Impact of mixed scattering processes on leptogenesis within hybrid seesaw framework

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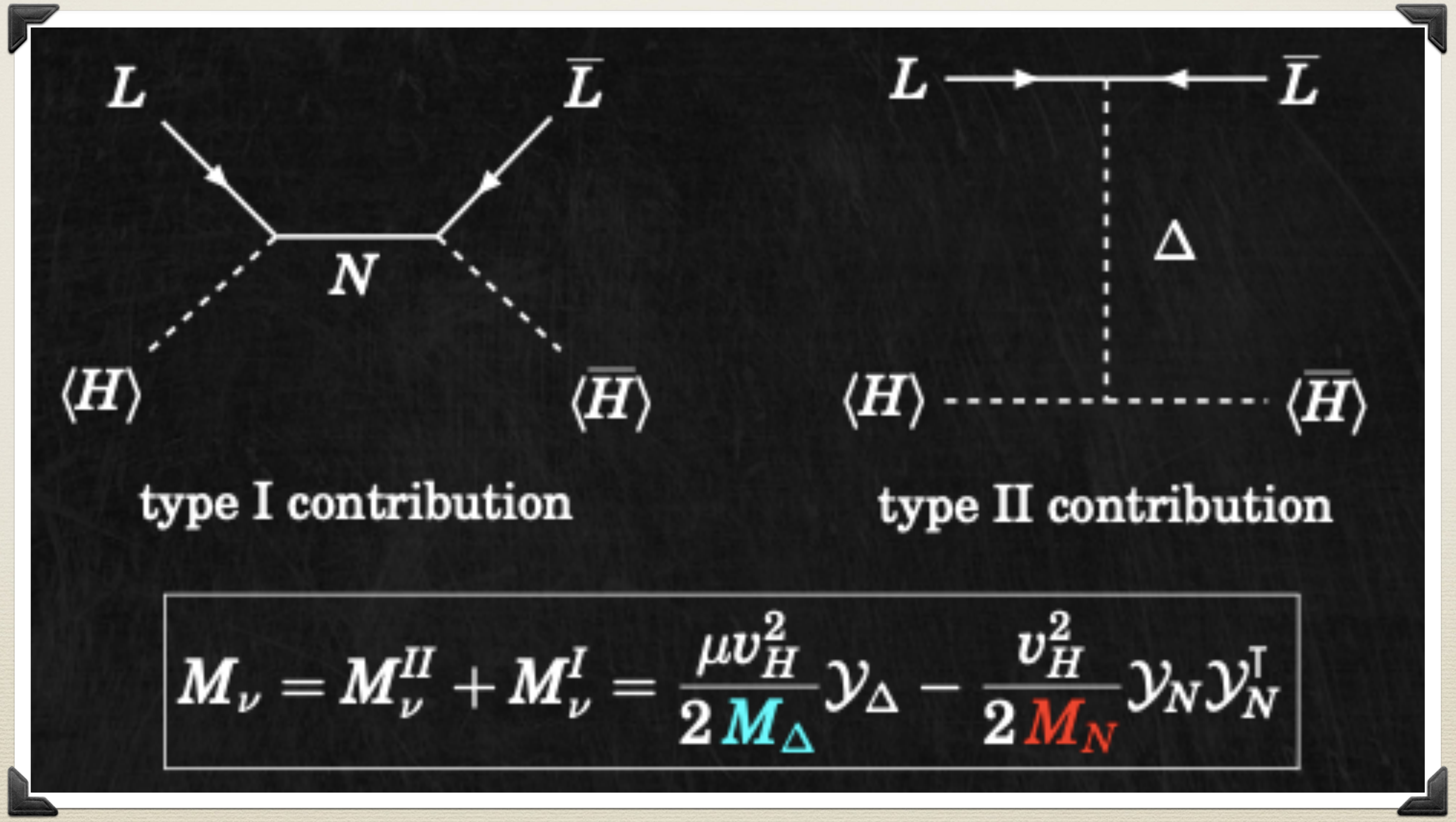
Hybrid Seesaw Models

- Remaining agnostic to the motivation for hybrid seesaw models
- Generic feature of lepton number asymmetry in degenerate/quasi degenerate hybrid seesaw framework
- Prototype example : Type I + Type II



Regimes of Leptogenesis in generic Hybrid Seesaw Models

The Washout Regime

- The asymmetry created by the heavier seesaw state gets washed out
- The present day asymmetry is dominantly created by the lighter state

The N_2 Regime

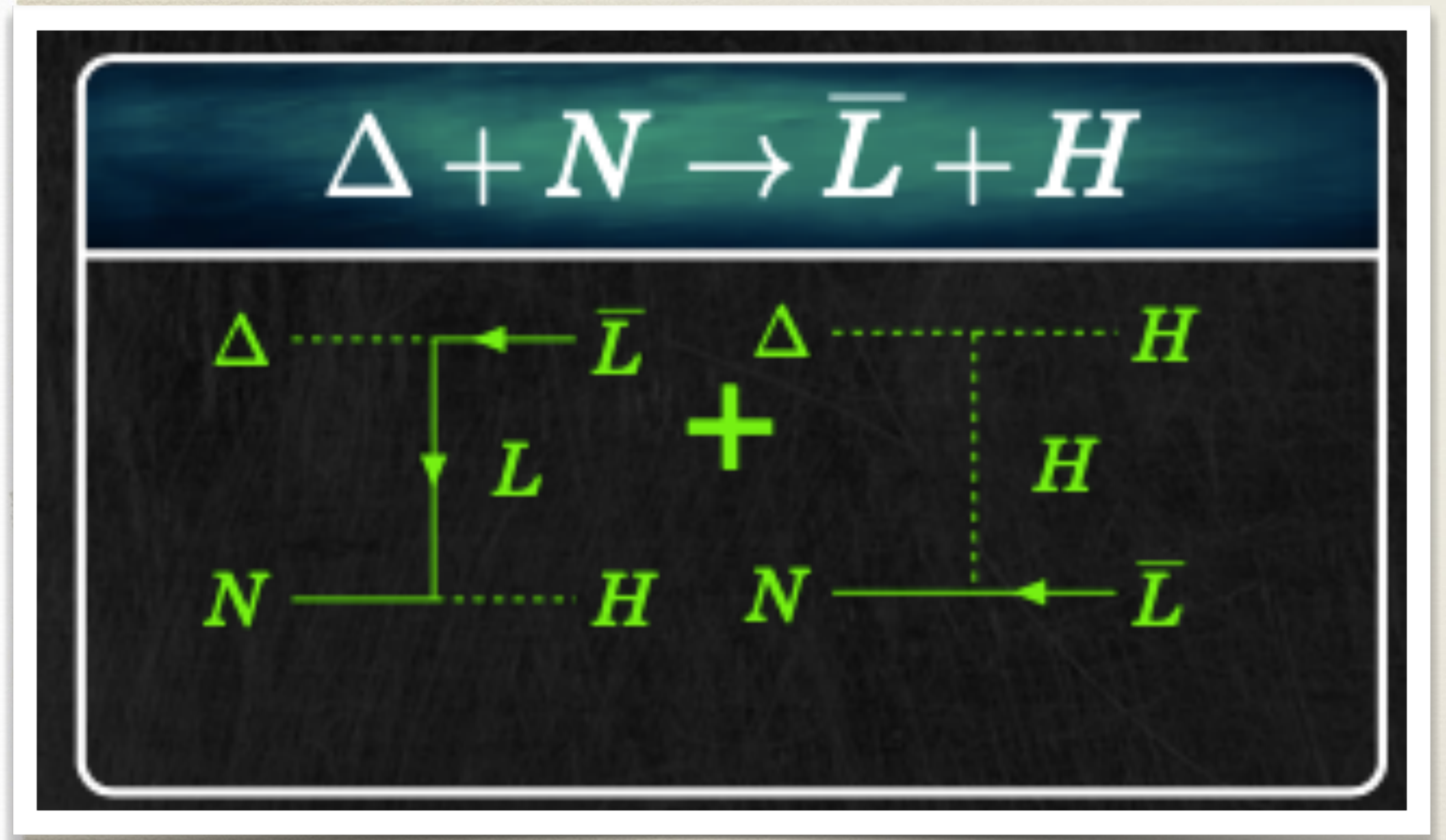
- The primordial asymmetry of the heavier state survives flavoured strong washout.
- The present day asymmetry is dominantly created by the heavier state

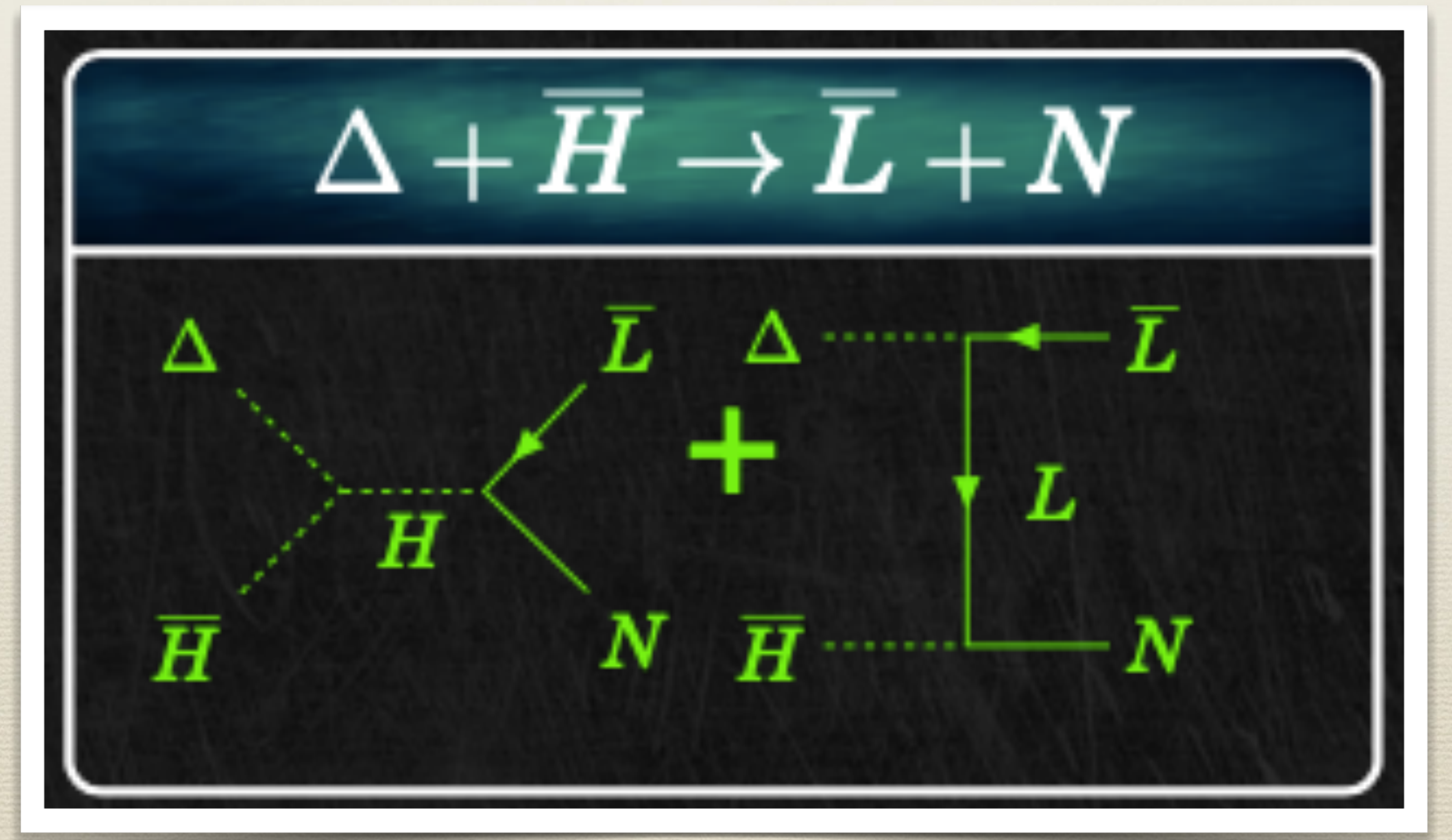
The Hybrid Regime

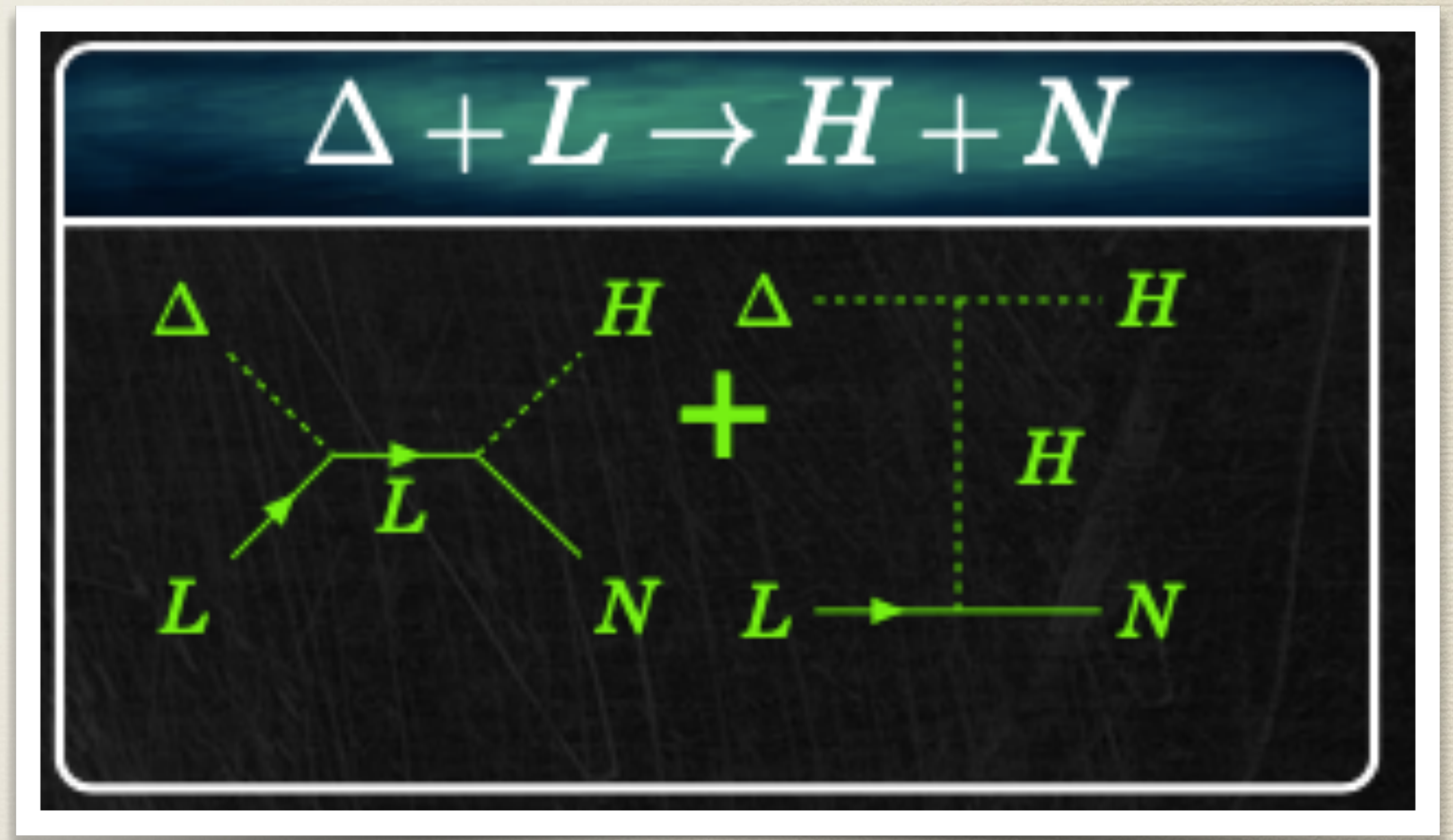
- Both states that are relatively degenerate contribute to the asymmetry.
- The present day asymmetry is created by a combined effect of all the seesaw states.

Mixed Processes in quasi degenerate Type I + Type II Models

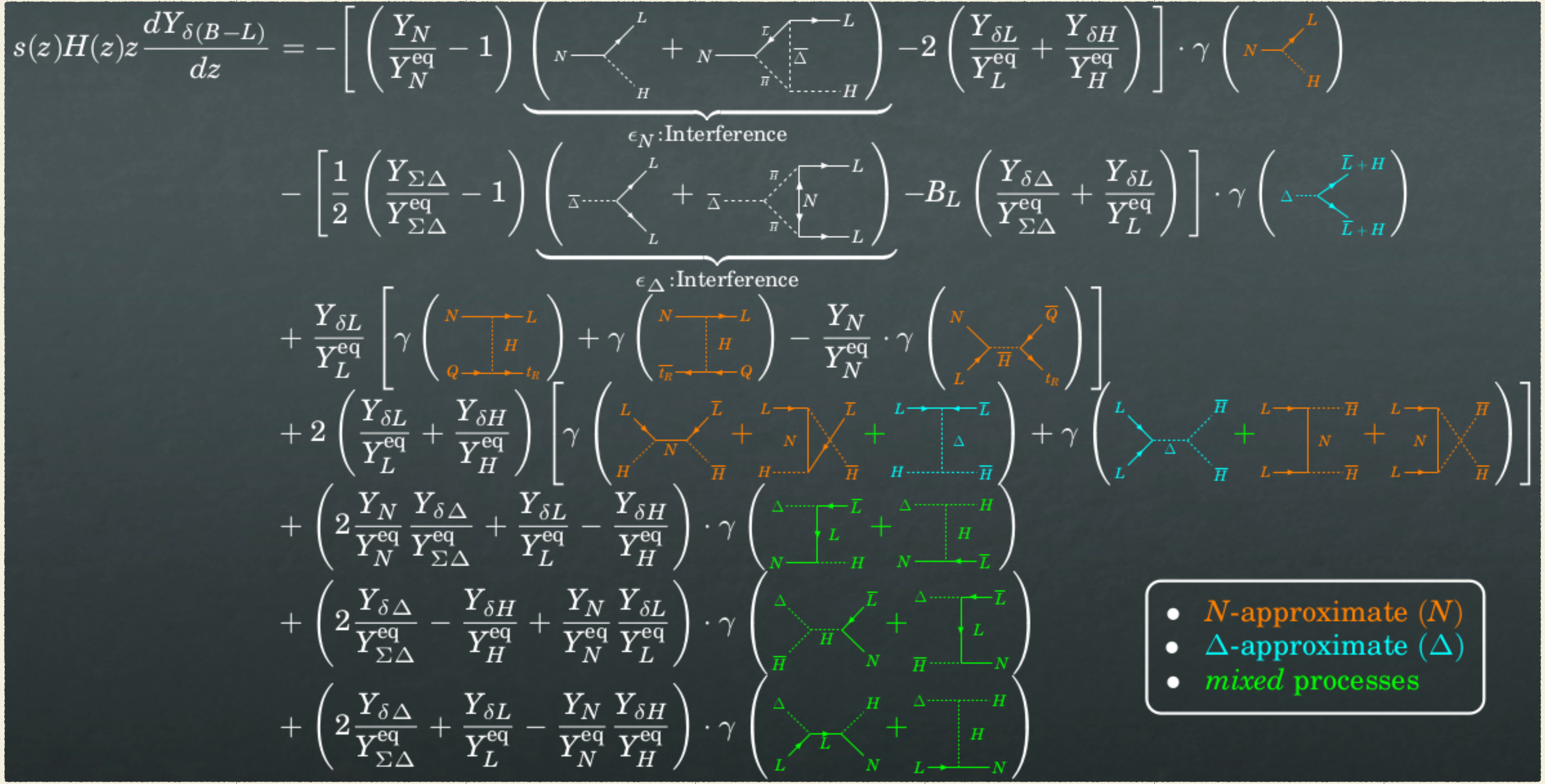
As the seesaw scales come close to each other, the often neglected mixed scattering topologies involving both the right handed neutrino and the scalar triplet may become important in the evolution of the lepton number asymmetry.

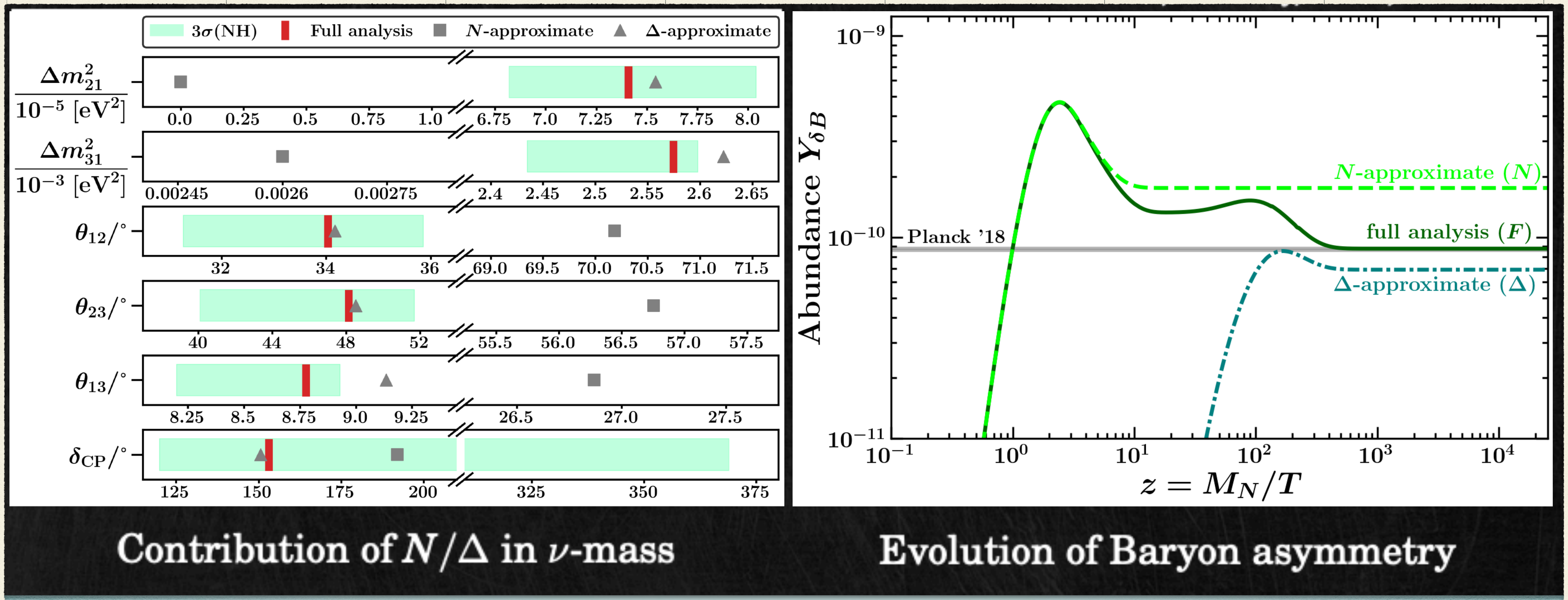






Representative Boltzmann Equation for the Hybrid Framework





Result: Benchmark Point

True Hybrid Scenario: the deviations range from 30 - 100%

Thermal correction can induce deviations of around 10%

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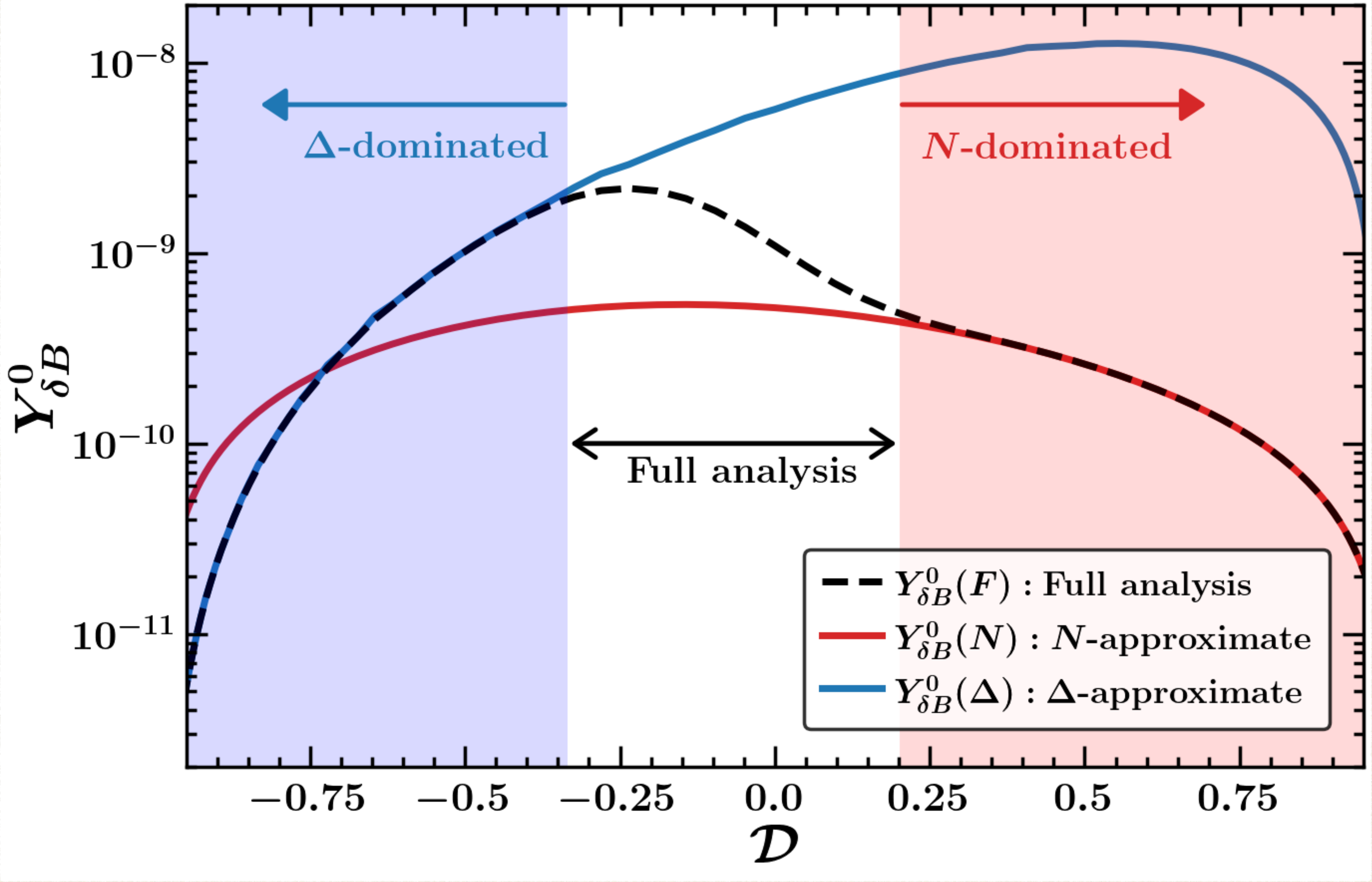

Degeneracy parameter $\mathcal{D} \equiv \dfrac{r-1}{r+1} = \dfrac{M_\Delta - M_N}{M_\Delta + M_N}$

Degeneracy parameter and range where mixed processes are important

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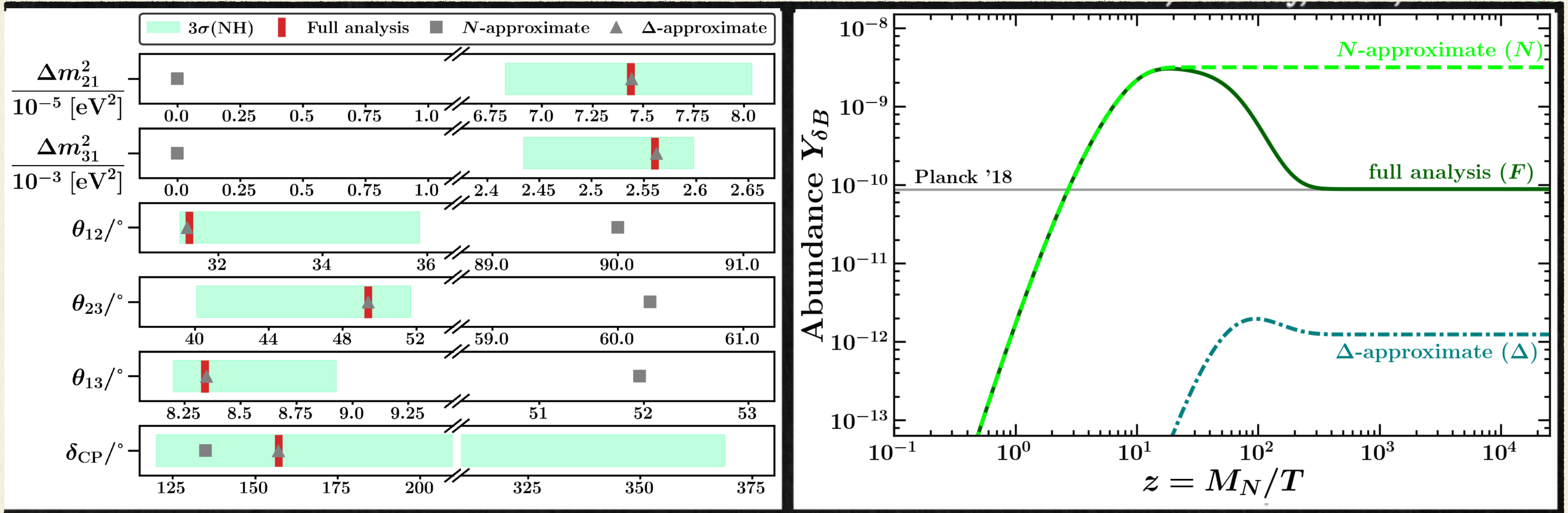
Conclusion

- For hybrid/multi seesaw scenarios, as the seesaw scales approach each other, the *mixed scattering* processes become increasingly important
- Degeneracy test: a degeneracy parameter $\mathscr{D} \lesssim |0.25|$ with $\epsilon_r = \epsilon_N/\epsilon_\Delta \sim \mathcal{O}(1)$ signifies approximations with lightest states cannot be trusted and a full analysis with *mixed scattering* processes is in order!

Thank You

Backup Slide



Contribution of N/Δ in ν-mass

Evolution of Baryon asymmetry

Result: Benchmark Point 2

An order of magnitude deviation is now obtained by tuning $\epsilon_r = \epsilon_N/\epsilon_\Delta \gg 1$

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