‘Generic’ Q_V - beyond 3rd gen

- Limits on single production from single-top cross section measurements

  A.Belyaev, G.Cacciapaglia

- Flavour constraints, operator basis constraint (systematic study)

  G.Cacciapaglia, A.Deandrea,
  G.Drieu la Rochelle, N.Mahmoudi

- Connection with Composite Higgs models

- ...

  G.Cacciapaglia, A.Deandrea,
  S.Lee, G.Moreau, V.Sanz

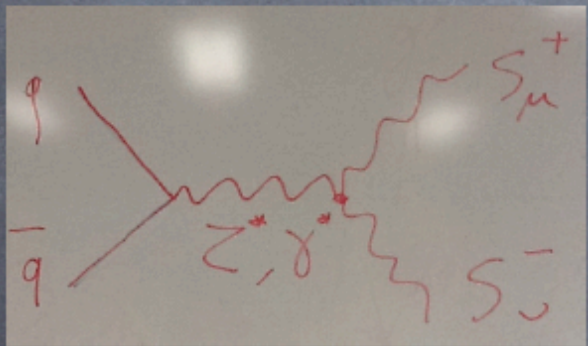
Keep contributing to the WIKI page:
http://phystev.in2p3.fr/wiki/2013:groups:np:simplivl

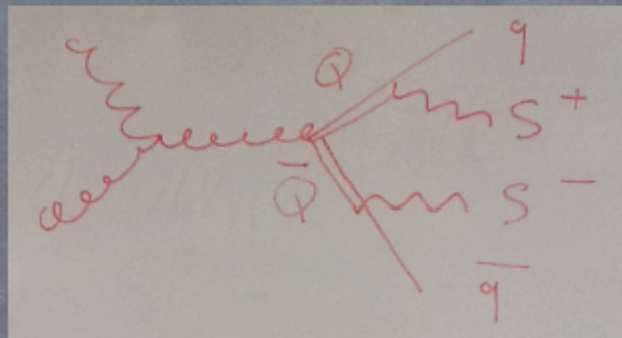
Paired resonances

- Are there scenarios where a single resonance is difficult/suppressed, and it's worthy looking for paired resonances?

Paired di-jet studied by CMS and ATLAS.

L.Basso, A.Belyaev, G.Cacciapaglia, A.Deandrea, G.Drieu la Rochelle





All final states: $jjjj$, $t\bar{b}jj$ and $t\bar{b}t$

Interesting one: $t\bar{b}jj$.

$\mathcal{L} = g_s\, \bar{u}_R S_\mu^+ \gamma^\mu d_R + h.c.$

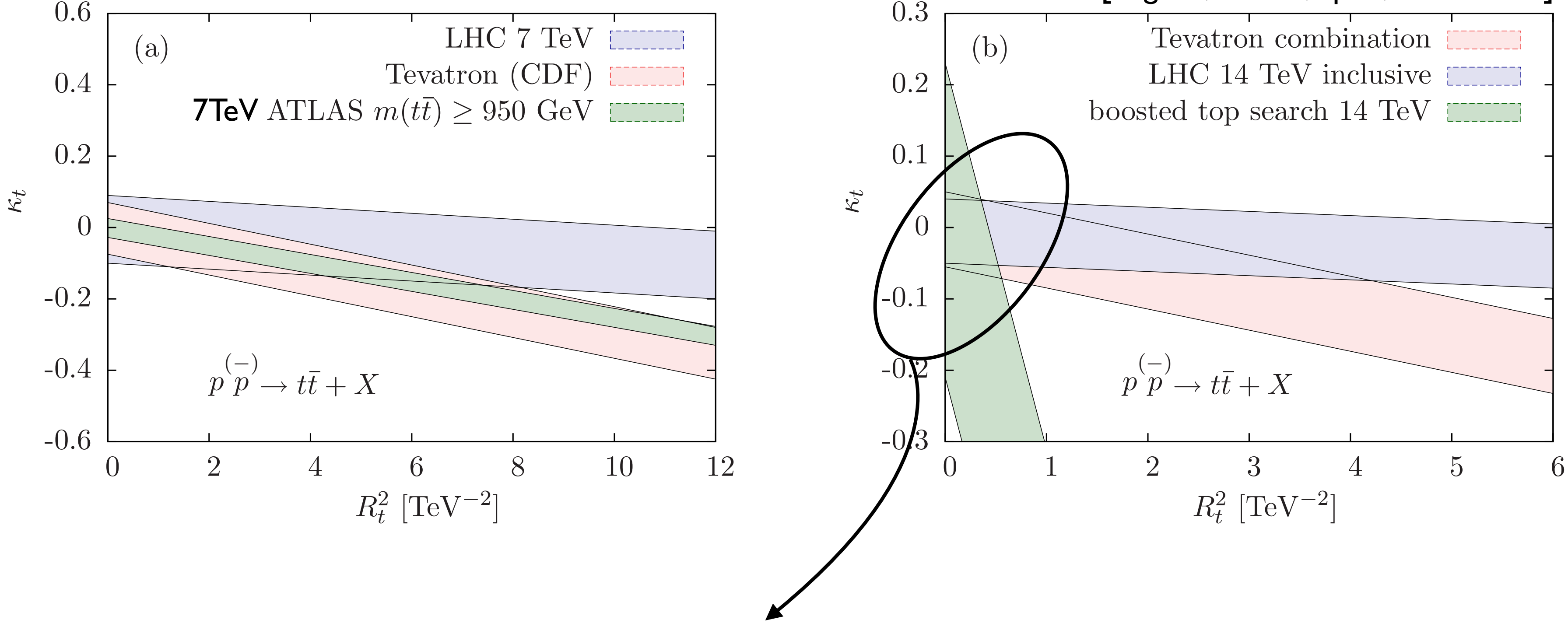
$S^+ \to t\bar{b}, \quad jj$

single production, Drell-Yan $u\bar{d} \to S^+ \to jj, t\bar{b}$: bounds on the plane m_S vs. g_s;

- lots of tops at the LHC, but only a few Higgses
- strongly interacting EW scale $\supset$ top compositeness

$$\mathcal{L}_R = -g_s \frac{R_t^2}{6}\, \bar{t}\gamma^\mu \, \mathcal{G}_{\mu\nu}\, D^\nu \, t + \text{h.c.},$$
$$\mathcal{L}_\kappa = g_s \frac{\kappa_t}{4m_t}\, \bar{t}\sigma^{\mu\nu}\, \mathcal{G}_{\mu\nu}\, t\,, \ldots$$

[Englert, Freitas, Spira, Zerwas '12]



- Limitations by systematic uncertainties? Are there analysis-related issues? Impact of top-tagging?
- Complementarity to m(tt) shape analyses? Is it better?

Englert, Spannowski

Enhancing the longitudinal fraction of V's in VV scattering

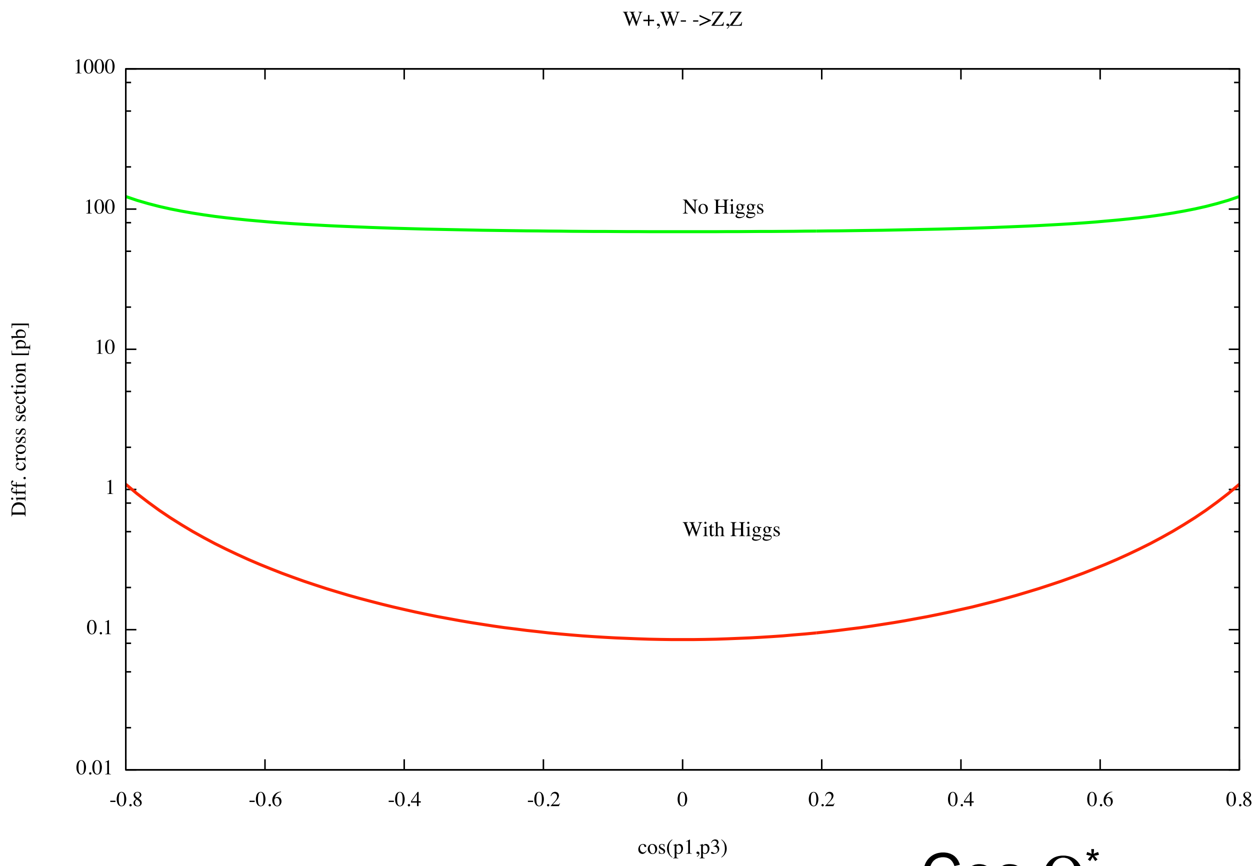
People involved: A. Belyaev, E. Boos, V. Bunichev, G. Cacciapaglia, , A. Deandrea , Y. Maravin, A. Pukhov, R. Rosenfeld… [add your name]
http://phystev.in2p3.fr/wiki/2013:participants:alexander.belyaev:wlwl

Motivation:
. to explore the LHC sensitivity to the new physics involving non-SM Higgs couplings to vector boson which lead to enhancement of the $V_L V_L \text{->} V_L V_L$ amplitudes due to the violation of large cancellations which are provided by the SM Higgs boson

Goal:
. devise cuts to filter-out the transverse polarizations, which mask the presence of New Physics, and determine their efficiency.

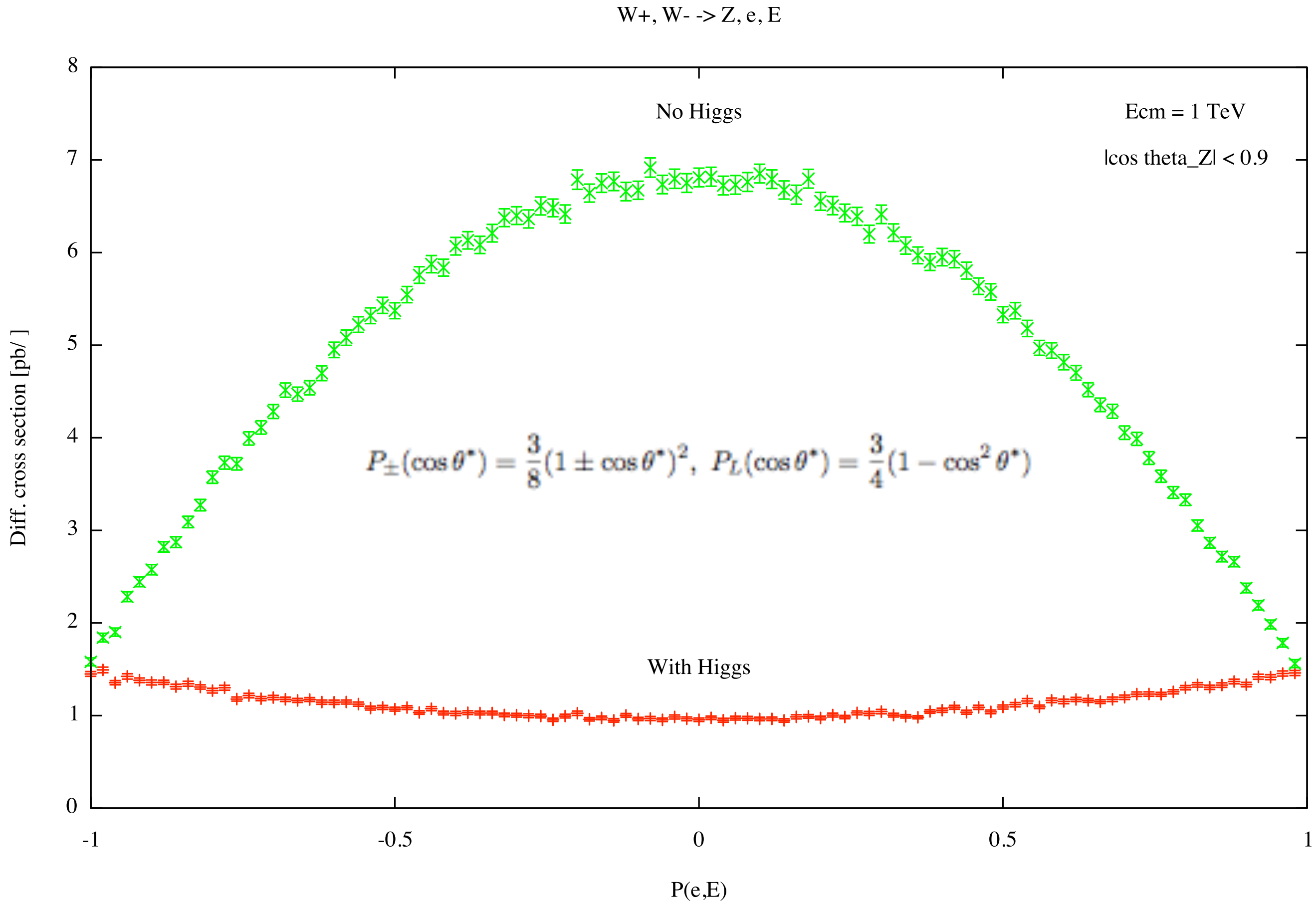
Huge literature about this, e.g.: Han et al (2009), Kalinowski at al (2012), …

Very simple preliminary tests



Cos Θ^{*}_{Z}

Angular distribution of electron in the rest frame of the parent Z after angular cut in the other Z angular distribution



Promising?

Constraining Natural SUSY

E. Conte, B. Fuks, S. Kraml, S. Kulkarni, L. Mitzka, B. O'Leary, S. Pataraia, W. Porod
S. Sekmen, D. Sengupta, N. Strobbe, F. Würthwein, W. Waltenberger

scenario considered:

- higgsino like states $\tilde{\chi}^0_{1,2}$, $\tilde{\chi}^+_1$, few GeV mass differences
- $\tilde{t}_1$, $\tilde{b}_1$, arbitrary nature
- $\tilde{g}$

mass hierarchy: $m_{\tilde{\chi}} < m_{\tilde{q}1} < m_{\tilde{g}}$
two-fold strategy:

- constraining the scenario using existing simplified model results
- doing a proper analysis

compare results of both

Status:

- parameter ranges fixed
- agreement on how to set up the chain from SLHA input files to n-tuples
  $\Rightarrow$ runs will start in the next days

Natural SUSY and RPV

E. Conte, M. Dolan, B. Fuks, K. Howe, Y. Jiang, B. O'Leary, M. Marjanovic, S. Pataraia, W. Porod, P. Richardson, A. Raklev, N. Strobbe

scenario considered:

- higgsino like states $\tilde{\chi}^0_{1,2}$, $\tilde{\chi}^+_1$, few GeV mass differences
- $\tilde{t}_1$, $\tilde{b}_1$, arbitrary nature
- $\tilde{g}$

broken R-parity: any of them can be the LSP
Idea: systematically check which signatures have not yet been covered by existing analyses
Status: all final states worked out, check of LHC results still ongoing, two potentially interesting cases so far

- long lived LSP, in particular in case of the LLE-operator, e.g. $\tilde{g}$ five-body decays
- UDD-operator: in some corner of the parameter space one has $2h + 4j$ as final state

Top polarization in sbottom decays

R. Godbole, B. Fuks, W. Waltenberger, T. Golling, S. Kraml, G. Belanger, S. Kulkarni

- Effect of top polarization in stop decays is known to be significant
- Top polarization in sbottom decays can play a role in determining the reach for direct sbottom searches when sbottom decays to top + chargino are considered
- Aim: To quantify the reach for sbottom searches by including the effect of top polarization
- Two steps involved:
  - Quantify the effect of the spin co-relations on the reach of sbottom searches
  - Construct new observables which utilize the information of the top polarization in order to enhance signal
- Final states considered:
  - Case I. LSP is higgsino: Final state - ttbar + MET - results exist, will be used for cross-checks
  - Case II. LSP is bino or winolike: Final state - single lepton + jets + MET or same sign leptons + jets + MET - new case being considered
- Status: new benchmarks being searched for, basic machinery in place

Compressed SUSY spectrum at the LHC

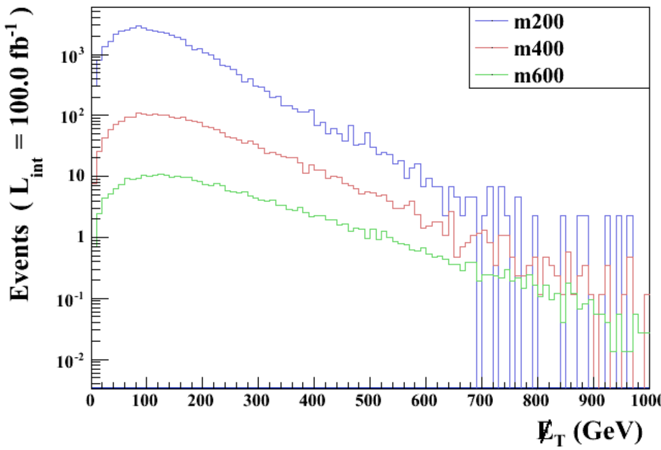
- People: B. Fuks, F. Moortgat, P. Richardson, A. Wilcock

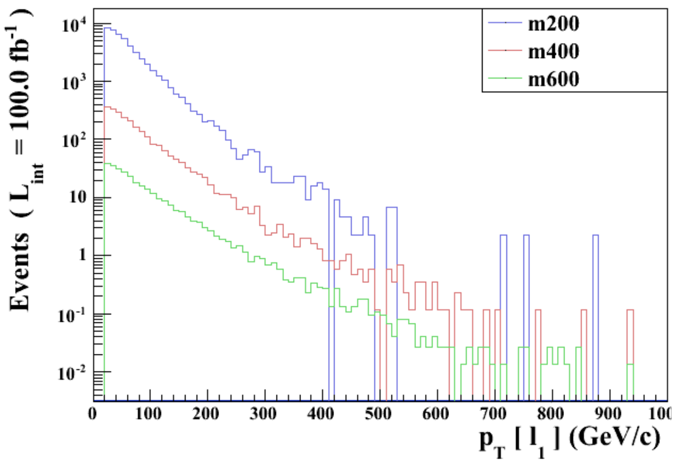
- Goal: accessing compressed SUSY spectra at 14 TeV through crazy topologies
  - Toy channel: $pp \to \tilde{g}\ \tilde{t}\ t \to t \not{E}_T$
  - Other tested channels: too low cross sections

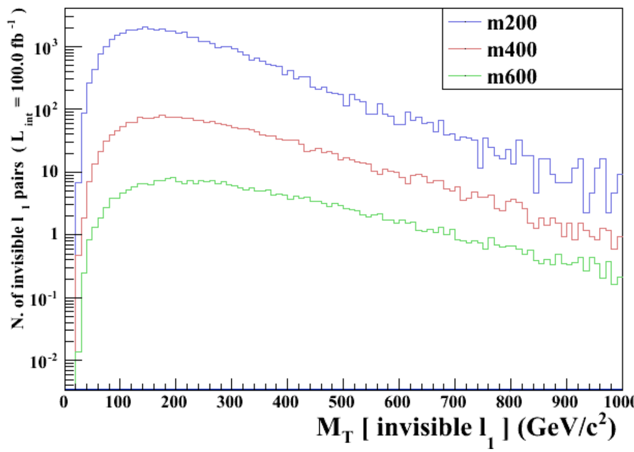
- Benchmark scenarios
  - sbottom, sgluino and stop masses at 200 GeV, 400 GeV, 600 GeV
  - neutralino mass at 190 GeV 390 GeV, 590 GeV

- Moderate cross sections:
  - 2 pb, 100fb and 10 fb for a SUSY scale of 200 GeV, 400 GeV and 600 GeV, respectively

- Some signal distributions for 100 fb^{-1} and for a leptonic top decay:







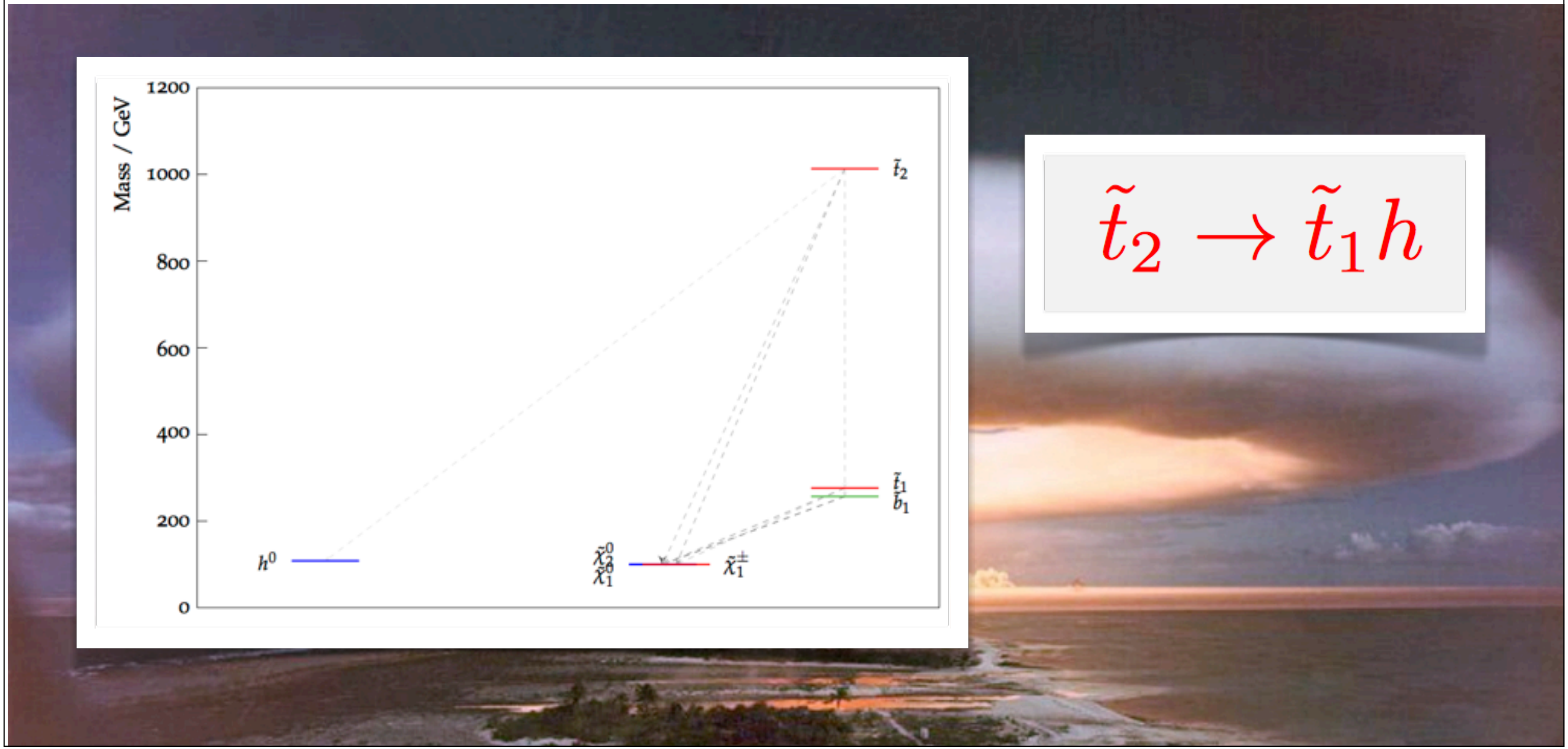
The Susy H-bomb

Englert, Spannowsky, Weiler, Brooijmans, Richardson

Super-spectrum:

Compressed spectrum, boosted topologies,

Higgs(es), natural, $m_{\tilde{t}_1} - m_{\tilde{\chi}_0} < 50\,\mathrm{GeV}$



$$\tilde{t}_2 \to \tilde{t}_1 h$$

Non Minimal Flavour Violation in the squark sector

K. De Causmaecker, B. Fuks, S. Sekmen, N. Strobbe, W. Porod, N. Mahmoudi

Goal

Study the effect of NMFV on current exclusion limits

Workflow

- scan over model space including NMFV
- check which points are allowed from low energy observables ($b \to s\gamma$, $B_s \to \mu\mu$, $B_u \to \tau\nu$, $b \to s\mu\mu$, Δa_μ, $\Delta M(B_s)$)
- identify several benchmark points/planes and generate events
- implement existing (CMS) analysis and study how the exclusion limits change

Model parameters

- Gaugino mass scale (M1:M2:M3 = 1:2:6), range [100,1600], step 250
- $M_{SUSY} = m_{\tilde{q}} = m_{\tilde{l}}$, range [100,1600], step 250
- $A_0 = A_{t/b/\tau} = \{0, 500, -1000, -5000, -10000\}$
- μ, range [100,850], step 250
- m_{A_0}, range [100,1600], step 250
- $\tan\beta = \{10, 40\}$
- $\lambda_{LL}, \lambda_{RR}, \lambda_{LR}$, range [-0.9,0.9], step 0.15

Higgs sector of the (unconstrained) MSSM with CP violation

A. Arbey, J. Ellis, R. Godbole, N. Mahmoudi

Study of the implications of the Higgs observables on the CP violating MSSM scenarios.

Parameters: pMSSM like scenario with 19 free parameters,
in addition to 6 CP phases: $\phi_1, \phi_2, \phi_3, \phi_{A_t}, \phi_{A_b}, \phi_{A_\tau}$

Considering all the available constraints from:

- Higgs sector
- EDMs
- flavour physics
- dark matter

Two approaches:

- Random flat scans over all the parameters
- Geometric approach for the CP phases to avoid large EDMs

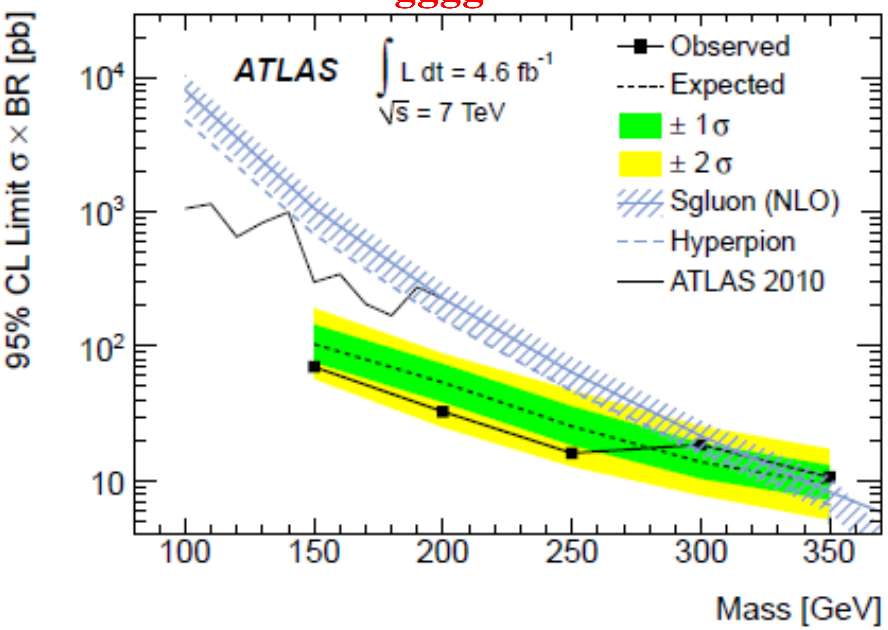
J. Ellis et al., arXiv:1006.3087

Pair produced sgluons

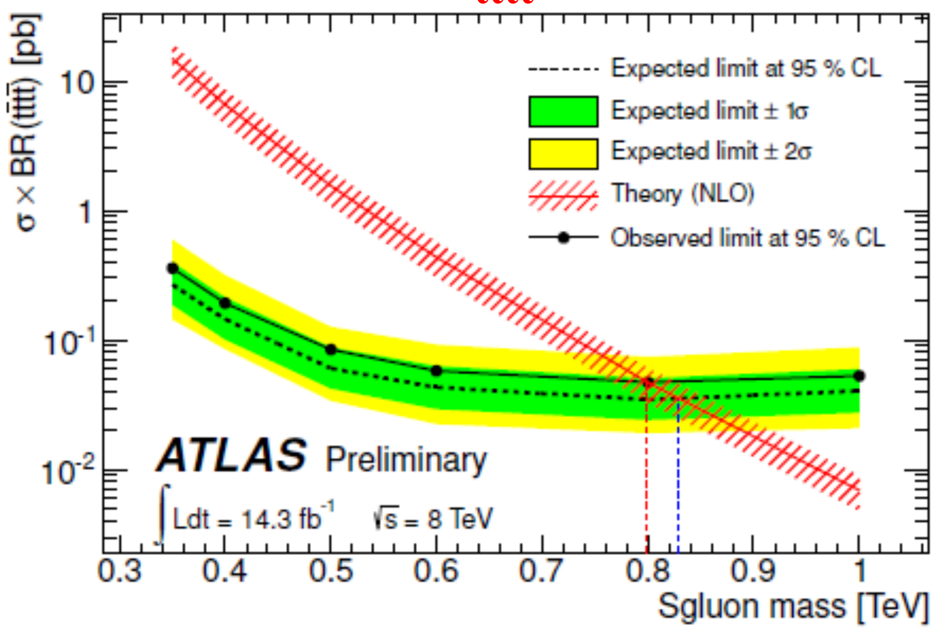
Benjamin Fuks, Dirk Zerwas + LPC Clermont-Ferrand

- Explore final states with several top quarks at the LHC
  - color octet scalars (SUSY: sgluon, TC:HyperPion+Coloron)
- Pair production and single production
- Final states (a choice):
  - gggg (done by ATLAS), tttt (done by LH11 and ATLAS), ttgg
- Chain at Les Houches:
  - PYTHIA8 with external dsigma/dcostheta*
  - DELPHES
  - Future: Feynrules (as in 2011)

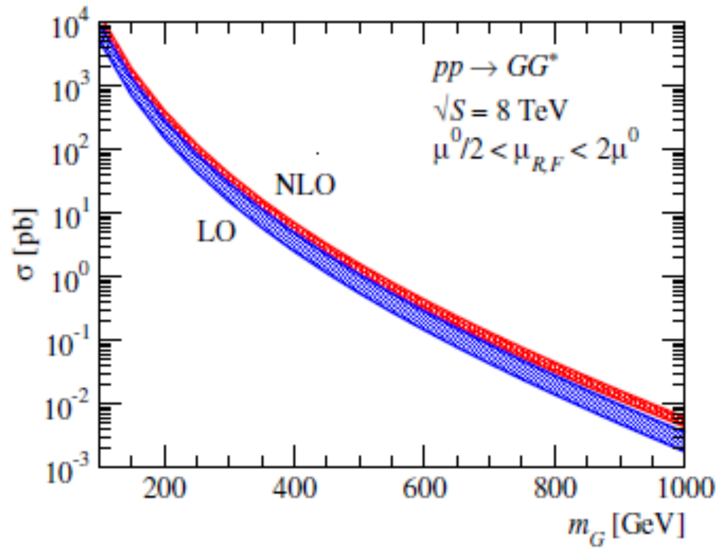
gggg



tttt



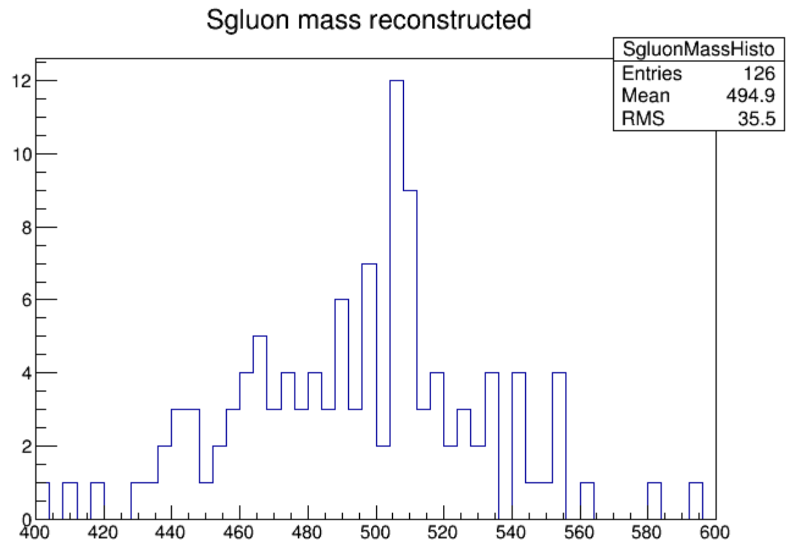
Scenarios and Status



Scenario ttgg:

- **Cross Section NLO (Goncalves-Netto et al. PRD 85 (2012) 114024)**
- **500GeV: 1.3pb * (BRmax=0.5) = 650fb**
- **PYTHIA8 Step: OK 10K ggtt produced**
- **DELPHES Step: OK 10K through fast simulation**

- **Sanity check of generation and simulation ok**
- **after DELPHES:**
- **at least 1 lepton**
- **jets > 30GeV**
- **example: is there a dijet mass combination close to 500GeV? (see figure)**
- **more checks/analysis necessary**



Natural focus point SUSY via mono-γ/j

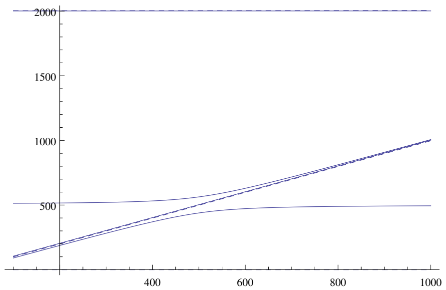
Comparing the capability of LHC13 with XENON1T in 2017

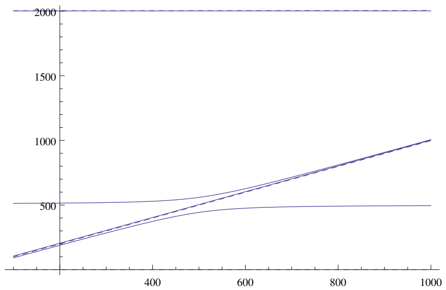
Consider Natural SUSY scenarios with light M_1

Focus points region: $\mu < M_1$ or $\mu \simeq M_1$ so $\Omega_\chi h^2 \lesssim 0.12$,
$M_2 \sim 1\,\mathrm{TeV}$, $M_A \sim 1.5$ TeV, $\tan\beta = 10{,}40$

- Using MadGraph5 and Delphes for LHC@13.5,14 TeV
- Compare results to XENON1T curves

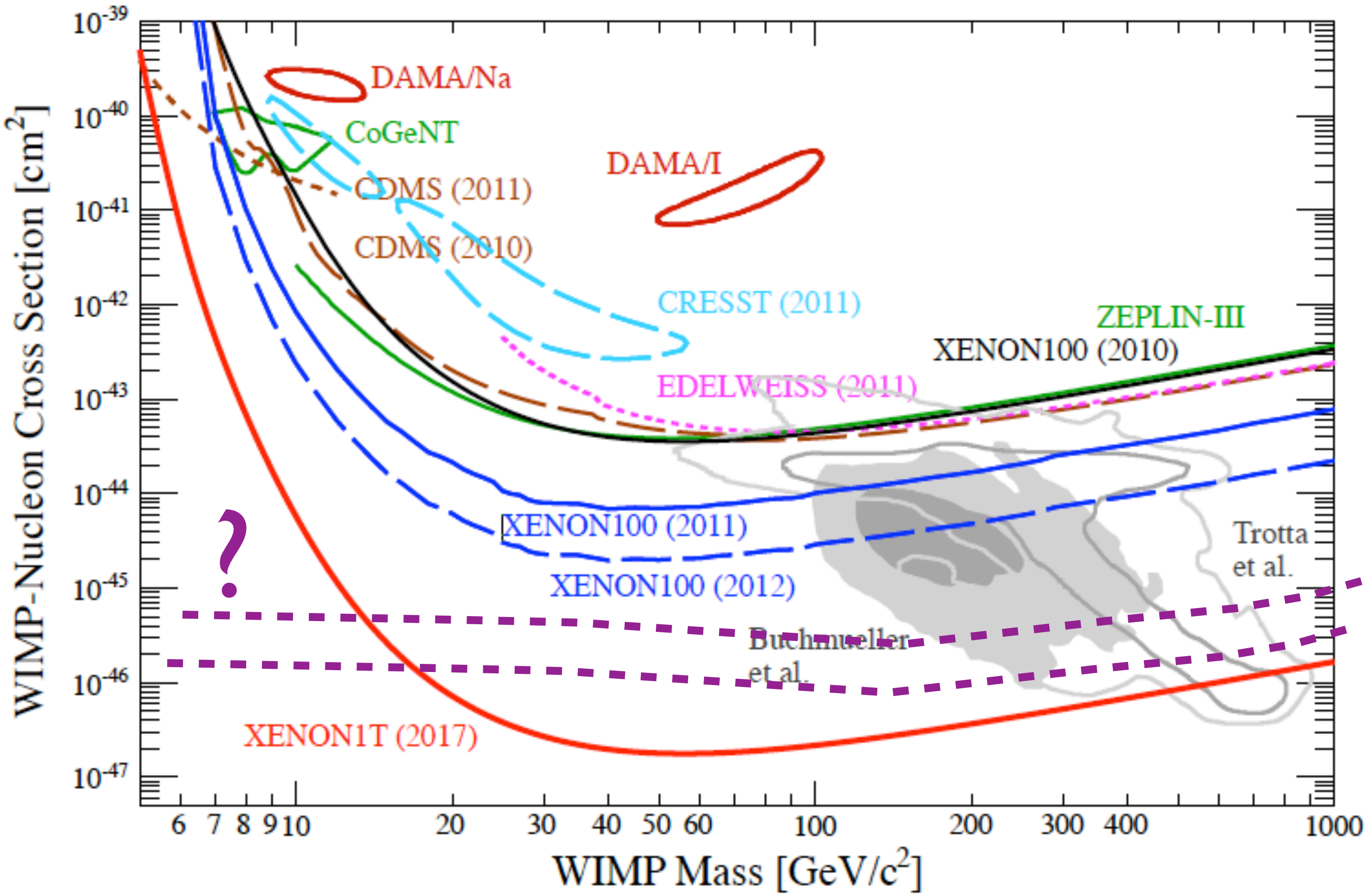
A.Belyaev, A.Bharucha, W.Porod, V.Sanz





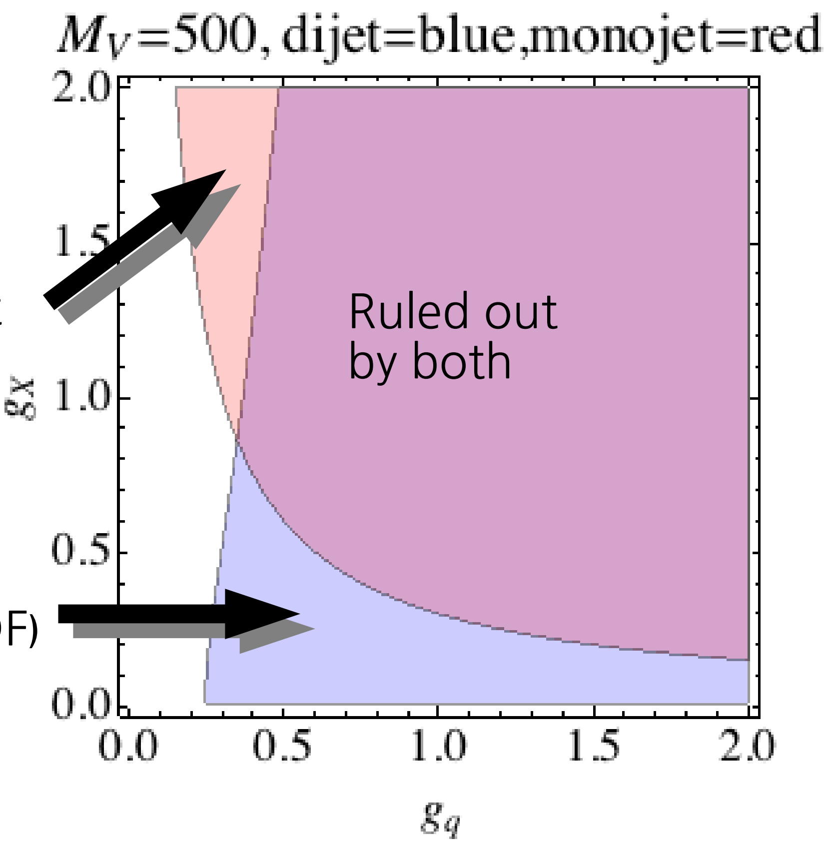
Chargino/Neutralino masses for $\tan\beta = 10, 40$

How low will the LHC13 go?

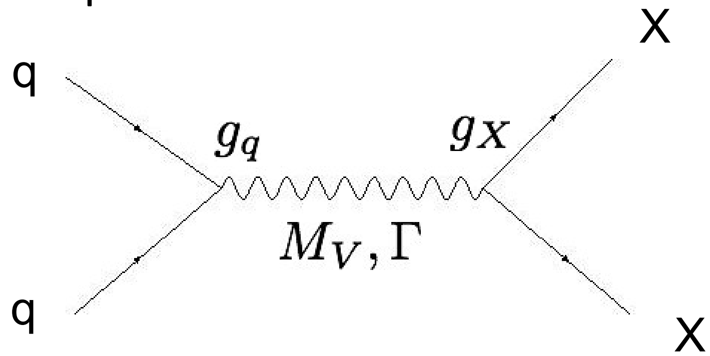


Exploring new signals for simple UV completions of effective dark matter

For simple UV completions of effective DM operators what other searches are complementary to monojet?



Vector operator simplified model:



Relevant searches:
Monojet, Dijet, Dilepton, Monophoton, Paired Dijet, Dijet res + MET, ...

Interested people:
A. Bharucha, A. Goudelis, K. Howe, G. Krnjaic, M. Marjanovic, B. Shuve

LHC monojet search interpretations: indirect detection and relic density

LHC monojet search results currently reinterpreted in terms of DM scattering cross-sections with matter (as for direct detection exp.), using effective/simplified models

→ Can we set also limits on indirect detection (gamma, proton, anti-proton spectra)?

→ Can we deduce a lower limit on the relic density?

→ Which effective models are the most strongly constrained?

→ What if more than one mediator/operator are present?

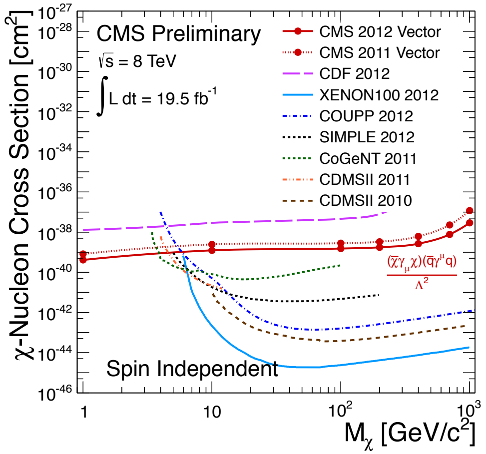
→ Which (full) models are the most interesting in this context?

→ Can we reinterpret the DM direct search results in terms of LHC cross-sections?

Interested people: A. Arbey, C. Balazs, G. Bélanger, F. Boudjema, A. Goudelis, Y. Jiang, N. Mahmoudi, S. Pukhov

Presentation of Results

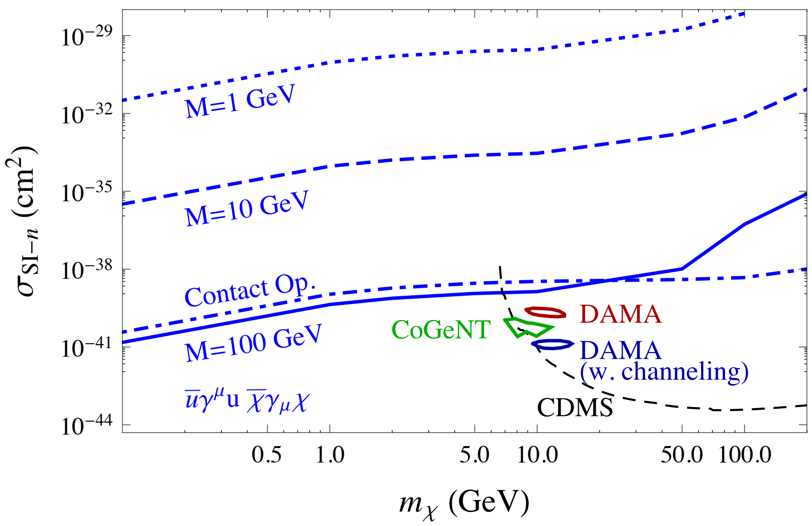
- Effective field theory for DM production at colliders
  - Ex.: $\mathcal{O} = 1/\Lambda^2 \bar{\chi}\gamma^\mu \chi \bar{q}\gamma_\mu q$
- Current CMS plot, 8 TeV 20/fb (EXO-12-048-pas):

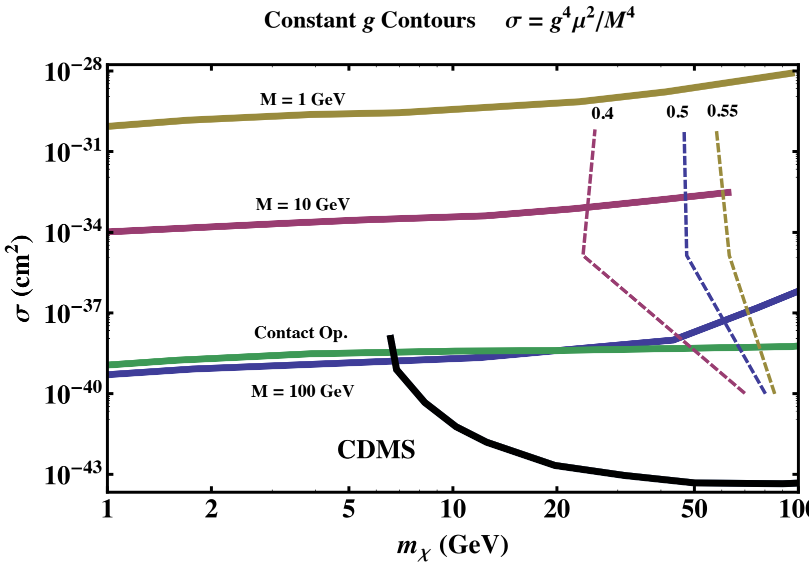


- For many parameters, effective field theory not valid
- Show where effects of mediator mass are important and perturbativity limits
- Always make clear whether effective operator is for **direct detection** or **LHC monojets**
  - CMS analysis mixes the two by quoting bounds on Λ even when bounding cross sections in the full theory
- Interested people: Alex Arbey, Csaba Balazs, Andreas Goudelis, Kiel Howe, Yun Jiang, Gordan Krnjaic, Brian Shuve

Presentation of Results

- Bai, Fox, Harnik, arXiv:1005.3797 plot on left, proposed plot on right ($\Gamma_{\text{med}} = M_{\text{med}}/100$):





- Include contours of mediator couplings (comparison with direct mediator search limits); makes it clear if theory is perturbative
- Can replace line for each mediator mass with a band that sweeps out different values of mediator width
- Similarly, can plot a band associated with the nuclear uncertainties for σ_{SI} for each mediator mass

End of Stay at Les Houches

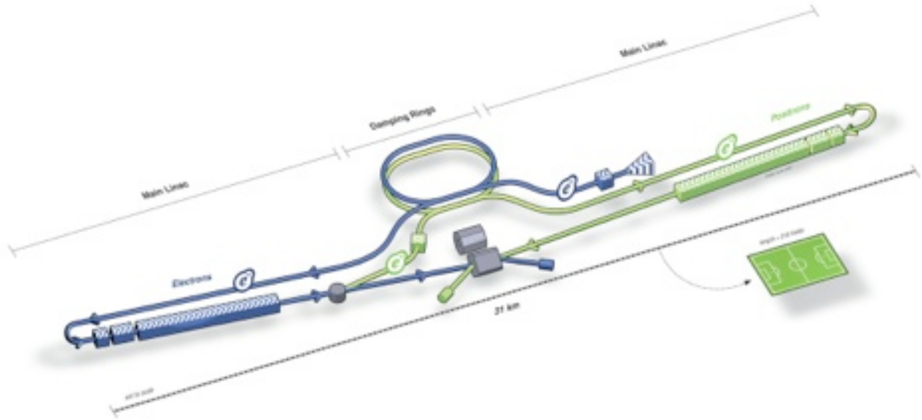
- Many interesting projects started...
  - ... and time to go home

End of Stay at Les Houches

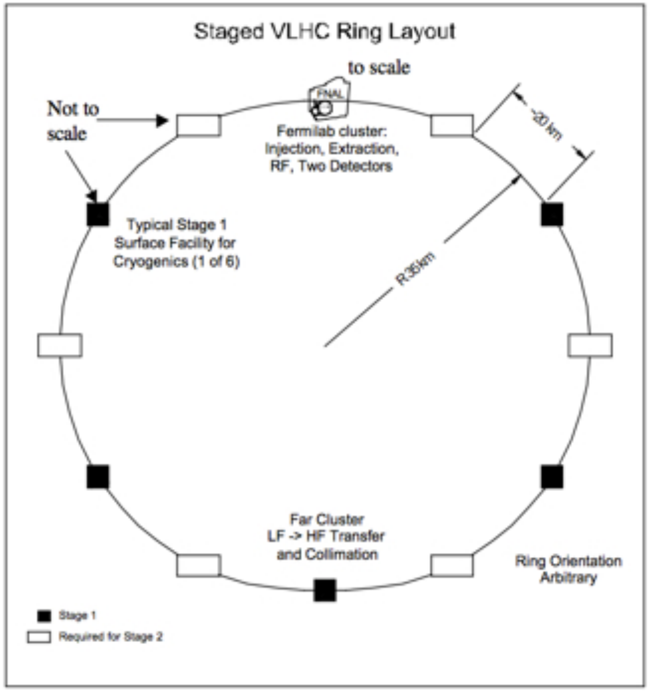
- Many interesting projects started...
  - ... and time to go home
- Contributions to proceedings are due ~mid-December
  - Template and instructions on the web (not wiki)

End of Stay at Les Houches

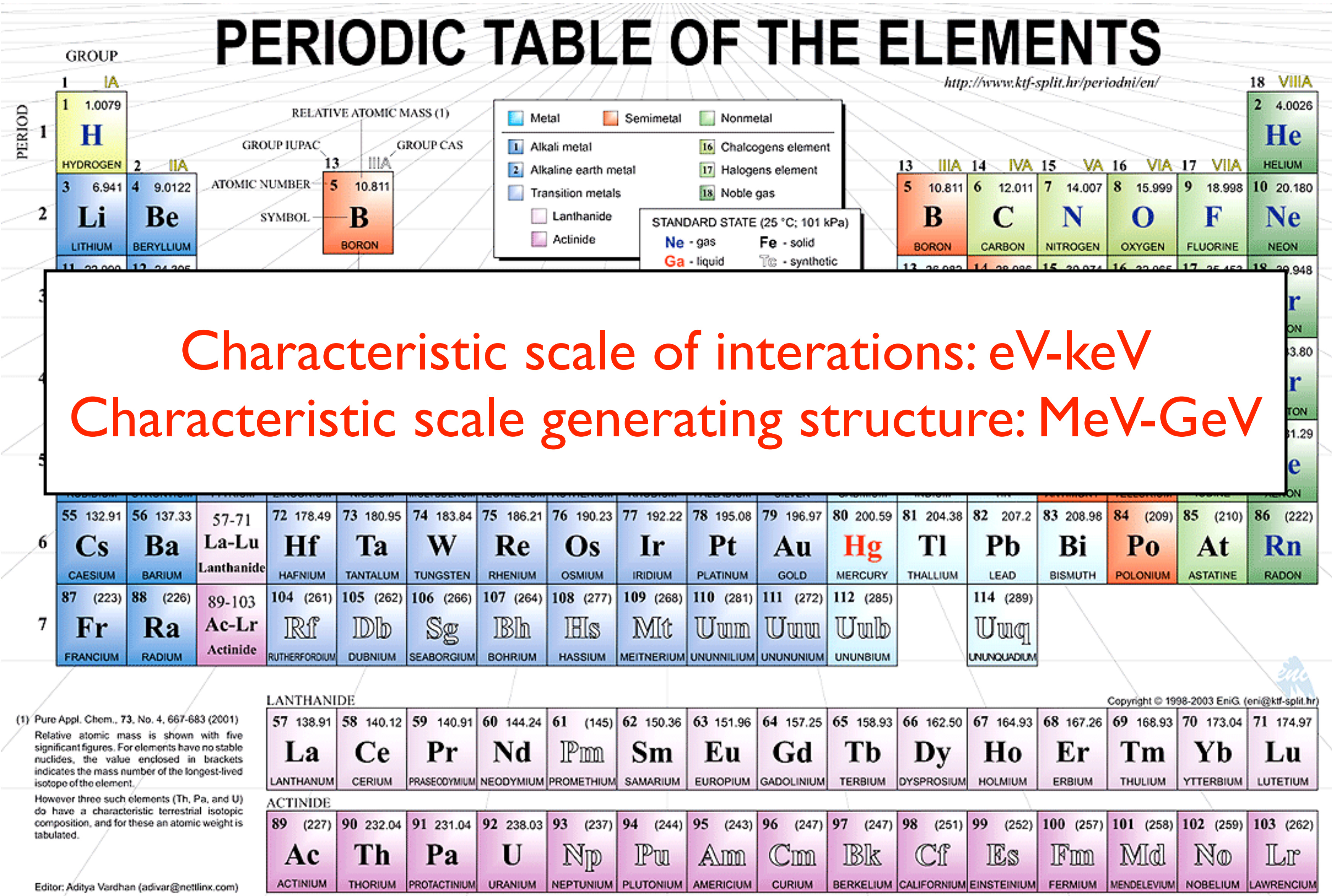
- Many interesting projects started...
  - ... and time to go home
- Contributions to proceedings are due ~mid-December
  - Template and instructions on the web (not wiki)
- What should we push?



?



Care to Guess?



Characteristic scale of interations: eV-keV

Characteristic scale generating structure: MeV-GeV