Résumé des conférences d'hiver 2014

Disclaimers:

Résumé LHC-centrique

Beaucoup de résultats étaient déjà publics avant les conférences

Résumé de:

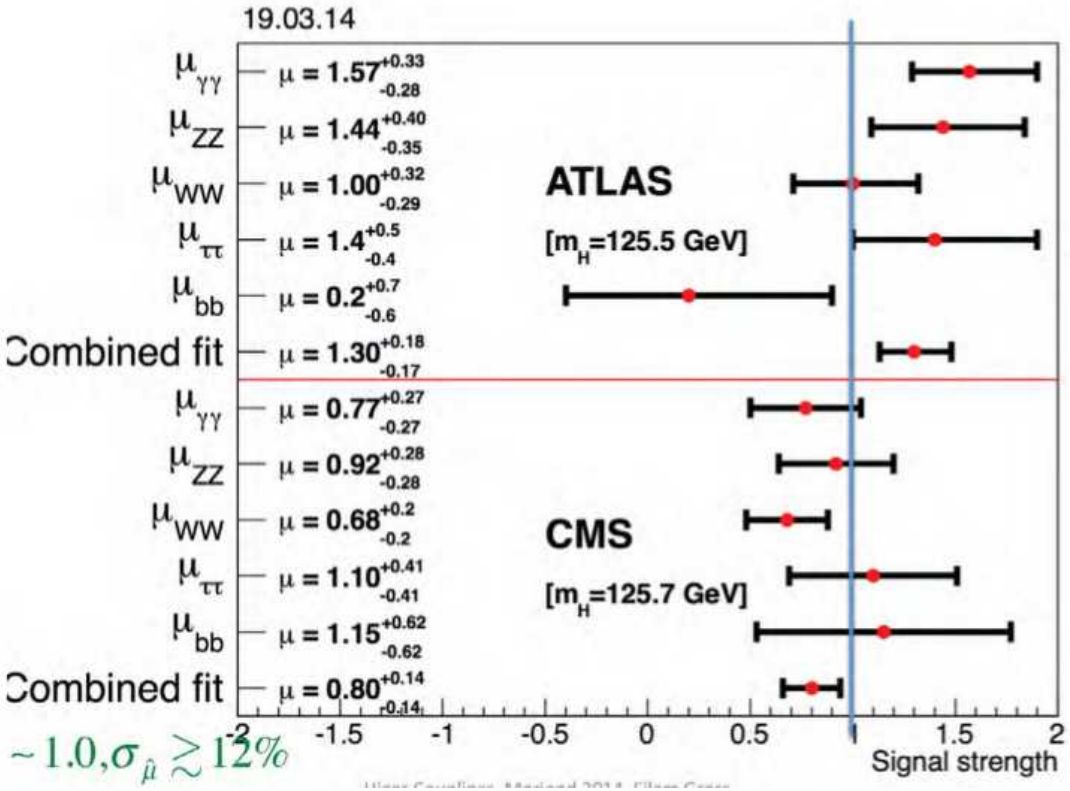
Aspen: https://indico.cern.ch/event/276476/timetable/#20140119

Moriond EW: https://indico.in2p3.fr/conferenceOtherViews.py?view=standard&confId=9116

Higgs mass and couplings

ATLAS	CMS (new ZZ(4l) not used)
125.5 +-0.2 (stat) $^{+0.5}_{-0.6}$(syst) GeV	125.7 +- 0.3(stat) +- 0.3(syst) GeV

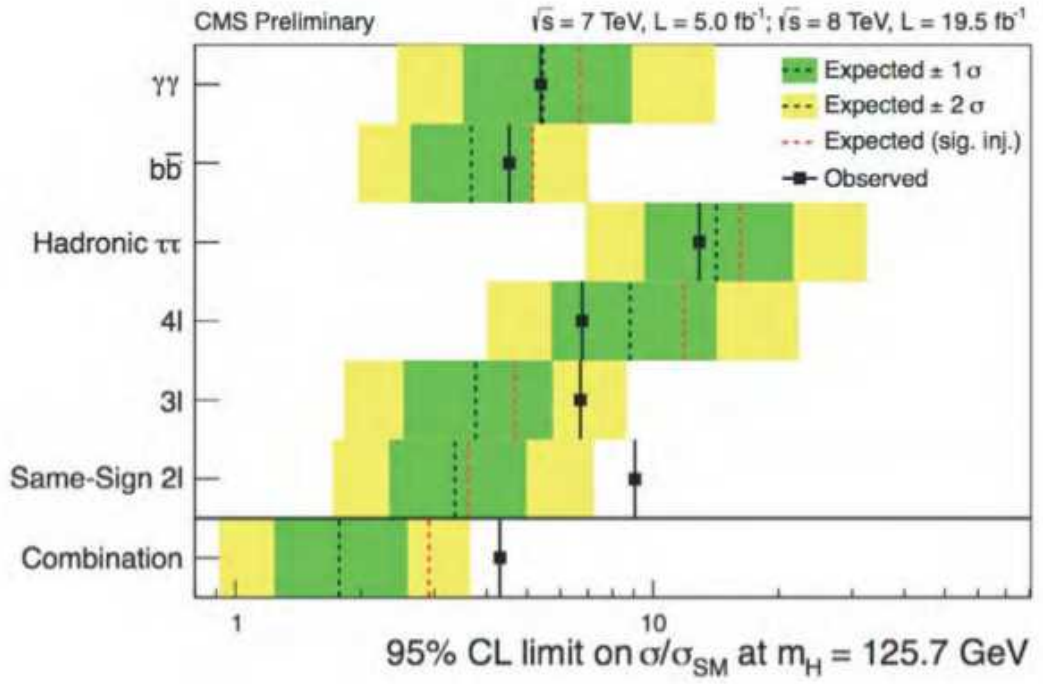
- **Overall comparison of all individual μ values:**



$\sim 1.0, \sigma_{\hat{\mu}} \gtrsim 12\%$

Higgs: Production associée avec top-antitop (ttH)

- **CMS has performed a search in ttbar+H; H -> γγ, bb, $\tau_h\tau_h$, leptonic (2l SS, 3l, 4l), and combined (*Botta*).**
- **Result is limit of μ = 4.3 (expected 2.9) 95% CL. Best fit value is μ = 2.5 + 1.1 – 1.0 (excess all in 2l SS).**



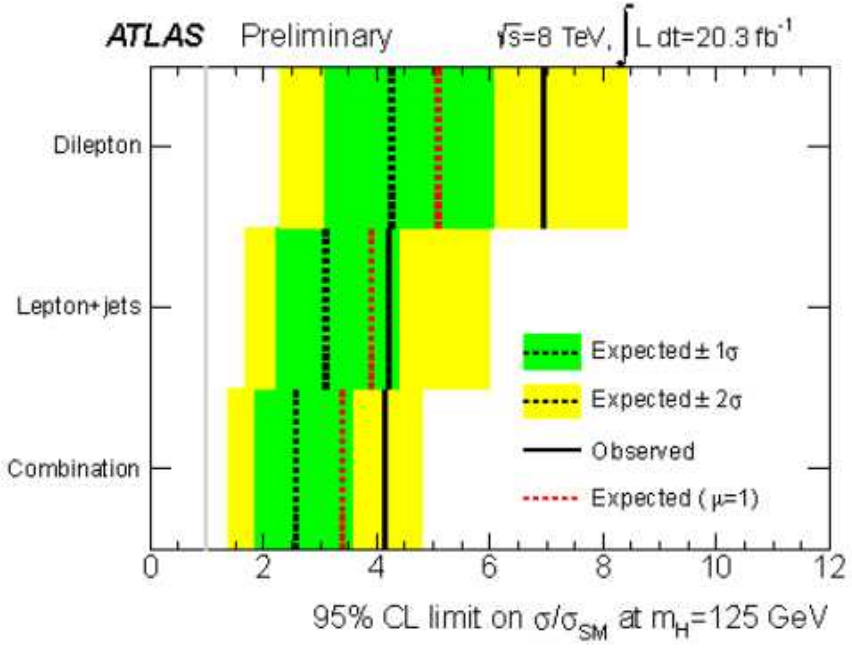
Internal consistency for common value is 22%.

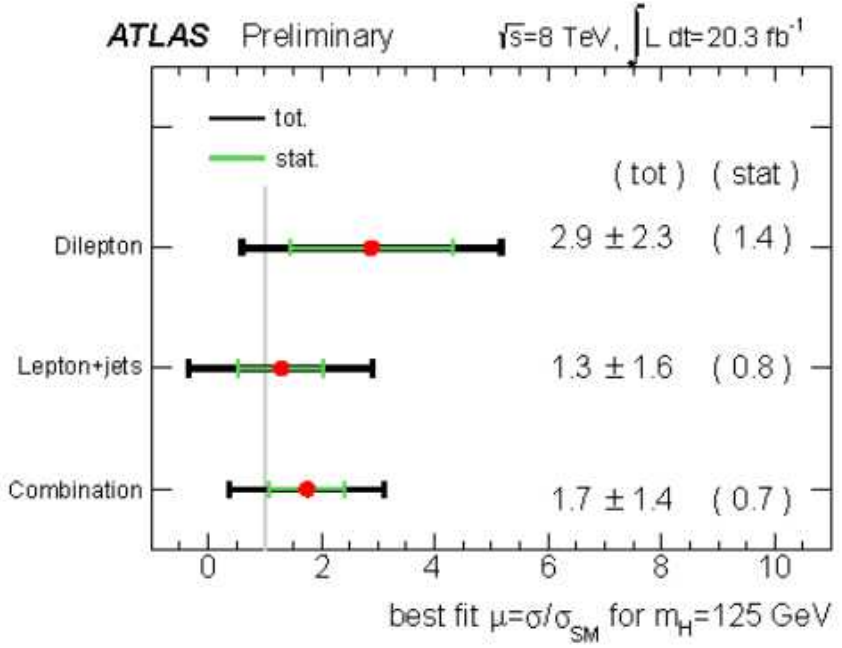
P-value for μ = 1 is 1.6σ

Note: ttbarH increases by almost 5 for Run2 @ 13 TeV

Higgs: Production associée avec top-antitop (ttH)

- **ATLAS has performed a search in ttbar+H; H -> γγ. Observed limit of μ = 4.7 (5.4 expected). Leptonic (2l, 3l, 4l, ττ) modes in progress (*Le Menedeu*).**
- **New analysis in ttbar+H; H -> bb. Result is limit of μ = 4.1 (expected 2.6) 95% CL. Best fit value is μ = 1.7 +/- 1.4**



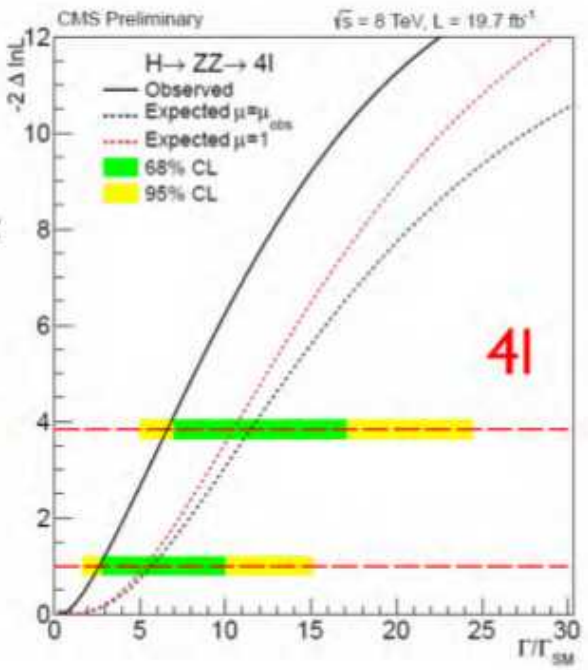


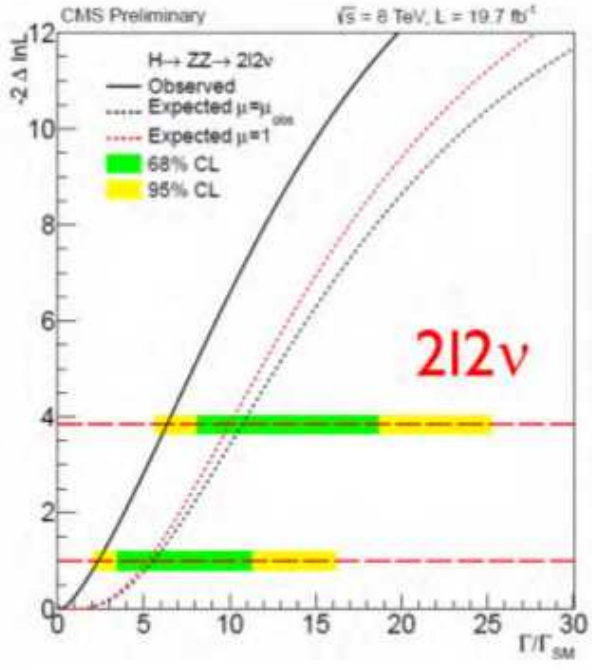
Higgs interferometry: Higgs width from on-shell/off-shell production ratio

- **At Moriond, CMS released first measurement of $r=\Gamma/\Gamma_{SM}$, using H -> ZZ decaying into 4l and 2l2ν (PAS HIG-14-002) (*Covarelli*).**
- **They use their published H -> ZZ on-shell cross-section value $\mu=0.93^{+0.26}_{-0.24}$, and also compare with $\mu=1.0$ for reference.**
- **They use a kinematic discriminant, similar to that of Campbell et al. to reduce the qq -> ZZ continuum relative to the gg signal.**

At 95% CL:

Expected
r < 11.5
Observed
r < 6.6



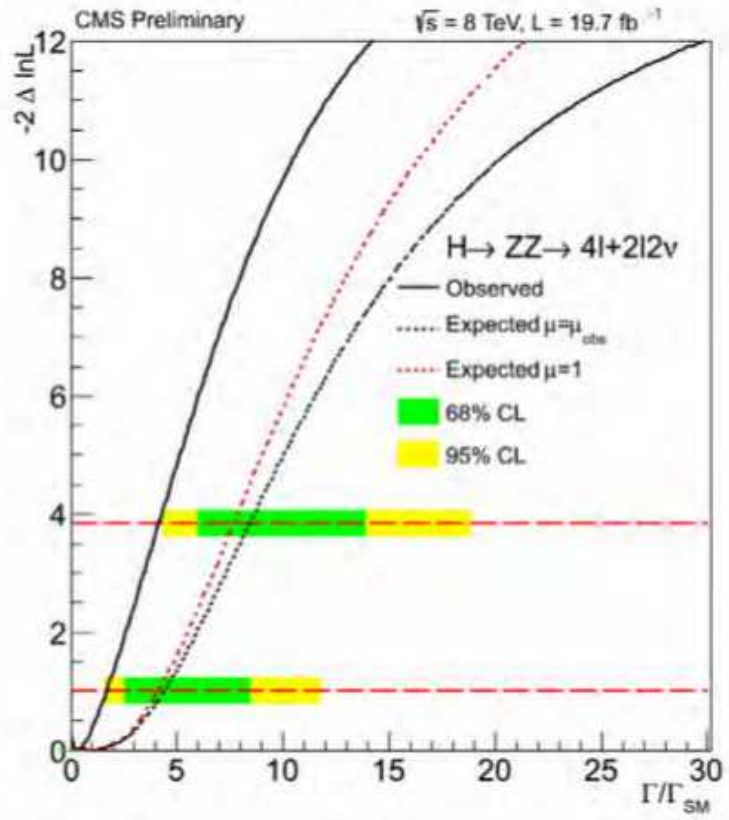


At 95% CL:

Expected
r < 10.7
Observed
r < 6.4

Higgs interferometry: Higgs width

- **Combination of two channels gives:**



- Combined observed (expected) values
  - $r = \Gamma/\Gamma_{SM} < 4.2$ (8.5) @ 95% CL
    (p-value = 0.02)
  - $r = \Gamma/\Gamma_{SM} = 0.3^{+1.5}_{-0.3}$
- equivalent to:
  - $\Gamma < 17.4$ (35.3) MeV @ 95% CL
  - $\Gamma = (1.4^{+6.1}_{-1.4})$ MeV

Very important result ! Observed limit is half of expected – data deficits in both channels ? Theory systs (LO+K_f) under control ?

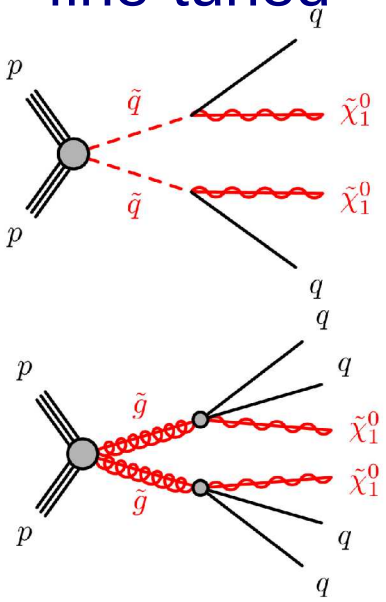
SUSY and Exotics at LHC: Summary of Run 1

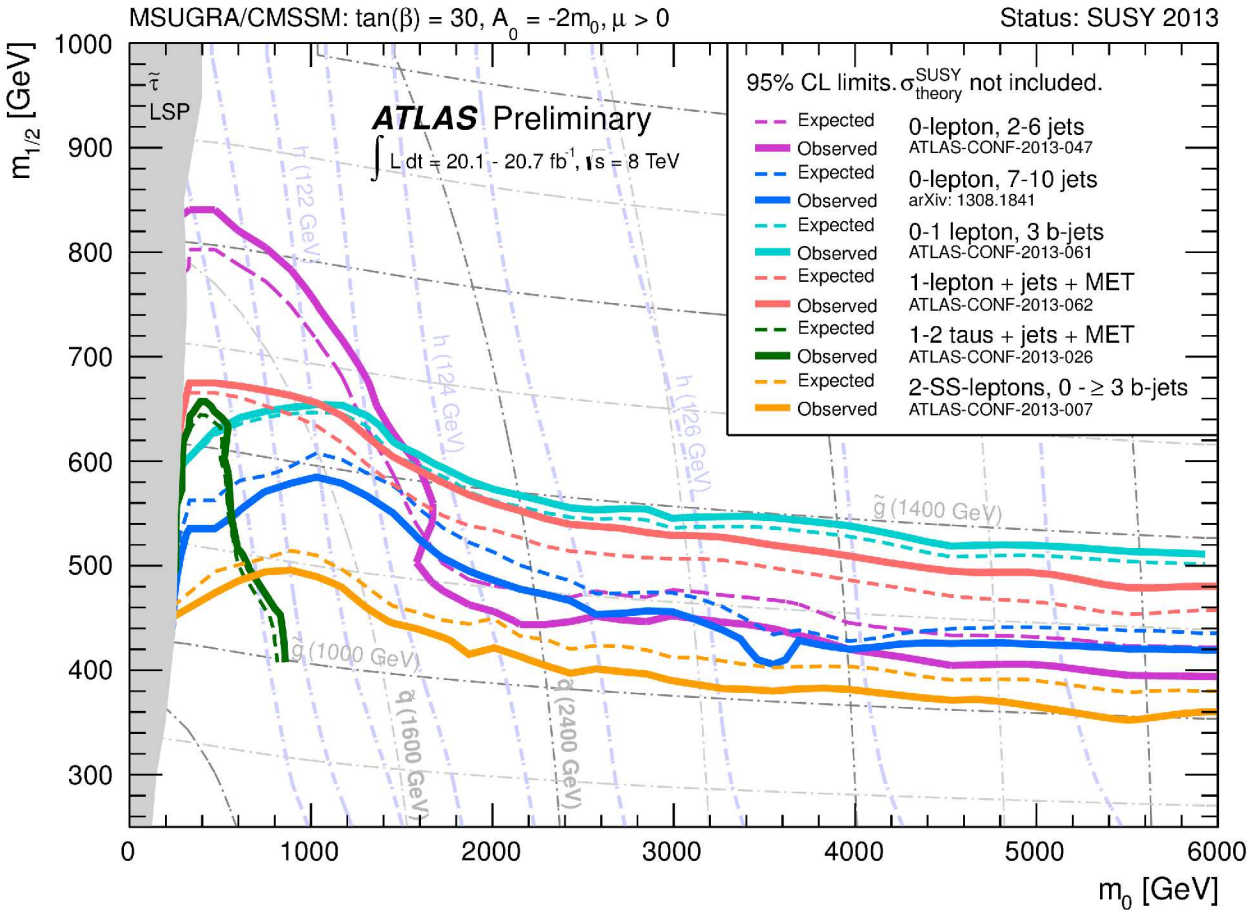
- The 8 TeV LHC data have been investigated extensively
  but still a lot of work in progress
- Unfortunately, still no hint of BSM physics in the LHC data...

	Approx. Lower Limit (95% C.L.)
VLQ T and stop ($tt \rightarrow tt\chi\chi$)	700 GeV
gluino	1.4 TeV
KK gluon → top-antitop res.	2 TeV
Z' → dilepton (SSM)	3 TeV
Excited quark → dijet	4 TeV

Supersymmetry: Strong Production

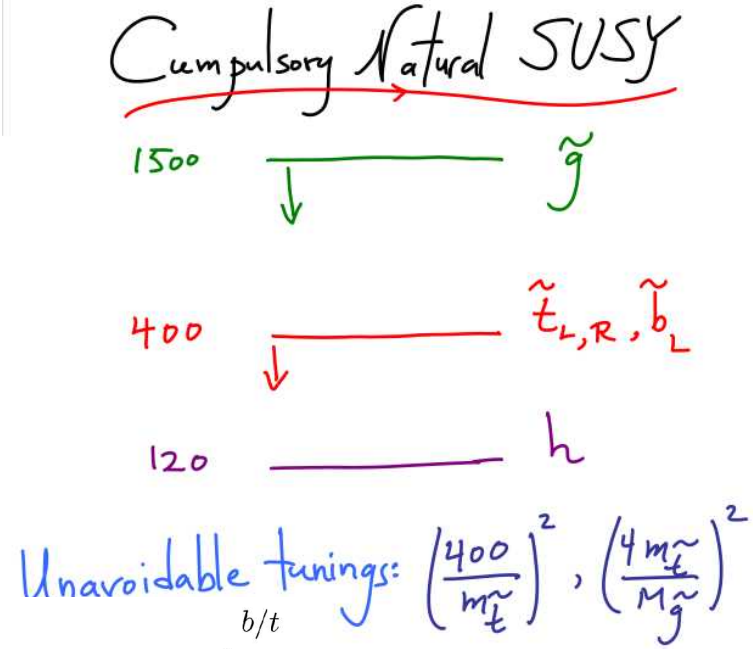
- Summary of strong-production searches
- cMSSM interpretation: squark and gluino mass > 1.4 TeV (95% CL)
- Conclusion: cMSSM is fine-tuned

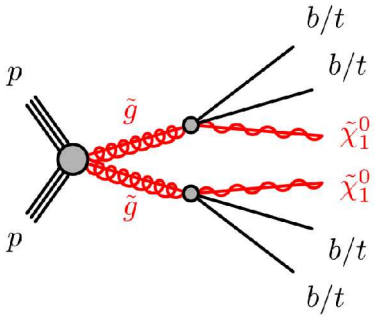


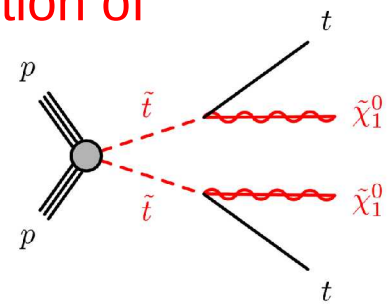


Supersymmetry: 3rd generation

- Natural (i.e. not fine-tuned) SUSY requires:
  - → stop/sbottom are light
  - → gluino somewhat light
  - → 1st and 2nd generation squarks are allowed to be very heavy
- 2 strategies:
  - → gluino production decaying to stop/sbottom
  - → direct production of stop/sbottom

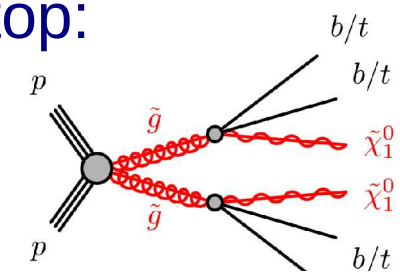


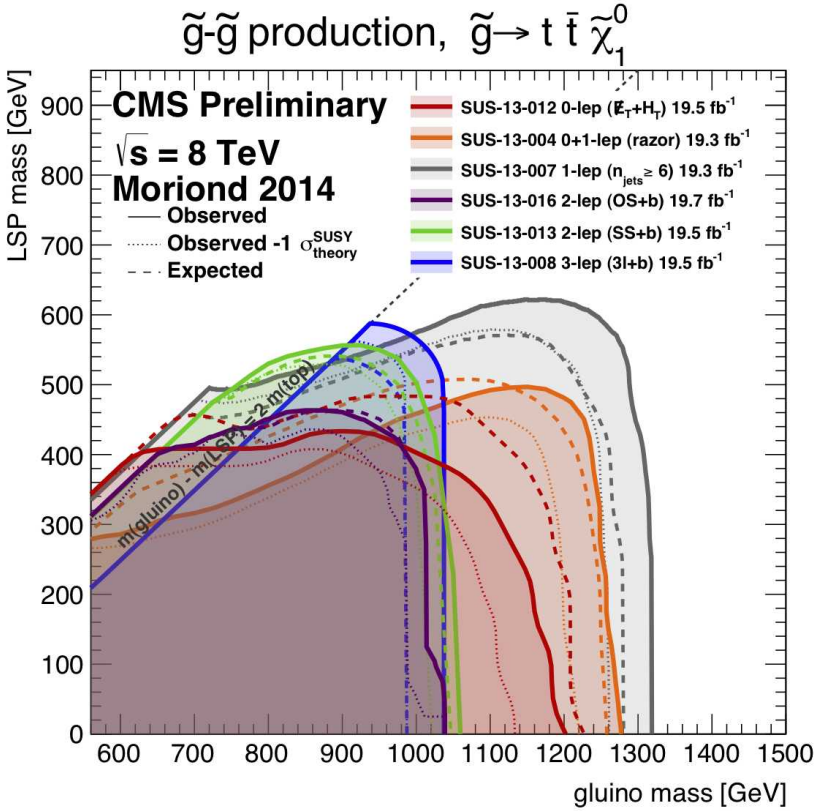




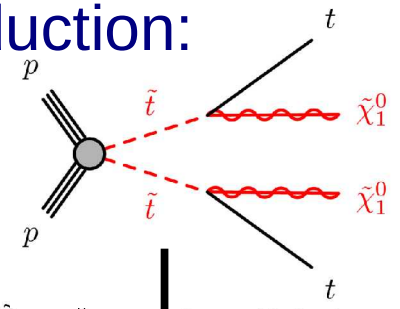
Supersymmetry: 3rd generation

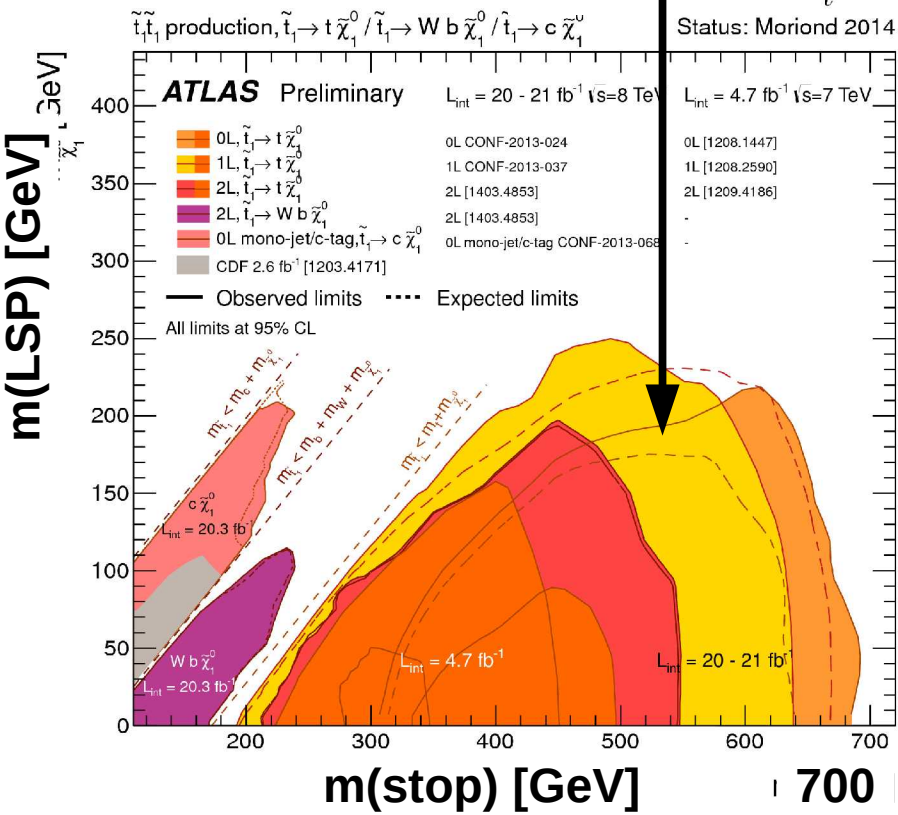
- Gluino to stop:





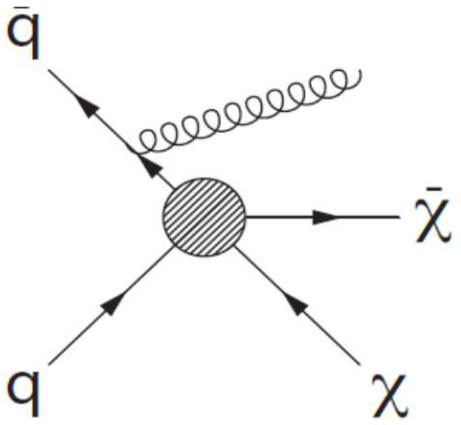
- Direct stop production:

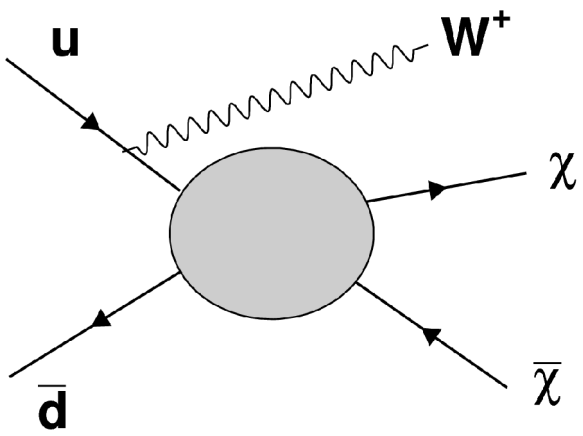


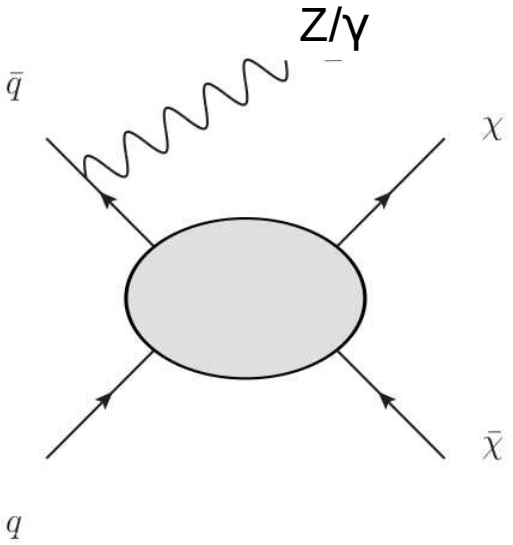


Search for Dark Matter at LHC

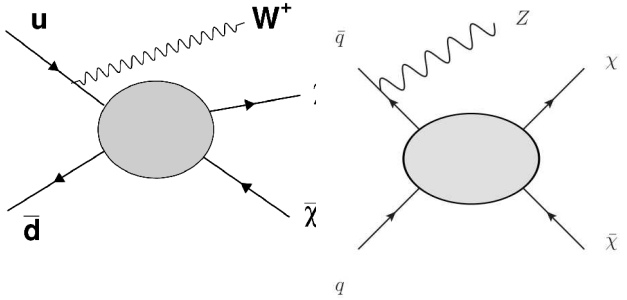
- Dark matter pair-production
  - → Observe only the Initial State Radiation
  - → Consider g/γ/W/Z radiation:
    - mono-jet + missing ET
    - mono-photon + missing ET
    - W or Z (lν/ll or dijet + missing ET)
    - Z→ dilepton + missing ET



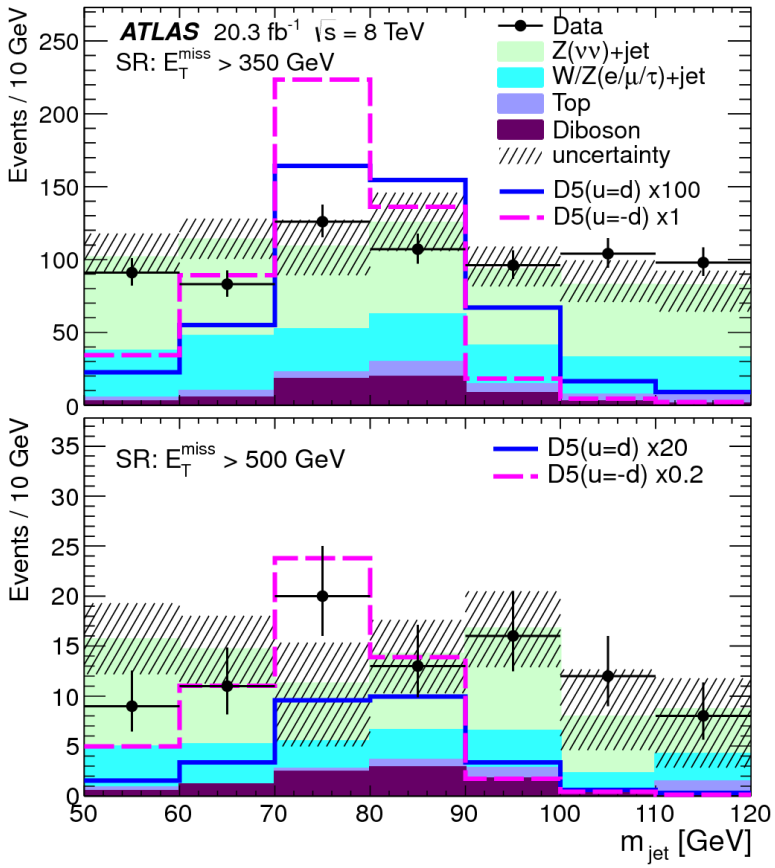




Search for Mono-W & Mono-Z (hadronic decay)



- High-momentum W → qq or Z → qq reconstructed with one large-radius jet
  - → Cambridge–Aachen algorithm with a radius parameter of 1.2
- Select jets with mass consistent with W or Z hadronic decay
- Inclusive trigger MET > 150 GeV
- Final selection:
  - → MET > 350 GeV
  - → MET > 500 GeV



Search for Dark Matter

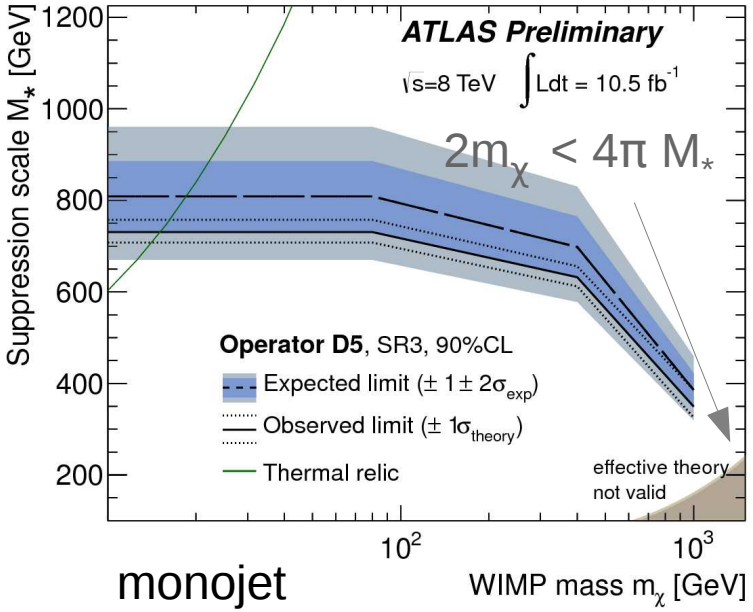
- Limits presented in several ways:
  - → Consider several operators of effective theory described in arXiv:1008.1783
  - → Loose constraint on EFT validity assumes WIMP production is near threshold: $q^2 \sim 2m_\chi < 4\pi M_*$
  - → M = mediator mass = $M_* \sqrt{(g_q g_\chi)}$

    Perturbativity requires $M < 4\pi M_*$

    → Back-of-the-envelope:

    if $M_* < 400$ GeV, mediator is produced on-shell i.e. at much higher q^2

Name	Initial state	Type	Operator
D1	qq	scalar	$\frac{m_q}{M_*^3}\bar{\chi}\chi\bar{q}q$
D5	qq	vector	$\frac{1}{M_*^2}\bar{\chi}\gamma^\mu\chi\bar{q}\gamma_\mu q$
D8	qq	axial-vector	$\frac{1}{M_*^2}\bar{\chi}\gamma^\mu\gamma^5\chi\bar{q}\gamma_\mu\gamma^5 q$
D9	qq	tensor	$\frac{1}{M_*^2}\bar{\chi}\sigma^{\mu\nu}\chi\bar{q}\sigma_{\mu\nu}q$
D11	gg	scalar	$\frac{1}{4M_*^3}\bar{\chi}\chi\alpha_s(G^a_{\mu\nu})^2$



monojet

Search for Dark Matter

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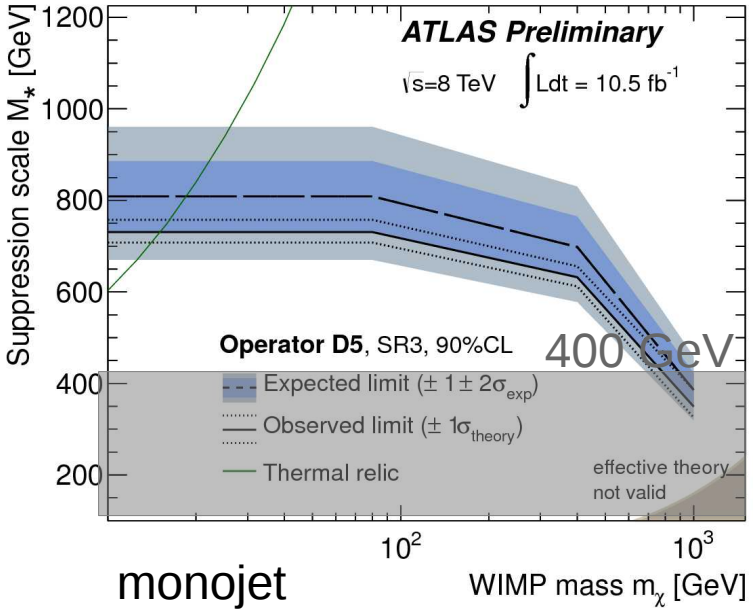
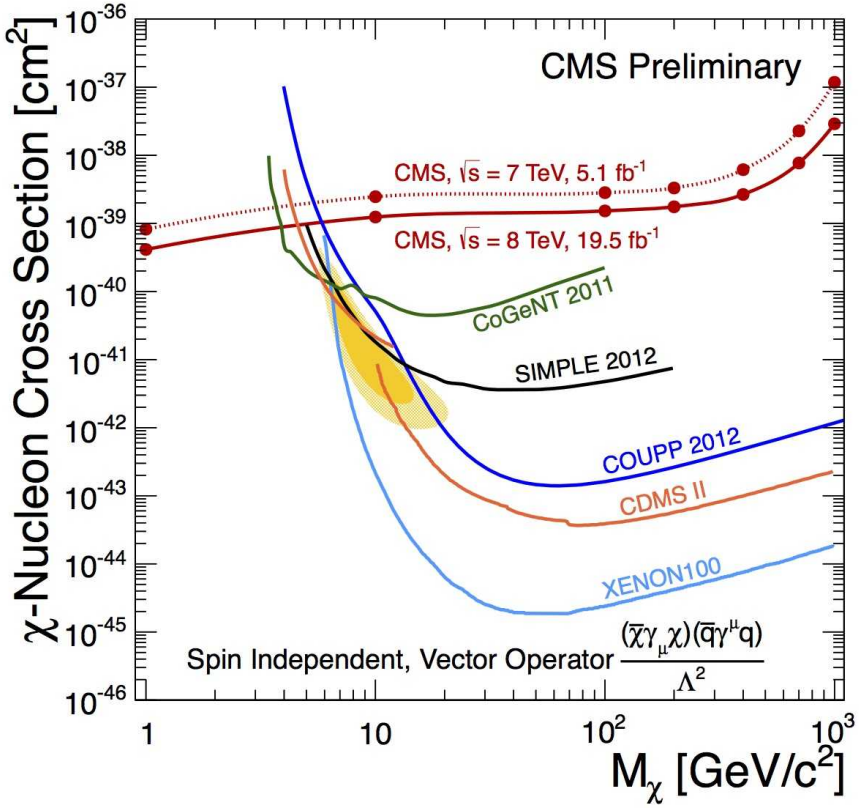
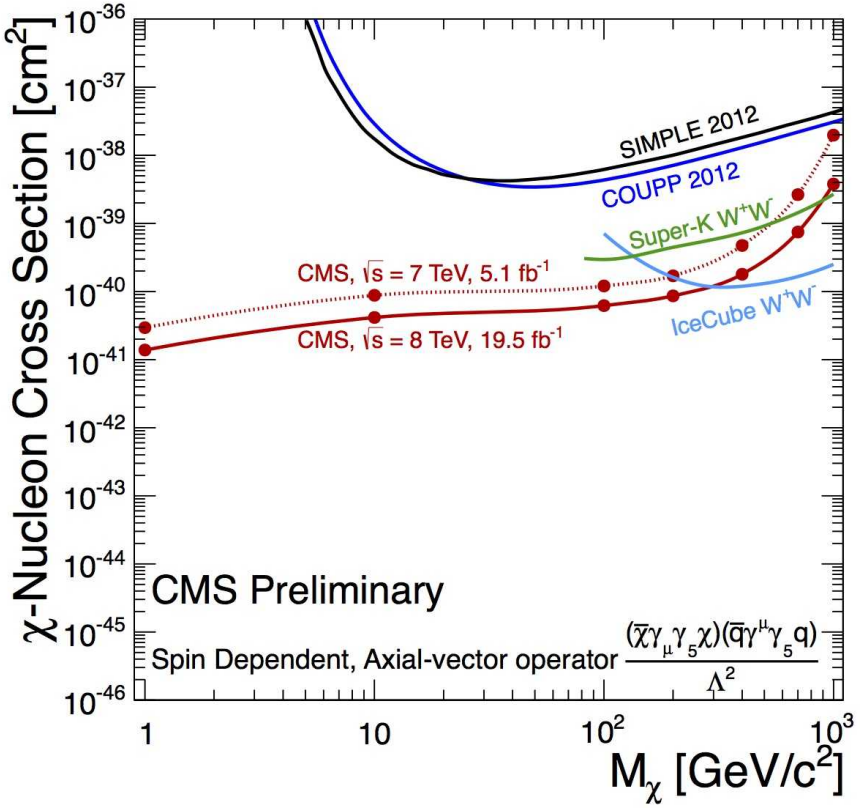


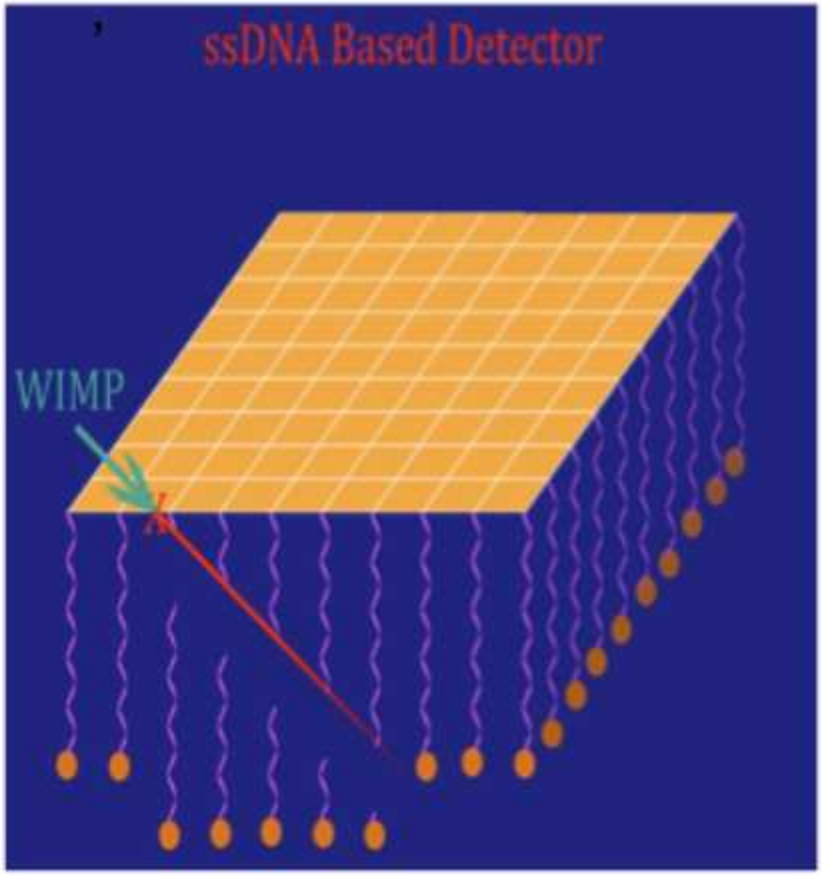
Search for Dark Matter





Direct Dark Matter Search with DNA

- 1 kg Gold, 1 kg ssDNA, identical sequences of bases with an order that is well known



BEADED CURTAIN OF ssDNA

WIMP from galaxy knocks out Au nucleus, which traverses DNA strings, severing the strand whenever it hits.

Katherine Freese (Aspen)
https://indico.cern.ch/event/276476/session/8/contribution/22

Direct Dark Matter Search with DNA

Diurnal Modulation (due to Earth's rotation)

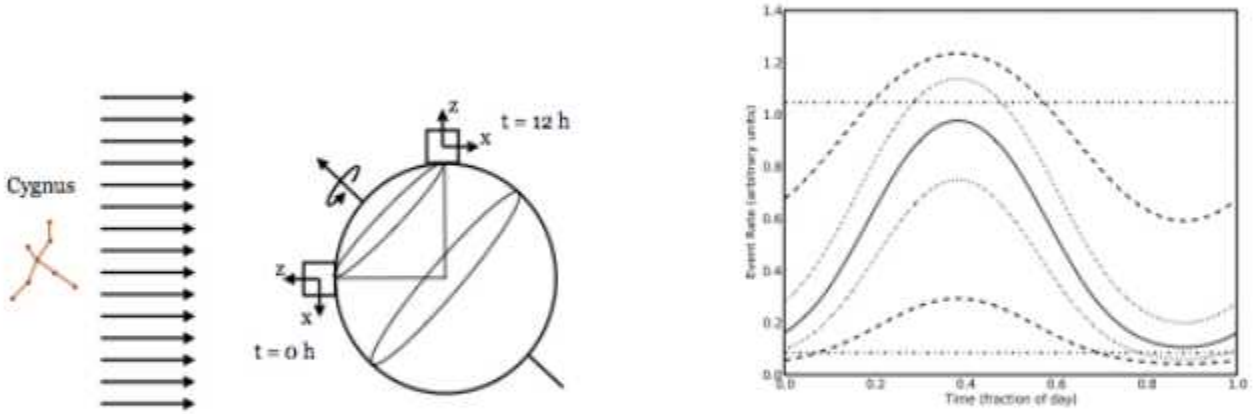
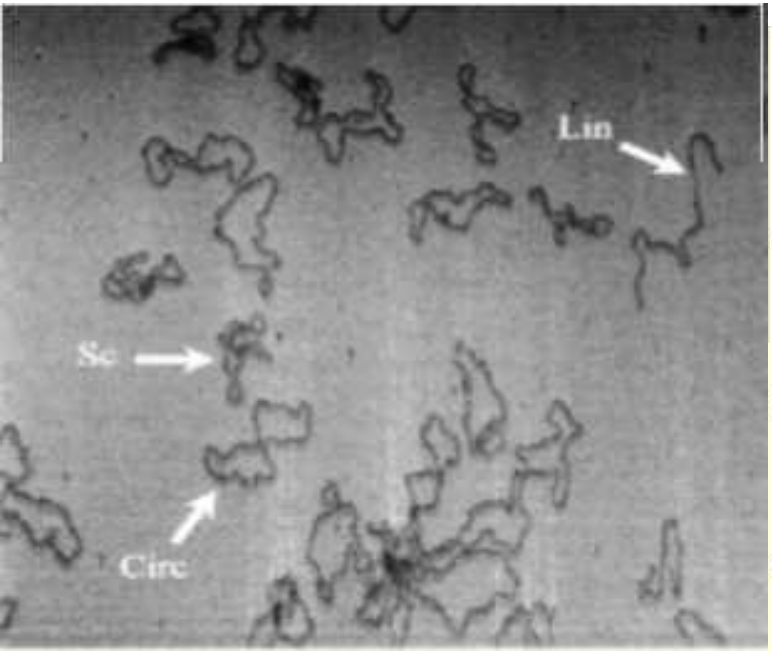


Fig. 2. (left) The daily rotation of the Earth introduces a modulation in recoil angle, as measured in the laboratory frame. (right) Magnitude of this daily modulation for seven lab-fixed directions, specified as angles with respect to the Earth's equatorial plane. The solid line corresponds to zero degrees, and the dotted, dashed, and dash-dot lines correspond to $\pm 18°$, $\pm 54°$ and $\pm 90°$, with negative angles falling above the zero degree line and positive angles below. The $\pm 90°$ directions are co-aligned with the Earth's rotation axis and therefore exhibit no daily modulation. This calculation assumes a WIMP mass of 100 GeV and CS_2 target gas. (from Ref. [13]).

Directional capability allows to reject background very efficiently

Direct Dark Matter Search with DNA

Production de ségments d'ADN linéaires:



Experimental issues

- How to keep ssDNA strands straight? Electric or magnetic field (Church)
- How to get severed strands to fall down: use electric or magnetic field?
- How to scoop the severed ssDNA (e.g. once per hour): use magnetizable rod?

Direct Dark Matter Search with DNA