

Non-WIMP DM candidates

Bertone, Hooper, & Silk (2004) hep-ph/0404175

• standard model neutrinos

$$\Omega_\nu h^2 = \sum_i \frac{m_i}{93 \text{ eV}} \quad \text{so } m_\nu = 1 \text{ eV} \rightarrow \Omega_\nu h^2 \approx 0.03 \text{ for 3 neutrinos}$$

Current limits $0.06 \leq m_\nu \leq 0.12 \text{ eV} \rightarrow 0.002 < \Omega_\nu h^2 < 0.0$
 \uparrow oscillations \uparrow structure formation $< 0.17 \Omega_b$

• Sterile neutrinos

normal neutrinos have left-handed chirality
so sterile neutrinos are hypothesized to have right-handed chiral

sterile neutrinos do NOT interact via the Weak Force, only Gravity

mass $\lesssim 1 \text{ eV} - 10^{15} \text{ GeV}$
Need $m > 10 \text{ keV}$ to form structure

Production is not thermal; can there be enough?

• Light Dark Matter

non-thermal scalars 1-100 MeV

• Kaluza-Klein DM

possible states in theories with extra, compactified dimensions

• WIMPzillas - super heavy DM

Unitarity bound: $M_{\text{Pl}} < 34 \text{ TeV}$ for CMB $\Omega_{\text{DM}} h^2 \approx 0.12$

But if not in thermal equilibrium, could have $m_{\text{DM}} > 10^{10} \text{ GeV}$

• Q-balls

mirror particles
CHAMPs (charged?)
SIDM
D-matter

cryptons
superweakly interacting dark matter
brane world DM
heavy fourth generation neutrinos
"etc."

Non-WIMP dark matter

Snowmass - 2013

arXiv: 1310.8642

[hep-ph]

- Asymmetric Dark Matter
- Axions
- Black Holes
- Mirror Dark Matter
- SIDM
- Sterile neutrinos
- Superheavy DM: WIMPzillas, quark/strange nuggets
- Supersymmetric Q-balls
- Supersymmetric non-WIMPs: axions, SuperWIMPs