Fitting SUSY Parameters and Early CMS Results

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Outline

Aims

- Explore the parameter spaces of models of supersymmetry (SUSY) to understand their features
- Determine how consistent particular models of SUSY are with our observation
- If we do see SUSY, what should it look like?
- If we don't, where might we expect to see it?

Models Covered

		Boundary Conditions
CMSSM	$m_0, m_{1/2}, A_0, tan(\beta), \mathrm{sign}(\mu)$	Unification +
VCMSSM	$m_0, m_{1/2}, A_0, \mathrm{sign}(\mu)$	$B_0 = A_0 + m_0$
MSUGRA	$m_0, m_{1/2}, A_0, \mathrm{sign}(\mu)$	$B_0 = A_0 + m_0; m_0 = m_{3/2}$
NUHM1	$m_0, m_{1/2}, A_0, m^2_{1,2}, \mathrm{sign}(\mu)$	$m_{1,2} = m_0 + \Delta m_H$

Observables

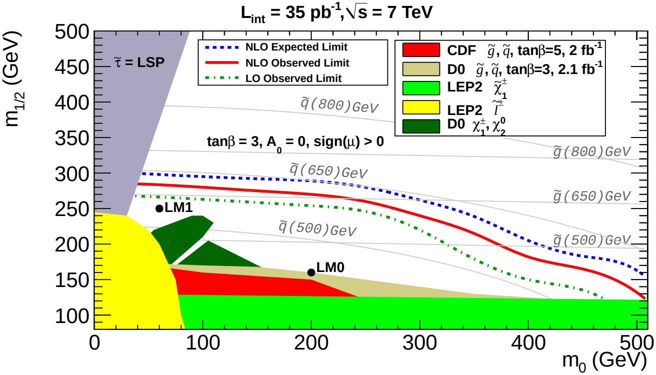
Examples

- Flavour Physics
  - $\mathrm{R}\left(b \to s\gamma\right)$
  - $\mathrm{BR}\left(B_s \to \mu\mu\right)$
  - $\mathrm{R}\left(B \to \tau\nu\right)$
- EWPOs
  - Γ_Z
  - $\mathrm{A}_{fb}(b)$,$\mathrm{A}_{fb}(c)$
- Cosmology
  - Ωh^2
  - σ_p^{SI}
- Particle Spectrum
  - M_{h^0} of particular interest
- Other indirect constraints
  - $\Delta(g_\mu - 2)$

Global Likelihood Function

$$
\begin{aligned}
\chi^2 = & \sum_i^N \frac{(C_i - P_i)^2}{\sigma(C_i)^2 + \sigma(P_i)^2} && (1)\\
+ & \chi^2(M_h) + \chi^2(\mathrm{BR}(B_s \to \mu\mu)) && (2)\\
+ & \chi^2(\text{SUSY search limits}) && (3)\\
+ & \sum_i^M \frac{\left(f_{SM_i}^{\mathrm{obs}} - f_{SM_i}^{\mathrm{fit}}\right)^2}{\sigma\left(f_{SM_i}\right)^2} && (4)\\
+ & \chi^2(\ldots) && (5)
\end{aligned}
$$

CMS Constraint

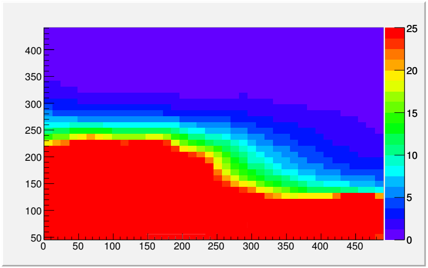


CMS Constraint: Function

$$\chi^2_{CMS} = \chi^2_\infty \left| \frac{M_C}{M} - 1 \right|^P ,$$

$$M \equiv \left(m_0^2 + m_{1/2}^2\right)^{1/2}$$

- $\lim_{M\to\infty} \chi^2_{CMS} = \chi^2_\infty$
- $\chi^2_{CMS}(M = M_C) = 0$



CMS Constraint: Parameter values

χ^2_∞

- Observed events $= 13$
- $\mathrm{SM}_{bkg} = 10.5^{+3.6}_{-2.5}$
- Excess$= 2.5$
- $95\% CL$: number of signal events compatible with the excess $= 13.4$ ($95\% = 1.96\sigma$)
- Total numbr of events for any signal $= 2.5 \pm 5.56$
- $\chi^2_\infty = 0.85$

NLO Expected (absense):

- 10.9 events
- $(10.9 - 2.5)/5.56 \Rightarrow 1.51\sigma$
- $\chi^2_{NLO_e} = 4.06$

NLO Observed:

- Similarly, $95\% = 1.96\sigma \Rightarrow \chi^2_{NLO_o} = 5.99$

These are used as boundary condition on our function