# ミューオンg-2のズレと暗黒物質残存量を説明する

# ミニマルな超対称模型の探索

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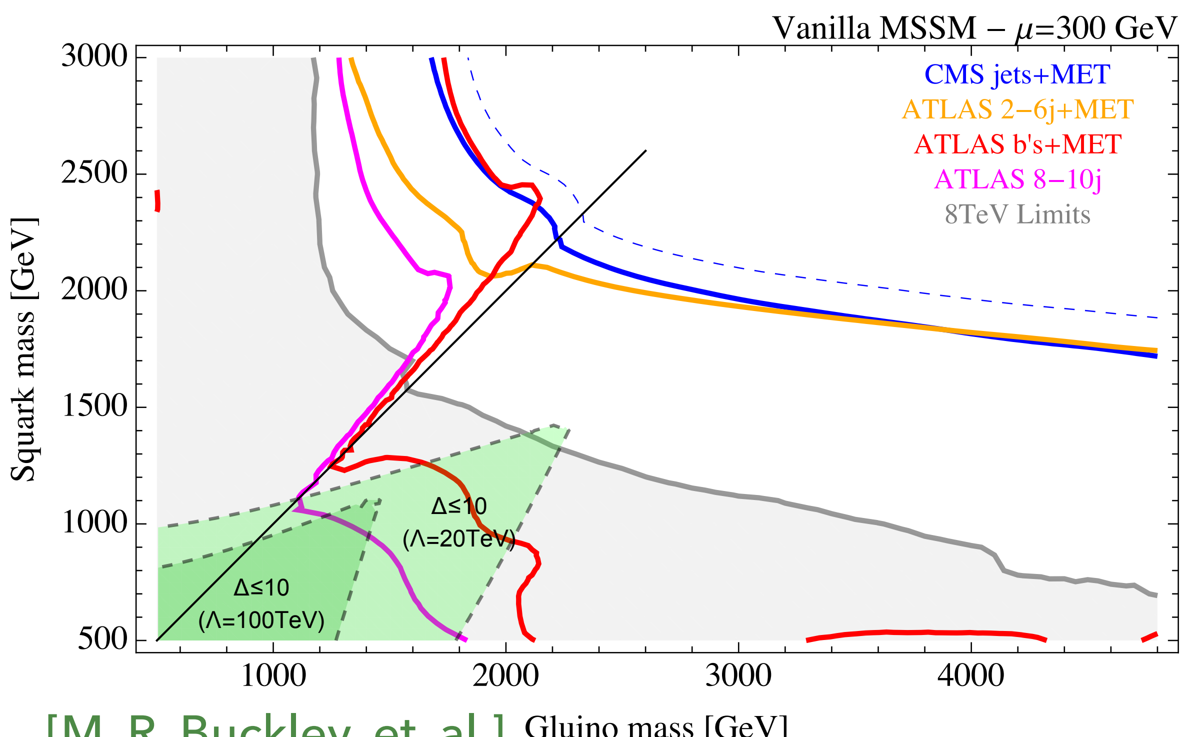
# Low energy SUSY??

1. Electroweak naturalness

- Higgsino, stop, gluino need to be light
- LHC 13 TeV constraint is so strong on stop and gluino that we cannot avoid O(1) % fine tuning in MSSM




[M. R. Buckley, et. al.]

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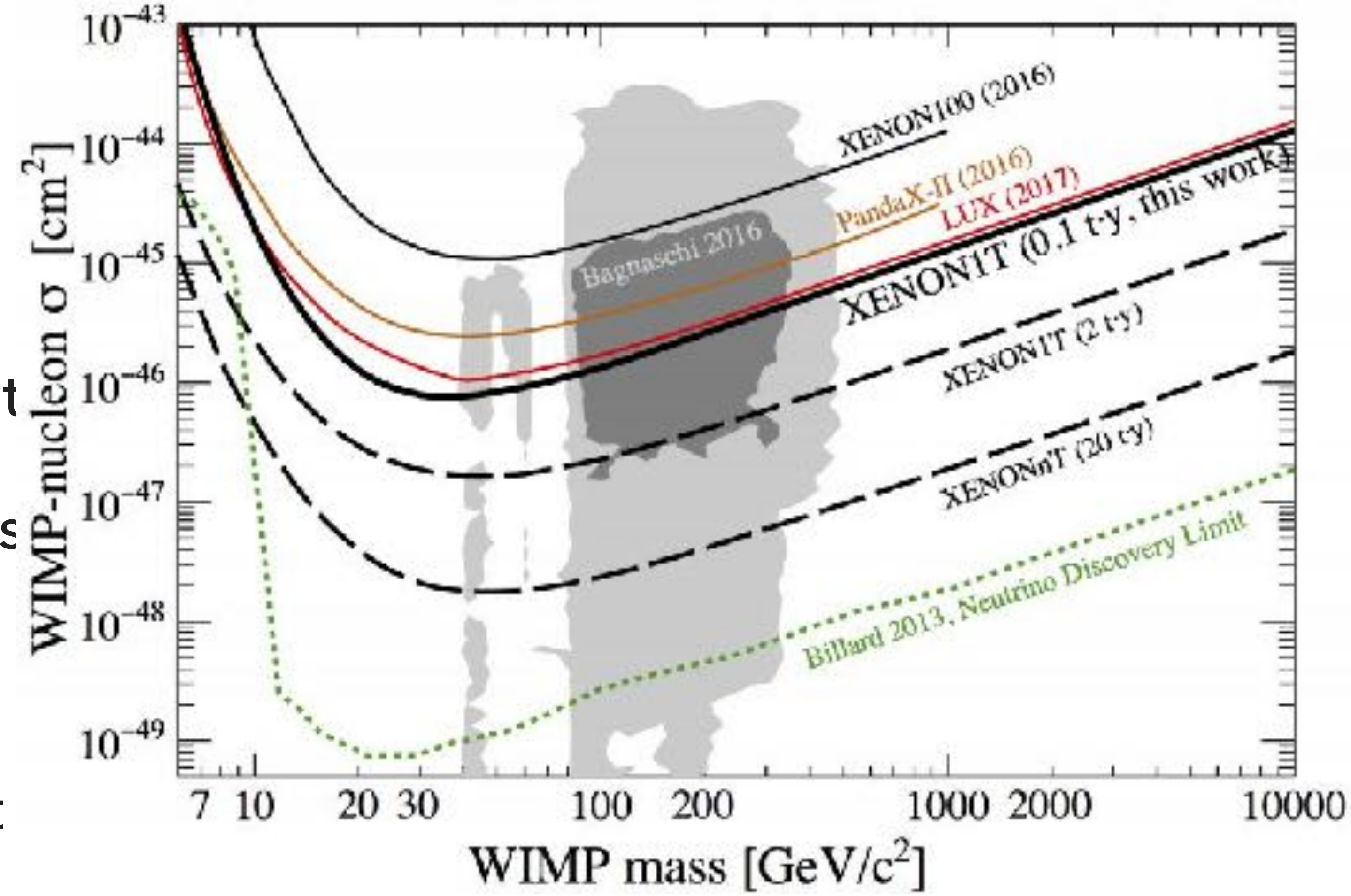


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- Lightest neutralino of 100 GeV - 1TeV can be DM by thermal freeze-out
- LHC constraints on Electroweak sector are not so severe as colored sector
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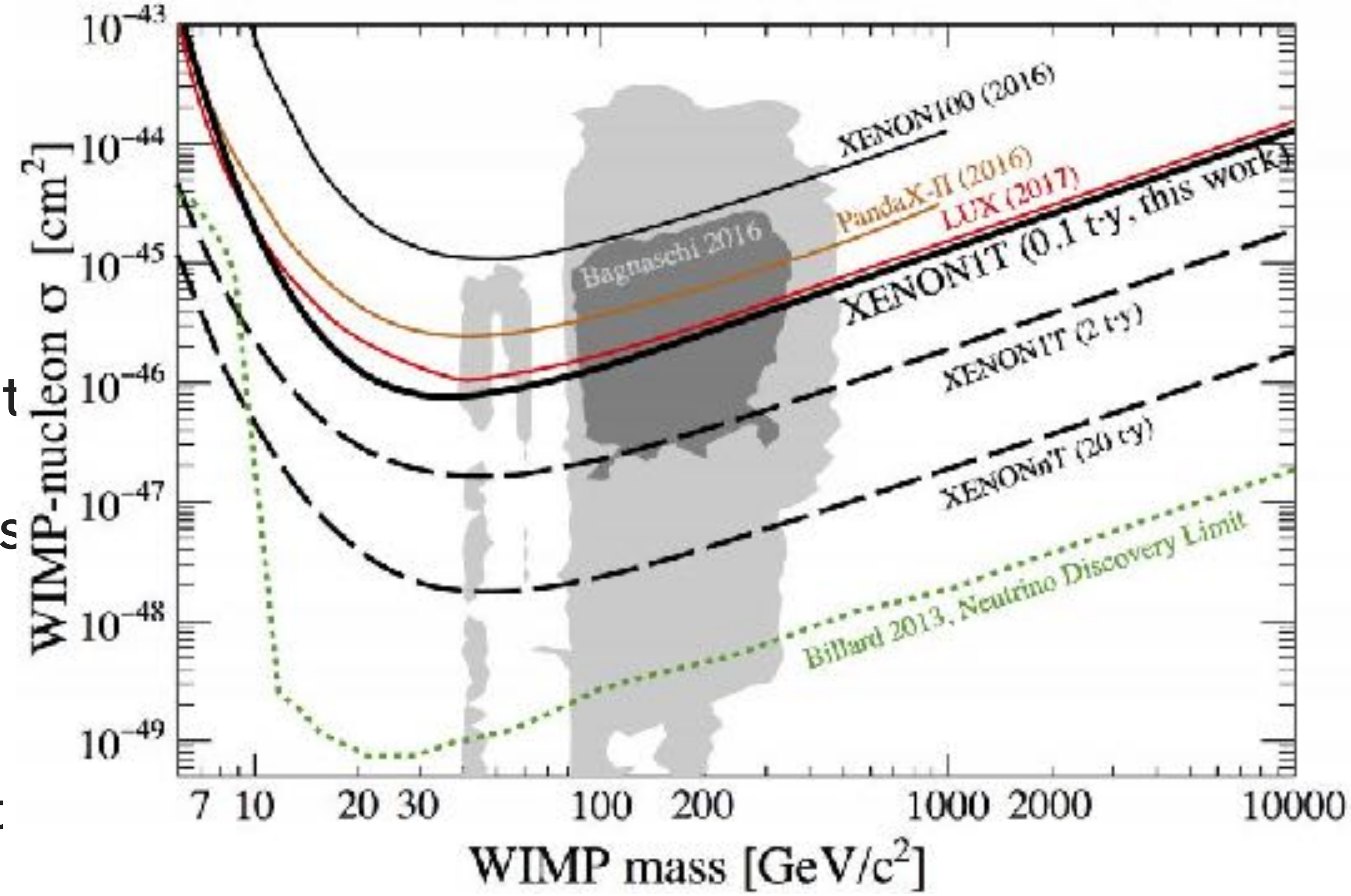


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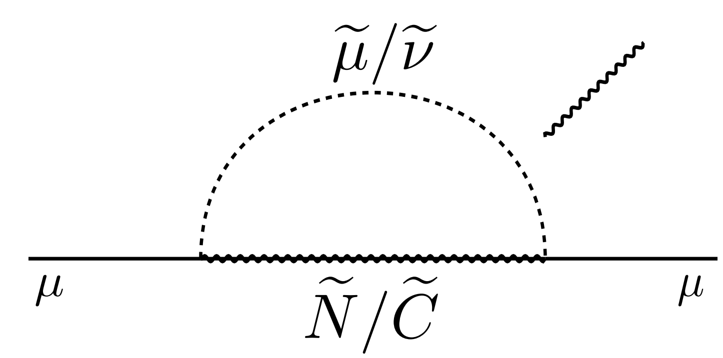
3. 1-loop correction for muon g-2

- 3σ discrepancy $a_\mu(\mathrm{exp}) - a_\mu(\mathrm{SM}) = (26.1 \pm 8.0) \times 10^{-10}$
- O(100) GeV neutralino/chargino, smuon can solve the discrepancy



# Bino-slepton coannihilation scenario

We want to study whether MSSM can **simultaneously** solve DM and g-2 or not

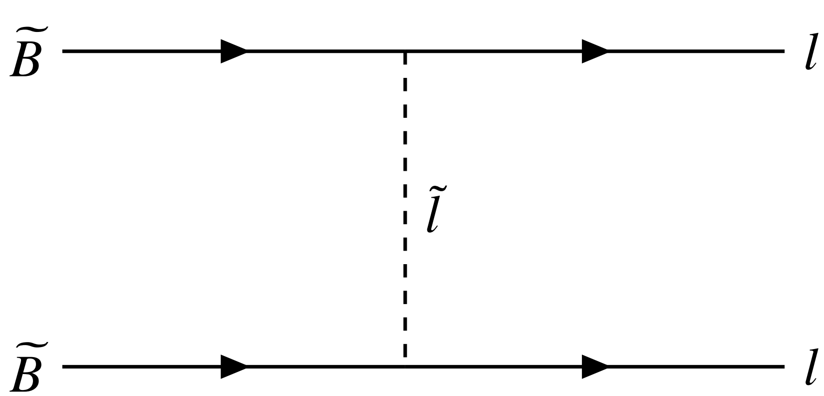
1. DM should be Bino-like

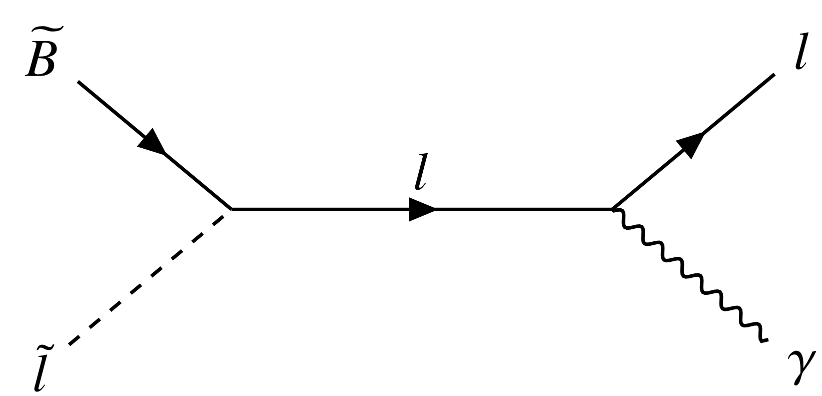
   Otherwise SUSY scale is > 1 TeV, which is too large to explain muon g-2

2. With the LEP bound on sleptons, Bino DM is overproduced

   When $m_{\tilde{\ell}} - m_{\widetilde{B}} \simeq 10\,\mathrm{GeV}$, coannihilation with sleptons provides DM abundance

   Light sleptons are also good for muon g-2 discrepancy



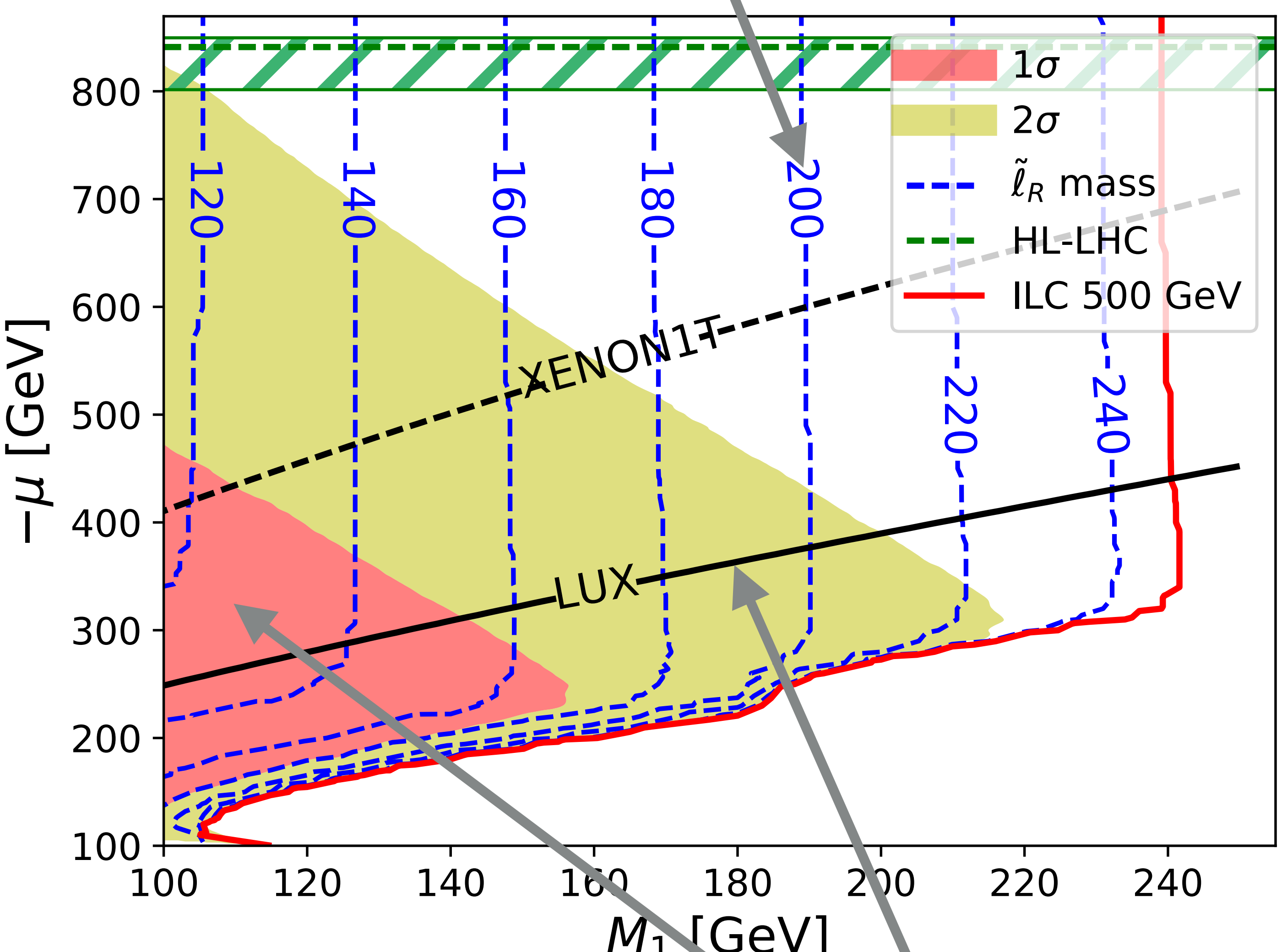



# Bino-slepton coannihilation scenario

- We consider the model where only Bino, Higgsino, right-handed sleptons are light
- Other SUSY particles are decoupled $\gtrsim 3\,\mathrm{TeV}$

3 parameters $M_1,\ \mu,\ m_{\tilde{\ell}_R}$

Slepton mass $m_{\tilde{\ell}_R}$ for $\Omega h^2 = 0.12$




Muon g-2 is explained at 1σ (2σ)

$(M_1, \mu)$

↓ Coannihilation determines slepton mass

$m_{\tilde{\ell}}$

↓ Muon g-2 is calculated by 3 parameters

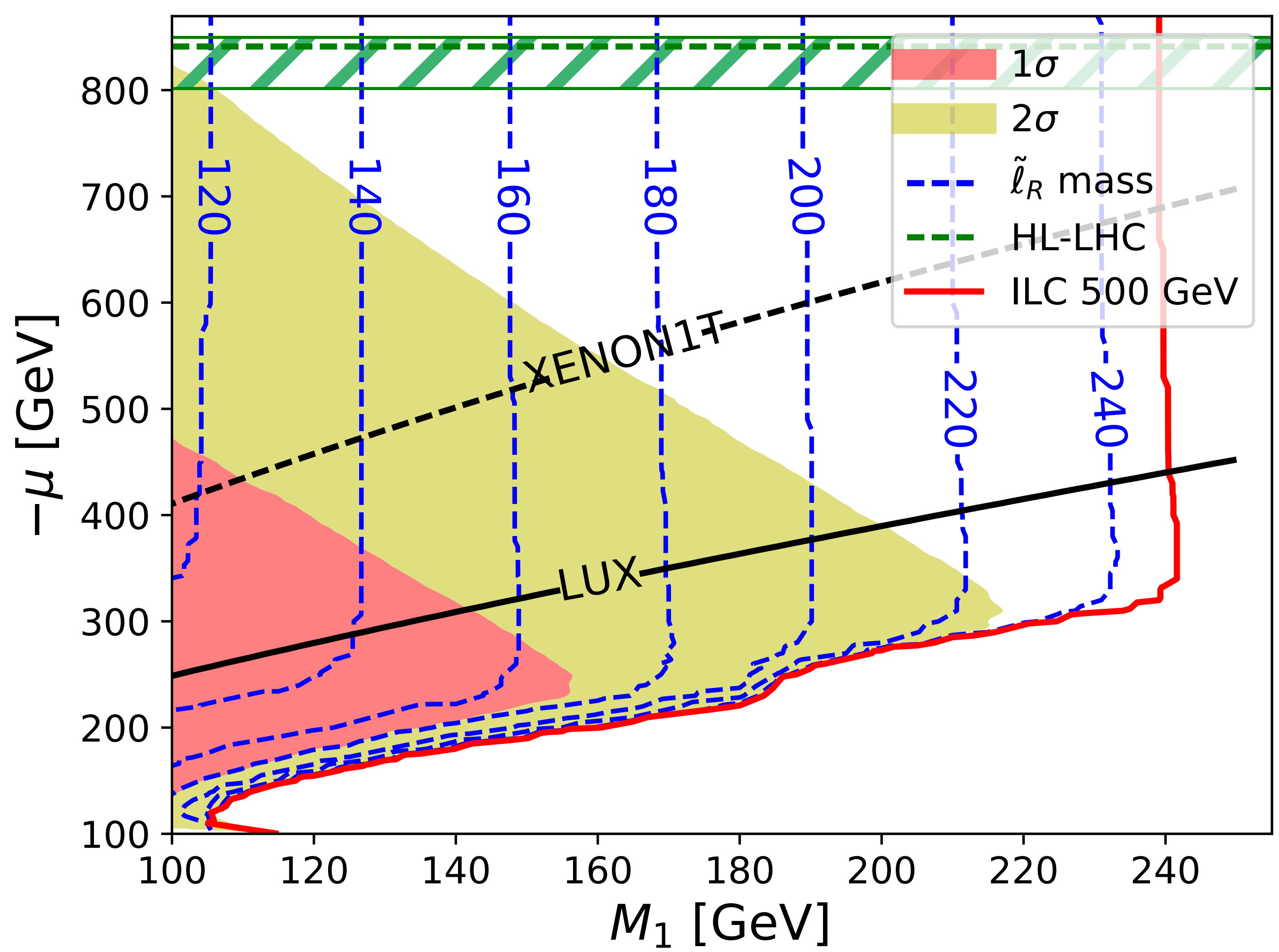
$\Delta a_\mu = \Delta a_\mu(M_1, \mu, m_{\tilde{\ell}})$

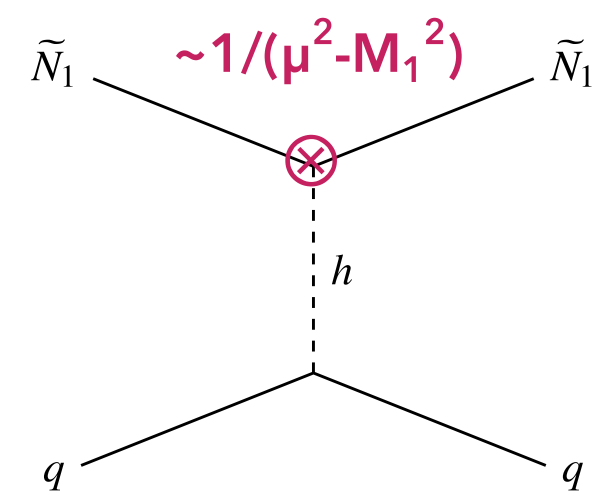
✓ tanβ = 40 fixed

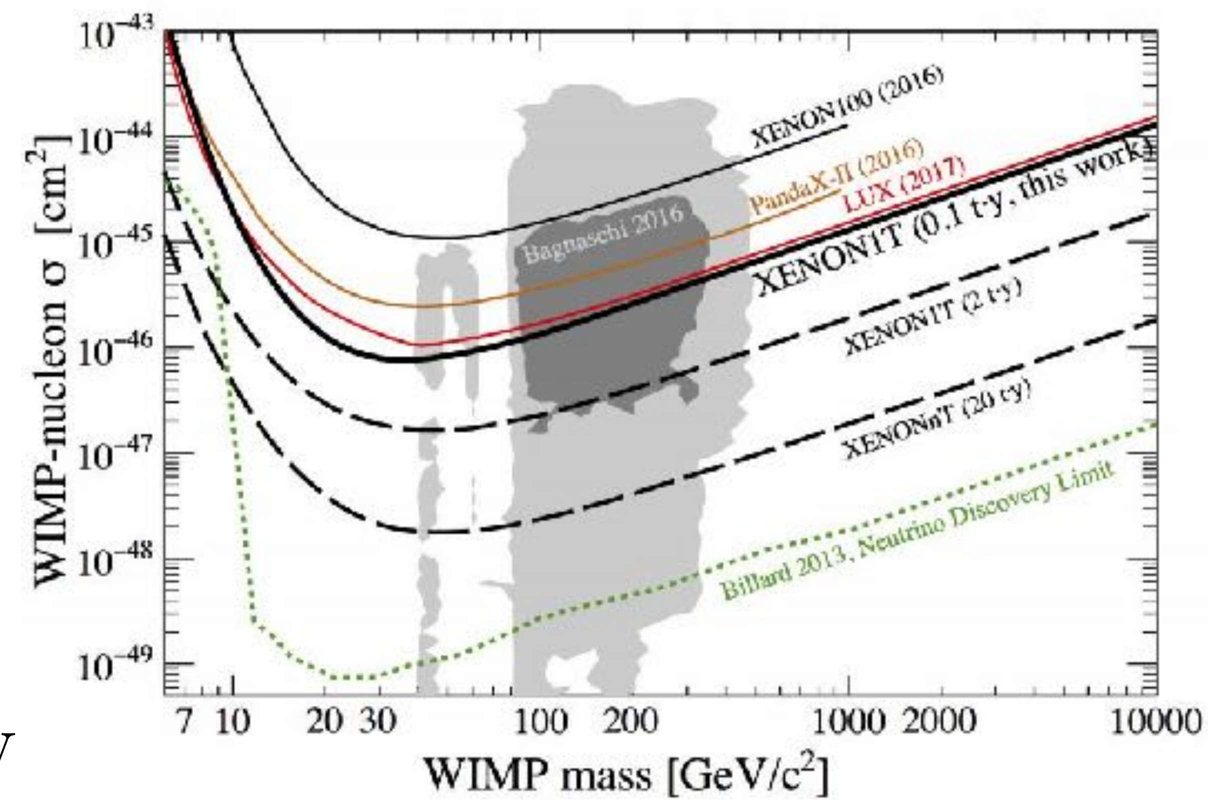
✓ Universal slepton masses

# Constraints & prospects: DM direct search

DM direct search on spin-independent scattering is sensitive to Higgsino component




LUX constraints already excluded $|\mu| \lesssim 300\,\mathrm{GeV}$

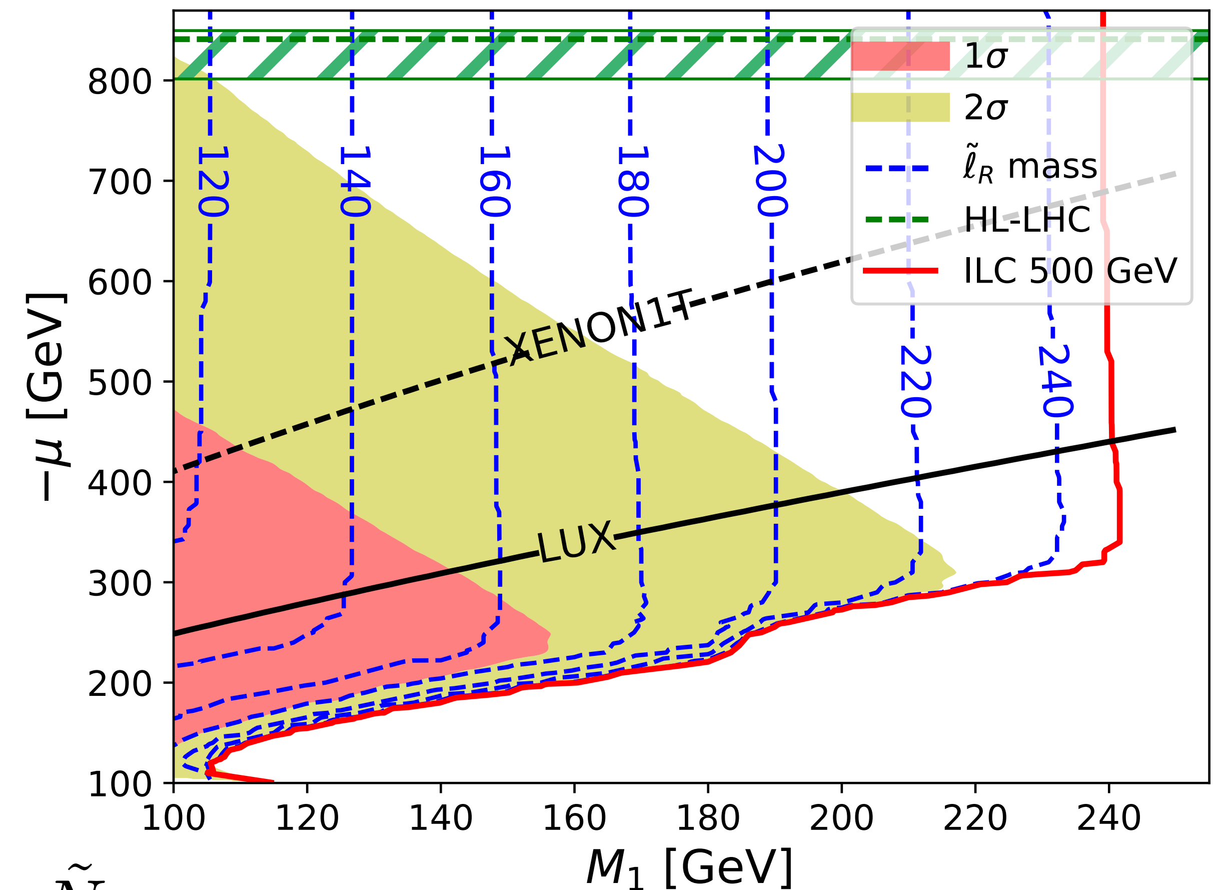
XENON1T will probe the parameter space for muon g-2 1σ

# Constraints & prospects: LHC search

1. Slepton production

$$pp \to \tilde{l}\tilde{l} \to l_{\rm soft}\tilde{N}_1 l_{\rm soft}\tilde{N}_1,$$

Due to the mass degeneracy,
emitted leptons are too soft to detect




2. Neutralino production: 2tau + $E_T^{miss}$

$$pp \to \tilde{N}_2\ \tilde{N}_3 \to \tau\tilde{\tau}\ \tau\tilde{\tau} \to \tau\tau_{\rm soft}\tilde{N}_1\ \tau\tau_{\rm soft}\tilde{N}_1$$

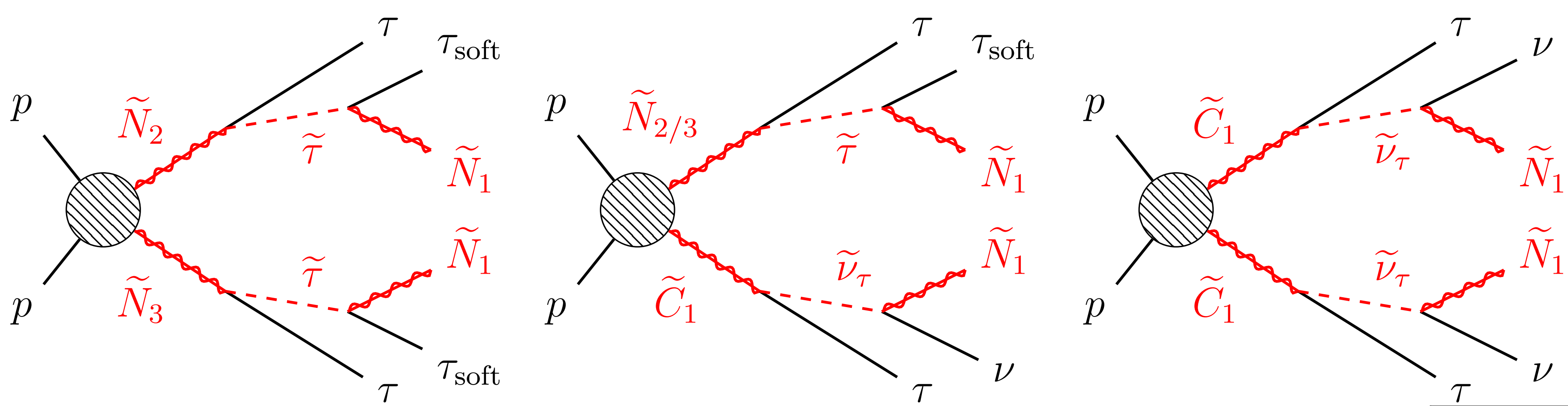
Due to large tanß for muon g-2, the Higgsino-like neutralino/chargino dominantly decay into tau & stau

- ✓ Current constraints are weaker than direct detection limits
- ✓ At future high-luminosity LHC with √s = 14 TeV & 3ab$^{-1}$, we can probe whole parameter space

# Stau search @LHC14

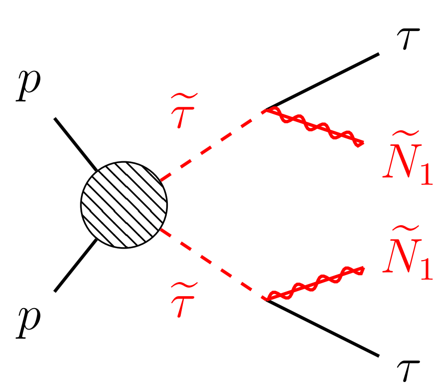
We use ATLAS study for prospects of direct stau production [ATL-PHYS-PUB-2016-021]

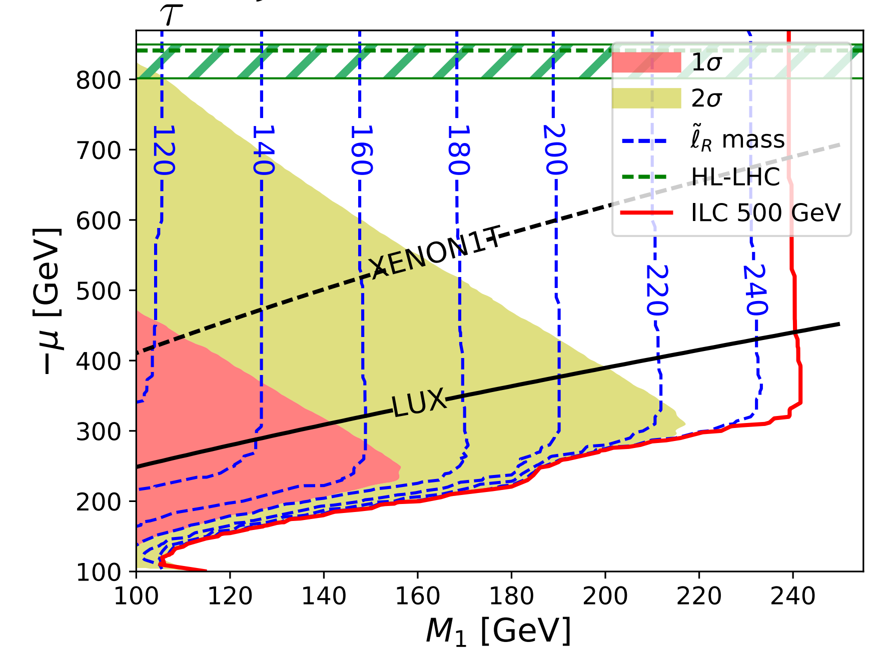
Our scenarios




ATLAS stau prospects

[ATL-PHYS-PUB-2016-021]



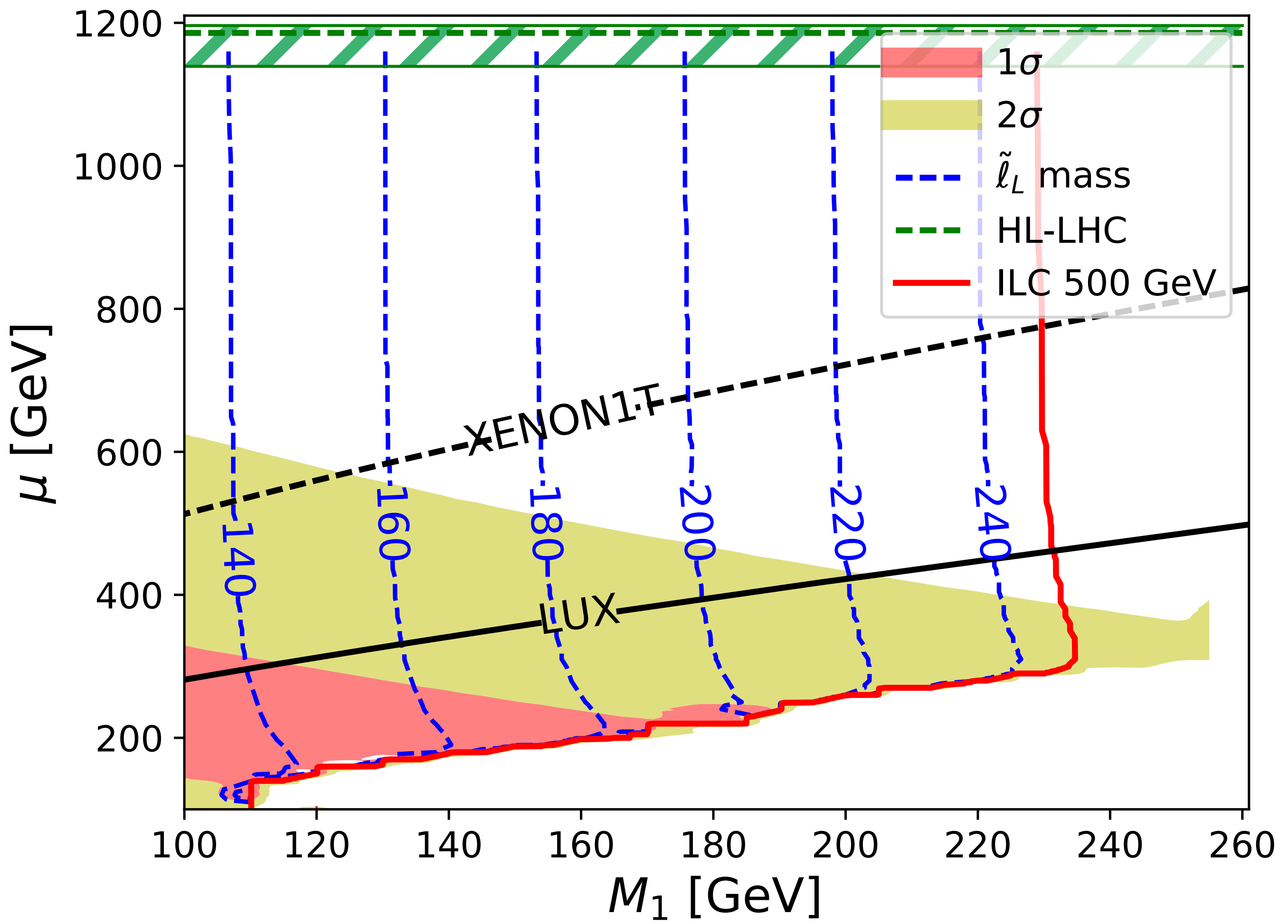

Soft staus cannot be detected, so our scenario and ATLAS prospects give similar signals

We can simply compare the production cross section

# Summary

- Low energy SUSY (~100 GeV) confronts severe experimental constraints
- Although EW fine-tuning cannot be avoided, MSSM still explains DM observed abundance and muon g-2 discrepancy
- Future LHC and DM direct search will probe most of such parameter space

# Left-handed slepton case




$$pp \to \tilde{N}_2\ \tilde{N}_3 \to \tau\tilde{\tau}\ \tau\tilde{\tau} \to \tau\tau_{\rm soft}\tilde{N}_1\ \tau\tau_{\rm soft}\tilde{N}_1$$

$$pp \to \tilde{N}_{2/3}\ \tilde{C}_1 \to \tau\tilde{\tau}\ \tau\tilde{\nu} \to \tau\tau_{\rm soft}\tilde{N}_1\ \tau\nu\tilde{N}_1$$

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