Analysis of WIMP, FIMP and SIMP dark matter production mechanisms in the early universe.

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General Objective

Study possible dark matter production mechanisms in the early universe.

WIMPs

Weakly Interacting Massive Particles

FIMPs

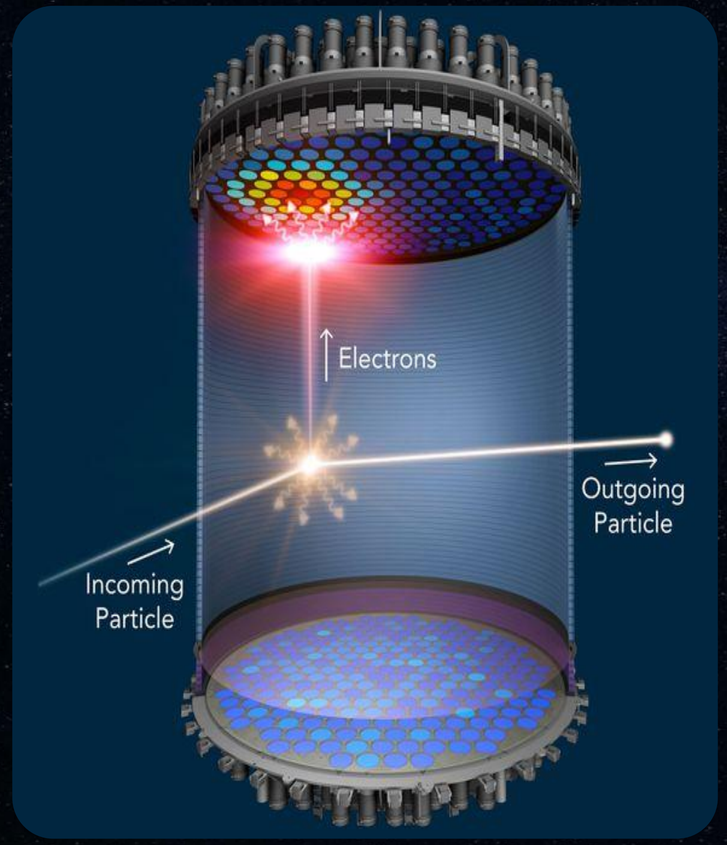
Feebly Interacting Massive Particles

SIMPs

Strongly Interacting Massive Particles

WIMP Mechanism

Weakly Interacting Massive Particles



LUX-ZEPLIN detector.

Characteristics

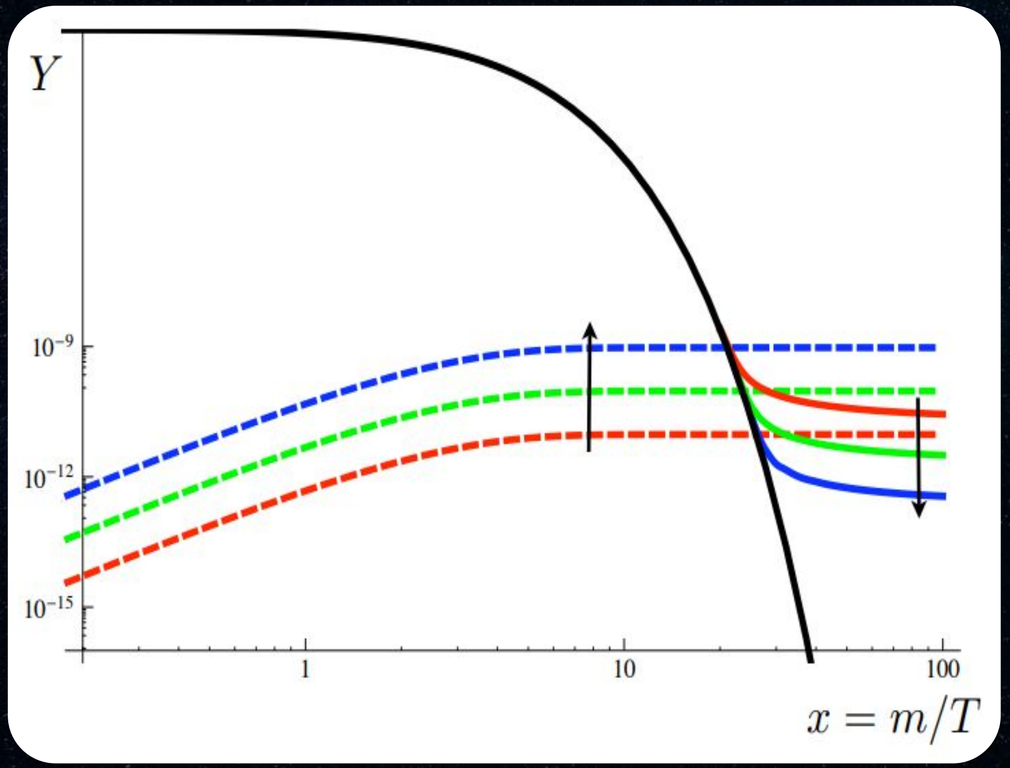
- Uses 2 → 2 aniquilation mechanism.
- Uses the Freeze-out method.
- No WIMP has ever been detected in LHC.
- Direct detection experiments are in progress

FIMP Mechanism

Feebly Interacting Massive Particles

Characteristics

- Also called Freeze in Massive Particles.
- Weaker baryonic interaction then WIMPs.
- Uses 2 → 2 interaction mechanism.
- Uses the Freeze-in method.
- Would be harder to have direct detection.



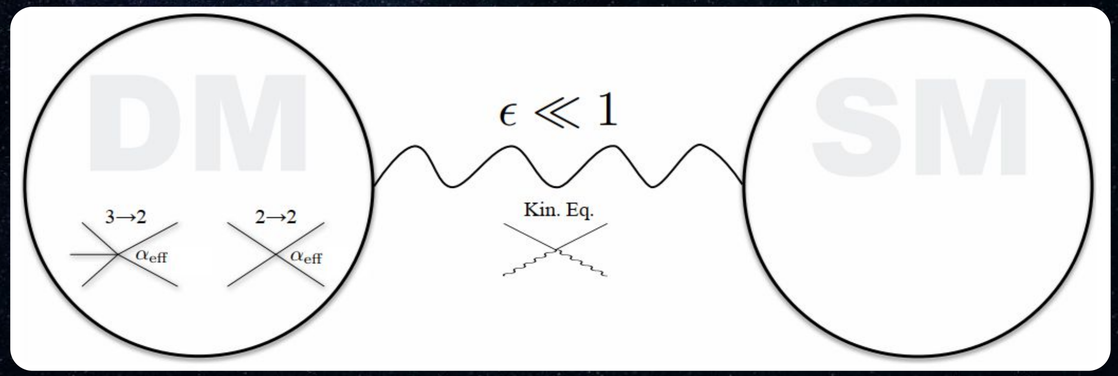
arXiv:0911.1120

SIMP Mechanism

Strongly Interacting Massive Particles

Characteristics

- Interacts strongly with itself.
- interacts weakly with baryonic matter
- Uses 3 → 2 or even 4 → 2 interactions.
- Uses the Freeze-out method.
- DM sector and SM sector are in thermal equilibrium.



arXiv:1402.5143

Boltzmann equations

WIMPs

$$\frac{dn_\psi}{dt} + 3Hn_\psi = -\langle\sigma_{\psi\bar{\psi}\to X\bar{X}}|v|\rangle\,[n_\psi^2 - (n_\psi^{EQ})^2],$$

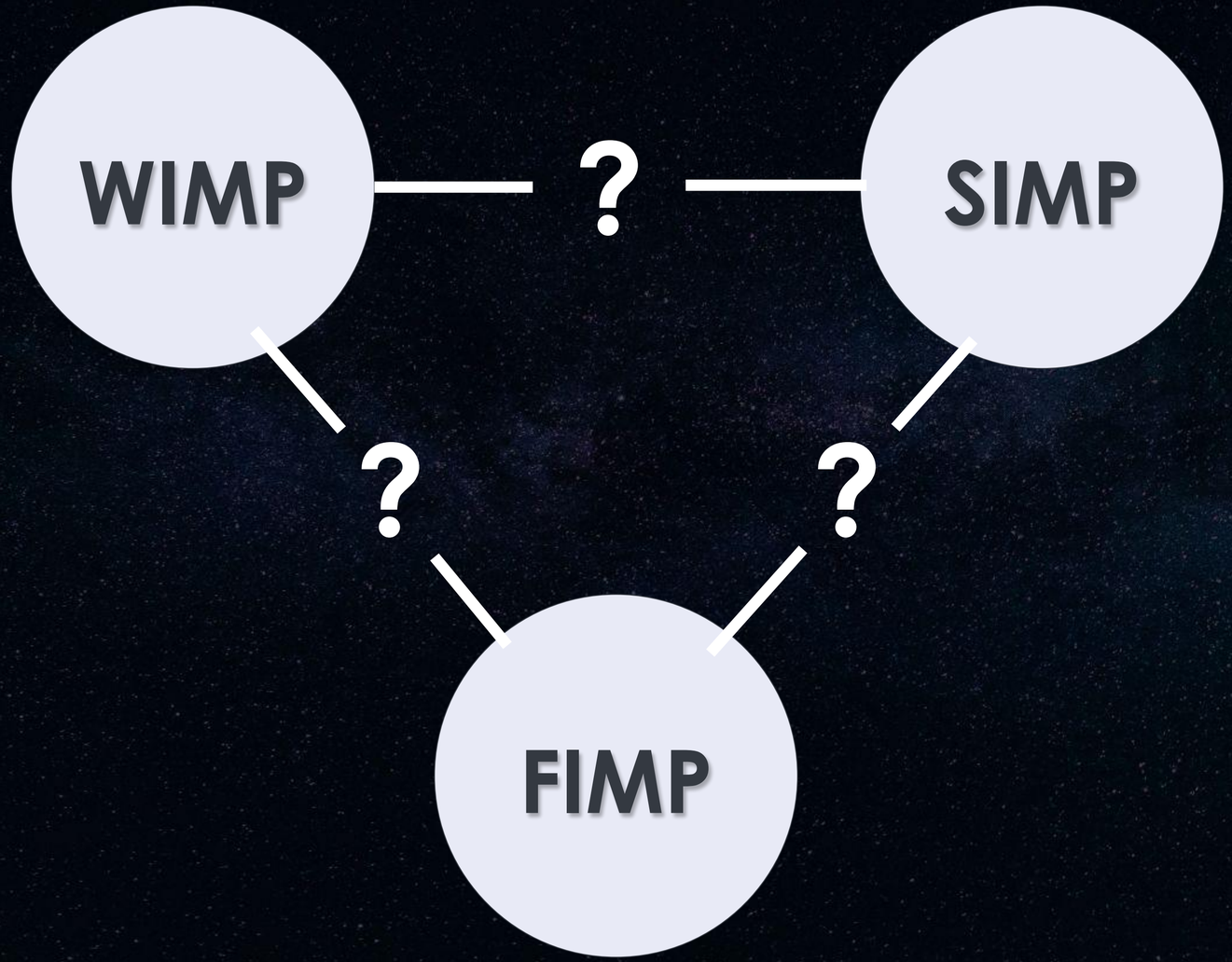
FIMPs

$$\frac{dn_\psi}{dt} + 3Hn_\psi = \langle\sigma_{\psi\bar{\psi}\to X\bar{X}}|v|\rangle\,(n_\psi^{EQ})^2.$$

SIMPs

$$\frac{dn_\psi}{dt} + 3Hn_\psi = -[n_\psi^3 - n_\psi^2 n_\psi^{EQ}]\,\langle\sigma v^2\rangle_{3\to 2} - [n_\psi^2 - (n_\psi^{EQ})^2]\,\langle\sigma v\rangle_{ann}$$

Expected Results



Thank you!

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