

Mixed Axion/Neutralino Dark Matter in Supersymmetric Models

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University of Oklahoma

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H. Baer, AL, S. Rajagopalan and W. Sreethawong
Mixed axion/neutralino cold dark matter in supersymmetric models.
arXiv:1103.5413

Originally proposed by:



K. Choi, J. Kim, H. Lee and O. Seto
Neutralino dark matter from heavy axino decay.
Phys.Rev.D77 (2008), 123501

Outline

- Motivation
- The PQMSSM
- Cosmological Constraints
- PQMSSM Cosmology
- Conclusions

The Strong CP Problem

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$$\mathcal{L}_\theta = \frac{\alpha_s}{8\pi} \theta \mathbf{G}_{\mu\nu} \tilde{\mathbf{G}}^{\mu\nu}$$

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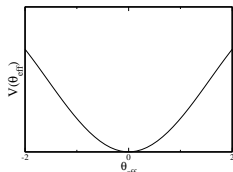
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 $\Rightarrow \tilde{\mathbf{a}} \rightarrow \tilde{\mathbf{g}} + \mathbf{g} \rightarrow \dots \rightarrow \tilde{Z}_1 + \text{visible}$
- $\tau_{\tilde{a}} \sim 10^{-4} - 10^2 \text{ s}$ ($m_{\tilde{a}} \sim 1 - 0.1 \text{ TeV}$, $f_a = 10^{12} \text{ GeV}$)

Cosmological Constraints

- DM: $\Omega_a h^2 + \Omega_{\tilde{Z}_1} h^2 = 0.1123$

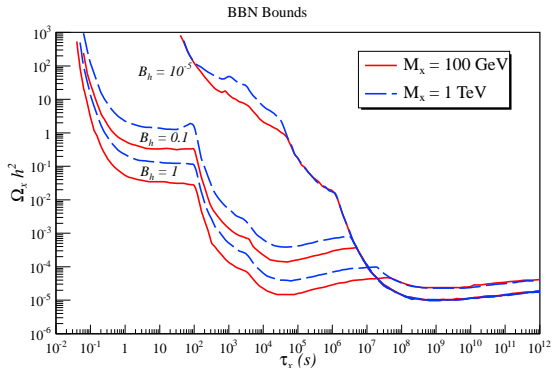
$$\Omega_a h^2 \simeq 0.23 \theta_i^2 \left(\frac{f_a}{10^{12} \text{ GeV}} \right)^{7/6}, \quad \Omega_{\tilde{Z}_1} h^2 = \Omega_{\tilde{Z}_1}^{fr} h^2 + \Omega_{\tilde{Z}_1}^{\tilde{a}} h^2$$

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- BBN (axino decays): (Jedamzik, PRD74 103509, 2006)



PQMSSM Cosmology

► **Parameters:**

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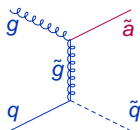
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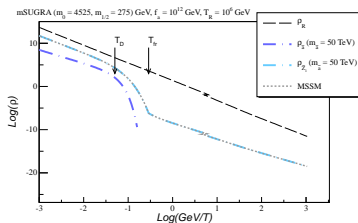
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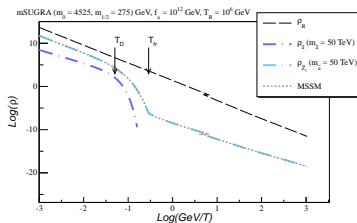
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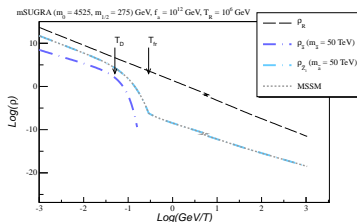
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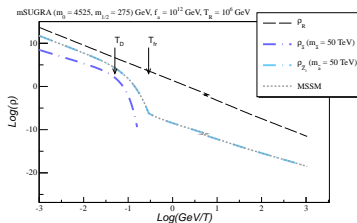
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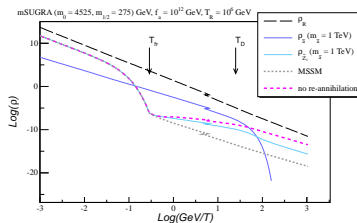
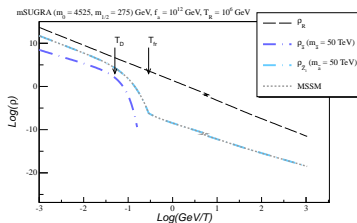
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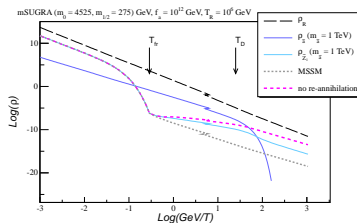
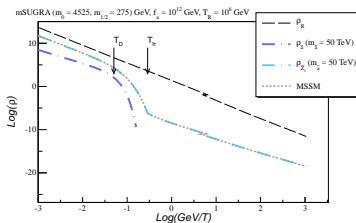
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Can reconcile DM constraints with models with large $\langle \sigma v \rangle$!

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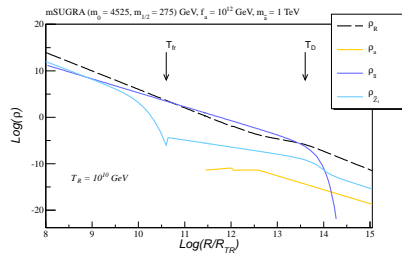
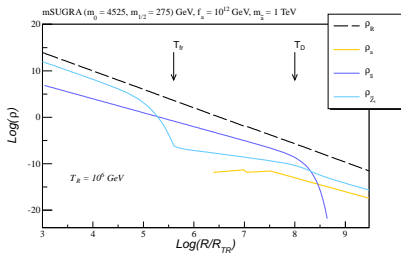
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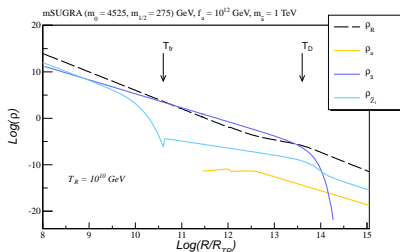
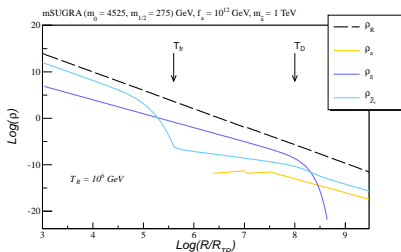
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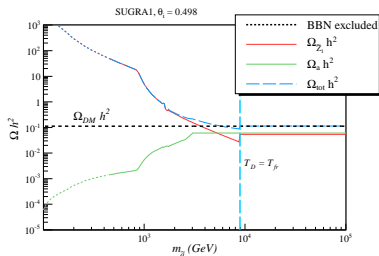
- ▶ $\Omega_a h^2$ gets diluted by ~ 20
- ▶ $\Omega_{\tilde{Z}_1} h^2$ is not affected

► DM Relic Density versus PQ parameters

$$(m_{\bar{a}} = 1 \text{ TeV}, f_a = 10^{12} \text{ GeV}, T_R = 10^{10} \text{ GeV})$$

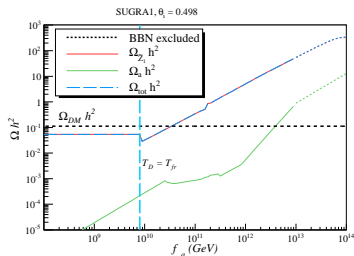
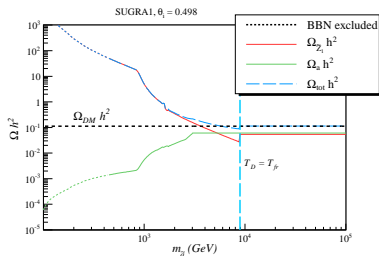
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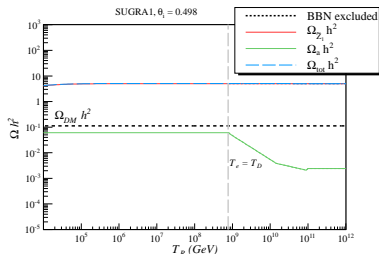
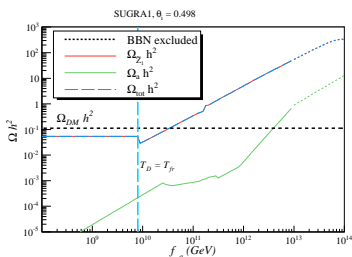
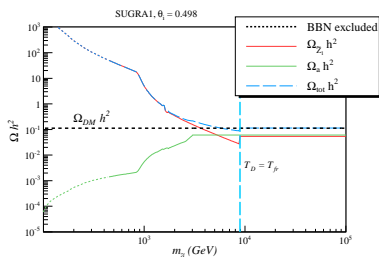
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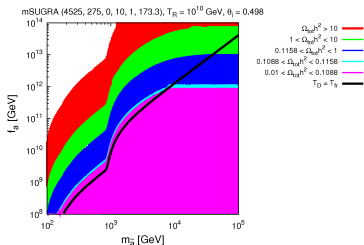
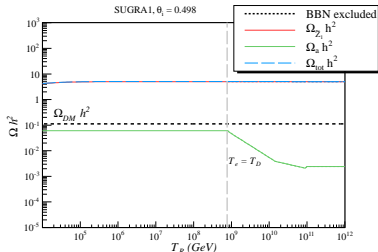
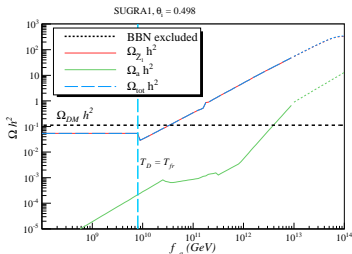
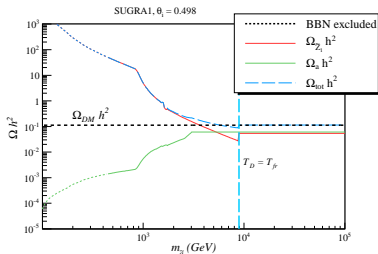
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 - Furthermore, if $T_R \gg 10^6 \text{ GeV} \Rightarrow$ early axino dominated universe
→ axions are diluted
→ "pure" neutralino DM scenario with large $\langle \sigma v \rangle$

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