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QUANTUM UNIVERSE

# Leptogenesis via bubble collisions



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Based on hep-ph/2404.XXXXX

**Goal**

study leptogenesis from decays of sterile (right-handed) neutrinos (RHNs) produced from runaway bubble collisions at a dark first order phase transition (FOPT) at a scale below the RHN mass



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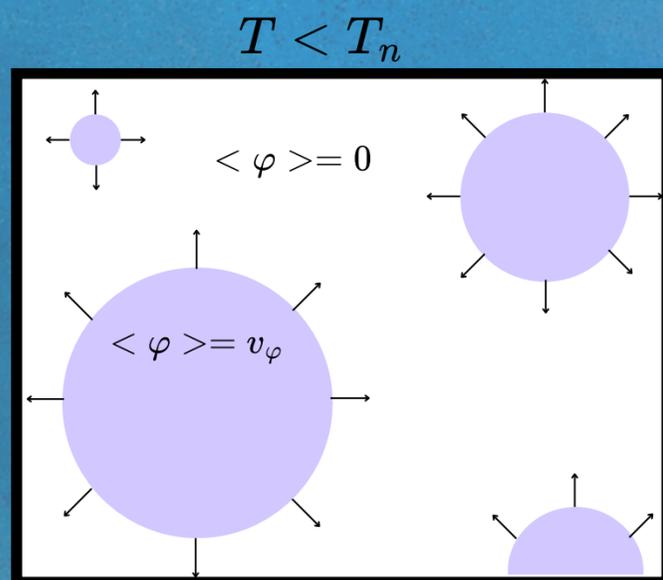
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## Framework

Model realization: *neutrino portal*

$$\mathcal{L} \supset y_D \varphi \chi N + y_\nu \bar{L} H N + M_N \bar{N}^c N$$

$\varphi \rightarrow$  scalar field driving FOPT

$\chi \rightarrow$  dark light sterile neutrino

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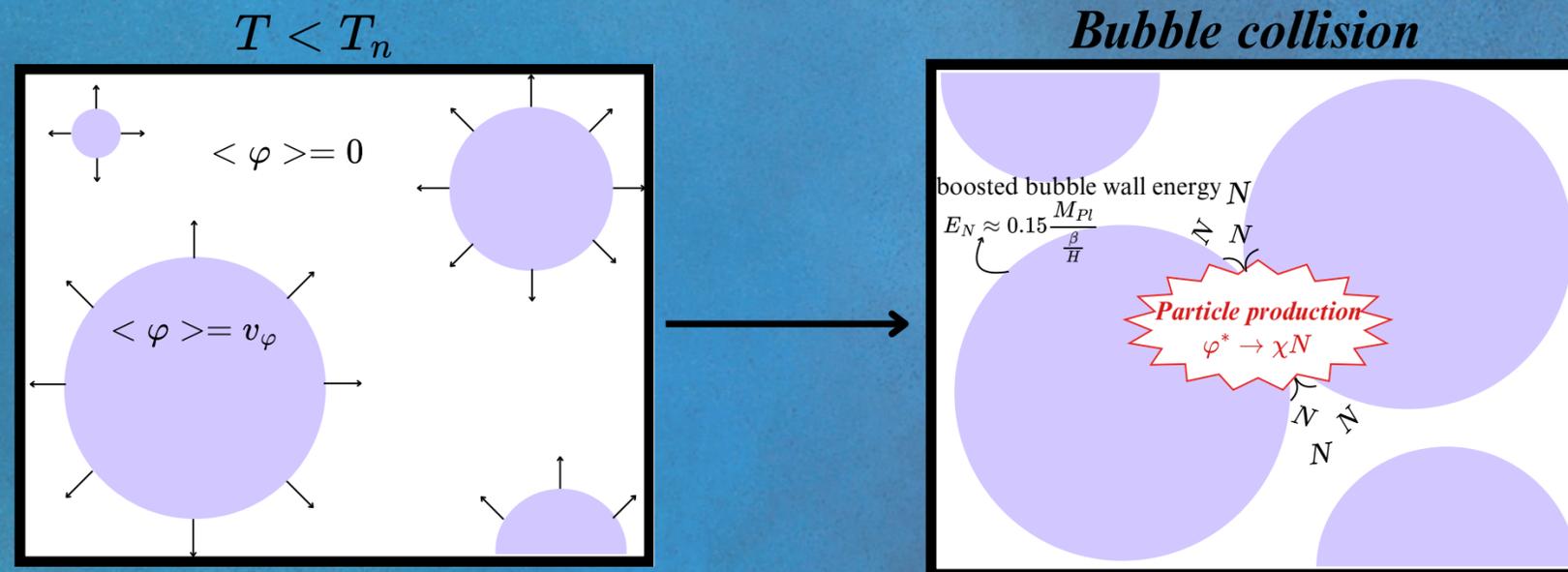
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## RHN production via bubble collisions

- ♦ off-shell propagating field quanta of the background field which can decay
- ♦ runaway behavior: bubble walls accelerate to large boost factors and gain energy  $\sim M_{Pl}/(\beta/H)$  to produce heavy particles when they collide



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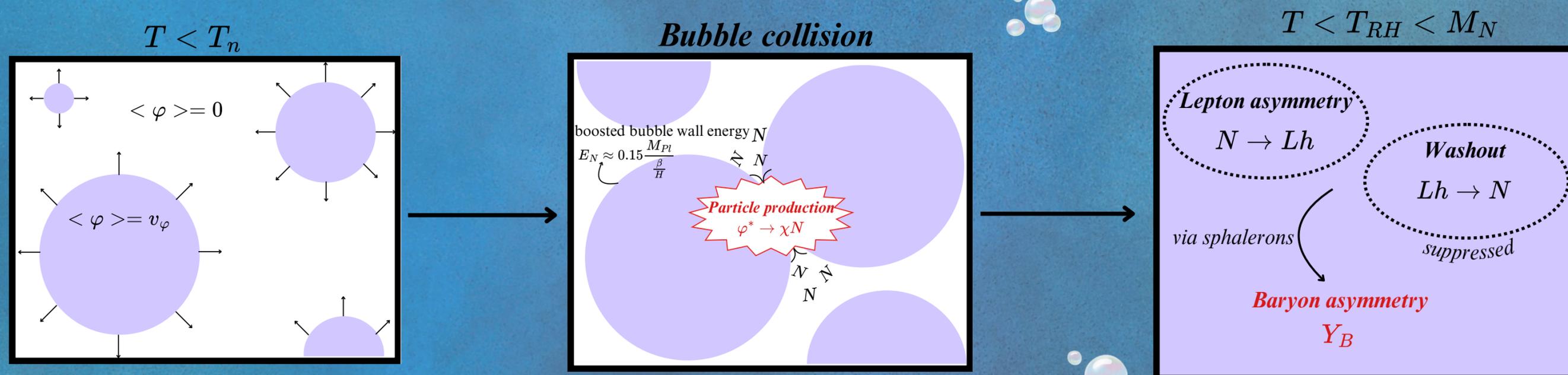
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**Non-thermal leptogenesis**

$$Y_B = Y_N c_{sph} \epsilon_{CP} k_{wash} k_{new}$$

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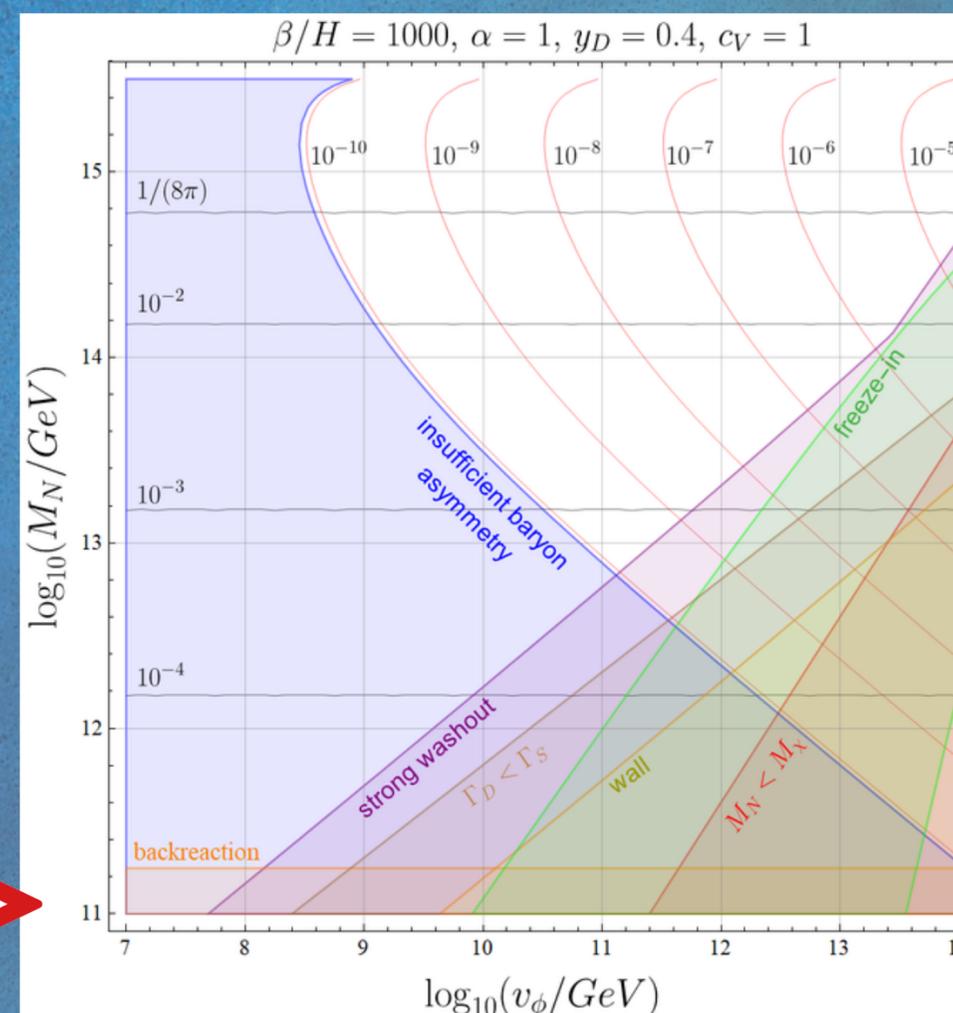
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## Conclusion

- ◆ RHNs produced at the natural mass scale  $10^{14}$  GeV, where they can give rise to SM neutrino masses via type-I seesaw with O(1) couplings
- ◆  $T_{RH} > M_N$  not required
- ◆ Relevant phase transitions at scales  $\geq 10^8$  GeV, within reach of future gravitational wave experiments



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more!

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