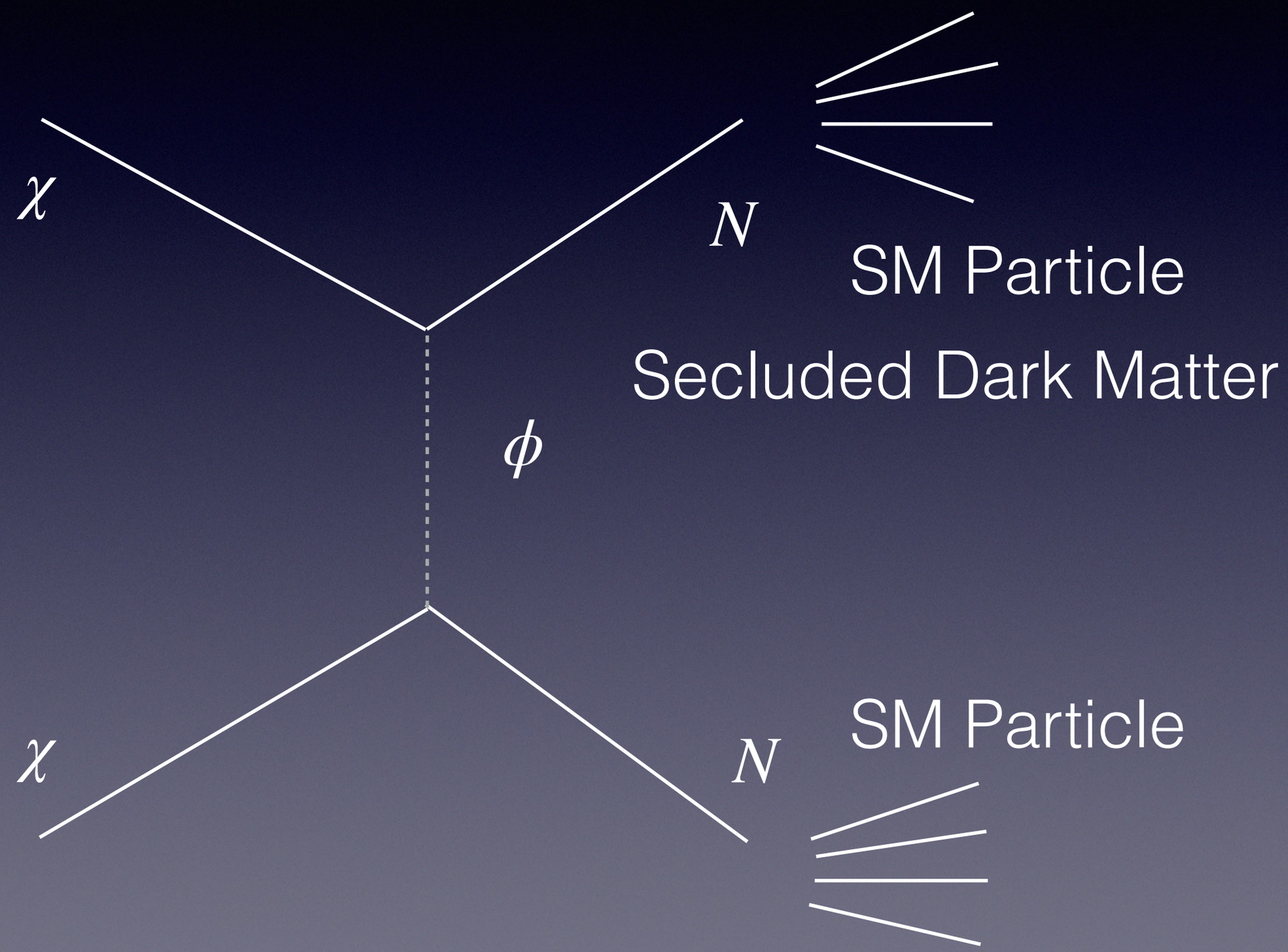
Thermal Effects Induced Freeze-in Dark Matter and the Gravitational Wave

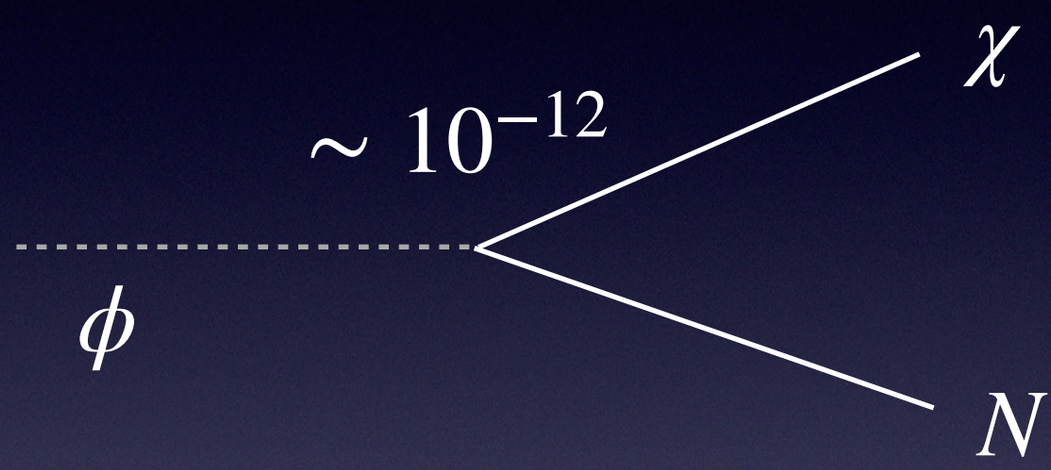
Yi-Lei Tang
Korea Institute for Advanced Study

In collaboration with Li-gong Bian

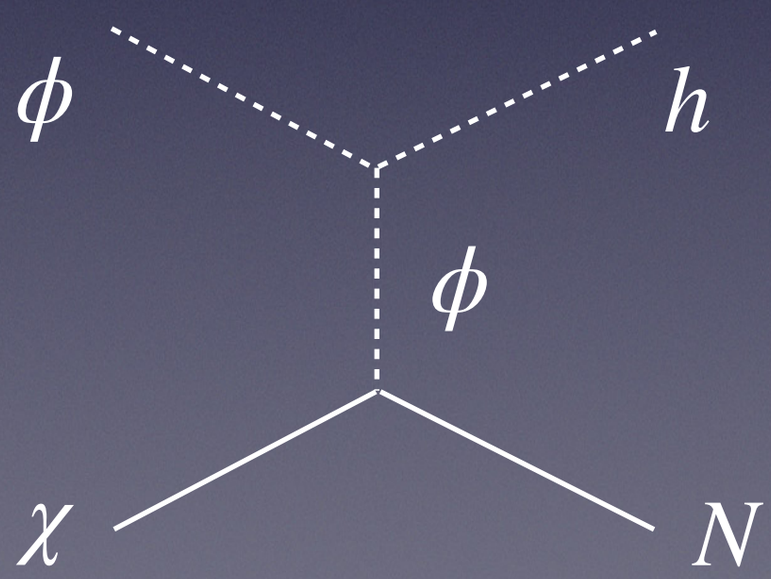
Sterile Neutrino and Dark Matter



Another Choice: Feebly-Interacting Massive Particle



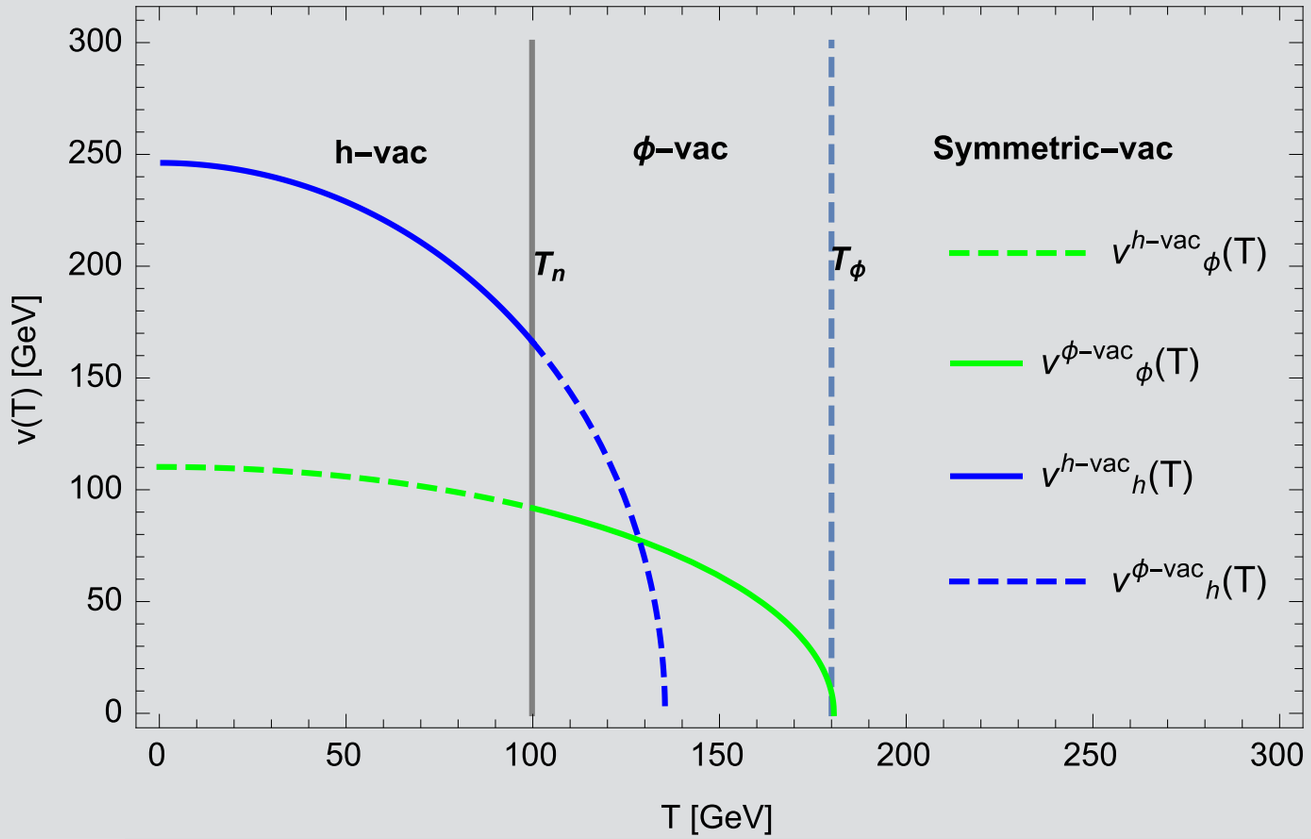
$1 \leftrightarrow 2$

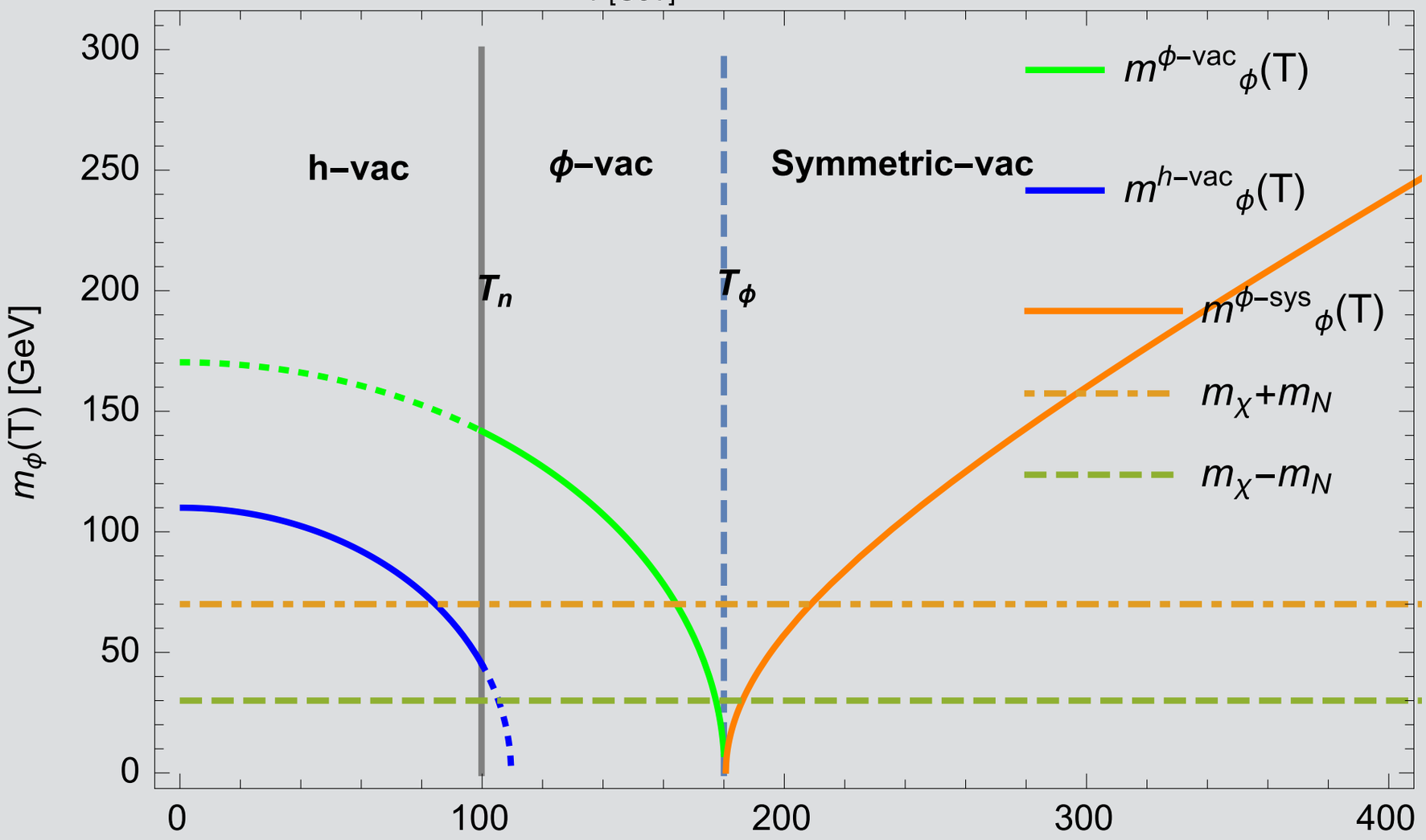


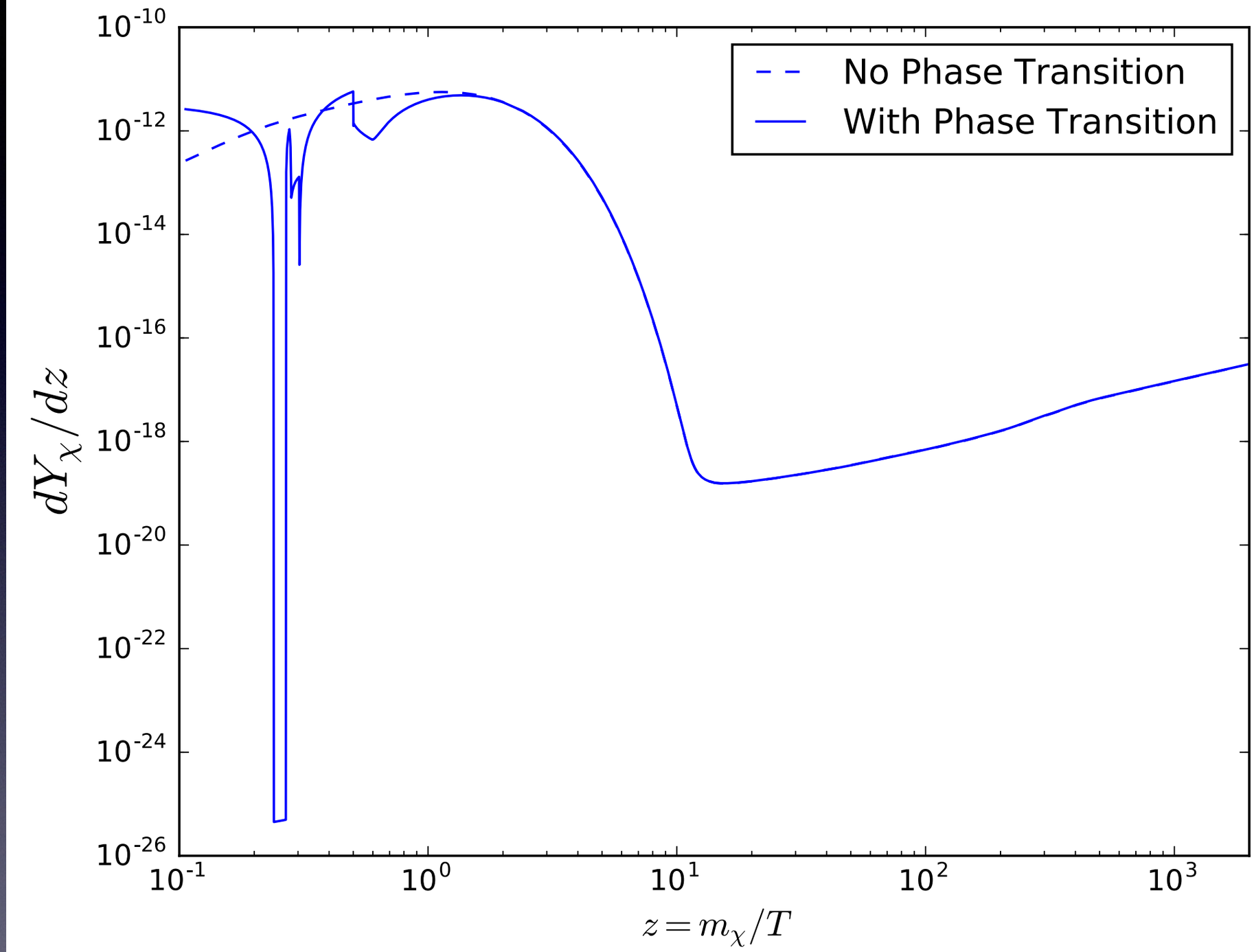
$2 \leftrightarrow 2$

Another Choice: Feebly-Interacting Massive Particle

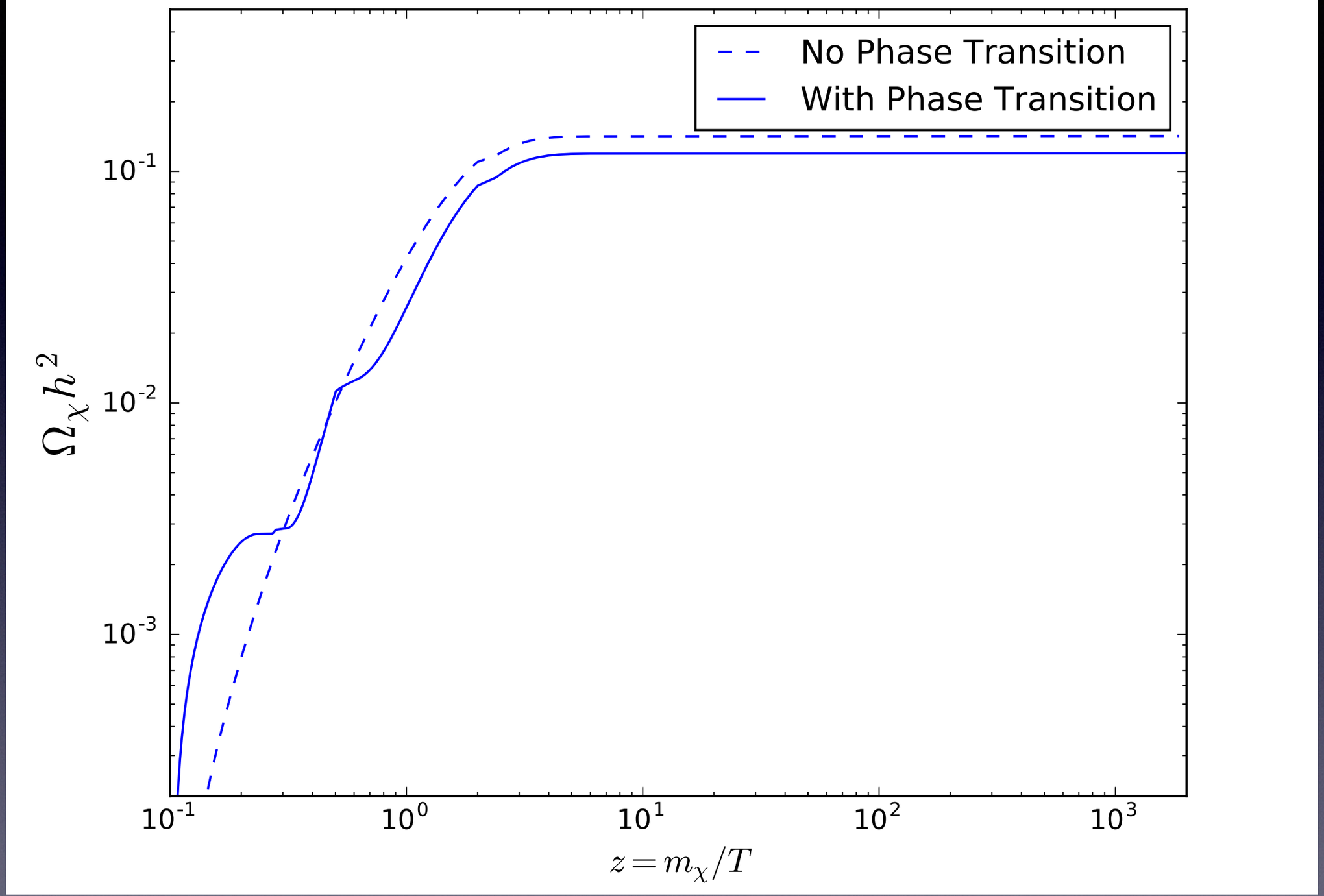
- In the situation of the WIMP, the freeze-out temperature is pretty low. $\sim \frac{m_{\mathrm{DM}}}{26}$
- In the FIMP situation, dark matter production happens at $T = 0.5 m_{\mathrm{DM}} \sim 2 m_{\mathrm{DM}}$
- Phase transition? Gravitational Wave?


h–vac
ϕ–vac
Symmetric–vac
T_n
T_ϕ
$v^{h\text{–vac}}{}_\phi(T)$
$v^{\phi\text{–vac}}{}_\phi(T)$
$v^{h\text{–vac}}{}_h(T)$
$v^{\phi\text{–vac}}{}_h(T)$
v(T) [GeV]
T [GeV]
0
50
100
150
200
250
300

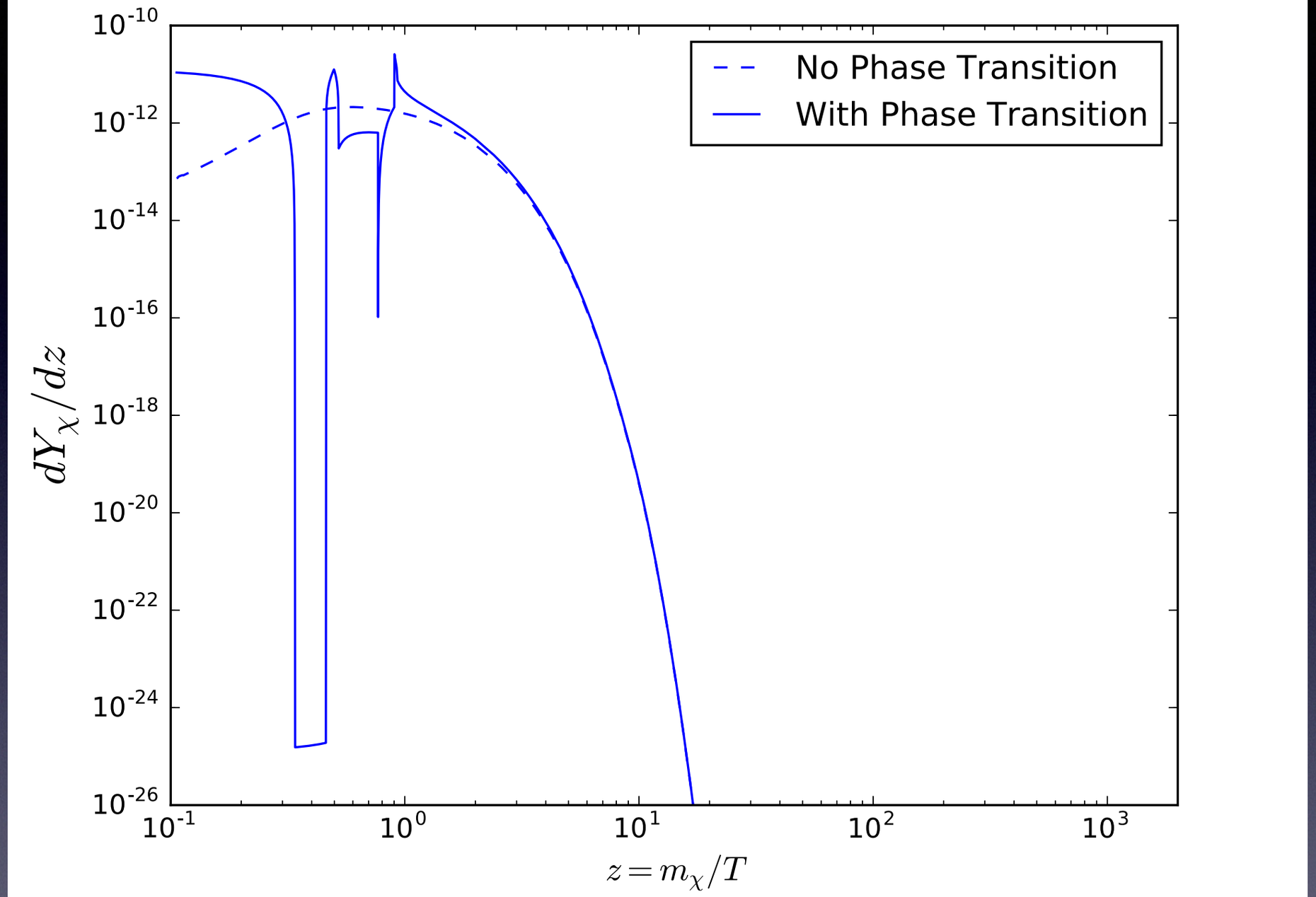

h–vac
ϕ–vac
Symmetric–vac
T_n
T_ϕ
$m^{\phi\text{–vac}}{}_\phi(T)$
$m^{h\text{–vac}}{}_\phi(T)$
$m^{\phi\text{–sys}}{}_\phi(T)$
$m_\chi+m_N$
$m_\chi-m_N$
m_ϕ(T) [GeV]
0
50
100
150
200
250
300
400



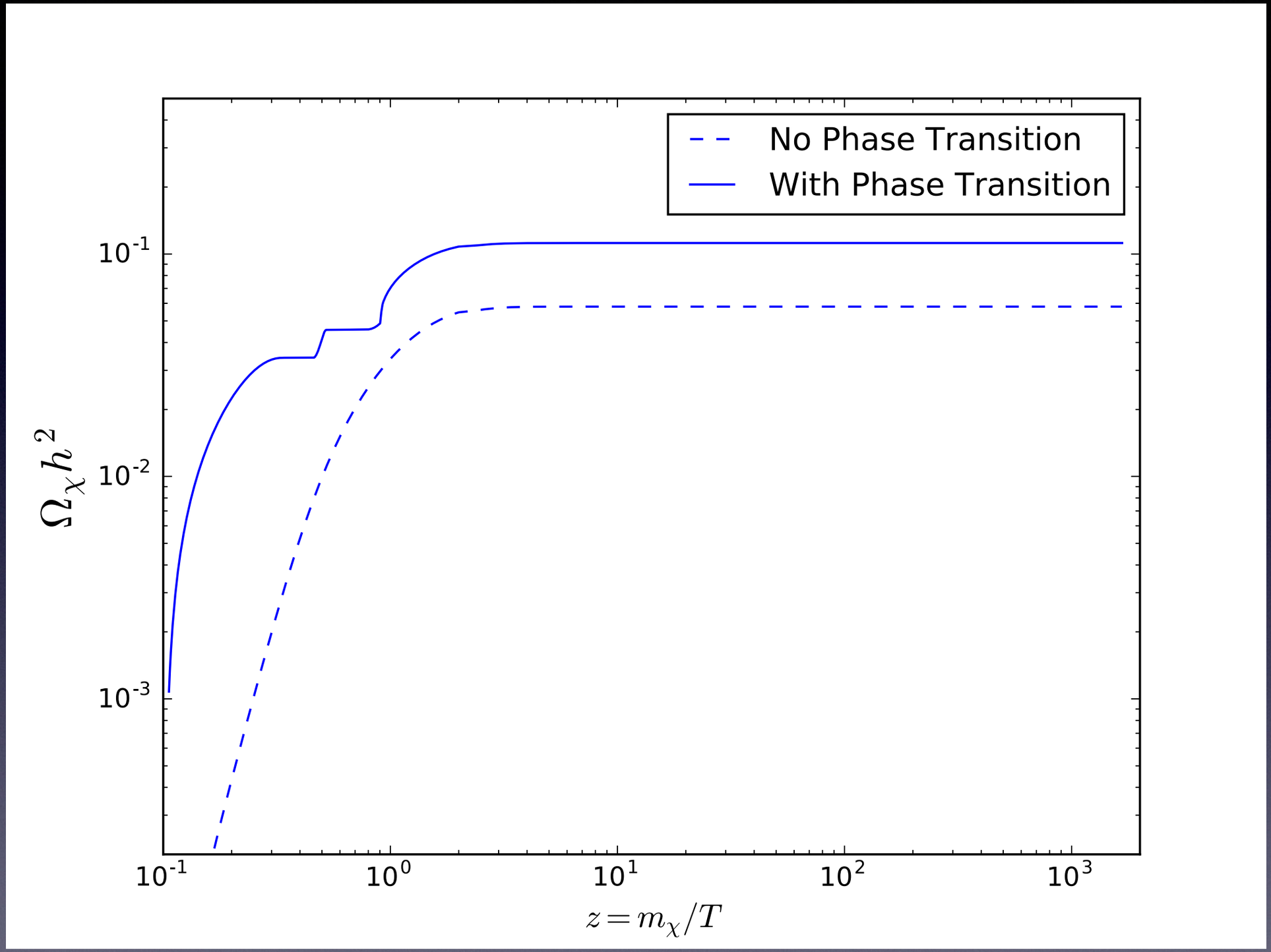
mS=110 GeV, mChi=50GeV, mRHN=20 GeV
yD=2.8e-12



mS=110 GeV, mChi=50GeV, mRHN=20 GeV
yD=2.8e-12

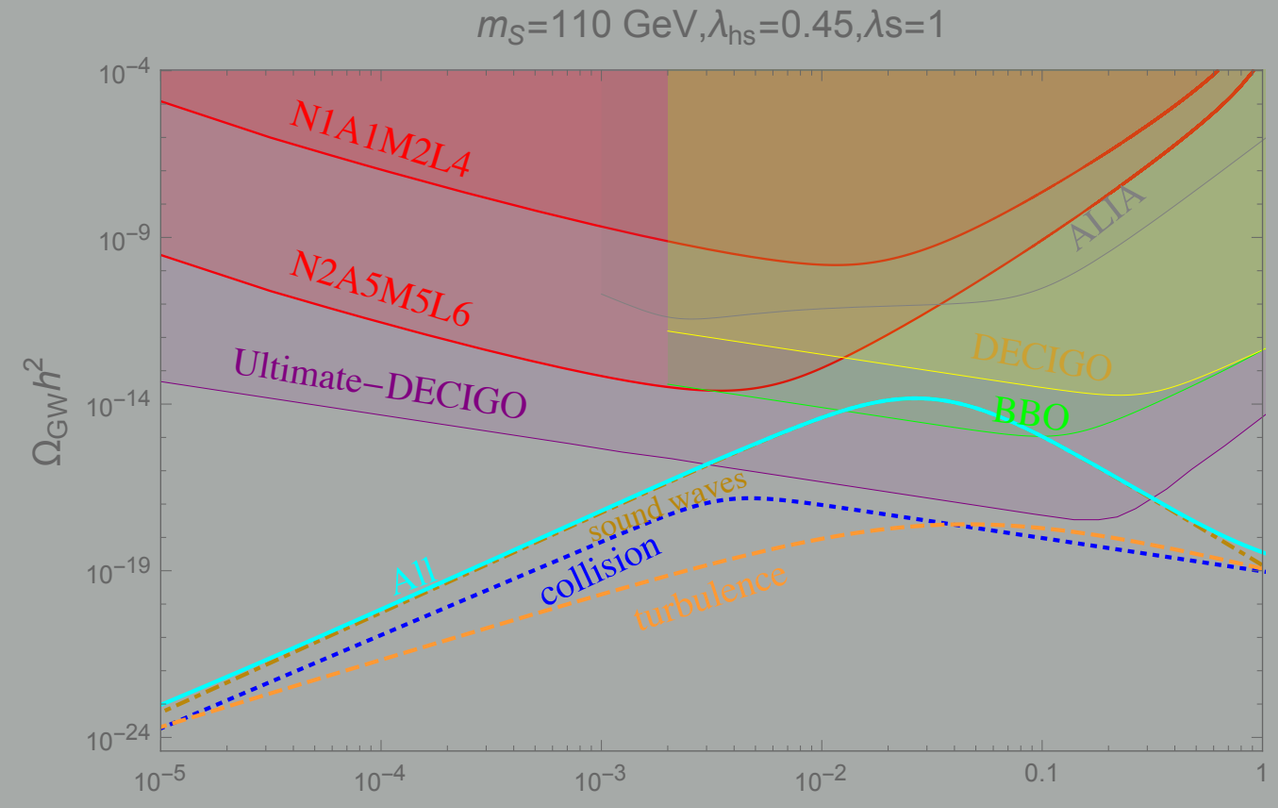


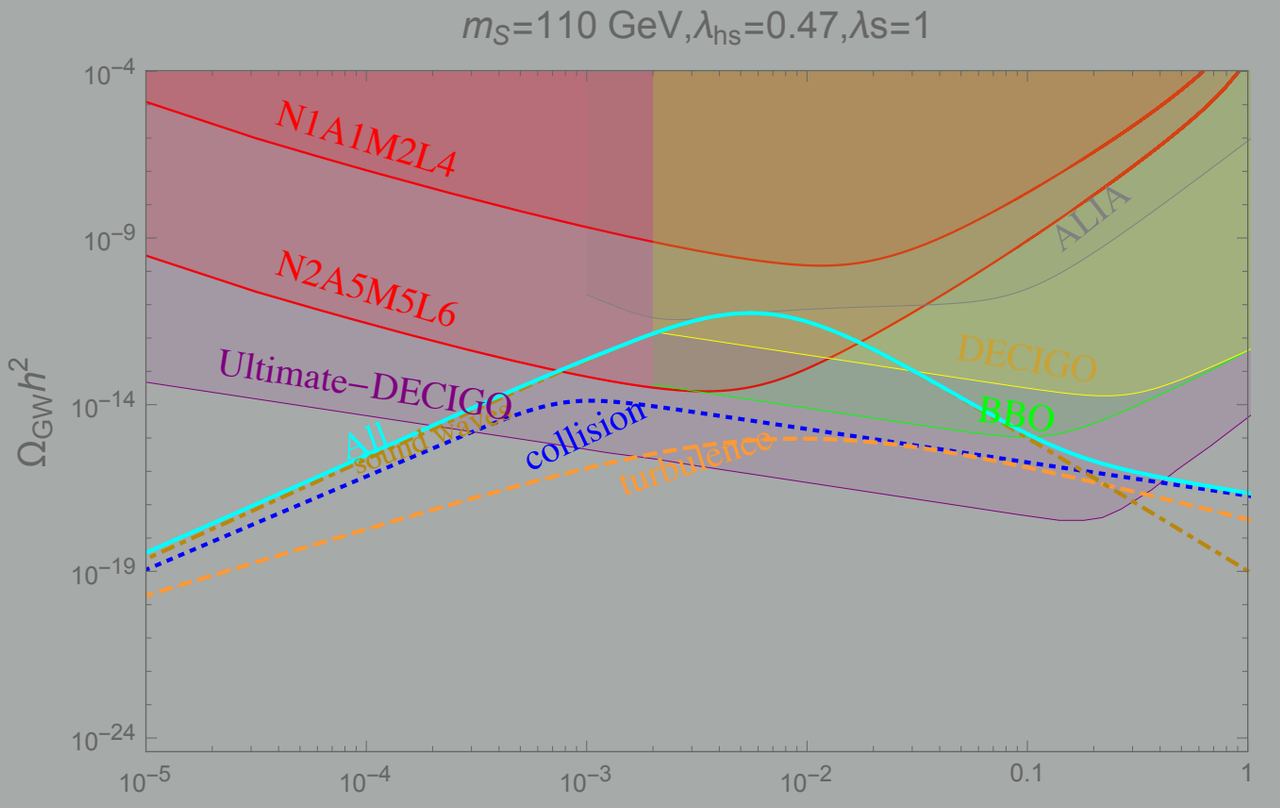
mS=110 GeV, mChi=90GeV, mRHN=40 GeV
yD=7.3e-12

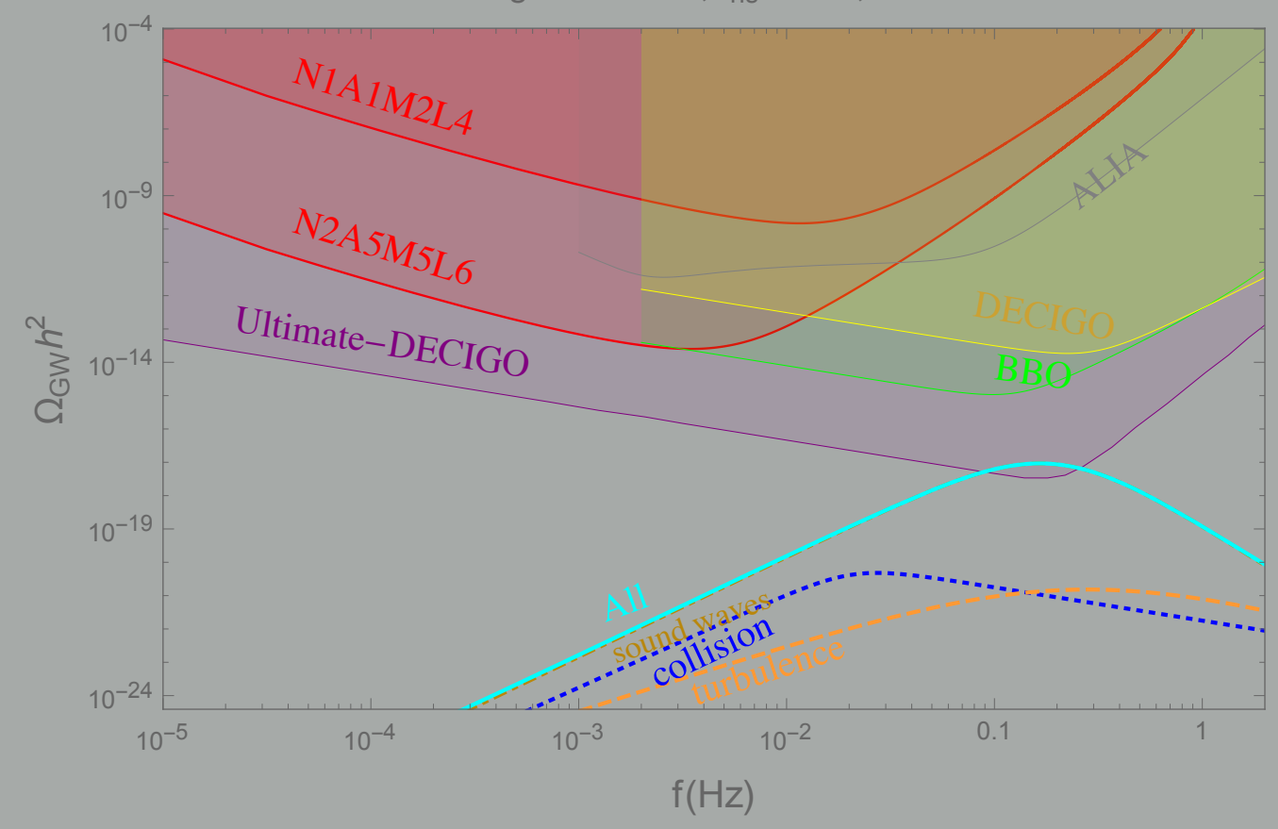


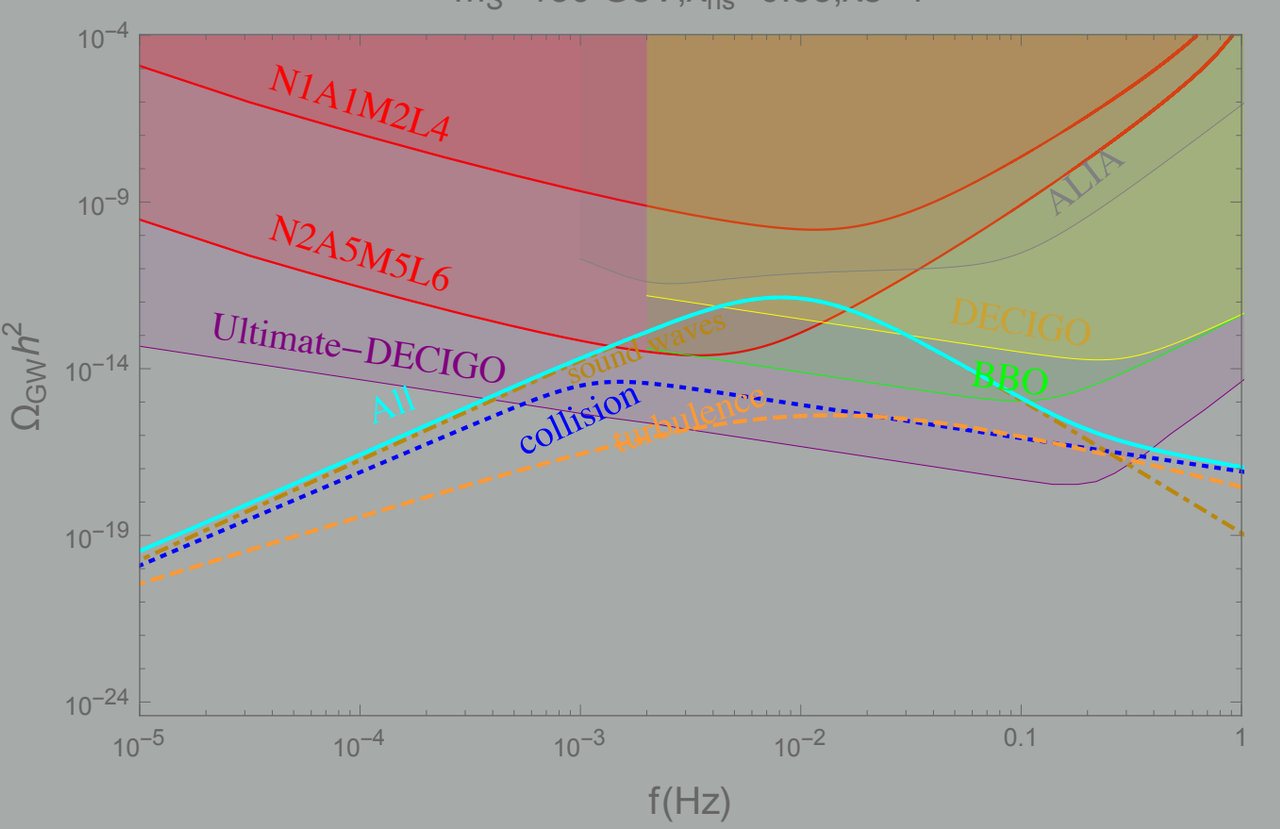
mS=110 GeV, mChi=90GeV, mRHN=40 GeV
yD=7.3e-12

Gravitational Wave Signals









Larger scalar mass gives lower GW signals.
Larger Higgs portal coupling of $\lambda_{\phi h}$, smaller peak frequency, higher magnitude of GW signals.