

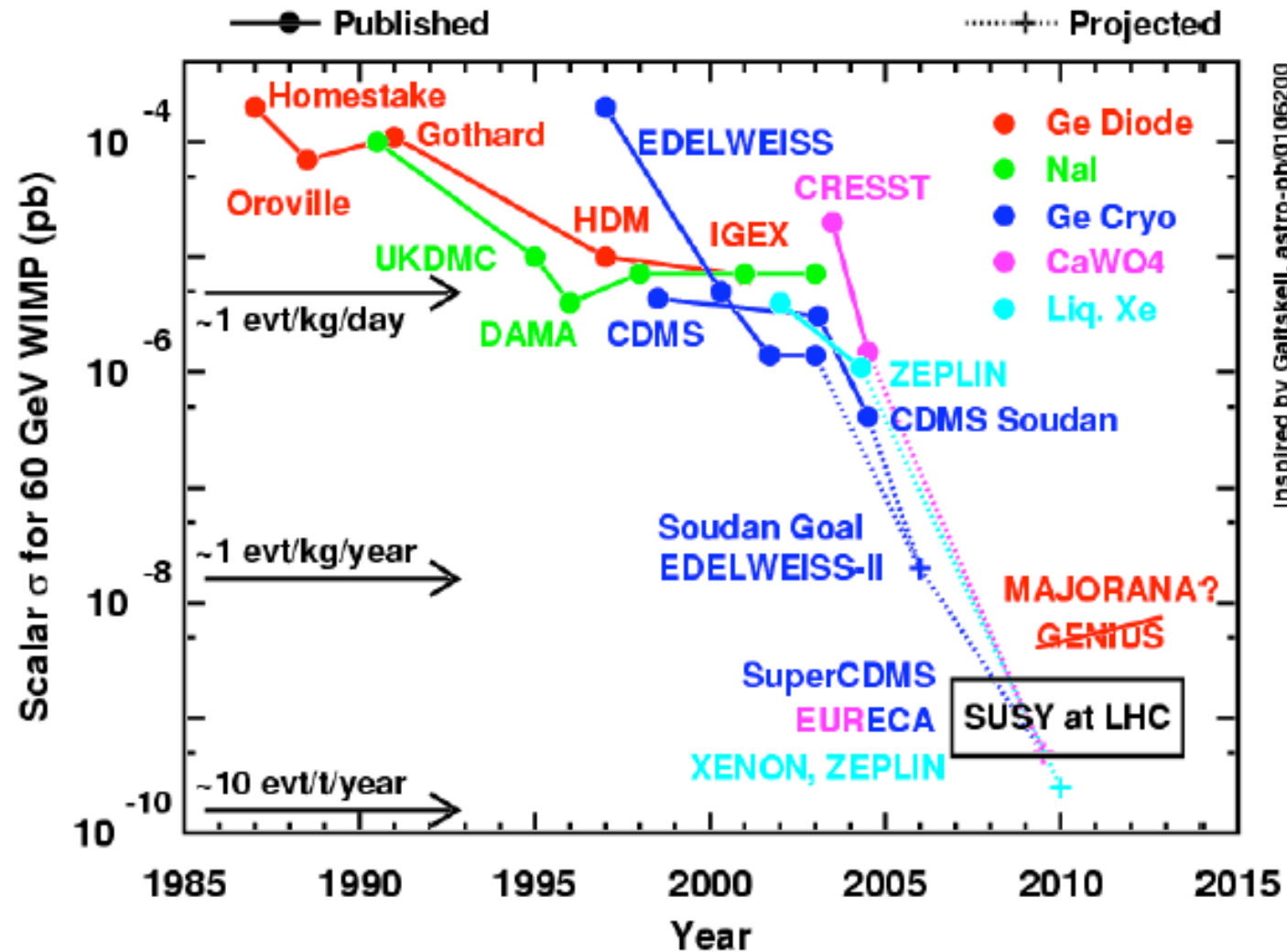
SuperBayeS.org

Neutralino direct detection prospects

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**(collaborators: Roberto Ruiz de Austri &
Leszek Roszkowski)**

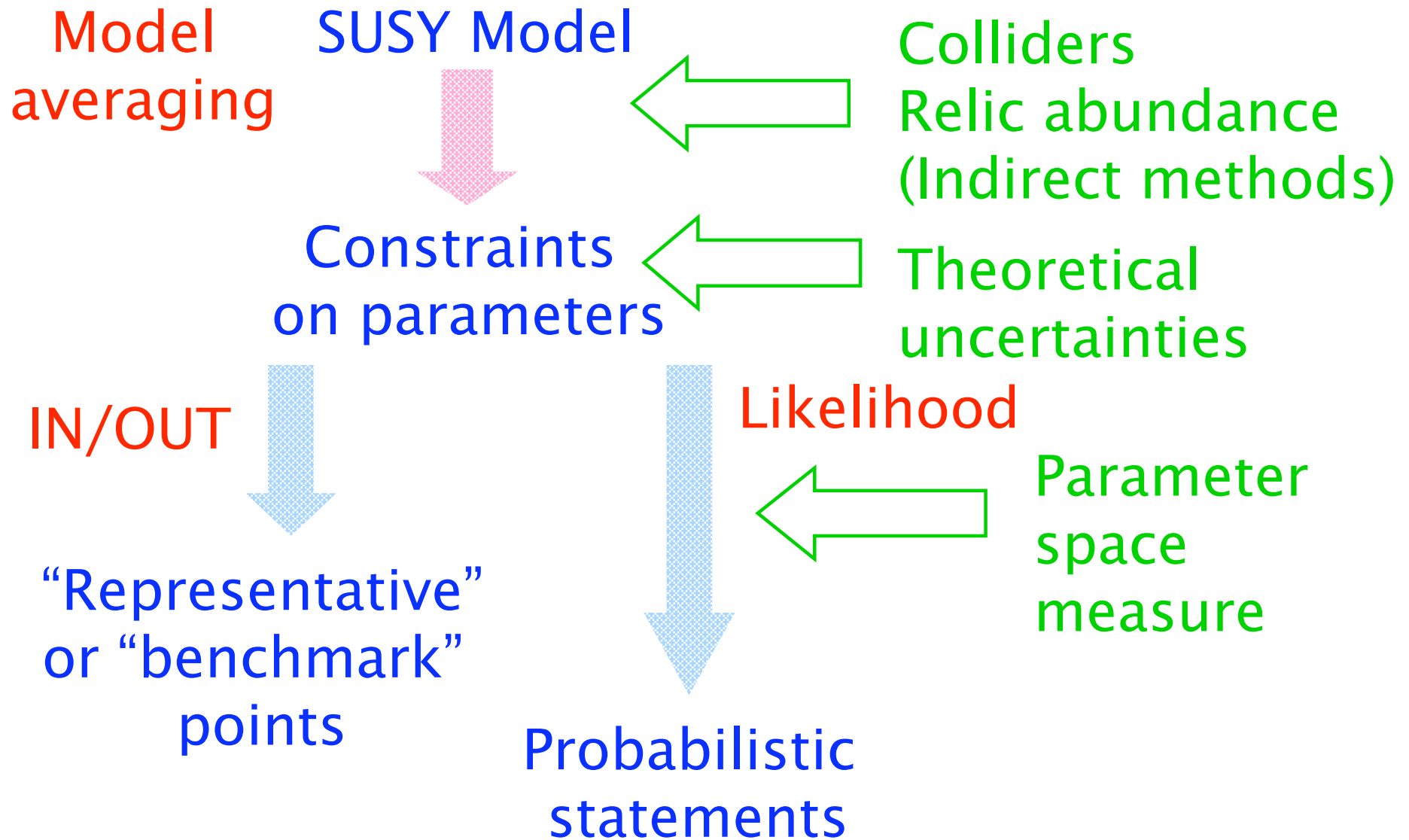
**University of Oxford, Astrophysics
St Anne's College**

Present and future reach



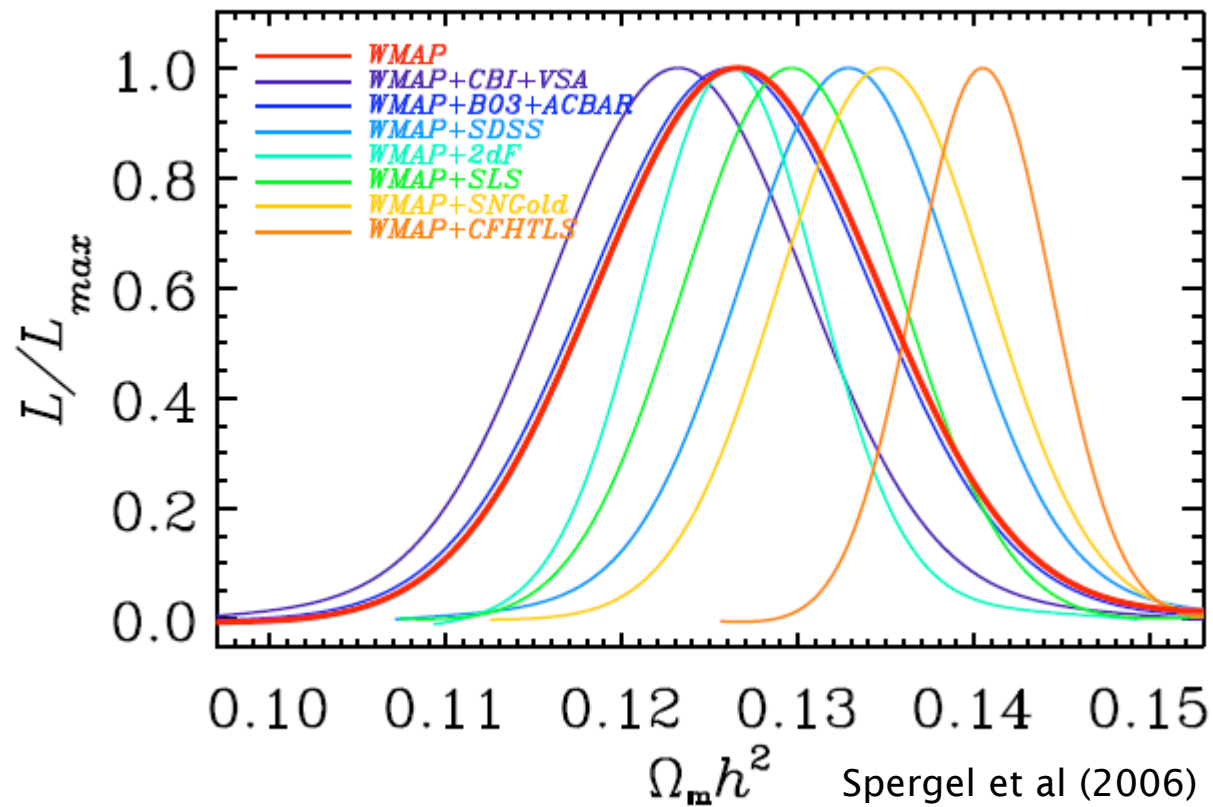
Courtesy Hans Krauss

Making predictions



A word of caution

CDM relic abundance determination



The Constrained MSSM

- General MSSM scenario: soft SUSY breaking

105 free parameters in the Lagrangian

- Assuming Universal boundary conditions at M_{GUT}

Gaugino masses:

$$M_1 = M_2 = M_3 = m_{1/2}$$

Scalar masses:

$$m_{H_d}^2 = m_{H_u}^2 = M_L^2 = M_R^2 = M_Q^2 = M_D^2 = M_U^2 = m_0^2$$

Trilinear couplings

$$A_u = A_d = A_l = A_0$$

Higgs vev ratio

$$\tan\beta = v_u/v_d$$

μ^2 from EWSB

A 4 (5) parameters
benchmark scenario
 $m_{1/2}, m_0, A_0, \tan\beta$ (sign(μ))

A Bayesian analysis of the CMSSM

- *CMSSM parameters*

$$m_0, m_{1/2}, A_0, \tan \beta, \text{sgn}(\mu)$$

- *'Nuisance' parameters*

$$m_b(m_b)^{\overline{MS}} = 4.20 \pm 0.07 \text{ (GeV)}$$

$$m_t = 171.4 \pm 2.1 \text{ (GeV)}$$

$$1/\alpha_{\text{em}}(M_Z)^{\overline{MS}} = 127.955 \pm 0.018$$

$$\alpha_s(M_Z)^{\overline{MS}} = 0.1176 \pm 0.002$$

- *Observables*

(with full likelihood)

SUSY mass limits (LEP II),

Higgs limits, BR's, $g-2$, EW observables

cosmological CDM abundance

- *Output: probability distribution and predictions*

Results using **SuperBayeS package**, which includes & employs SoftSusy, DarkSUSY, FeynHiggs, Bdecay and some cosmomc routines

➤ Roszkowski, Ruiz de Austri & RT (2007)

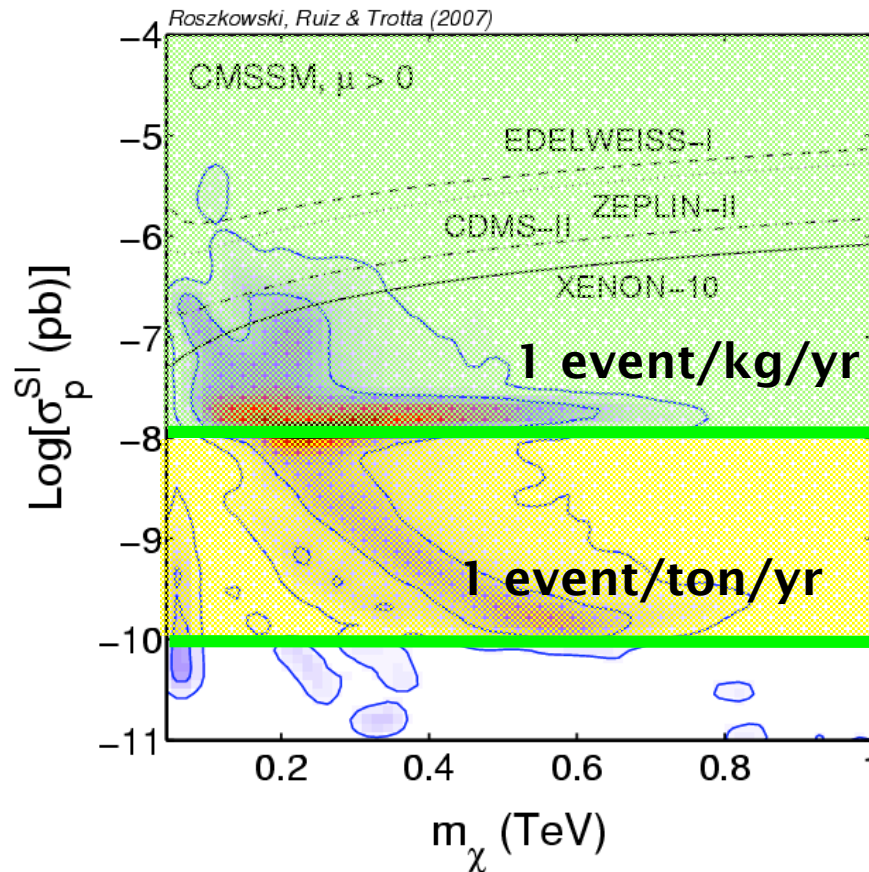
➤ Roszkowski, Ruiz de Austri, RT & Silk (2007)

➤ See also works by Baltz & Gondolo (2004), Allanach et al (2006)

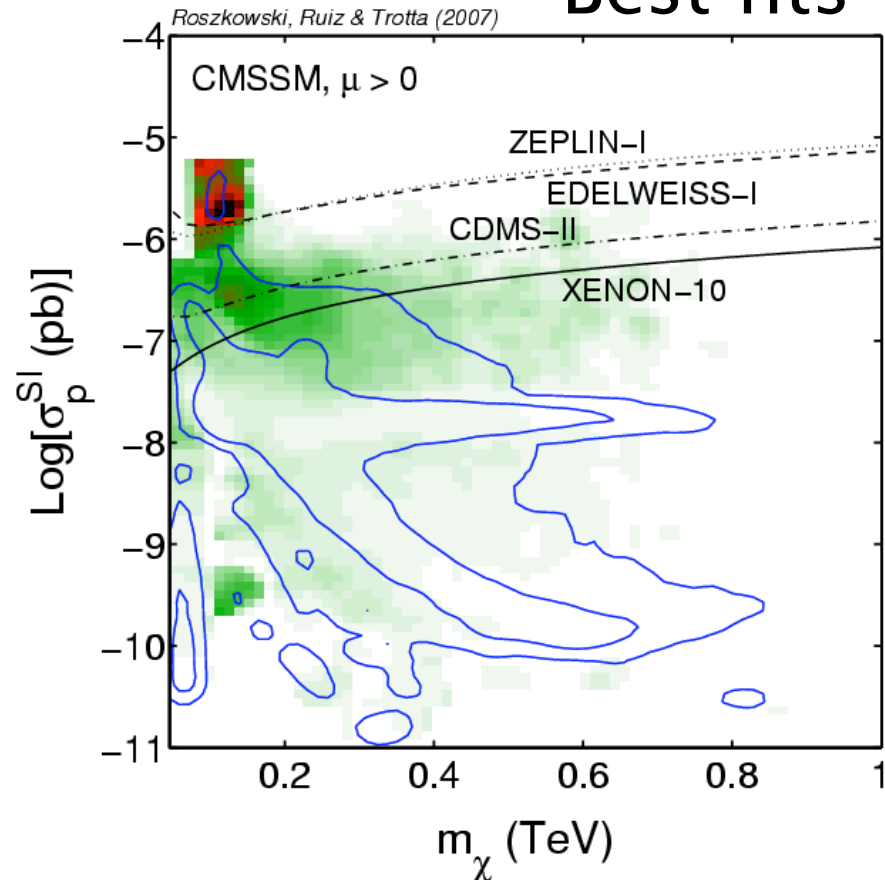
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DM direct detection in the CMSSM

New $b \rightarrow s\gamma$ value (2007)
 $BR(B_s \rightarrow s\gamma) = 3.11 \pm 0.21$ (TH)

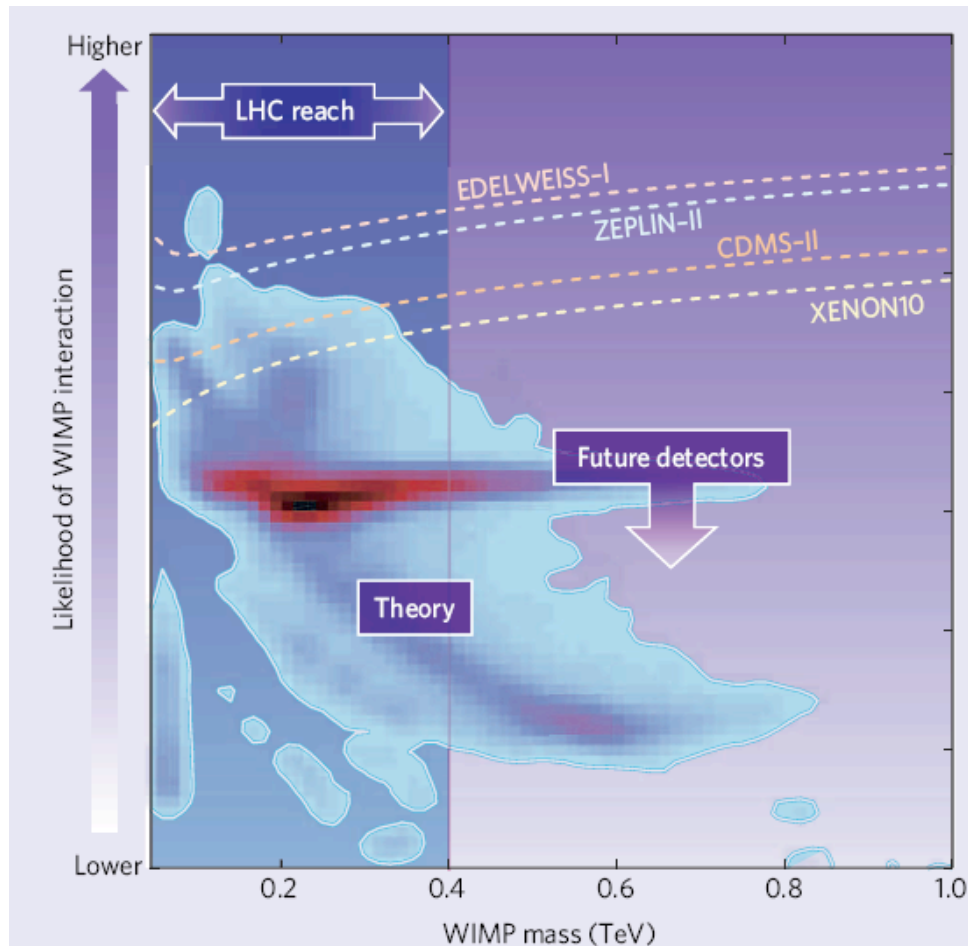


Spin independent
 “Best fits”

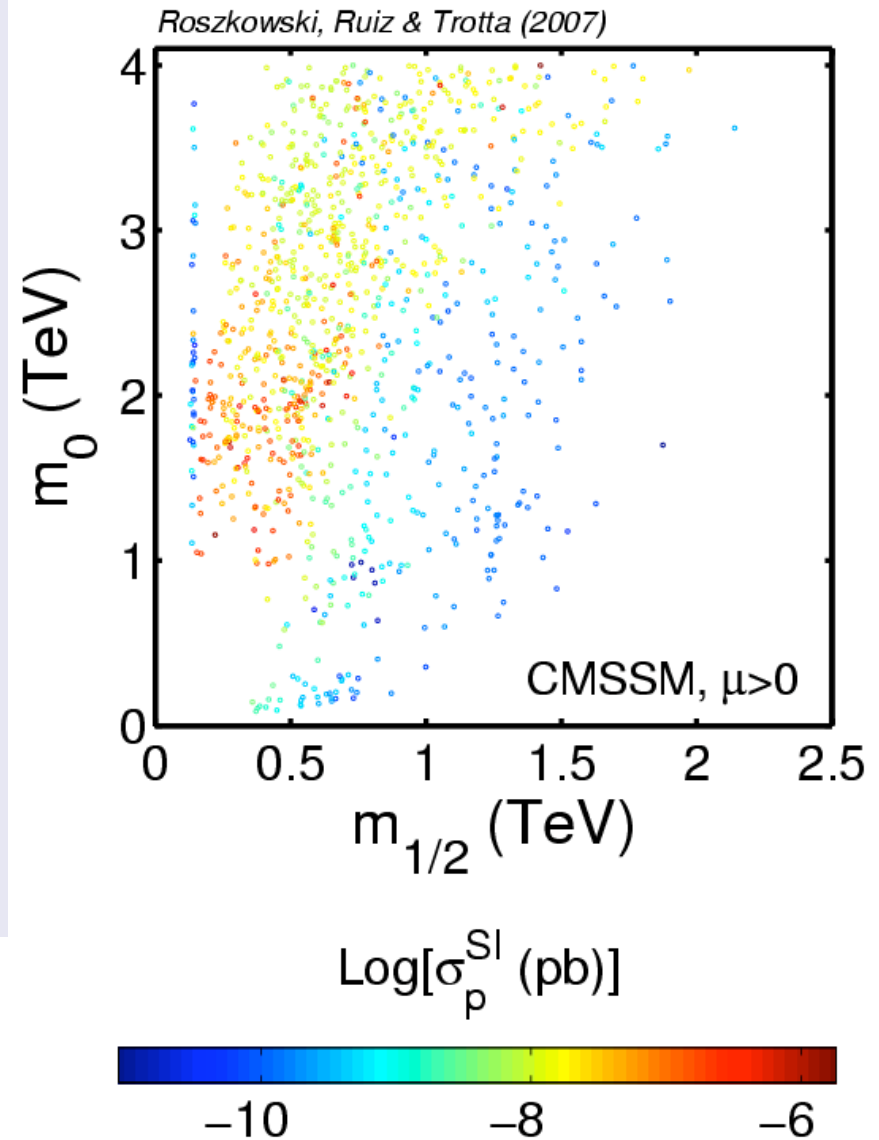


$$P(\sigma_p^{\text{SI}} > 10^{-10} \text{ pb}) = 0.984$$

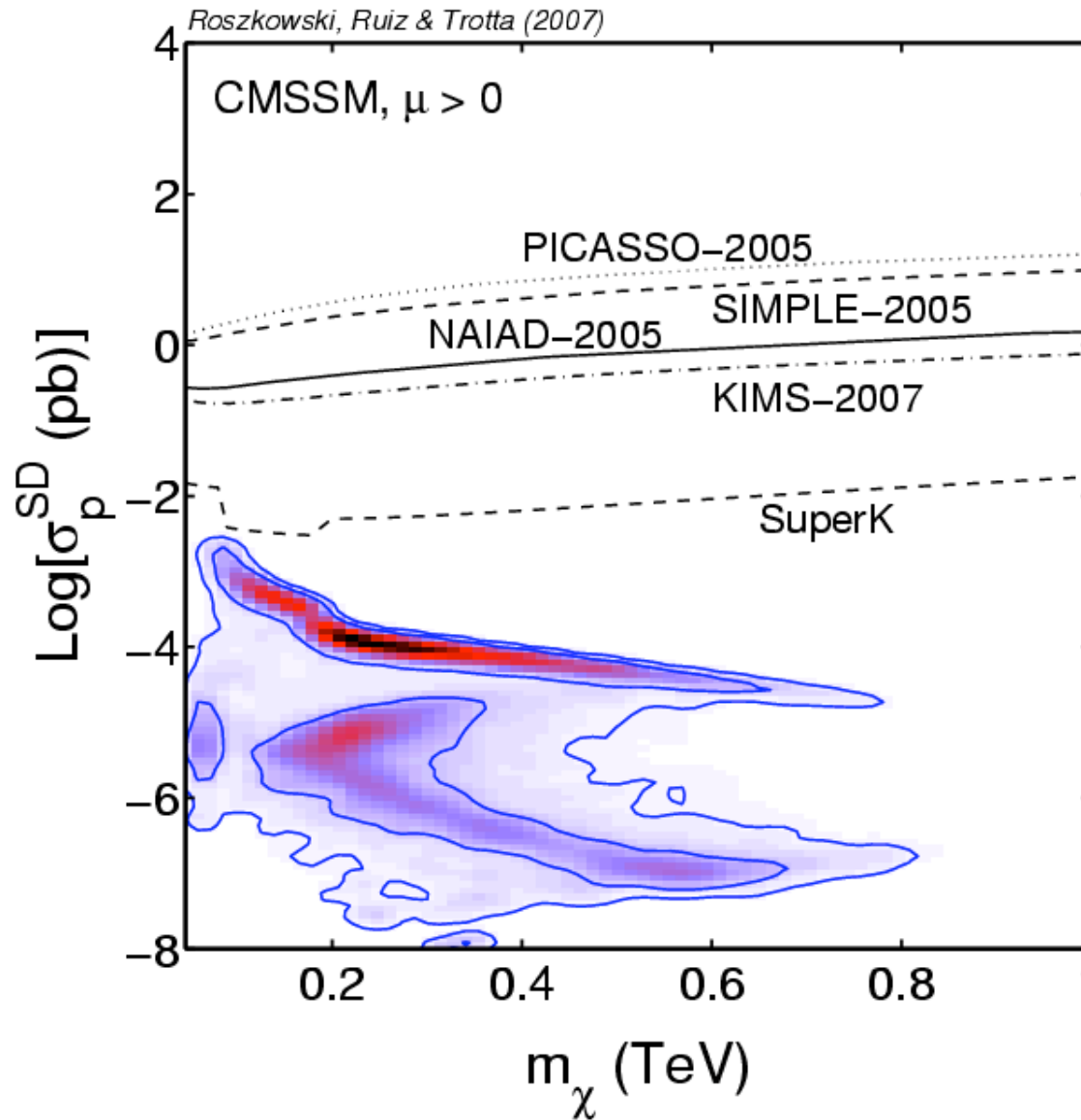
Complementarity of DD



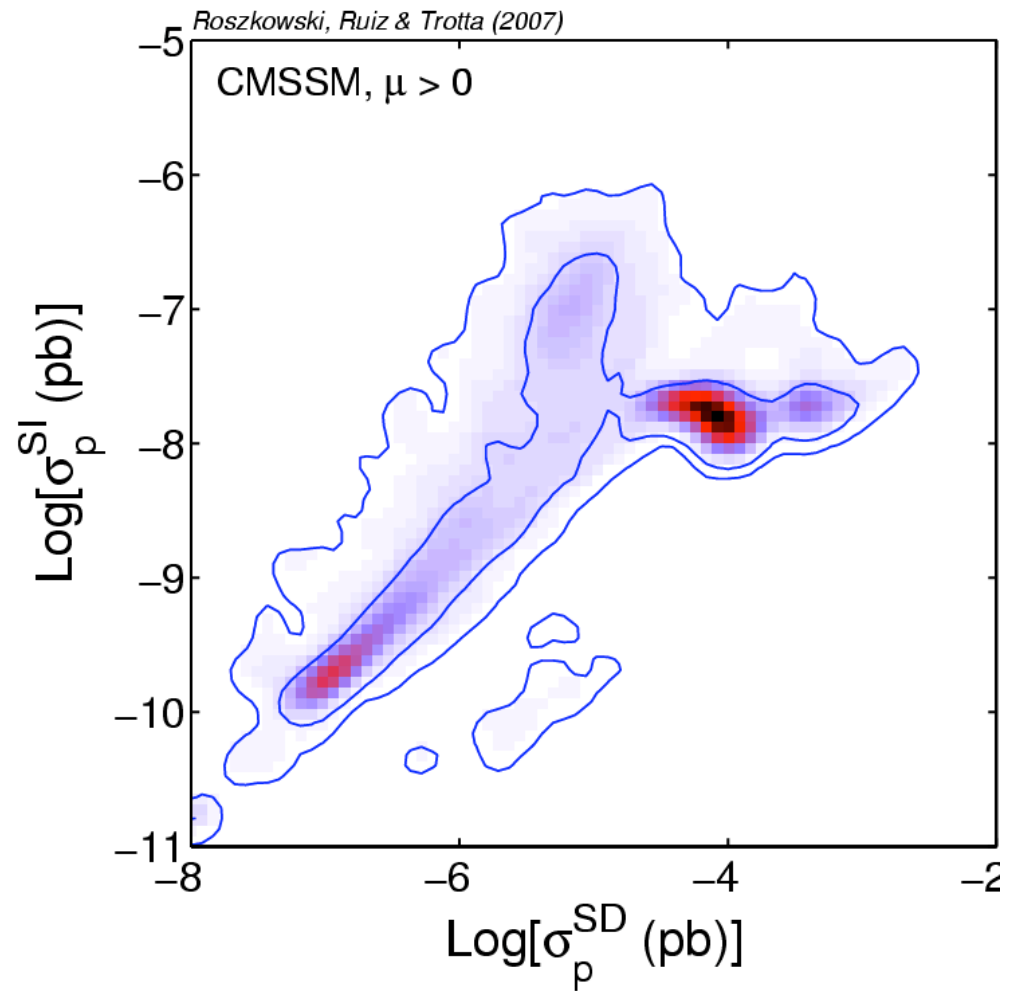
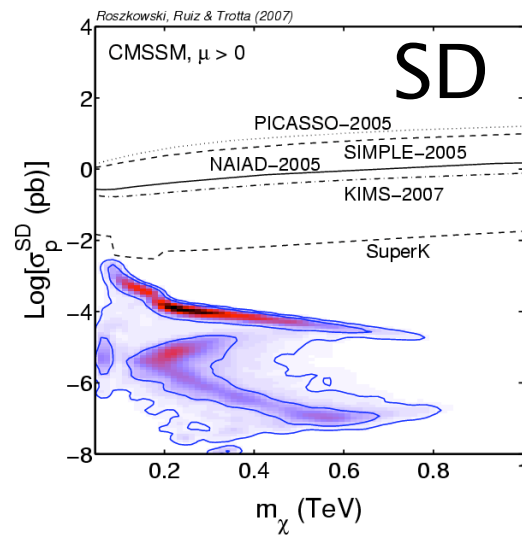
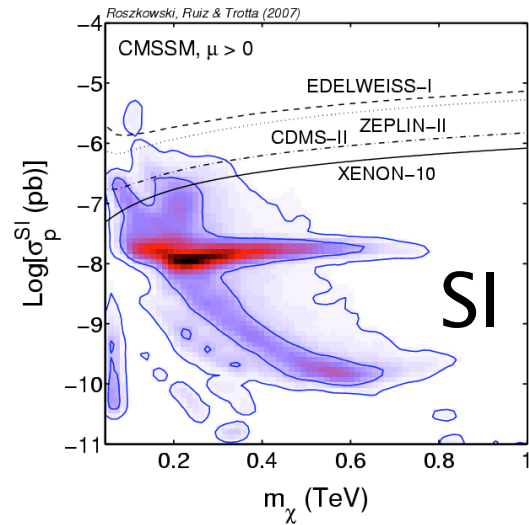
Nature, 448 (2007)



Spin dependent scattering



Expected correlations



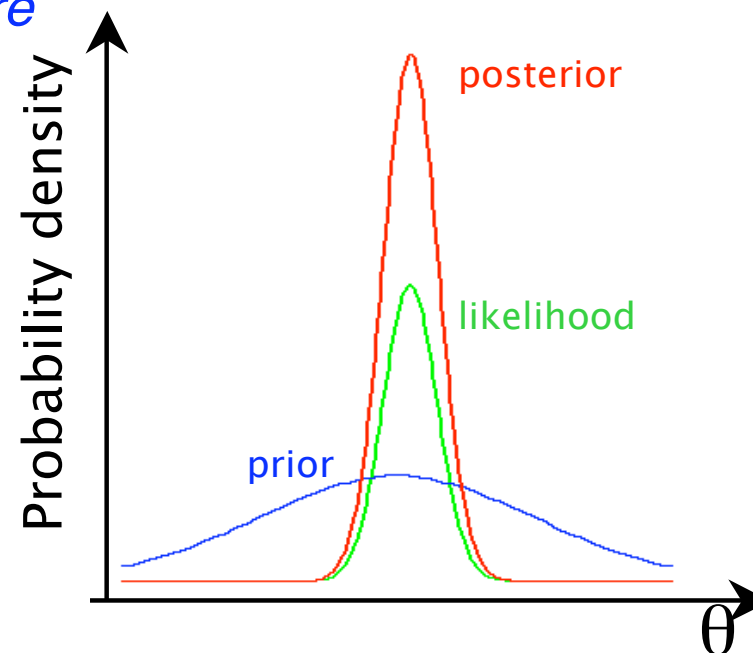
Robustness of predictions

- *Model-dependent statements! But it makes sense to start from the simplest one.*
- *Cosmo/Astro uncertainties: CDM abundance is the strongest constraint. Local abundance fairly uncertain.*
- *Theoretical uncertainties: partially included. Exception: form factors uncertainties (which are large)*
- *The measure problem: choice of measure*

$$\mathcal{P}(\theta|\mathbf{d}) = \frac{\mathcal{L}(\mathbf{d}|\theta)\pi(\theta)}{\mathcal{P}(\mathbf{d})}$$

θ : parameters

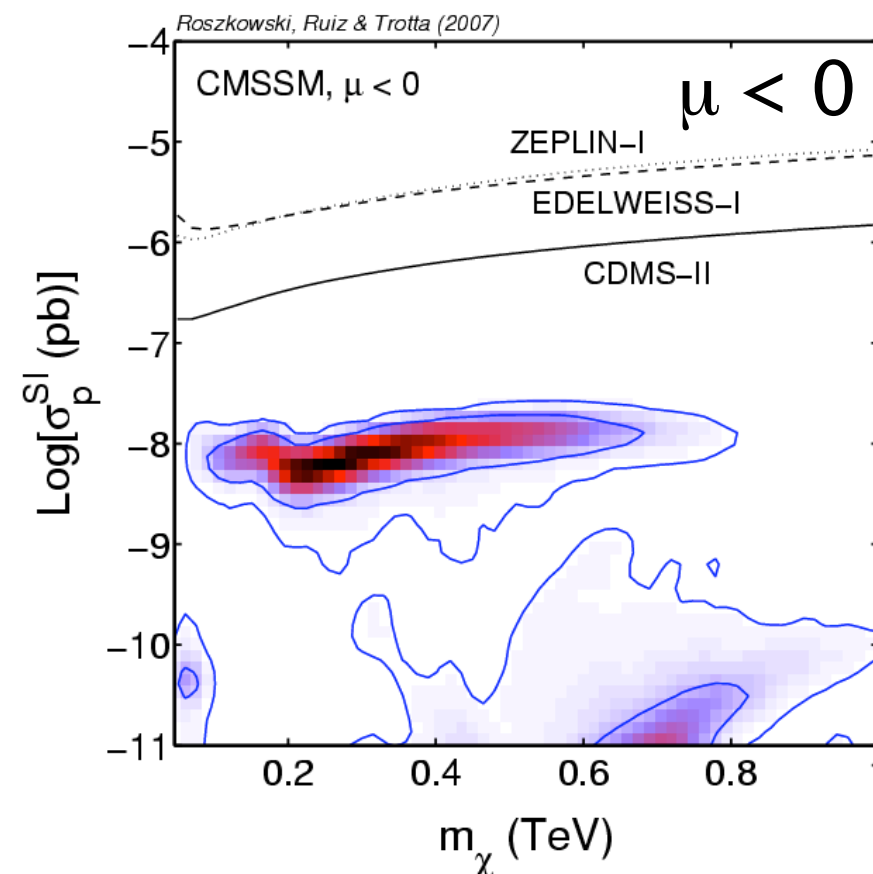
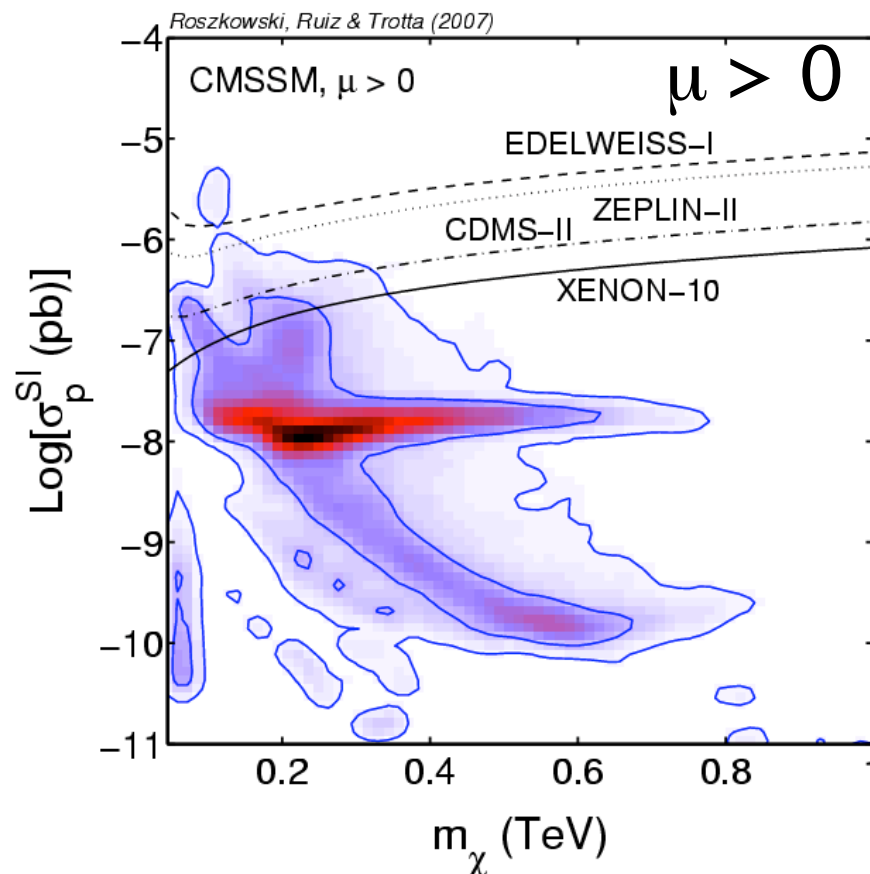
\mathbf{d} : data



Next step

- Model averaging: include alternative viable models and sum over them, with appropriate weights:

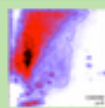
$$P(\mu < 0)/P(\mu > 0) \sim 0.1$$



Code released in July 2007, v 1.0:


- *Implements the CMSSM, but can be easily extended to the general MSSM*
- *Includes up-to-date constraints from all observables*
- *Fully parallelized, MPI-ready, user-friendly interface*
- *Bayesian MCMC or grid scan mode, plotting routines*
- *Produces probability and quality of fit plots for all observables, CMSSM parameters, derived quantities, ...*

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