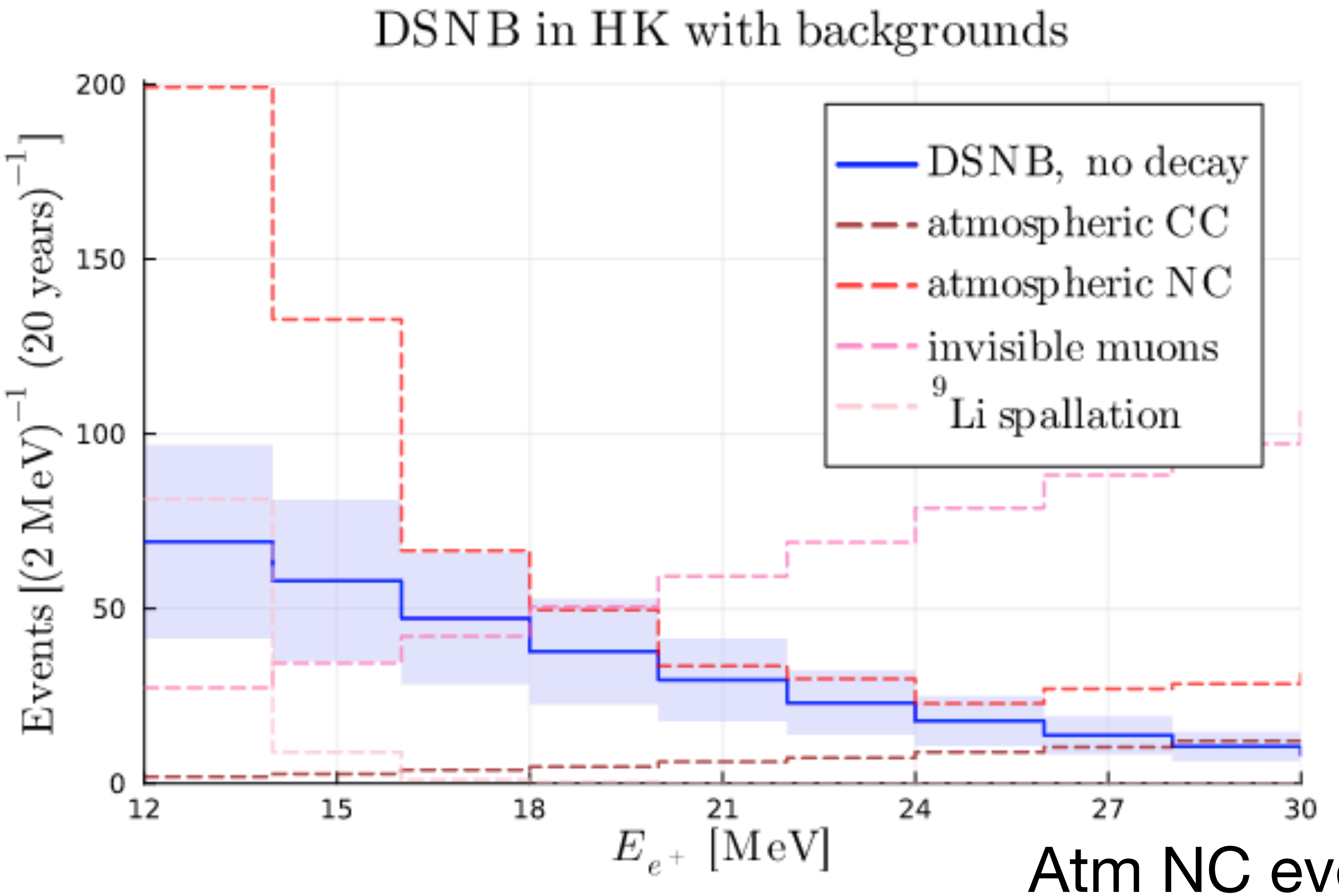
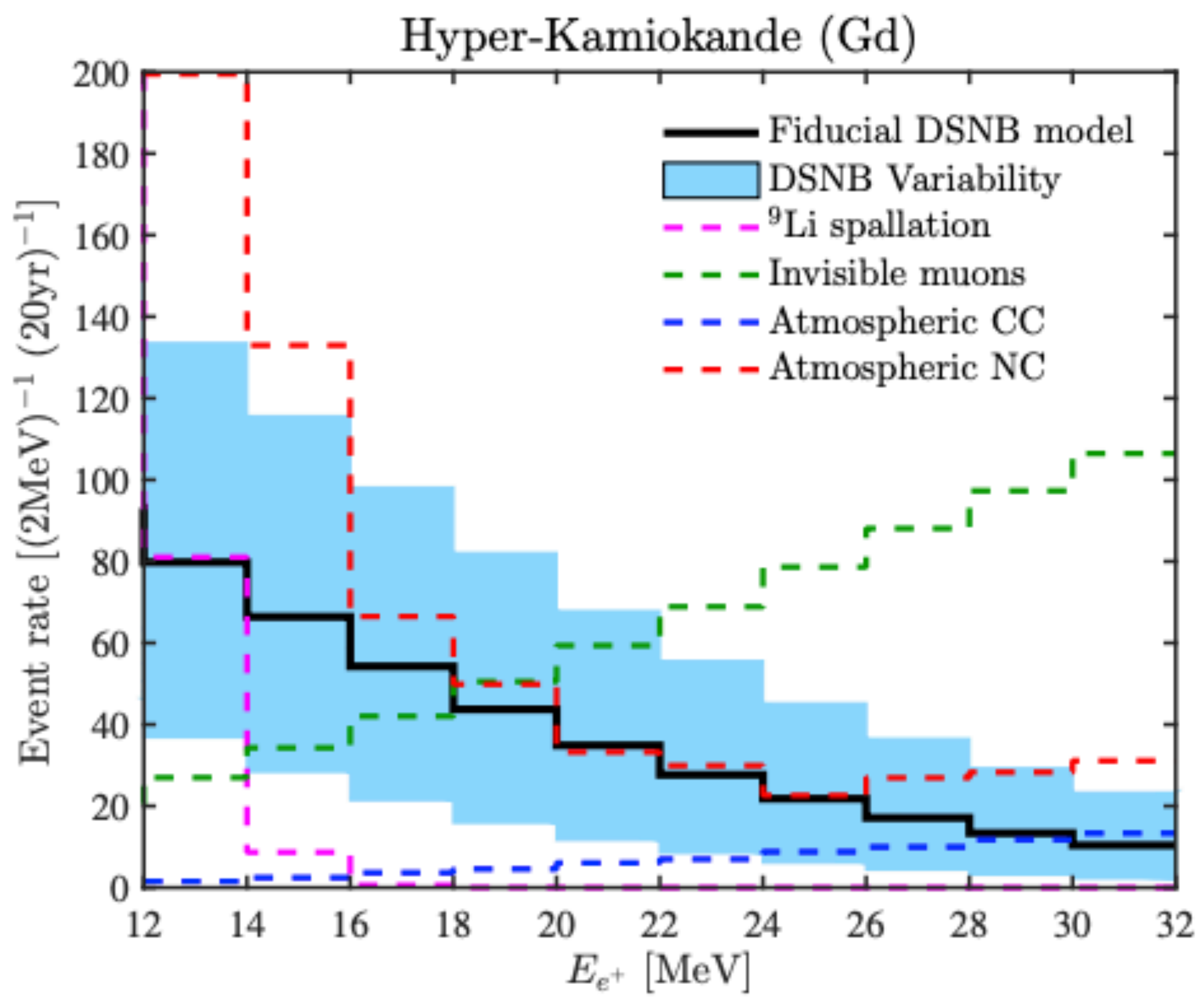
DSNB Decay Notes 7/10

Miller MacDonald

Reproducing the backgrounds (through digitization :)) from the Moller and Tamborra paper





Looking pretty good

Atm NC events could be completely removed?

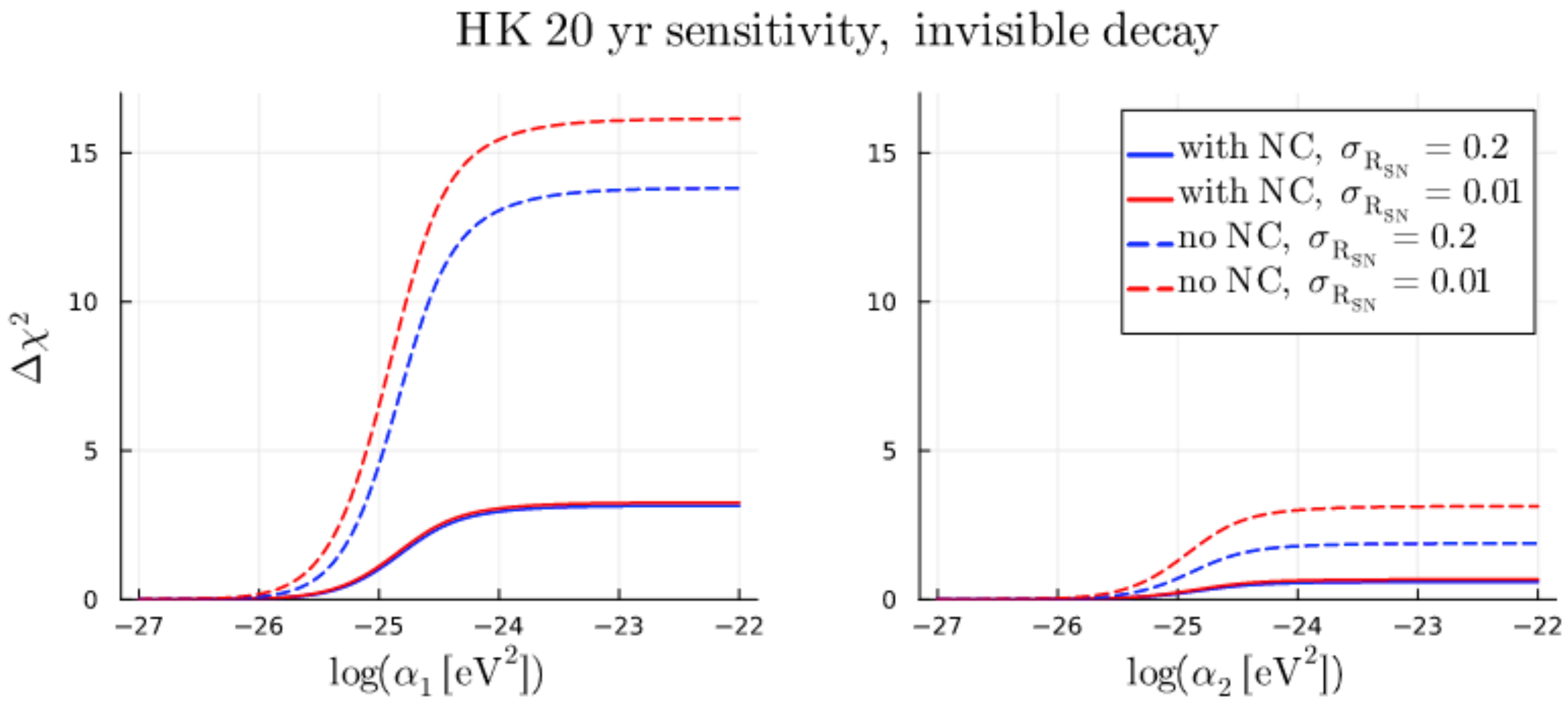
For each experiment, we have the following χ^2 function:

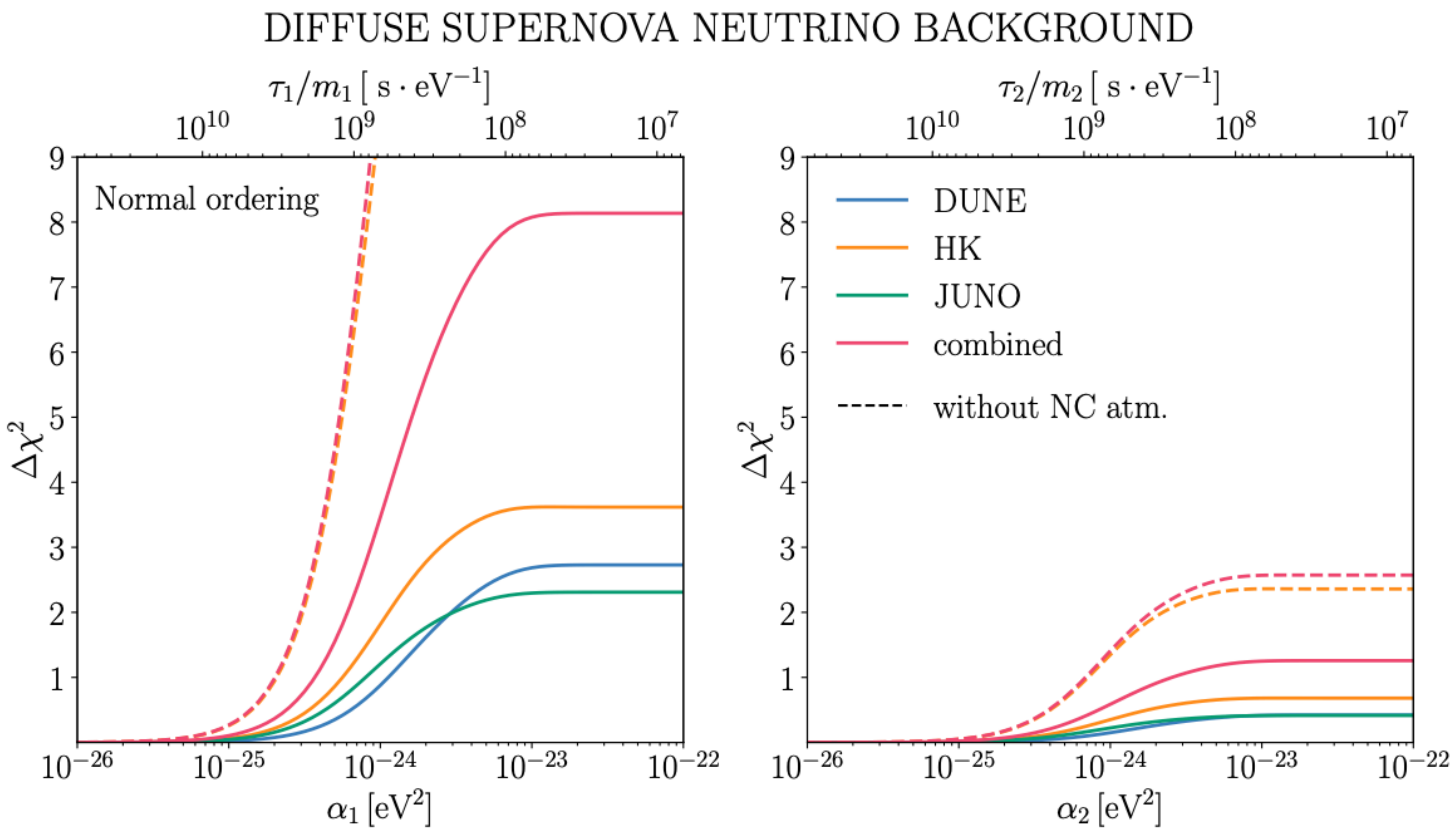
$$\chi^2 = 2\sum_{i=1}^{\#\text{ energy bins}}\left[(1+\xi)N_i + \sum_{n=1}^{\#\text{ backgrounds}}\eta_n B_{n,i} - S_i + \left(S_i + \sum_n B_{n,i}\right)\log\left\{\frac{S_i + \sum_n B_{n,i}}{(1+\xi)N_i + \sum_n (1+\eta_n)B_{n,i}}\right\}\right] + \left(\frac{\xi}{\sigma_{R_{\mathrm{SN}}}}\right)^2 + \sum_n \left(\frac{\eta_n}{\sigma_n}\right)^2$$

Ok conceptually, what does this mean…

I can't really see the logic behind how this is defined

For example, why do some backgrounds have pull parameter corrections but others don't? What's with the log in this expression? Does it have something to do with assuming Poisson statistics?



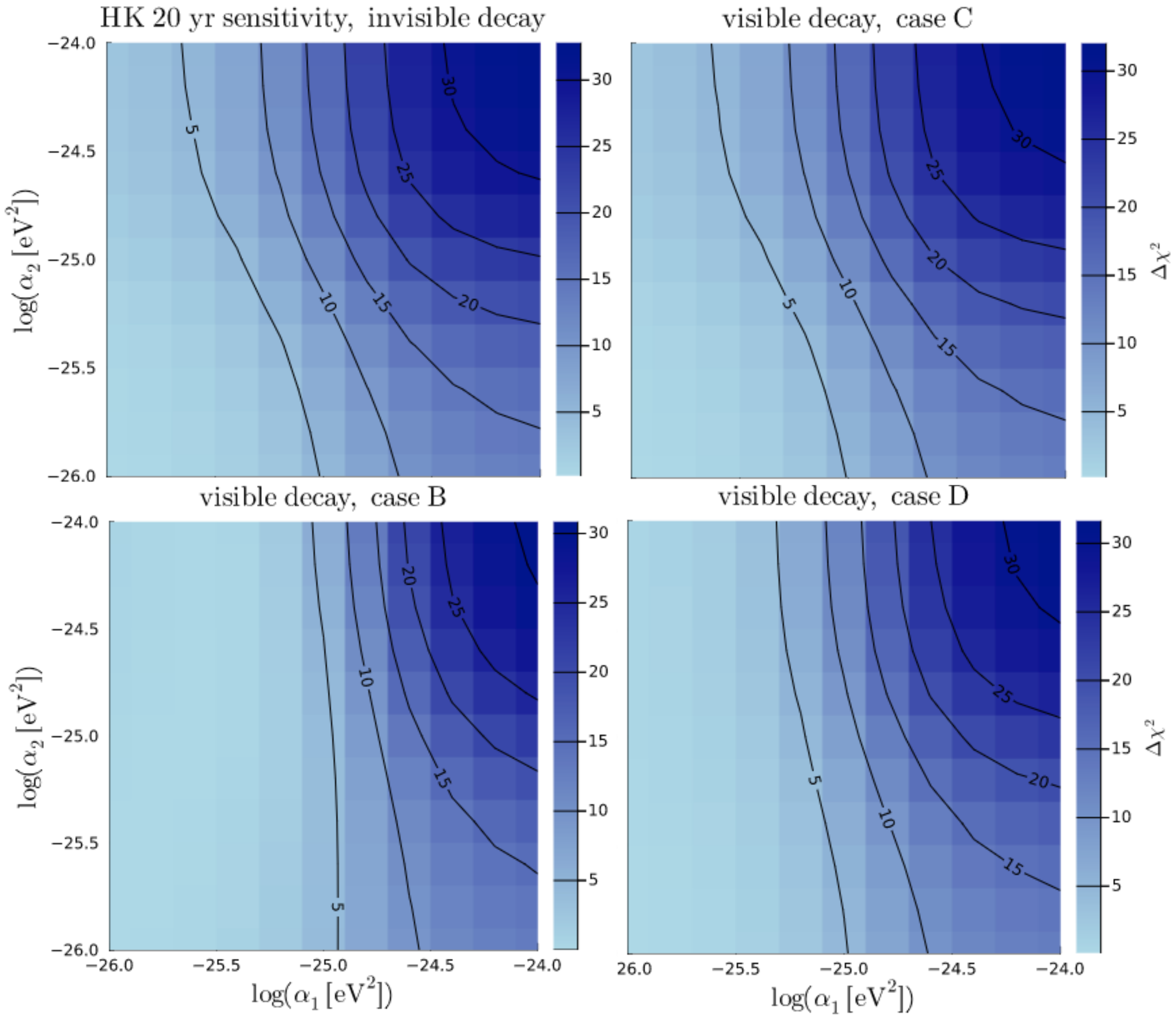


Chi squared results match qualitatively with the results in the <u>invisible decay paper</u>

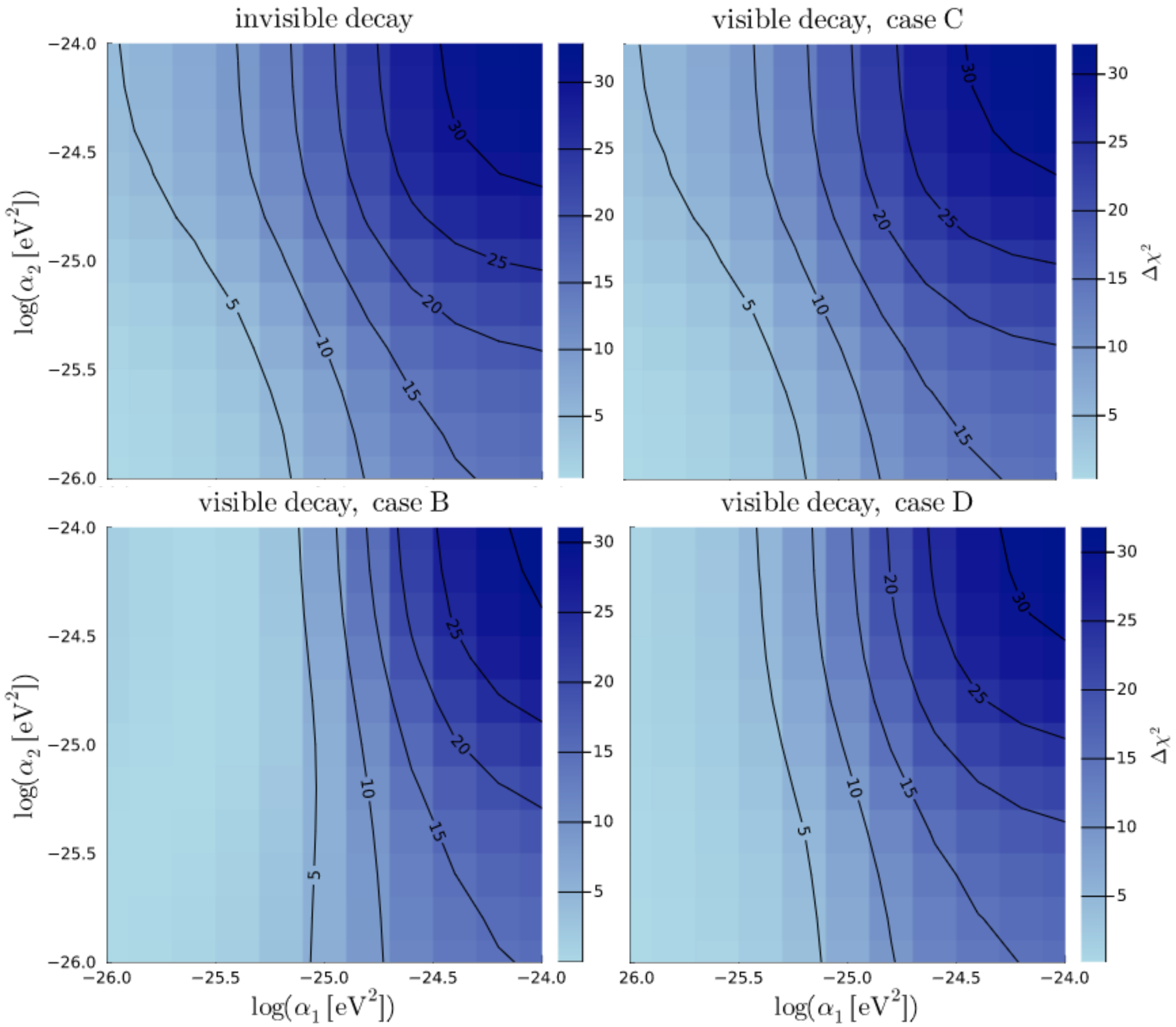
A priori, I would've expected that decreasing $\sigma_{R_{SN}}$ would have increased the sensitivity more, especially for an invisible decay case where the key signature is the normalization anyway

Some very preliminary sensitivity heat maps, top let should match-ish with the ones in the invisible decay paper (these are all without NC background and assuming $f_{\mathrm{BH}} = 0.21$)

$\sigma_{\mathrm{R_{SN}}} = 0.2$



$\sigma_{\mathrm{R_{SN}}} = 0.01$

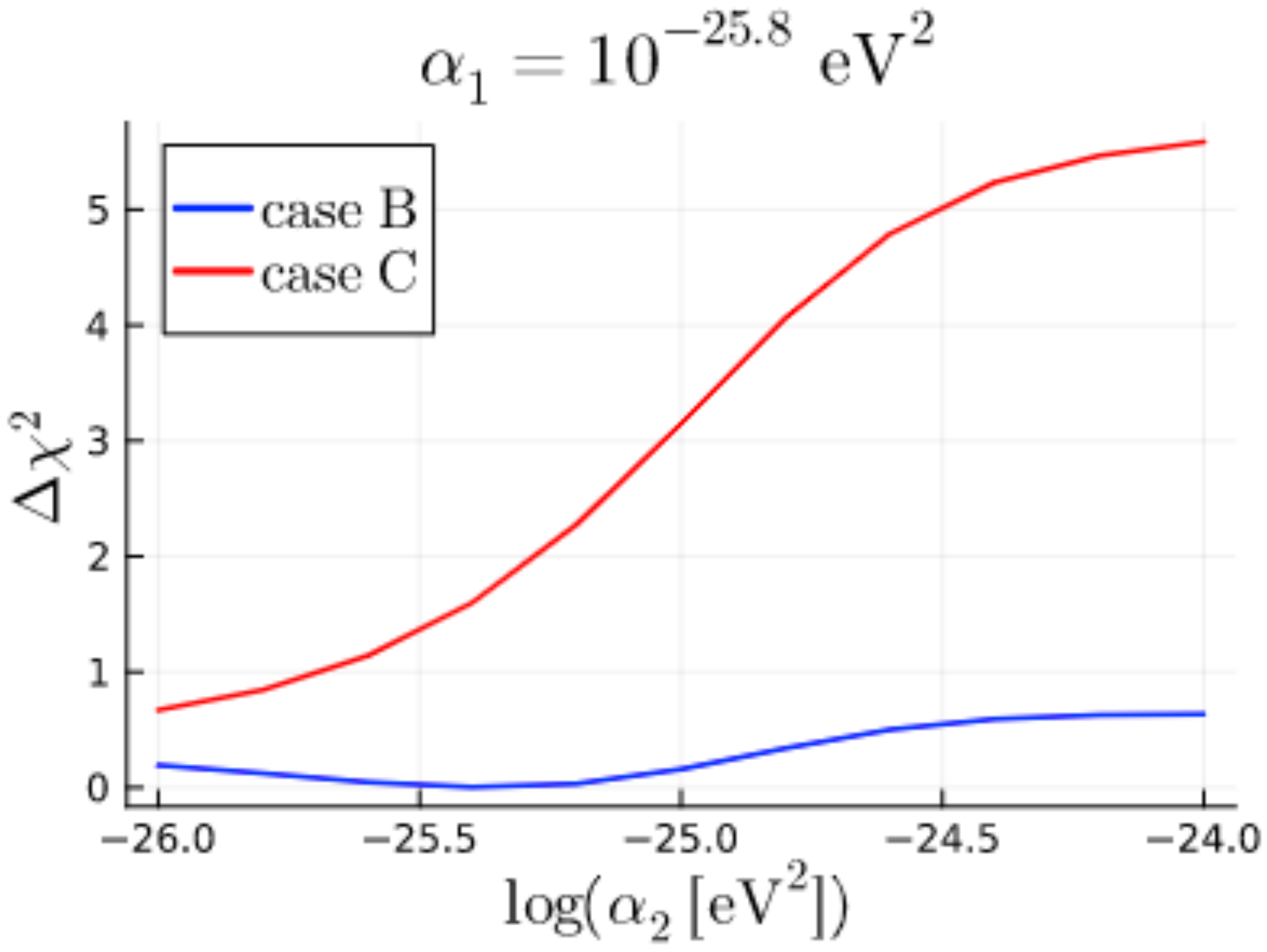


Initial observations:

- Case C and invisible decay look almost identical, which is expected: the only difference is that case C decays into ν_3 instead of invisible

- Also as expected: the top right areas of each heatmap, where all of the signals start to become degenerate, are also quite degenerate

- It seems like reducing the normalization error increases sensitivity the most in parts of the parameter space that are less robust to changing α_2



We see that for case B, there are hints of this "conspiracy" case, where $\alpha_2 \approx 10^{-26}$ corresponds to a slight flux deficit, $\alpha_2 \approx 10^{-24}$ corresponds to a slight flux increase, and the dip in the middle corresponds to the area where the fluxes are near-degenerate, but the effect is very minimal