Supersymmetry in the shadow of photini

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Reference:
arXiv:1206.0751; JHEP 1207 (2012) 164
Arvanitaki *et al*: arXiv:0909:5440; Phys.Rev.D81 (2010) 075018

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Photini in the UV

Main features of string theory:

1. supersymmetry
   - assume broken at low energy to solve hierarchy problem
2. extra dimensions (6)
   - assume small size
   - generically complex compactification manifold to get SM
     - very simple manifold: 6-torus
       $\rightarrow$ six 1- and 5-cycles, fifteen 2- and 4-cycles, twenty 3-cycles
     - IIB string theory: 4-form gauge field integrated over 3-cycle
       $\rightarrow$ 4D vector gauge field without charged matter $A^i_\mu = \int_{\Sigma_i} C_4$

string theory $\rightarrow$ SUSY SM

many extra "photon" superfields without any charged matter
can in principle mix with $U(1)$ hypercharge and among each other

Photini in the IR

- in SUSY limit, no observable effect:

$$\mathcal{L} \supset \int d^2\theta \; W_a W_a + W_b W_b - 2\epsilon W_a W_b$$

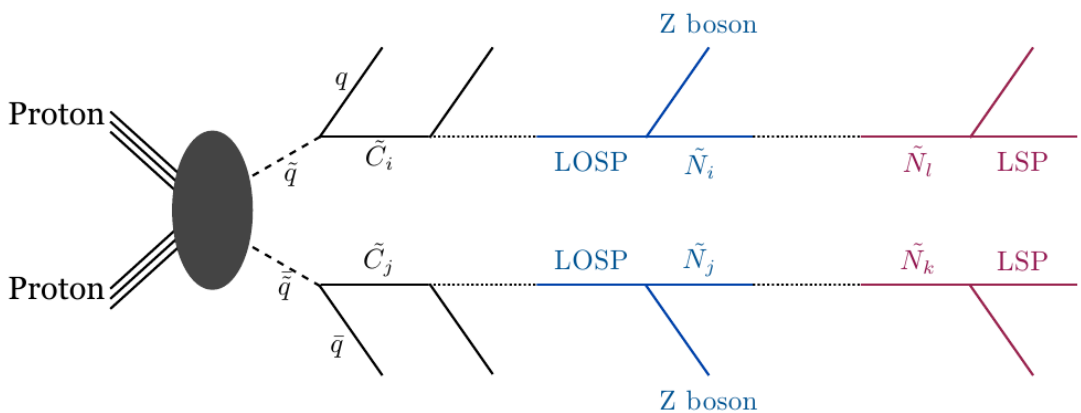
shift away mixing: $W_b \to W_b - \epsilon W_a$ and $g_a \to \frac{g_a}{\sqrt{1-\epsilon^2}}$

- physical effects from SUSY breaking, when gauginos get mass

$$\delta\mathcal{L} \supset \mathbf{z_{ij}} \lambda_i^\dagger i\sigma^\mu \partial_\mu \lambda_j - \mathbf{m_{ij}} \lambda_i \lambda_j$$

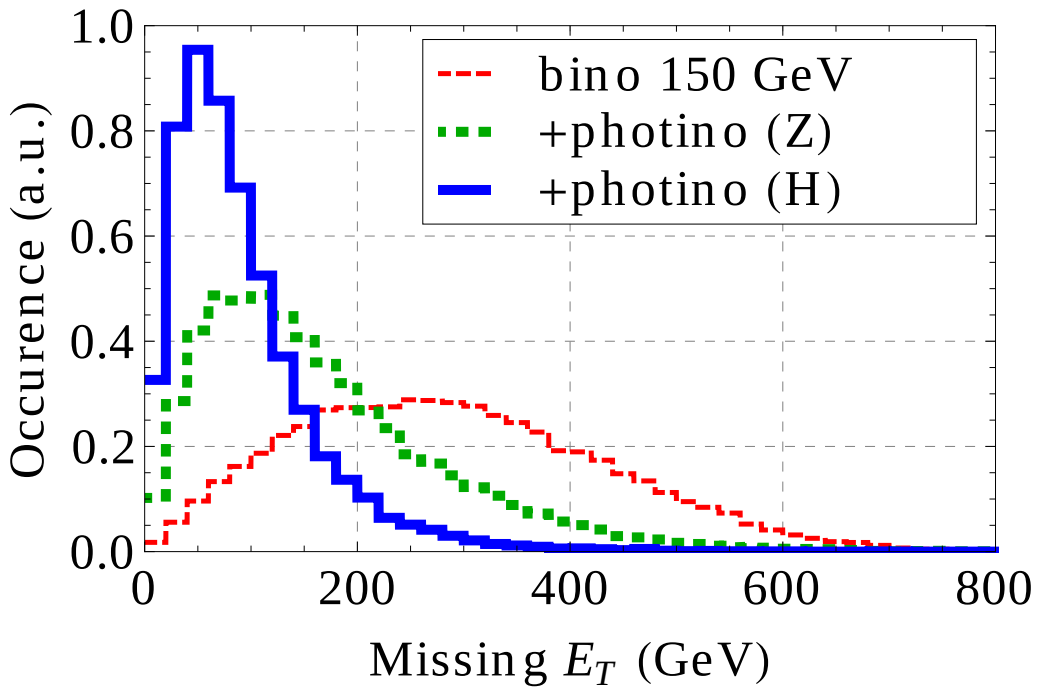
expect sizeable number of photini to be lighter than the bino

- bino-photino + interphotini cascade via emissions of h, Z, γ



Photini at the LHC

- reduction of missing E_T



Photini at the LHC

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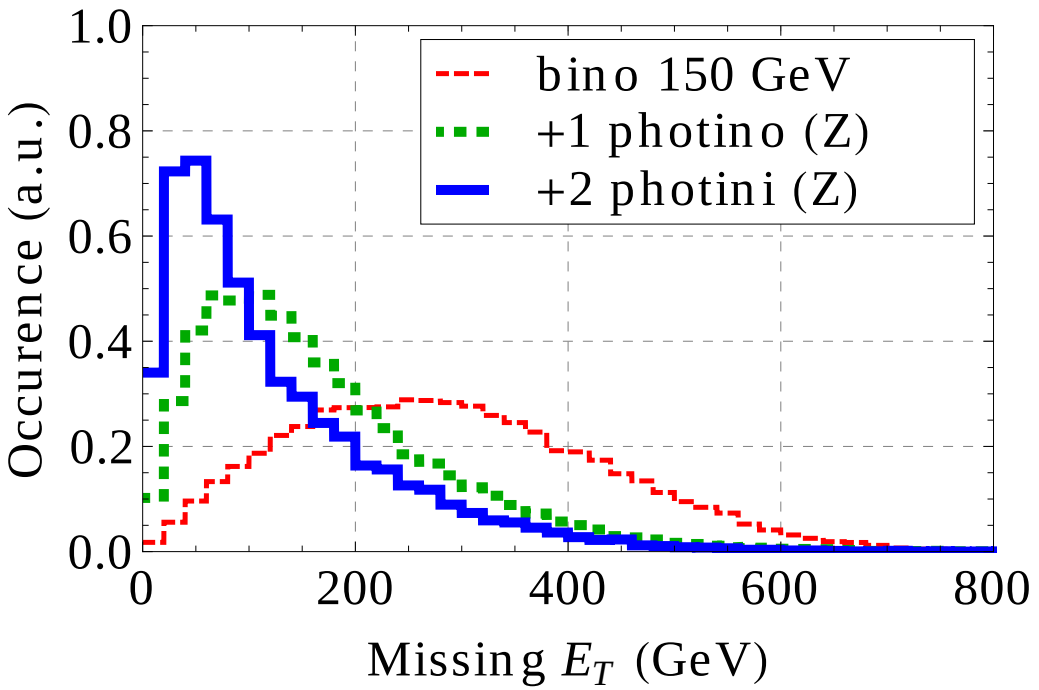
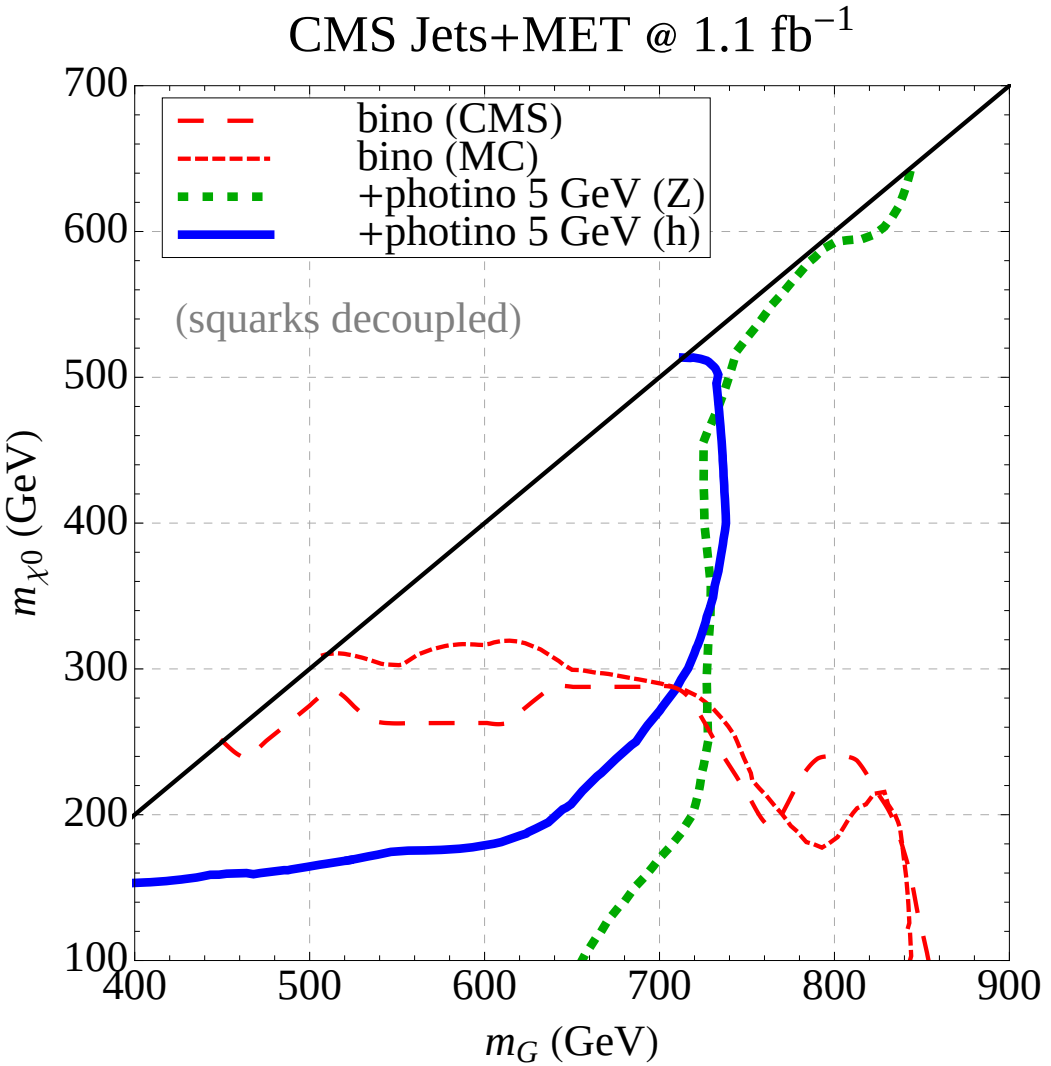


Photini at the LHC

- reduction of missing E_T
- drastically weakened hadronic search limits:
  - gluino-bino model



Photini at the LHC

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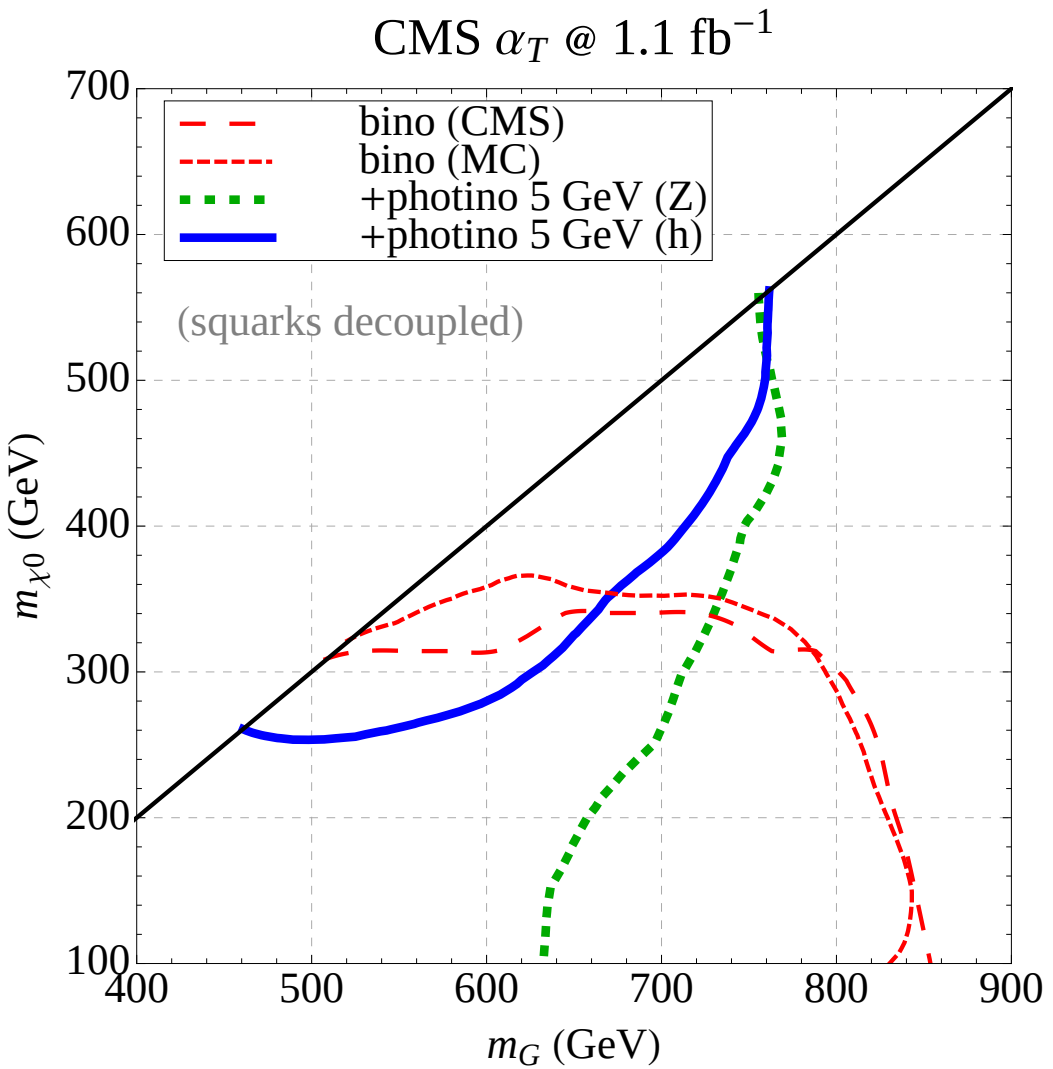
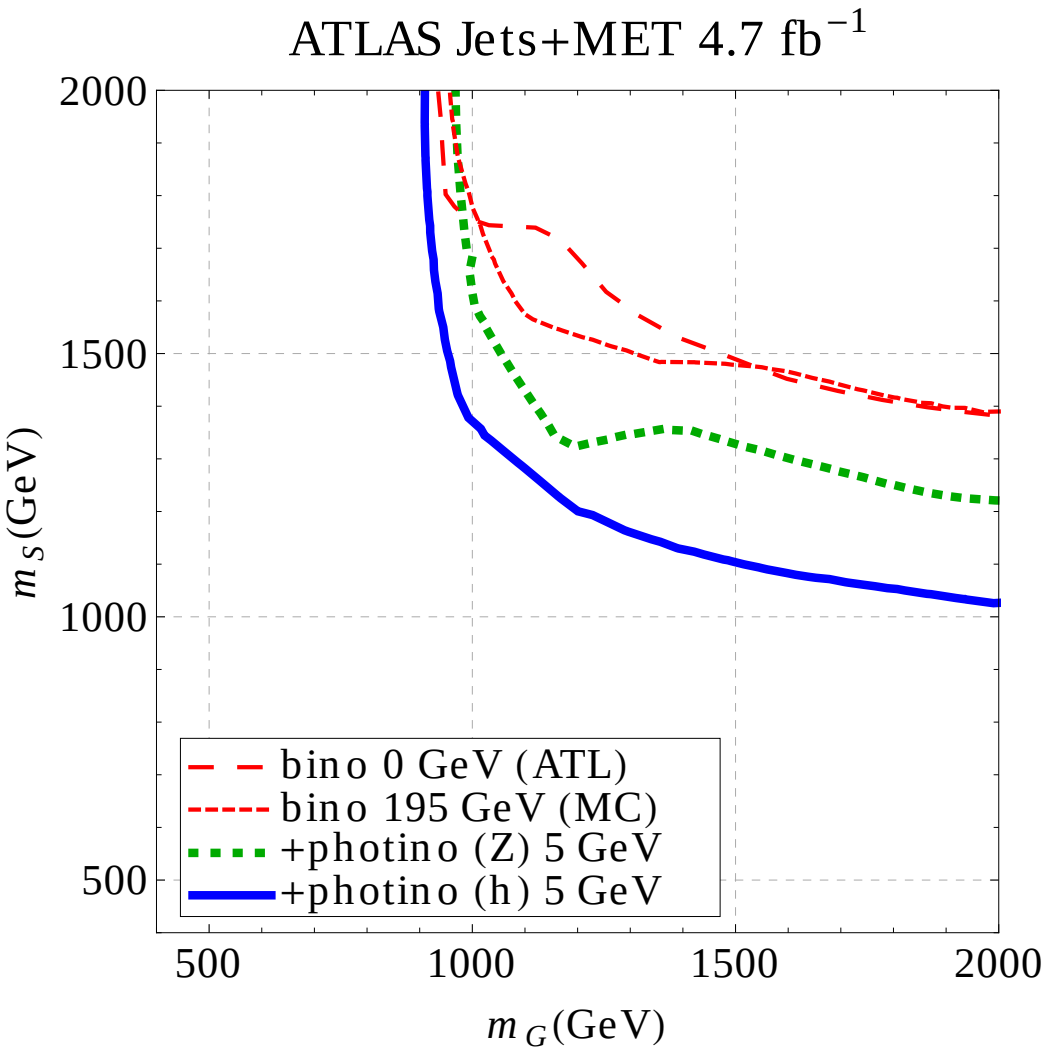


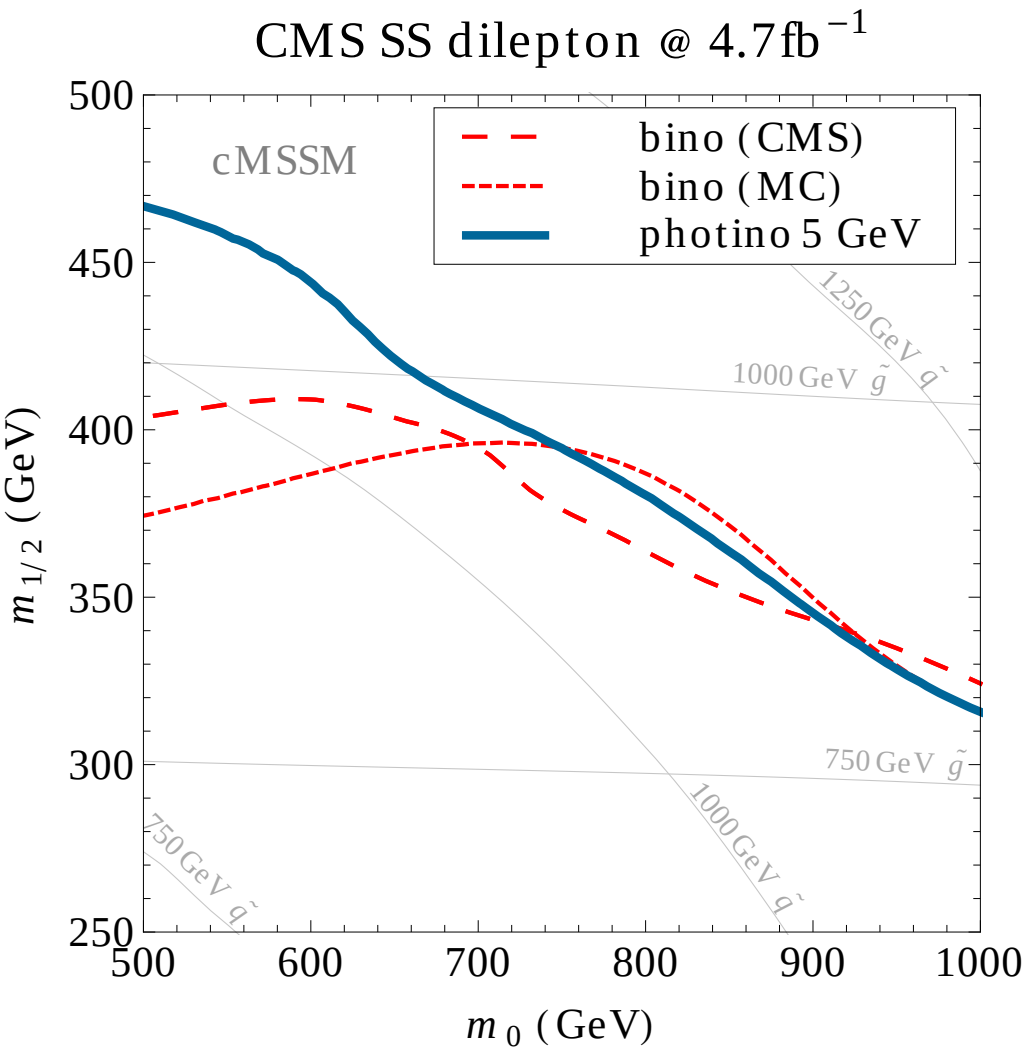
Photini at the LHC

- reduction of missing E_T
- drastically weakened hadronic search limits:
  - gluino-bino model
  - gluino-squark-bino model



Photini at the LHC

- reduction of missing E_T
- drastically weakened hadronic search limits:
  - gluino-bino model
  - gluino-squark-bino model
- slightly enhanced leptonic search sensitivity:



Conclusions

- **IF** supersymmetry exists at a low scale, then photini could be another signature of stringy origins;
- the "IF" above becomes more of an "if" if you believe there are generically many light $U(1)$ gauginos associated with realistic SUSY models