$H_1 \left(\frac{2}{\frac{1}{2}}\right)_+$ ← SM Higgs doublet } couple to $\gamma, Z, W^\pm$

$H_2 \left(\frac{2}{\frac{1}{2}}\right)_-$ ← New Higgs doublet

parity

$\underbrace{Q \quad u \quad D \quad L \quad \bar{E}}_{\text{SM charge, parity } +} \qquad N$

SM singlet parity "−"

(~sterile ν)

such that the only possible Yukawa for H_2 is

$$\mathcal{L} \supset y \bar{L} N \hat{H}_2 + h.c.$$

$$\left(\frac{\bar{2}}{-\frac{1}{2}}\right)\left(\frac{1}{0}\right)_-\left(\frac{\hat{2}}{\frac{1}{2}}\right)$$

$SU(2)$ $\quad 2 \otimes 1 \otimes 2 \supset 1$

$U(1)_Y$ $\quad -(-\frac{1}{2}) \otimes 0 \otimes \frac{1}{2} = 0$

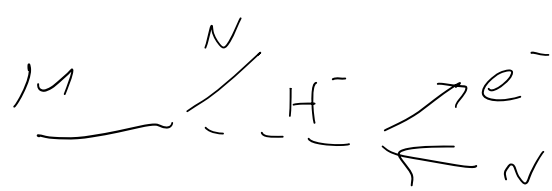
Z_2 $\quad + \otimes - \otimes - = +$

$$y(\bar{\nu}, \bar{e}) N \begin{pmatrix} H_2^0 \\ -H_2^- \end{pmatrix} \sim y(\bar{\nu} N H_2^0 - \bar{e} N H_2^-) + h.c$$

The H_2^0 doesn't have VEV → No seesaw.

if $m_N < m_{H_2}$, ⇒ N could be the DM candidate

if m_N light. (say $\lesssim$ keV) → Warm DM candidate



- then your Michael parameter calculation needs to include the stand-ν mass.

- for LEP, if $M_{H_2} \gtrsim 110$ GeV.
  then it can't be produced on-shell.

- For DM