When LHC/TEVATRON combine with XENON to exclude scalar DM

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TAUP2011, 6th of September 2011

Outline

- The Scalar DM extension of the Standard Model
- Dark matter constraints
- Invisible Higgs decay and LHC/TEVATRON analysis
- Perspective and Conclusion

Extensions of the SM

- Extension of the content of the SM : ν_R, SUSY

- Extension of the Gauge group, new «force» :
  extra U(1), SO(32)

- Extension of the space-time structure :
  supergravity, KK, strings

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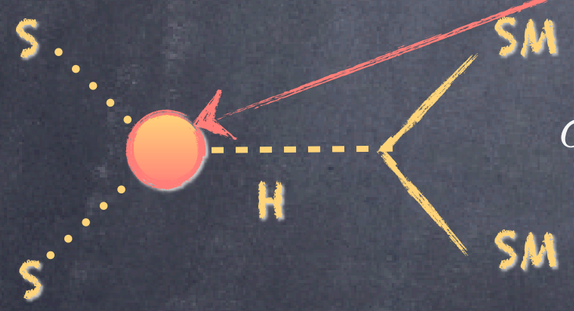
Singlet Extension of the SM

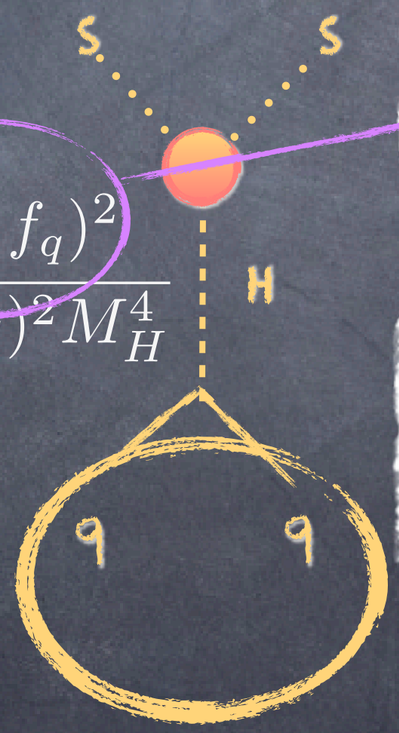
To build the simplest gauge invariant extension of the SM

$$\mathcal{L} = \mathcal{L}_{SM} + \frac{1}{2}\partial_\mu S \partial^\mu S - \frac{\lambda_S}{4} S^4 - \frac{\mu_S^2}{2} S^2 - \frac{\lambda_{HS}}{4} S$$

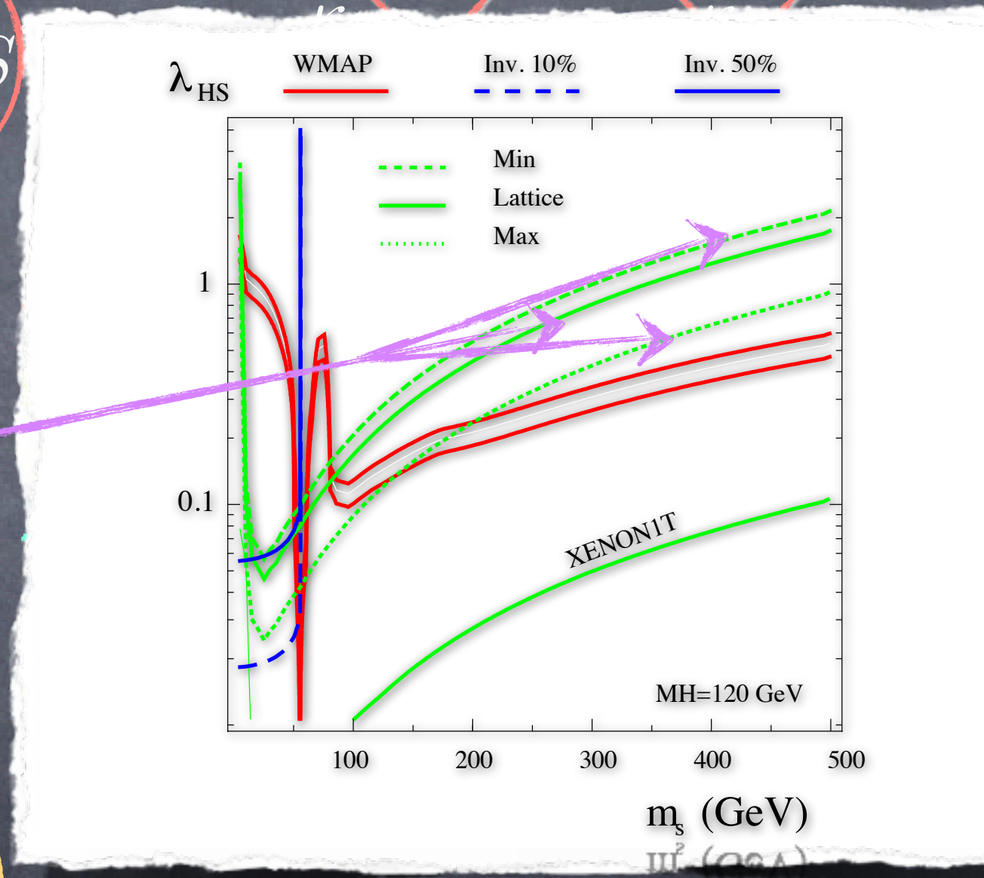
No phenomenology (<S>=0)



$$\sigma^{SI}_{S-p} = \frac{m_p^4 \lambda_{HS}^2 (\sum_q f_q)^2}{16\pi (m_p + m_S)^2 M_H^4}$$

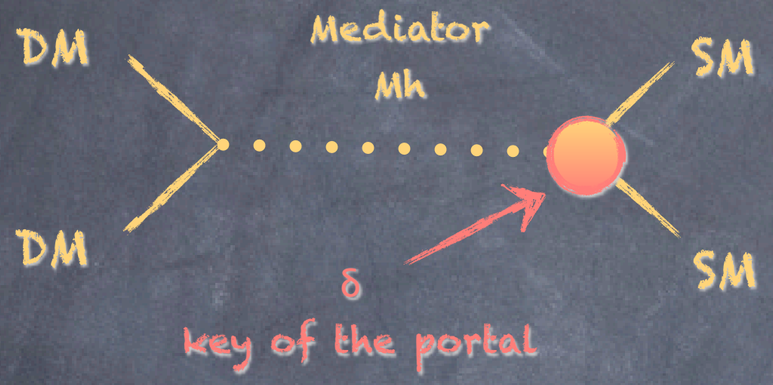


$$\langle \sigma_{f\bar{f}} v \rangle = \frac{\lambda_{HS}^2 (m_S^2 - m_f^2)^{3/2} m_f^2}{16\pi m_S^3 [(4m_s^2 - M_H^2)^2 + M_H^2 \Gamma_H^2]}$$



Constraints in «portal like» models

WMAP : $\sigma v \sim 10^{-26}$ cm3 s-1



$\sigma_{DM-SM} \sim 10^{-36}$ cm2

=> excess in DD exp.

Except around the pole : $2M_{DM} = Mh$: small δ to respect WMAP

=> small σ_{DM-SM}

In this case, high indirect detection rates !!

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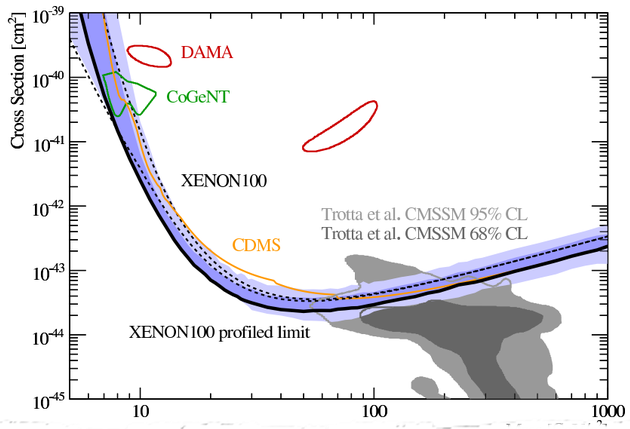
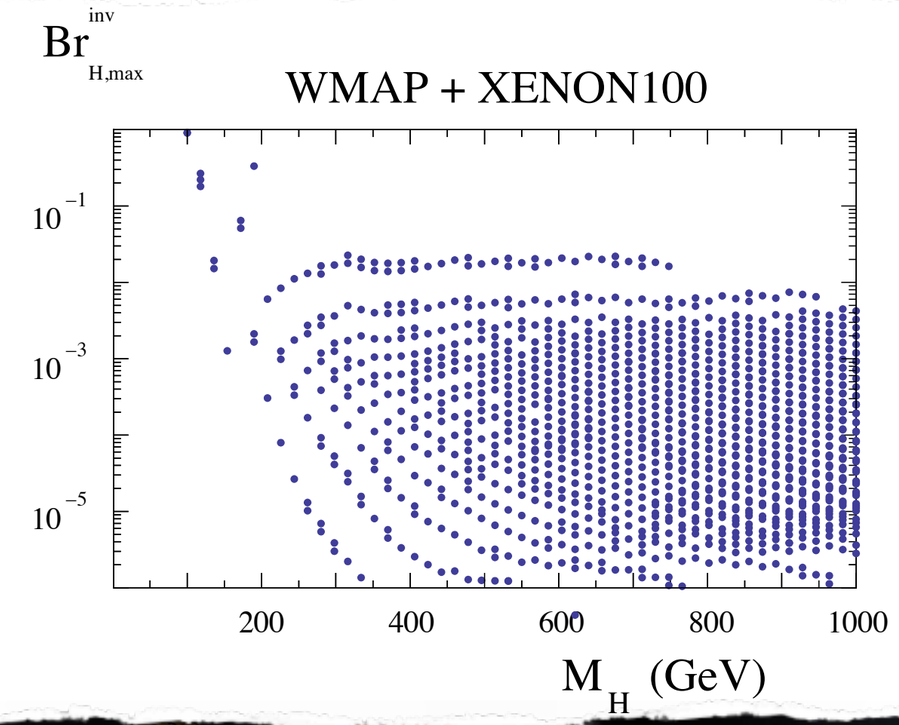
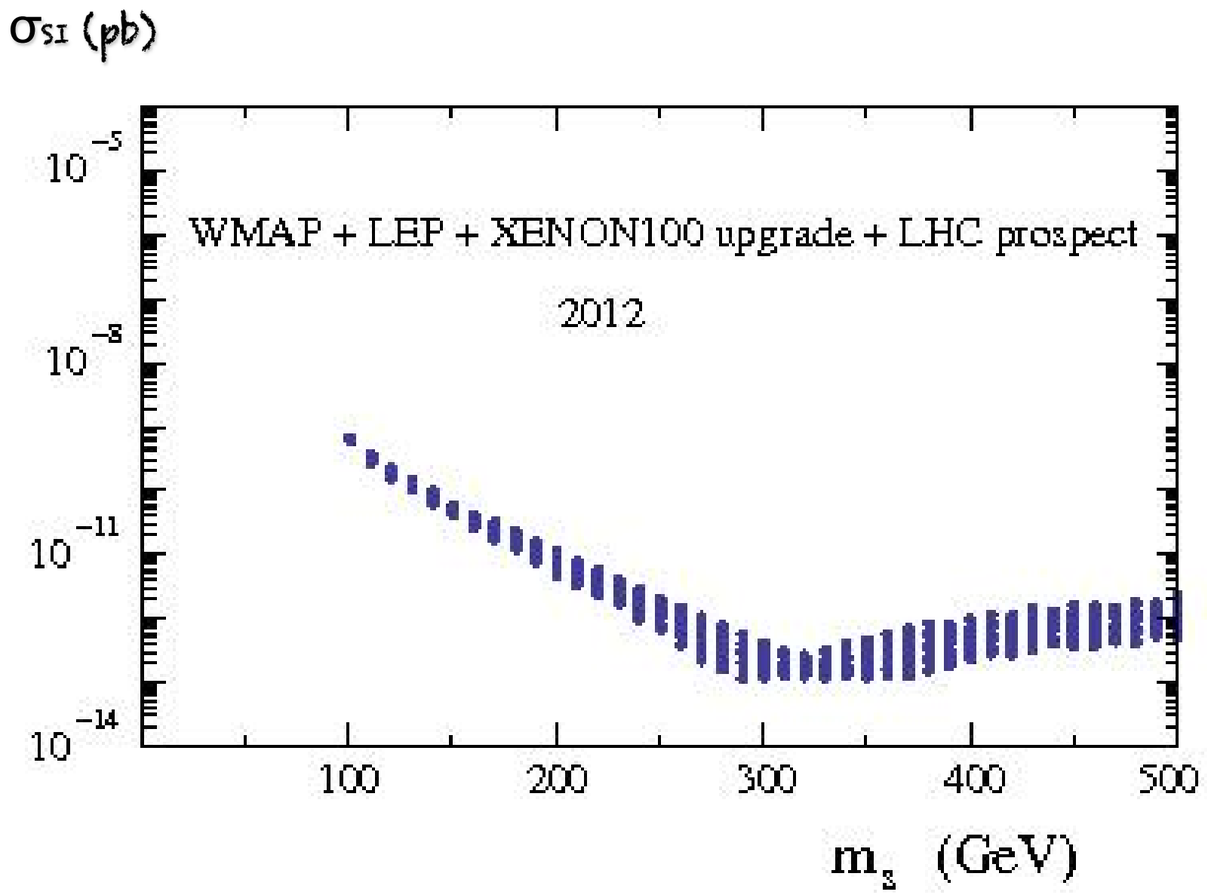
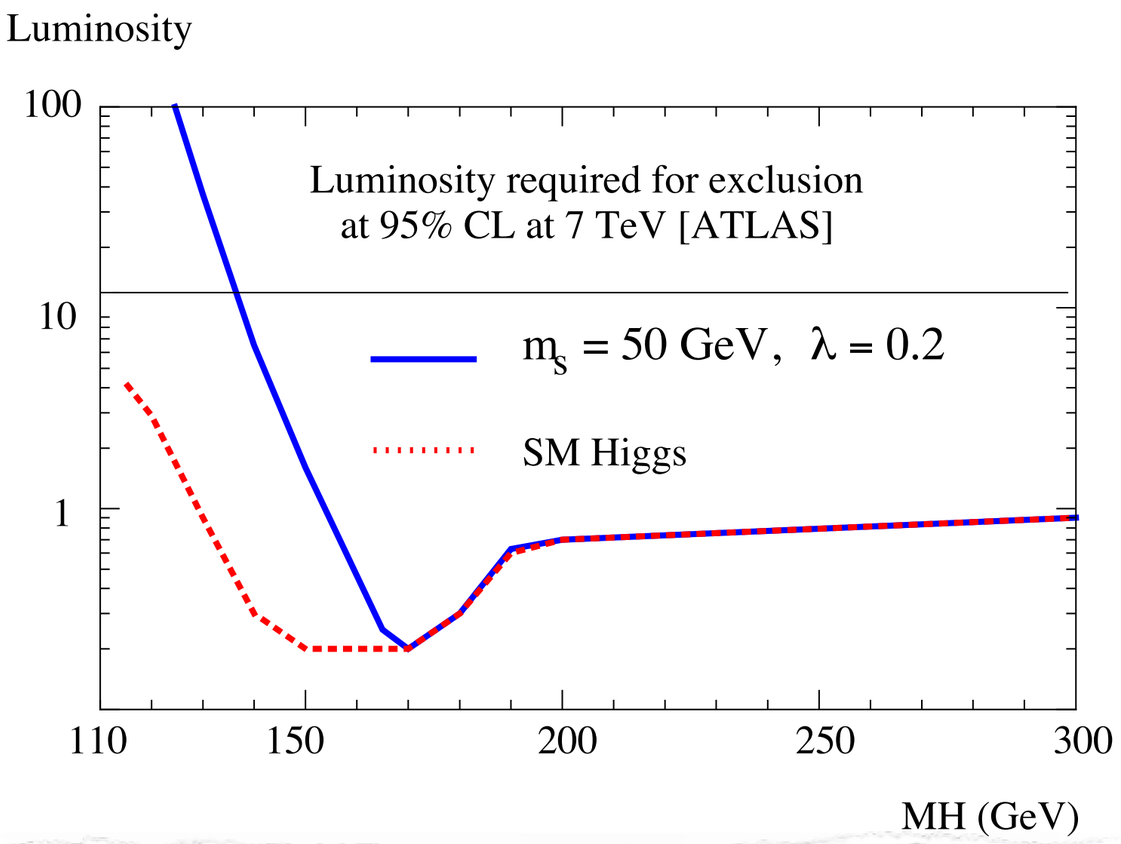
Invisible width of the Higgs

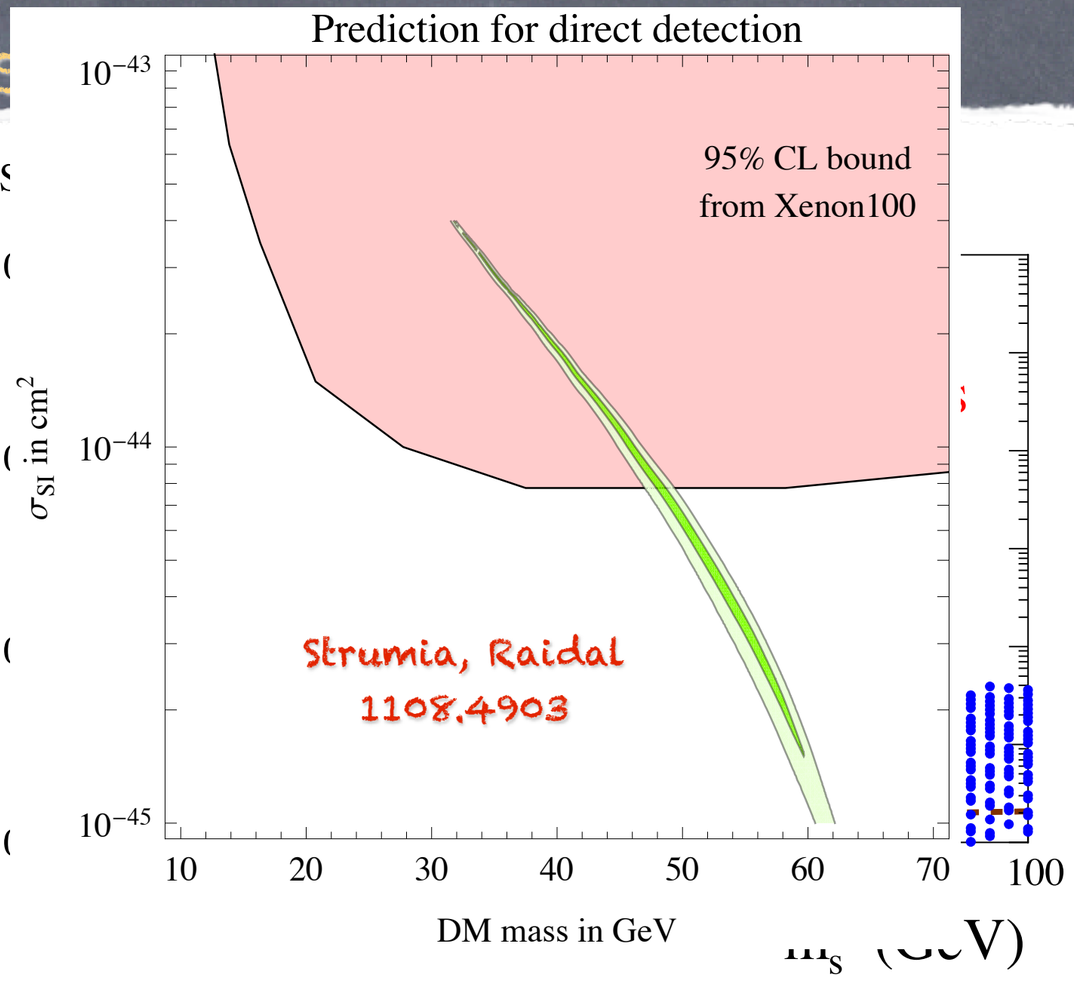






And if LHC sees nothing?





Conclusion

- Scalar DM is very predictive
- The model could be excluded by the end of the year
- Complementarity with LHC is fundamental