

# Instant nonthermal leptogenesis

Eun-Joo Ahn

Dept. of Astronomy and Astrophysics &  
Kavli Institute for Cosmological Physics  
The University of Chicago

with E. W. Kolb (UChicago & Fermilab)

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# Leptogenesis

♠ Create  $LS \rightarrow$  convert to  $BS$  (Fukigita & Yanagida 1986)

- **See-saw mechanism:** Yukawa coupling  $Y_{ij}^\nu$  of light left handed neutrinos  
- heavy right handed neutrinos ( $N$ )

$$\mathcal{L}_{\text{see-saw}} = \frac{m_{N_i}}{2} N_i^2 + Y_{ij}^\nu l_i N_j h$$

- $N$ s interact with CP asymmetry  $\epsilon$ .

E.g.  $N \rightarrow h + l (\bar{l})$  :

$$\epsilon \equiv \frac{\Gamma_{N \rightarrow h+l} - \Gamma_{N \rightarrow h+\bar{l}}}{\Gamma_{N \rightarrow h+l} + \Gamma_{N \rightarrow h+\bar{l}}}$$

♣  $N$  production and interaction

- When: *preheating, reheating, radiation era*
- How: *nonthermal, thermal*

## Our model

*keep it simple: standard model + see-saw*

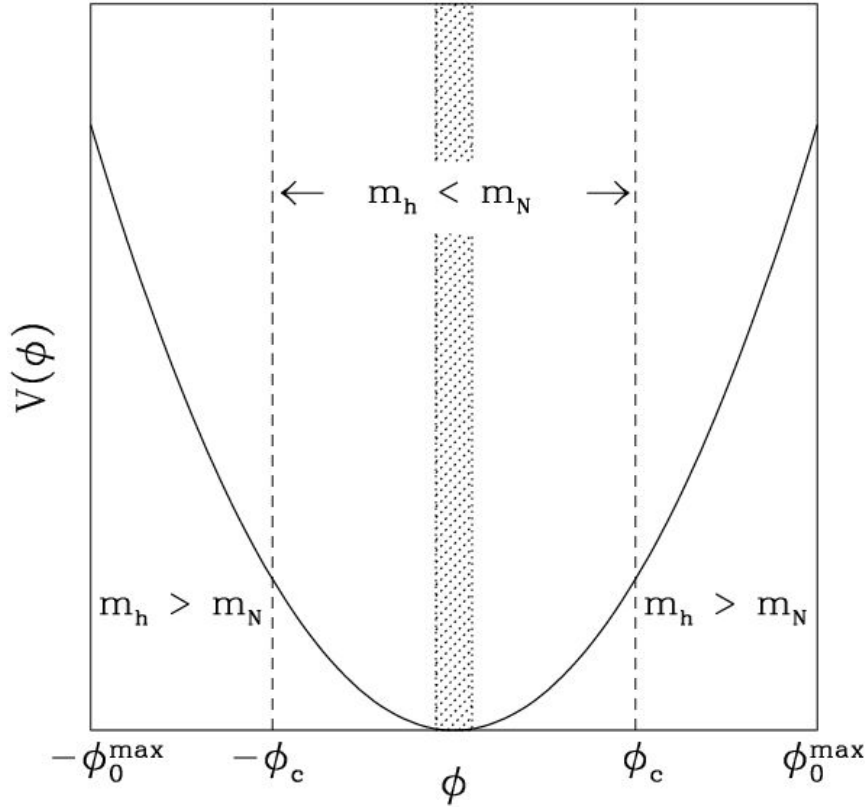
- Inflaton  $\phi$  (Hybrid inflation)
- Electroweak Higgs boson  $h$
- $N$  nonthermal:  $T < m_N$
- $\phi - h$  strong coupling instant preheating

◇ Preheating:  $\phi \rightarrow h$

◇ Interactions:  $h \rightarrow t + \bar{t}$  (thermalisation)

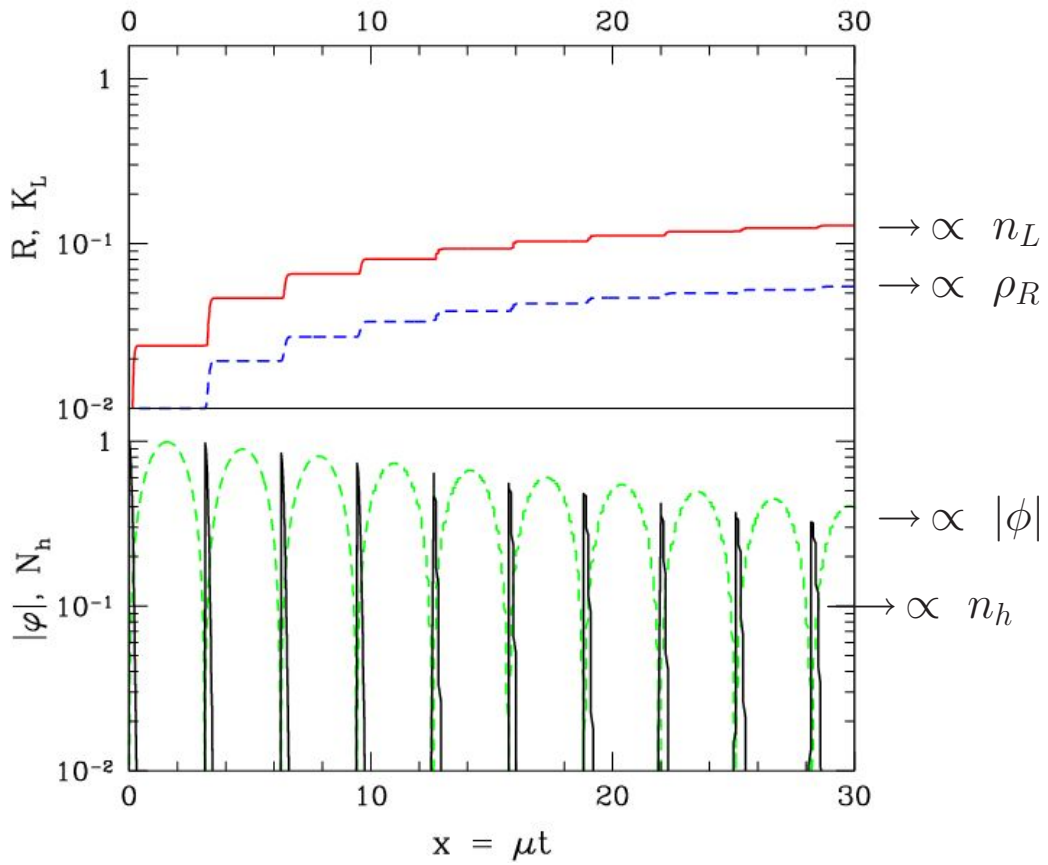
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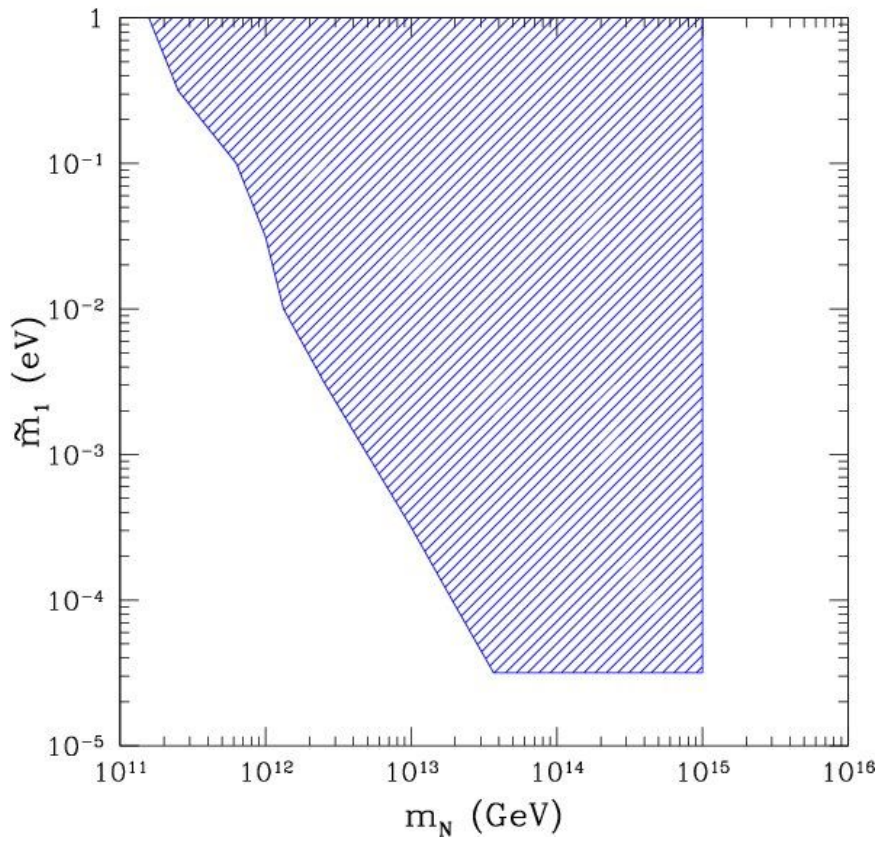


$$m_h > m_N : h \rightarrow N + l(\bar{l})$$

$$m_h < m_N : N \rightarrow h + l(\bar{l})$$



Boltzmann eqns.



Allowed values of  $N$  and  $\nu$  masses

## Conclusion

- A simple model of leptogenesis proposed
- which involves instant preheating and nonthermalness.