pMSSM Scenarios in view of Direct Dark Matter Searches and the LHC

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in collaboration with
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Several direct detection dark matter search experiments reported excess of events corresponding to a light WIMP with large scattering cross section;

Interpretation of these possible signals within the MSSM controversial due to LEP constraints on new particles with mass below 45 GeV;

Need the χ to be bino-liko to evade LEP Γ_z constraints;

Relic density requires small mass splitting with NLSP for efficient co-annihilation;

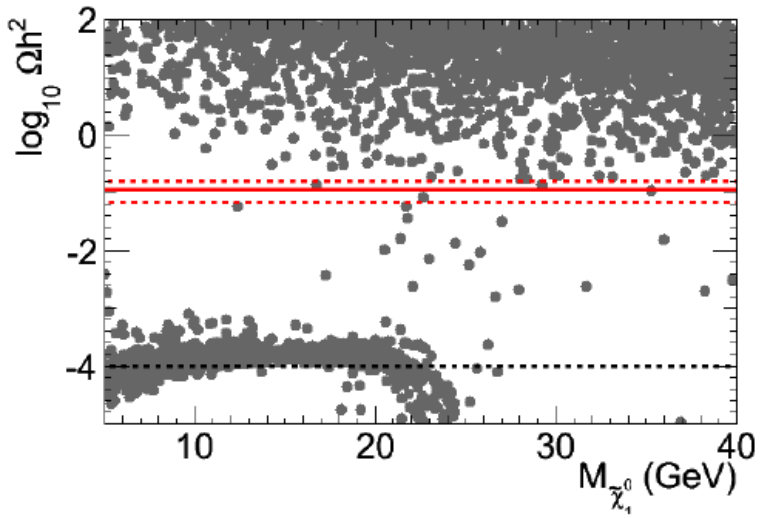
Of the possible scenarios: light charginos are excluded by the LEP2 bounds while a light sbottom can evade the LEP2 bounds and reduce $\Omega_\chi h^2$

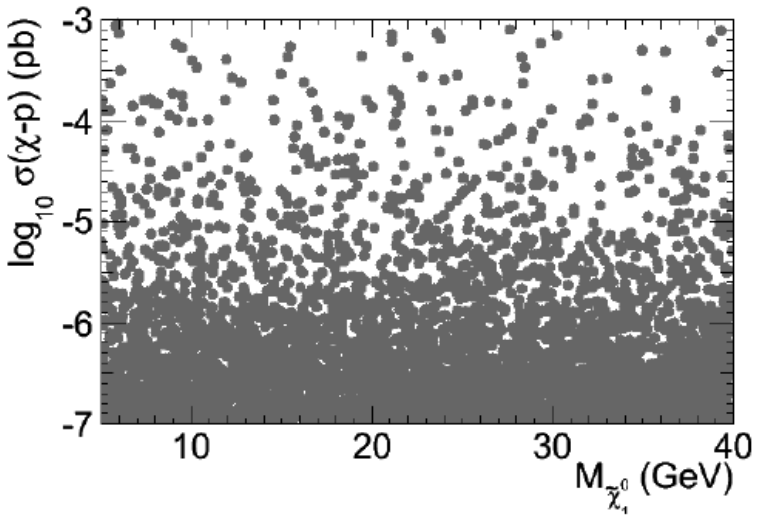
Study these scenarios using pMSSM scans and including flavour physics, LEP, Ωh^2, LHC Higgs and SUSY search results;

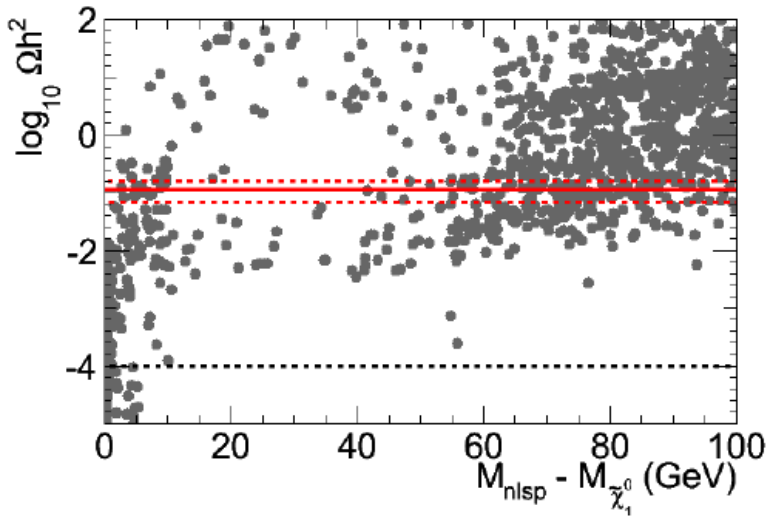
Important interplay between DM in direct detection and relic density and Higgs;

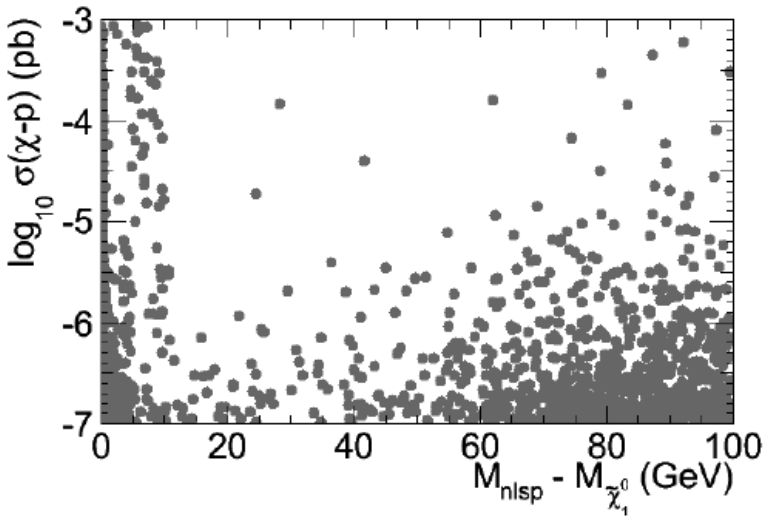
This presentation updates earlier published results in view of the recent CDMS and LHC Higgs results.

Arbey, MB, Mahmoudi, EPJC 72 (2012) 2169









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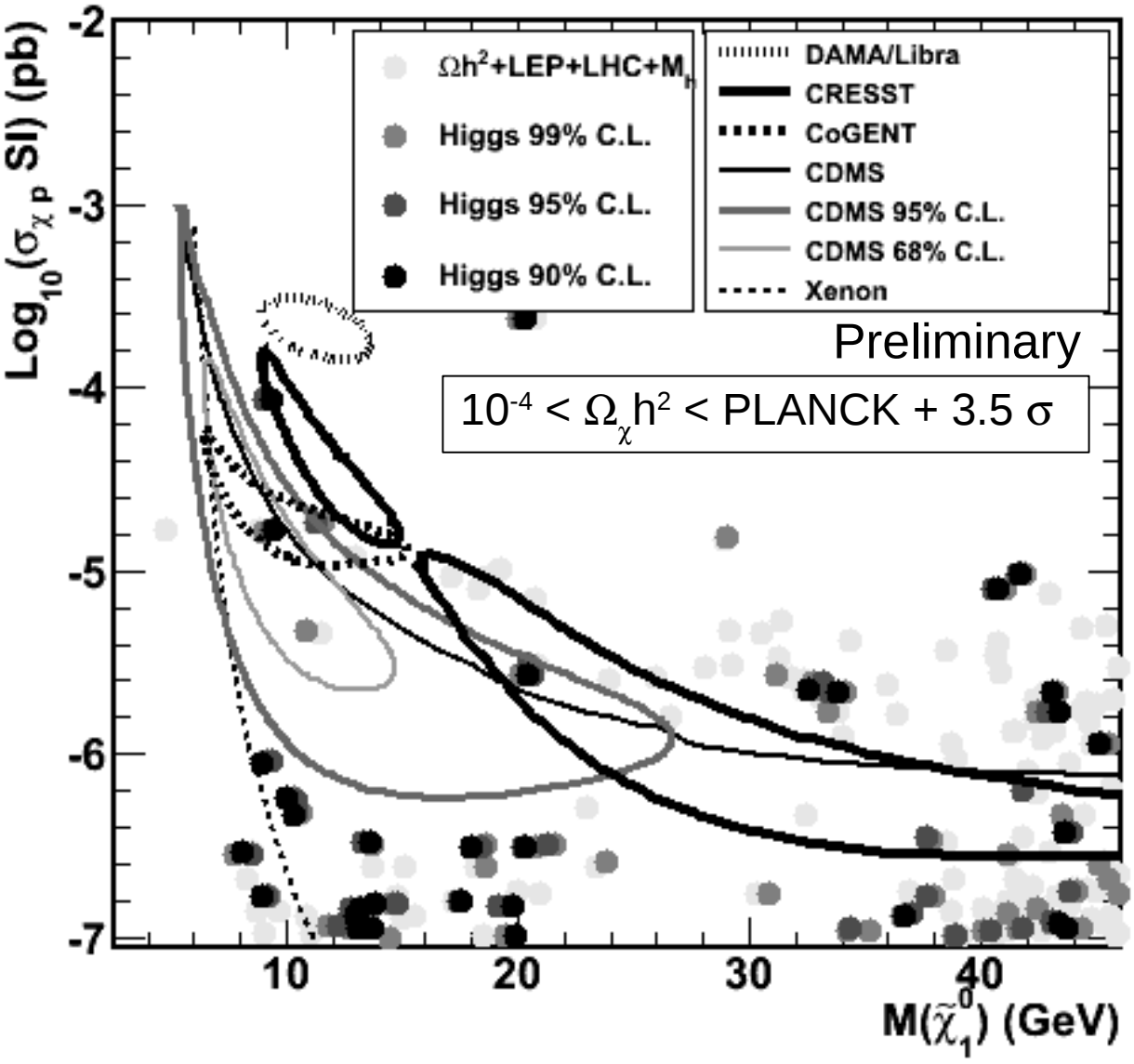
LHC Higgs Mass and Signal Strength Constraints

Parameter	Value	Experiment
M_h (GeV)	125.7±0.4	ATLAS[49]+CMS[43]
$\mu_{\gamma\gamma}$	1.20±0.30	ATLAS[40]+CMS[41]
μ_{ZZ}	1.10±0.22	ATLAS[42]+CMS[43]
μ_{WW}	0.77±0.21	ATLAS[44]+CMS[45]

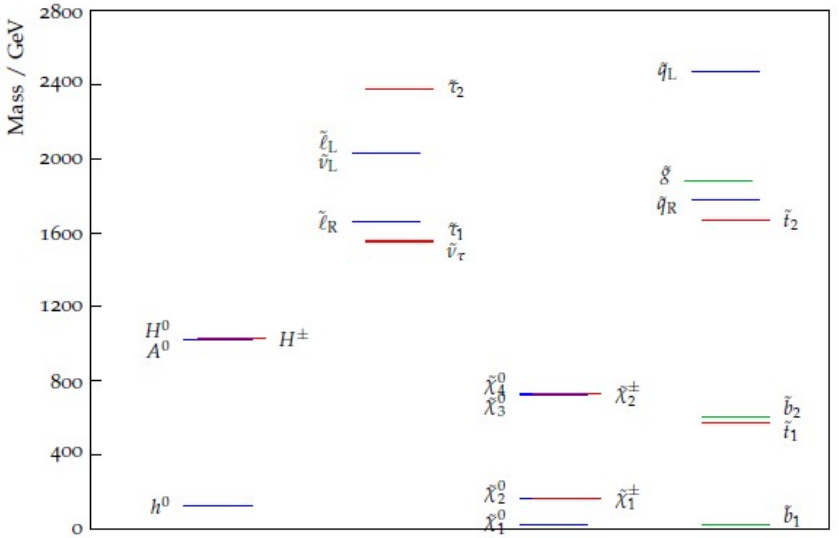
Impose χ^2 probabiility from LHC measurements on selected pMSSM points

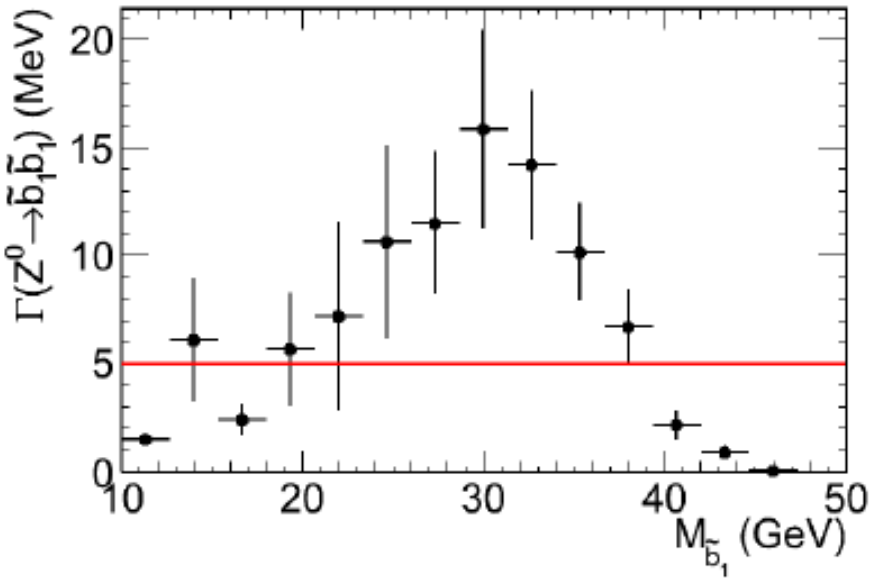
The pMSSM Points, CDMS and the Earlier Results

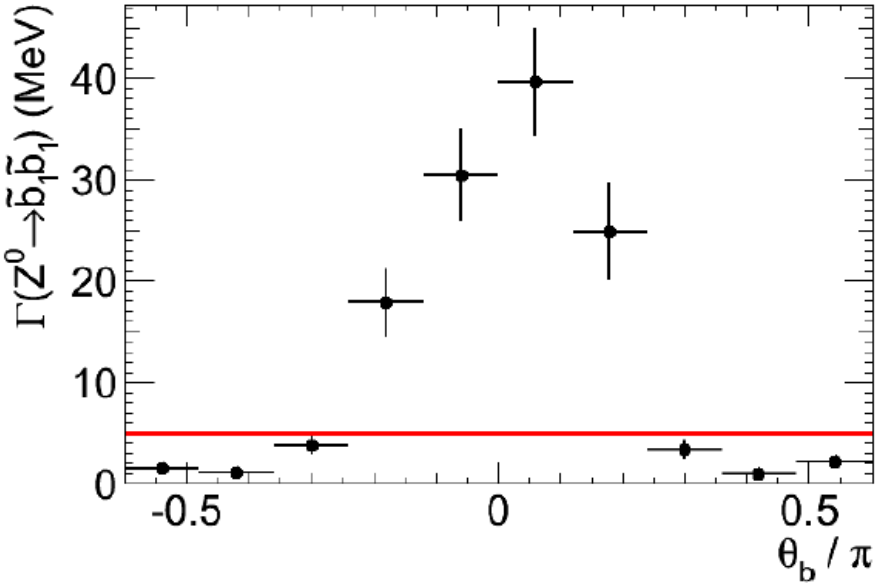


Light Sbottom Scenario

A very light b_1 is possible if b_R is light, the mixing angle θ_b is large and the b_1 is mostly b_R, it is interesing that this condition ensures at the same time the decoupling of b_1 from the Z realising some kind of “sbottom miracle”







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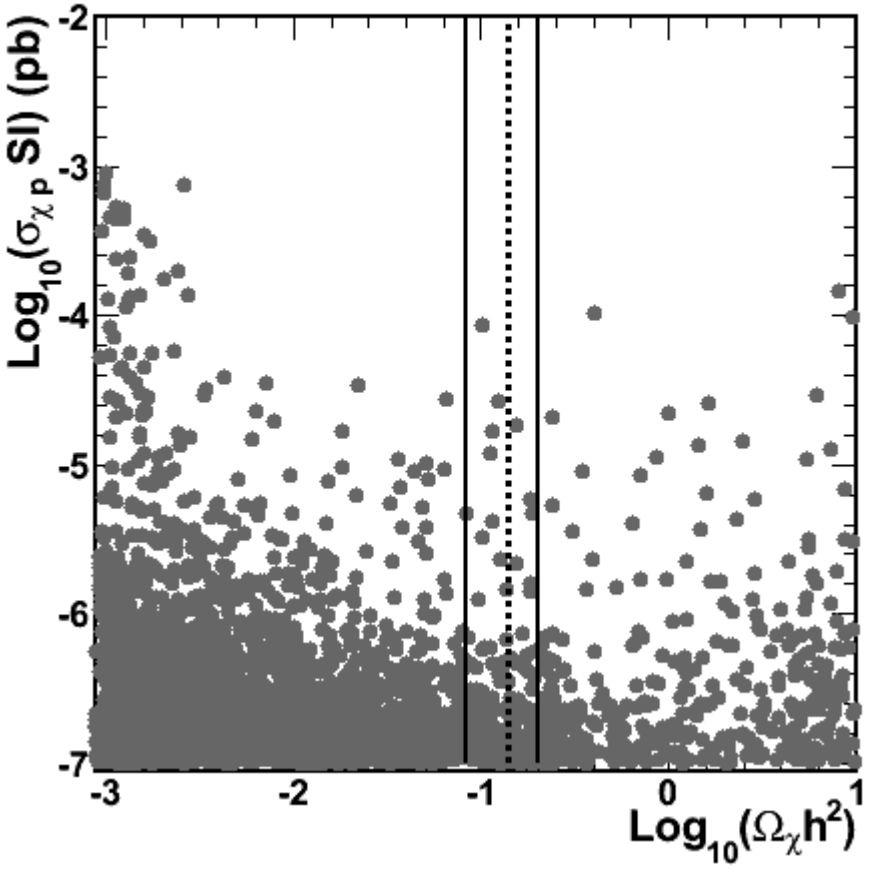
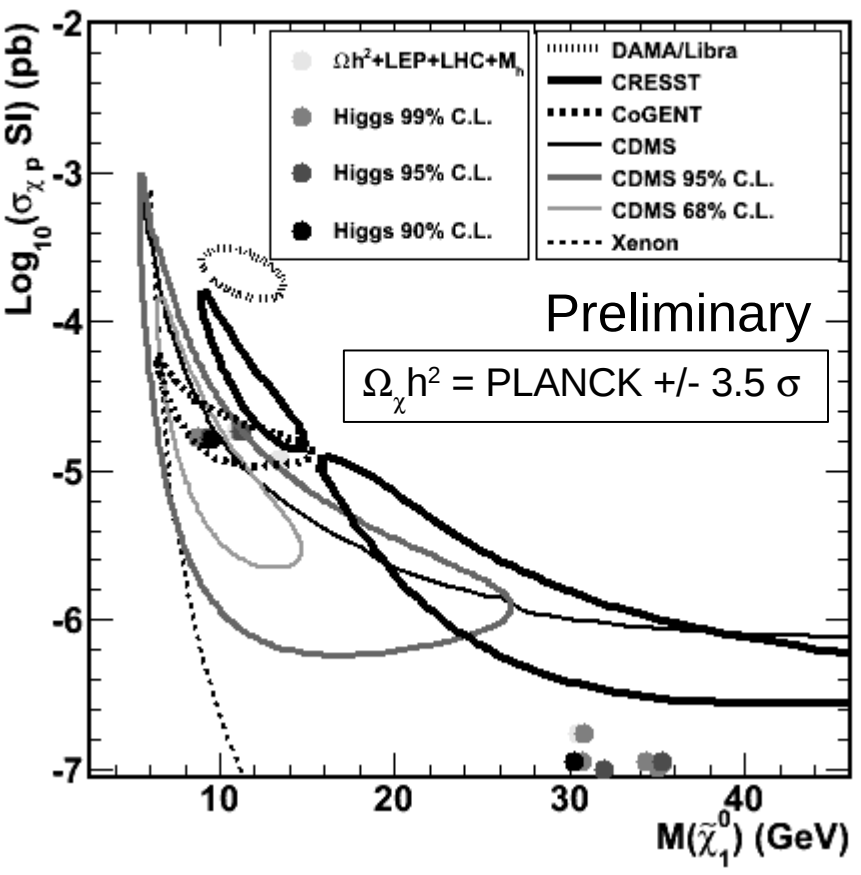
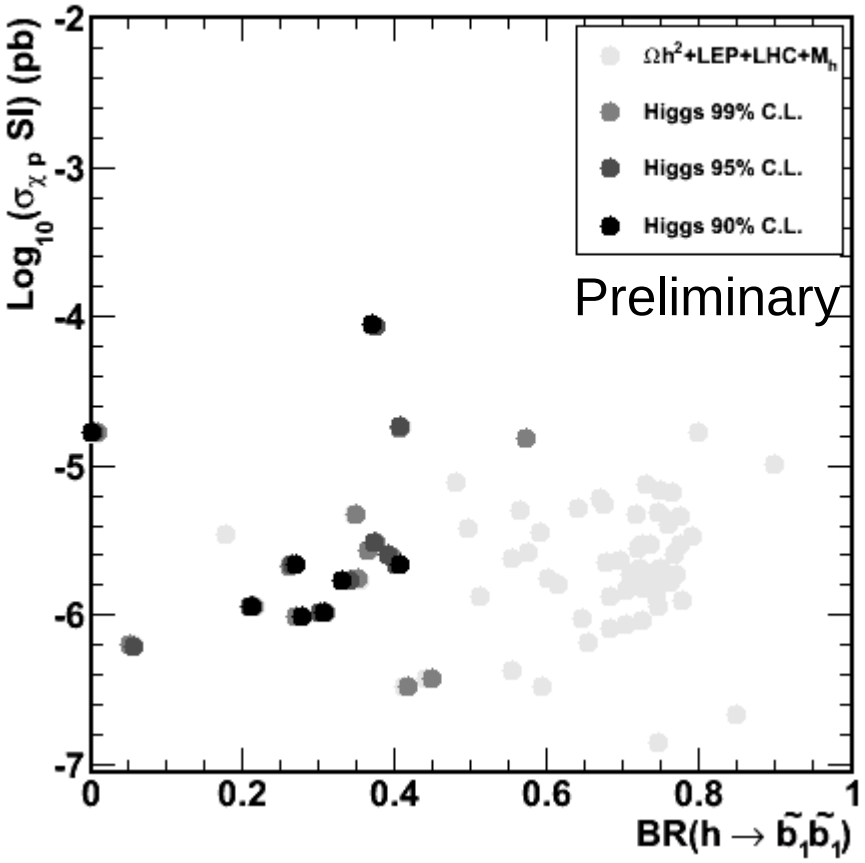
Dark Matter: Scattering Cross Sections and Relic Density



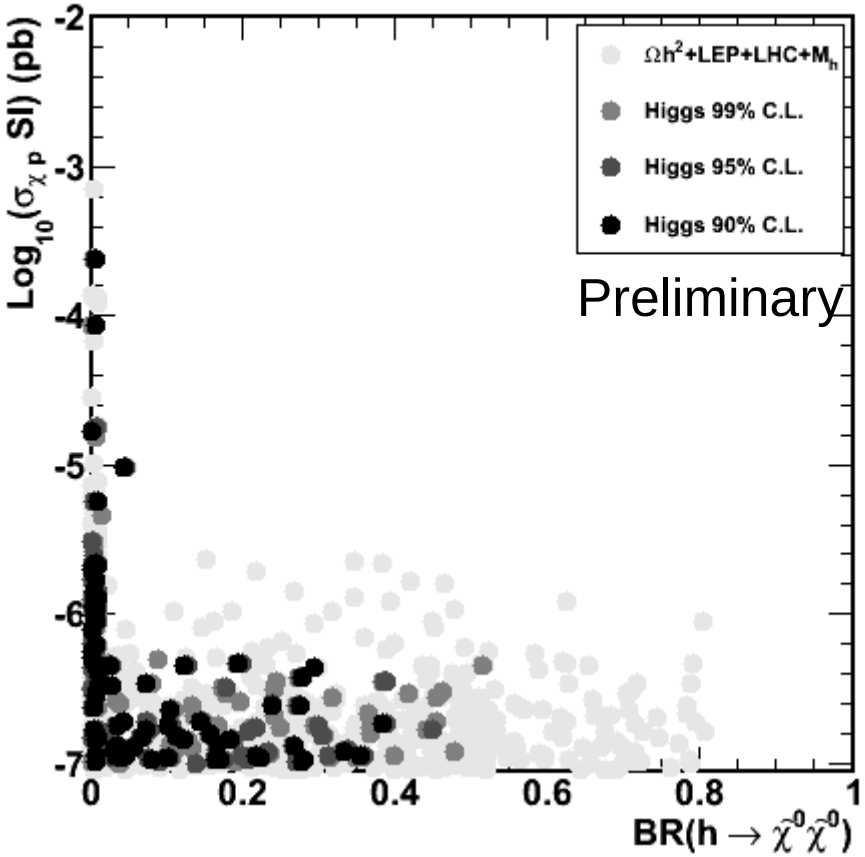


Non SM Higgs Decays

$h \rightarrow b_1 b_1$

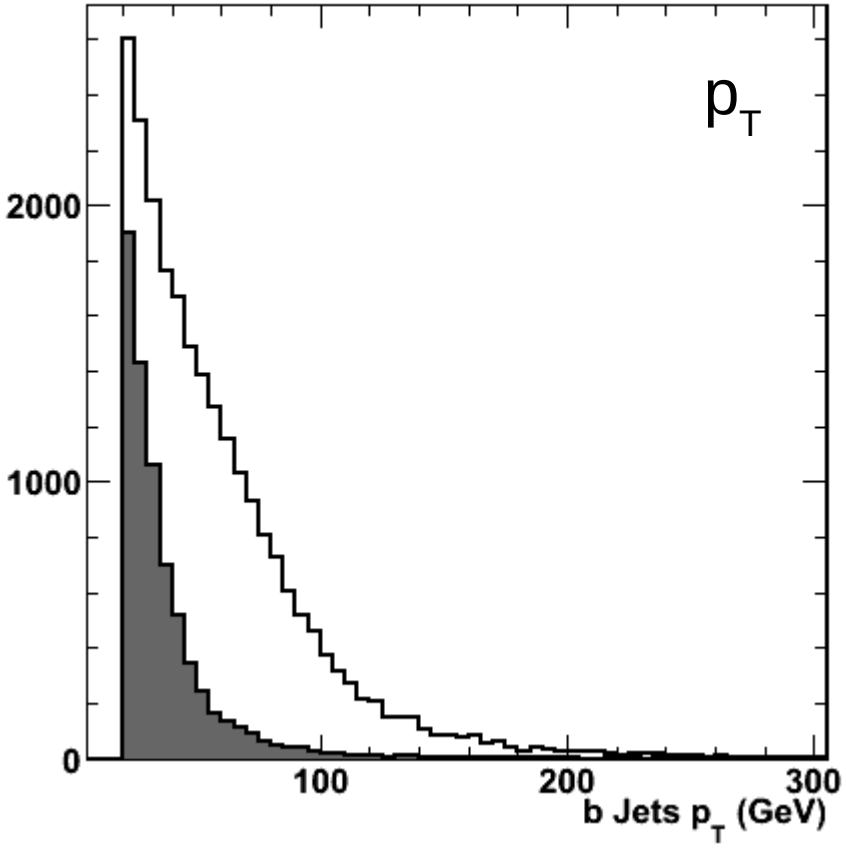


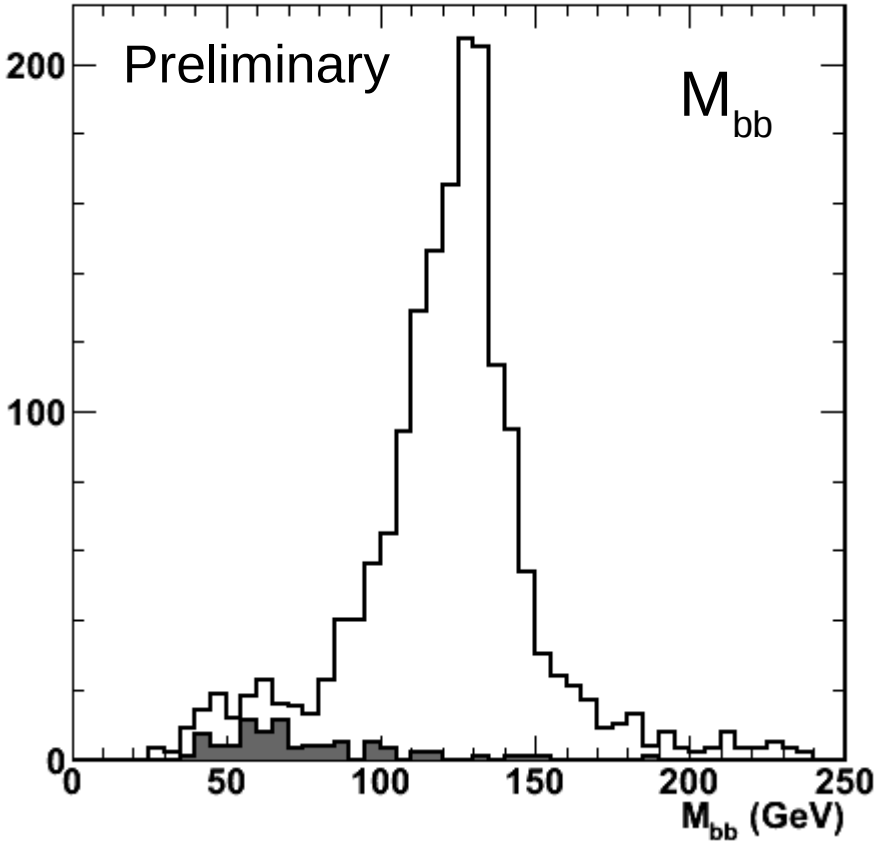
$h \rightarrow \chi^0 \chi^0$



Higgs Decays and Signal Strengths

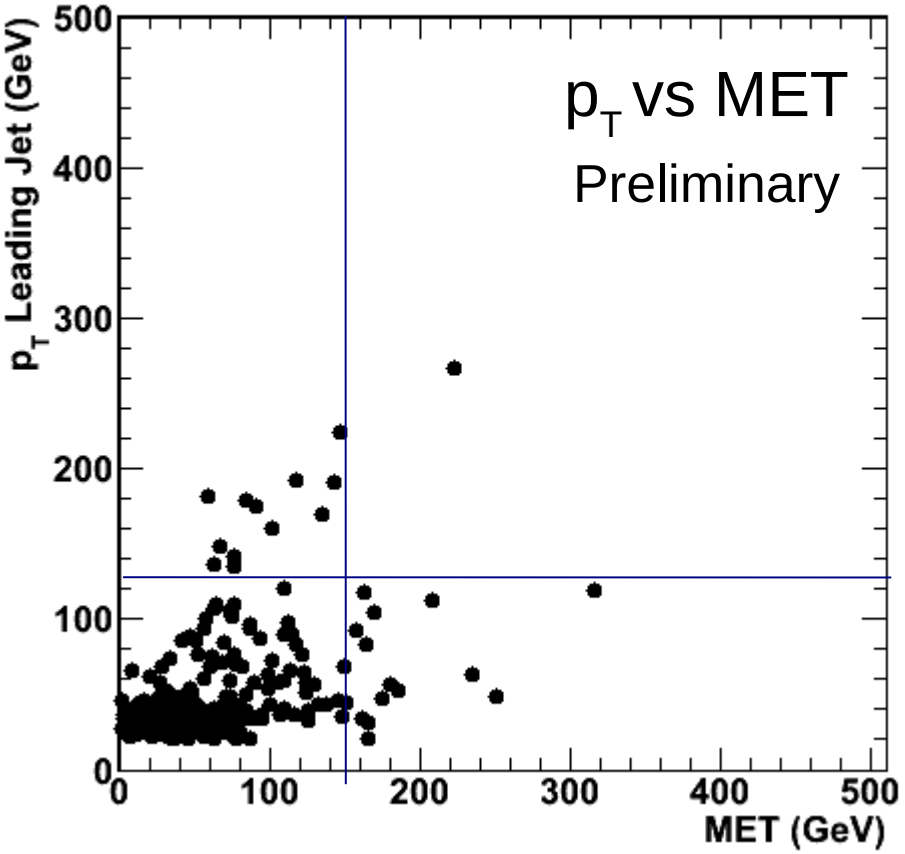
Simulate WH events with Pythia8, fast simulation with Delphes 3, comparison of $h \rightarrow bb$ and $h \rightarrow b_1 b_1$ decays:

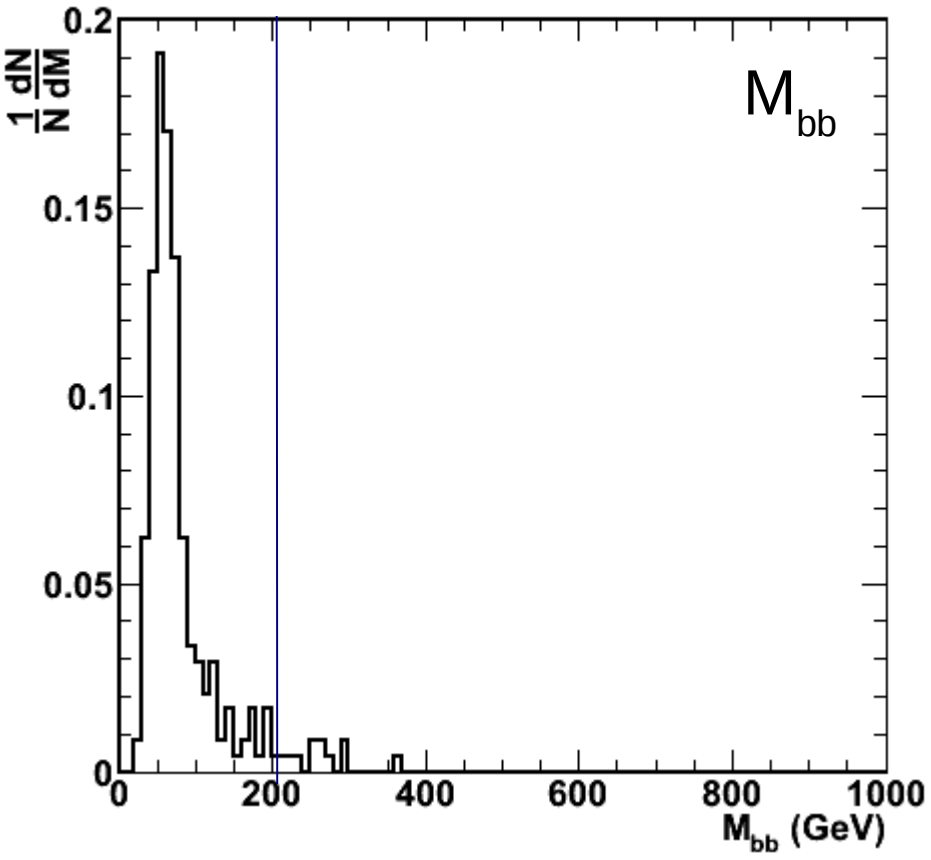




Light sbottom and Direct LHC Searches

Despite large cross section pp → $b_1 b_1$ escapes detection in SUSY analysis due to the small jet p_T and low MET ($\varepsilon \sim 2 \times 10^{-5}$) (Pythia 8 +Delphes 3 simulation):





Cuts of ATLAS-CONF-2013-053 compared to kinematics of pp → $b_1 b_1$ events in this scenario (similarly for the CMS b jets + MET α_T analysis of CMS-SUS-12-028)

Conclusions

MSSM offers solutions compatible with a light WIMP as implied by CDMS and other data, if reported events are due to DM scattering;

Light, almost degenerate sbottom scenario still viable in view of LEP and LHC constraints;

Important interplay between dark matter and Higgs sector through scattering WIMP cross section, relic density and invisible Higgs decays to be systematically pursued in coming years;

Sizeable $h \rightarrow b_1 b_1$ rate will provide good test once $h \rightarrow bb$ will have been established and signal strengths measured;

Interesting opportunities for dedicated searches of light sbottoms at LHC and a future lepton collider.