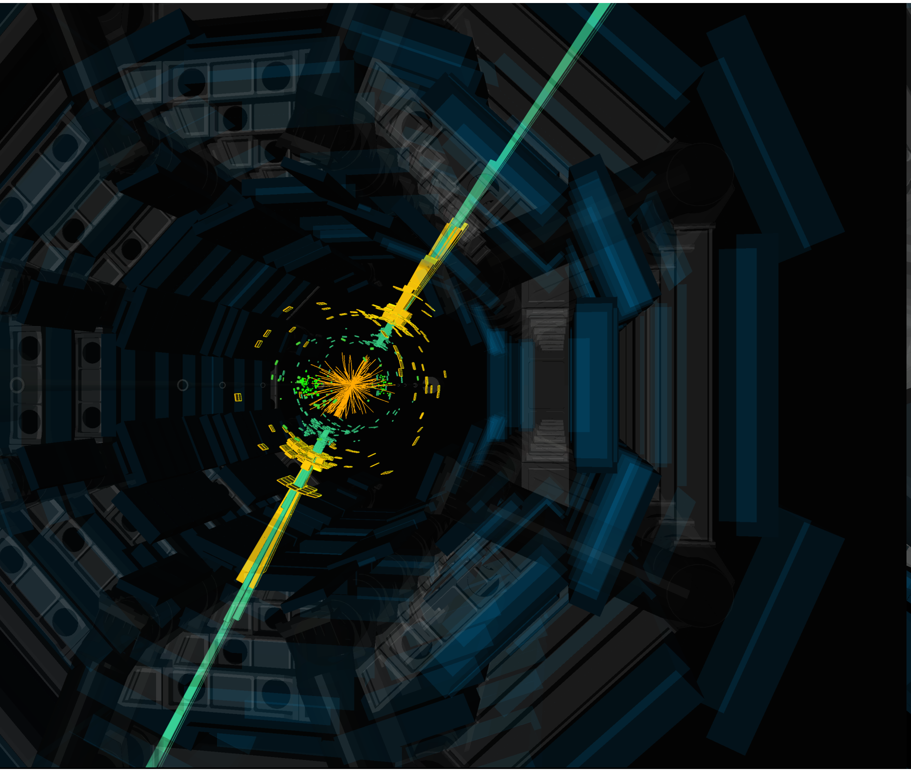
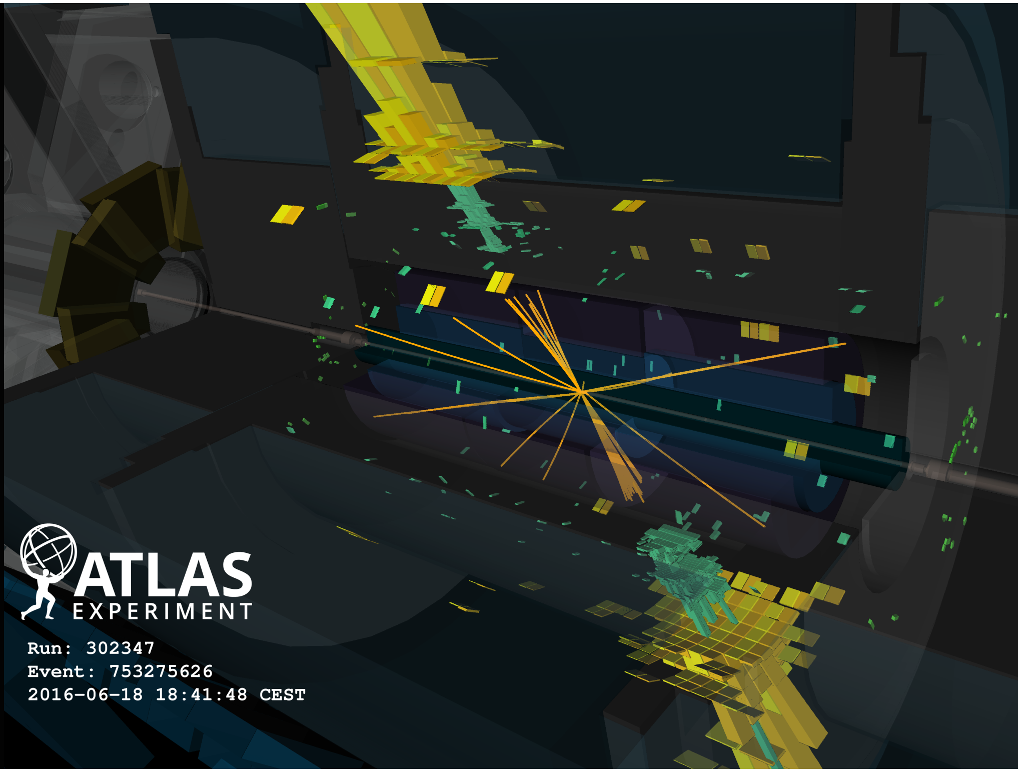
New Physics Searches at ATLAS

Highlights - ZPW 2017





Highest mass central dijet event 6.4 TeV

Marumi Kado
LAL, Orsay

ETH Zürich

January 9, 2017

Preamble and disclaimers

- ATLAS has produced more than 50 recent notes each including in many cases several search results, this will not be an exhaustive review.

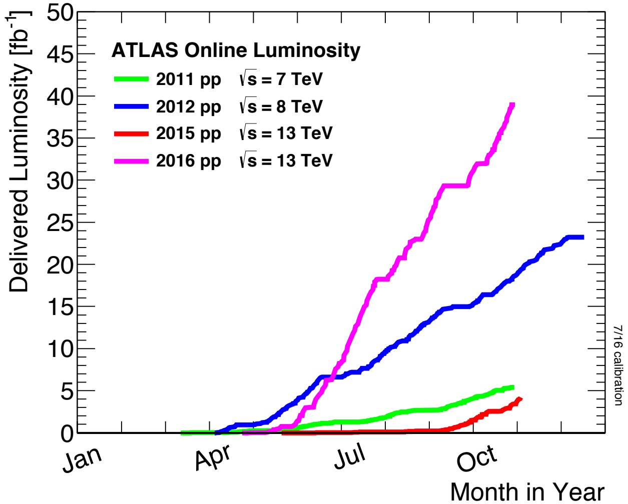
- This talk will try to emphasize when relevant the agreement between the data and the SM prediction, and point out where relevant if there are any deviations and try to emphasize the importance of the SM processes modeling in many of the searches.

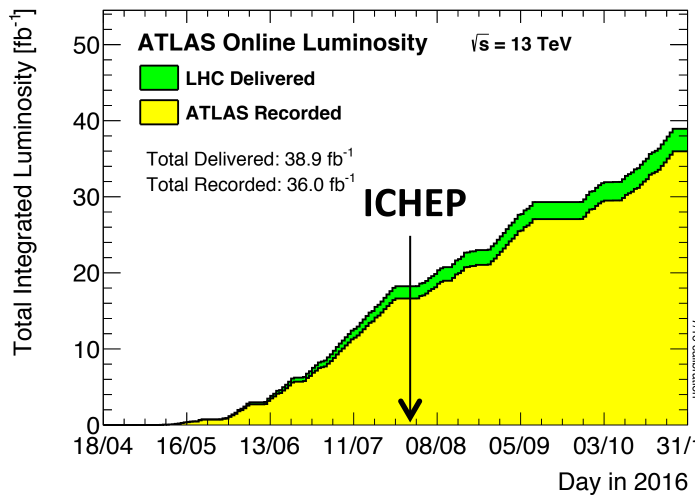
- It will also try to illustrate how the large diversity of possible new physics scenarios covered by ATLAS and how it is an essential component to ensure that no stone is left uncovered.

- Higgs search results from ATLAS will be covered by Florencia

All ATLAS public results are available at
https://twiki.cern.ch/twiki/bin/view/AtlasPublic

The Run 2 Dataset





What we currently have

Current dataset ~ 3 x ICHEP 2016 No updates with full dataset yet

Outstanding year for the LHC:

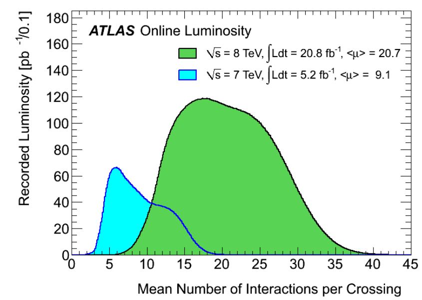
- Peak luminosity from 1.5 10^{34} $cm^{-2}s^{-1}$
- Integrated delivered luminosity of 40 fb^{-1}

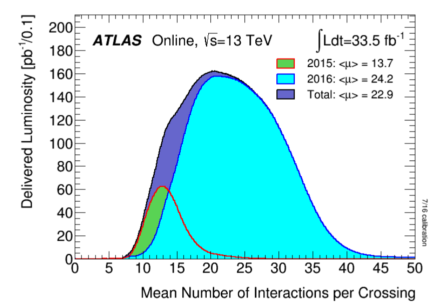
Excellent performance of ATLAS:

- In 2016 25 ns inter bunch spacing impact on Pile-up conditions
- ATLAS has recorded 36.0 fb^{-1}
- (with DT efficiency of ~94% and a DQ eff. of 93-95%).

For the physics:

- ICHEP dataset 10 - 12 fb^{-1} : Important threshold in luminosity where most searches reach well beyond Run 1 sensitivity (Higgs measurements as well).





Possible goals for next year

- Peak luminosity 1.4 - 2 10^{34} $cm^{-2}s^{-1}$ and Peak PU - 37 to 56
- Integrated luminosity between 45 and 60 fb^{-1}

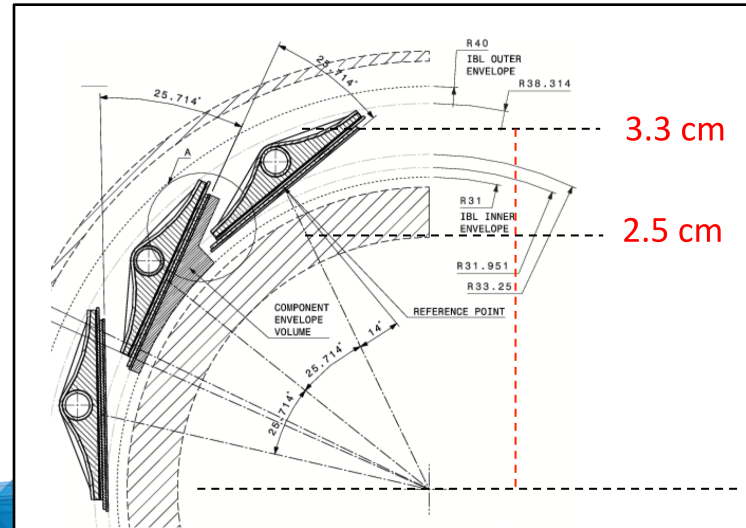
Reappraised goal for Run 2 150 fb^{-1}

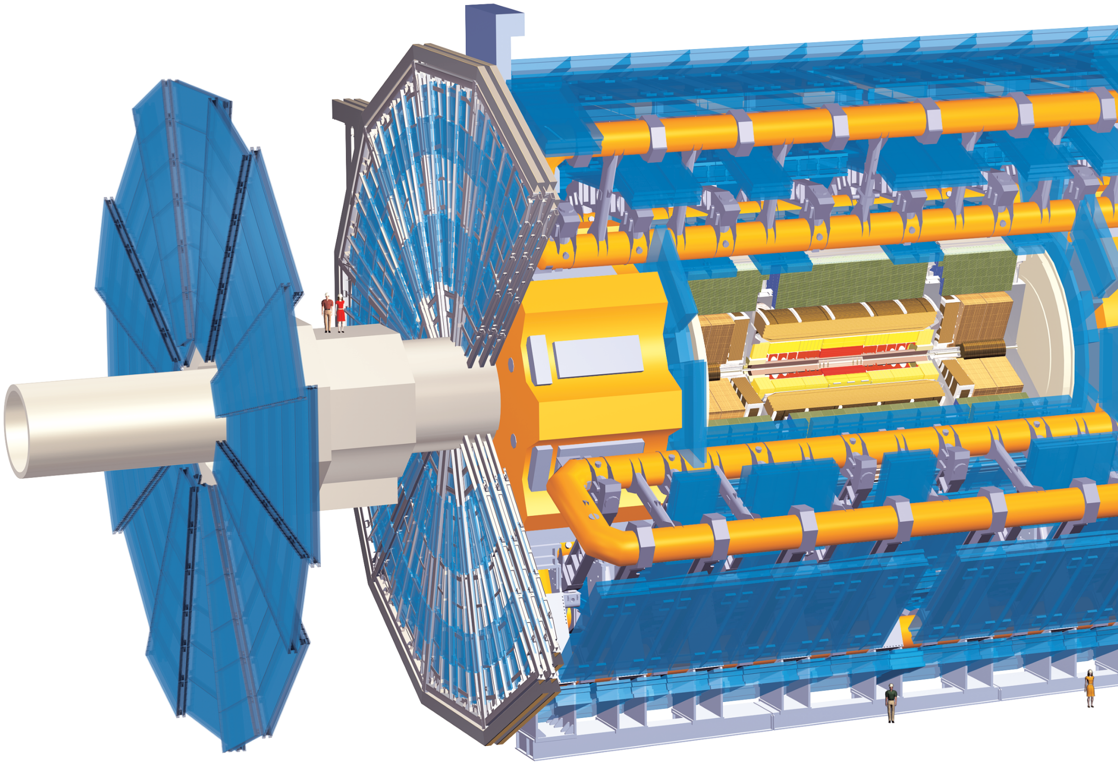
Doubling time of luminosity is now O(1 year)

Detector Status

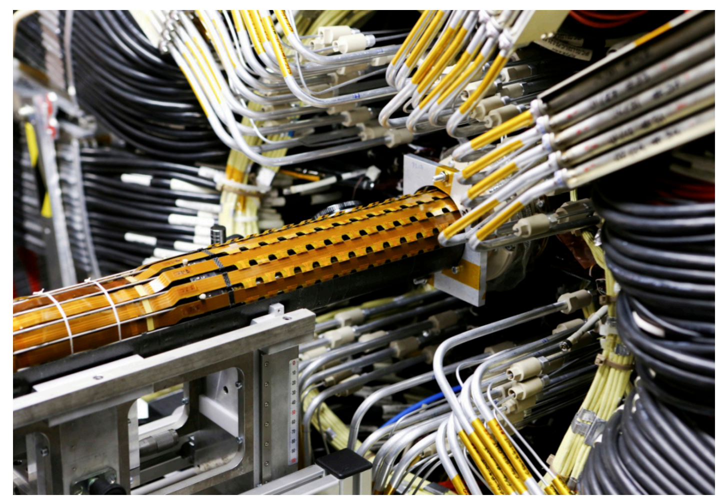
ATLAS – (First out of 3 upgrade phases)

- 4th innermost layer of pixels (3.3 cm, 2nd layer at 5.05 cm)
- Consolidation: Complete muon coverage, Luminosity detectors, Repairs (LAr and Tile), Beam Condition. Monitors
- Infrastructure: New Beam Pipe, Magnets and Cryogenic system, Muon Chamber shielding, New pixel services
- Trigger/DAQ: Increase max L1 rate from 75kHz to 100kHz, new Central Trigger Processor, Merge L2 and HLT farms, Additional SFOs for higher output rate, topological triggers, FTK





Inserted during LS1



Reconstruction Performance

Electrons and photons

- Single electron (γ) threshold 25 (140) GeV
- Likelihood (cut) based ID for electrons (γ) and MVA-based calibration
- In-situ calibration using Z, W and J/Psi

Muons

- Single muon trigger threshold 24-25 GeV (2 muons 6-6 GeV)
- Excellent performance (with few sporadic muon chamber failures)
- In-situ calibration of energy and ID efficiency with Z (and J/Psi)

Jets

- Single jet trigger threshold 380 GeV
- Anti-kT 0.4 algorithm used with detector noise cleaning cuts and track based variable to mitigate PU effect.
- JES in situ uncertainty reach ~1% level already (central and intermediate pT range) – using Z, γ and multi-jets.

MET

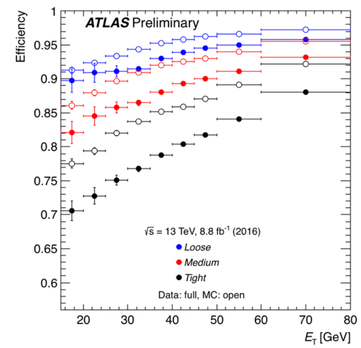
- MET trigger threshold 90-110 GeV
- Reconstruction use all calibrated objects and a track-based soft term

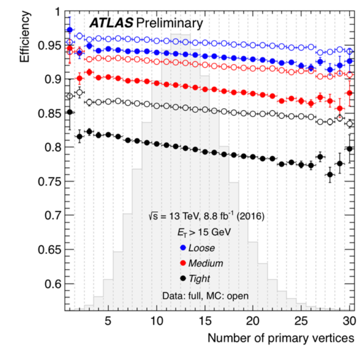
Taus

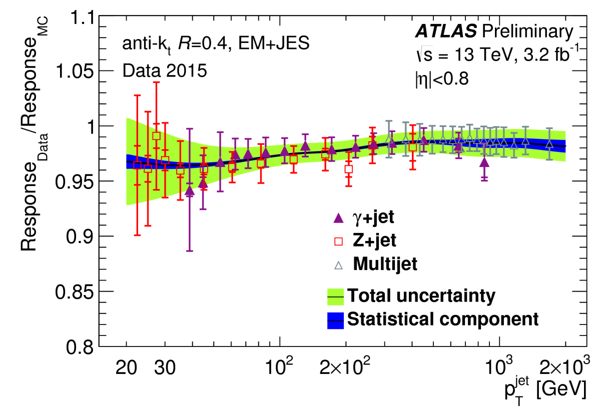
- BDT based identification (70% eff. and ~50 rej.)
- In-situ calibration based on Z events

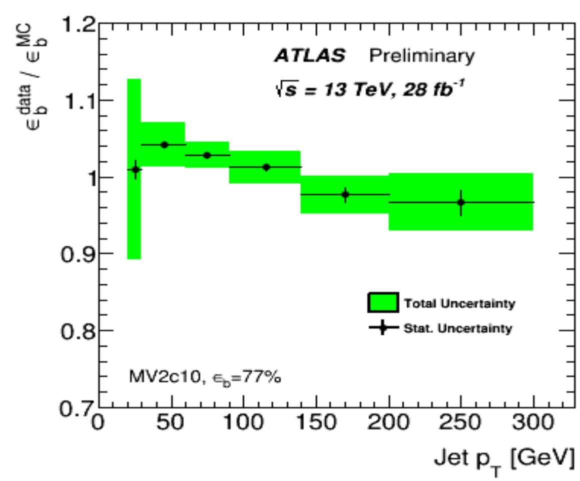
B-jets

- MVA based algorithm (77% eff., ~250 l-rej. and ~8 c-rej.)
- Improvement w.r.t Run 1 pT dependent but typically ~4 in rej.
- In-situ calibration of b-tag efficiency (using top events)







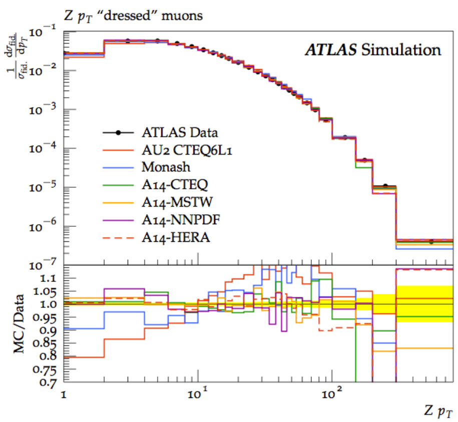


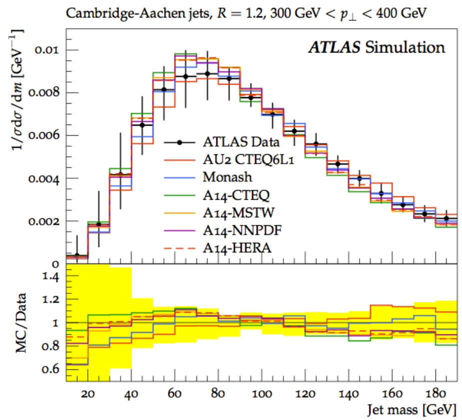
Reconstruction performance so far robust to PU

Physics Modelling

A14 Minbias tune (for PU)

Pythia 6 and 8 (using 7 TeV ATLAS data only)

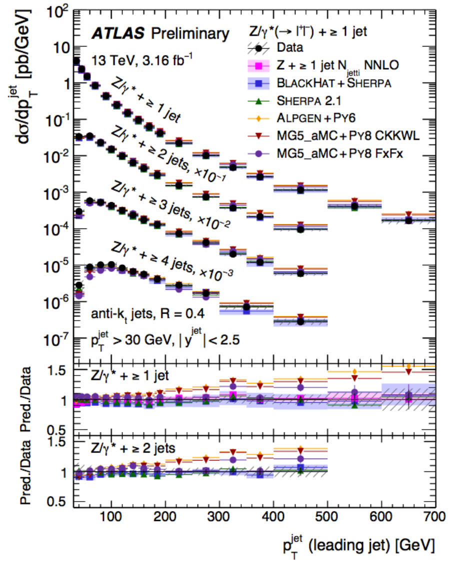


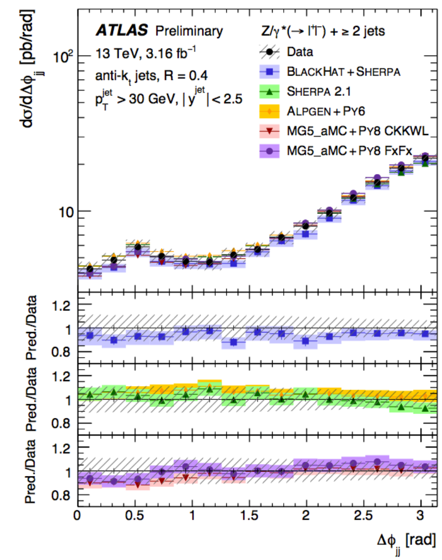


ATL-PHYS-PUB-2014-021

V+Jets , Dibosons, Tribosons

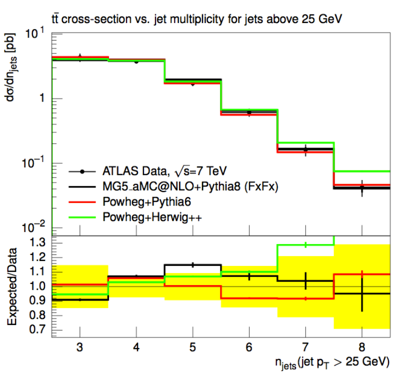
Sherpa NLO (2partons) and LO (up to 4 partons) 2.1.1

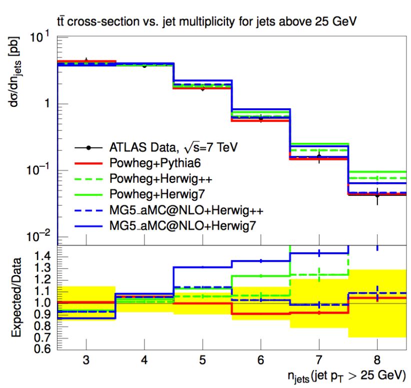




Top pair production

Powheg-Box v2 (hdamp =m$_t$) – Pythia 6.428 – EvtGen (HF decays) - CT10 PDFs – Perugia 2012 tune





Additional samples

(main backgrounds and signals)

e.g. Pythia 8, Sherpa LO, MG5_aMC@NLO

PDFs: CT10, CTEQ6L1, NNPDF3.0

Higher order cross sections used where calculations available

Thanks to the fruitful and very efficient interactions with theory Community

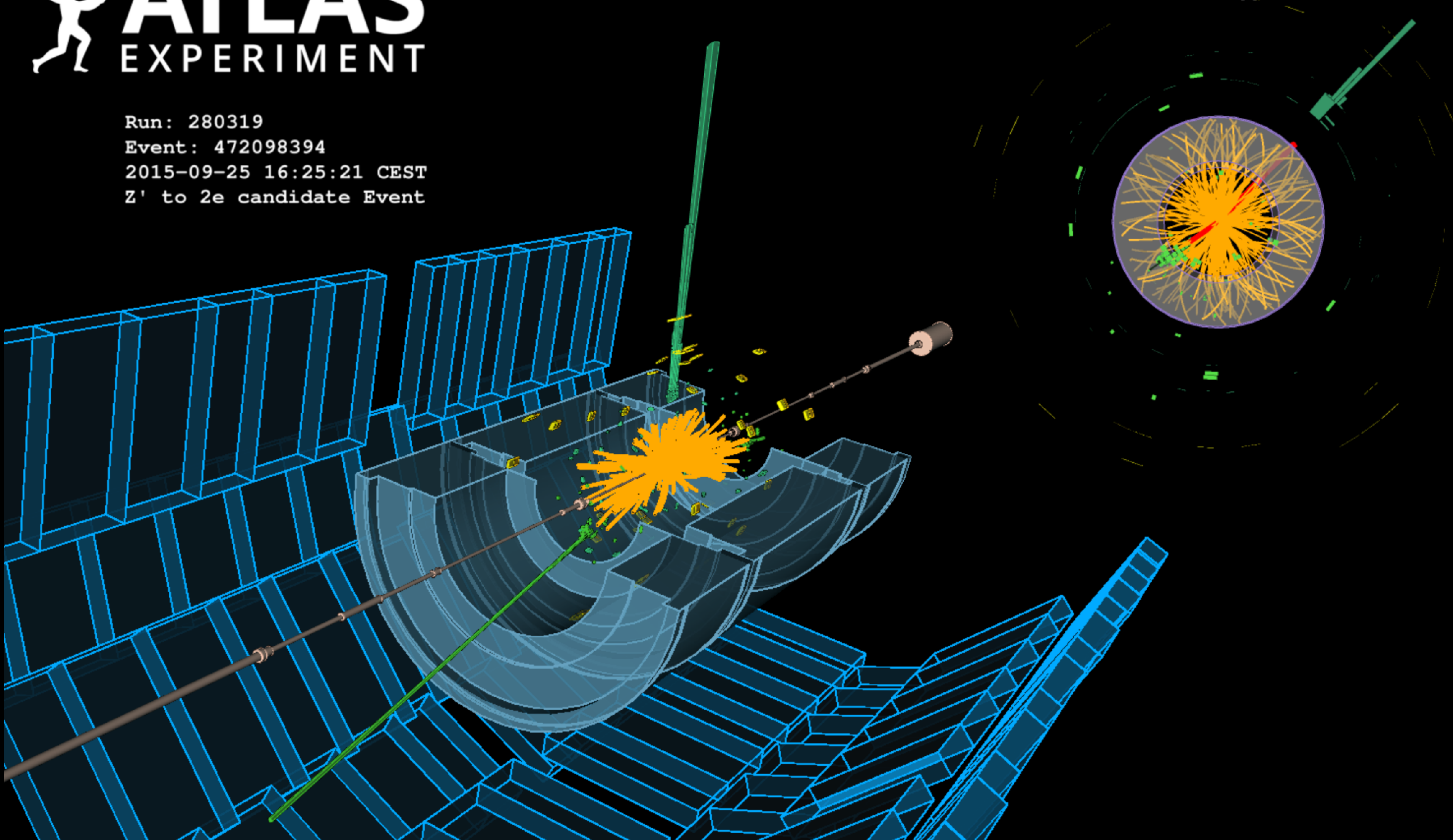
Di-Electron Event

Close to Highest Mass Dielectron

ET_1 = 370 GeV ET_2 = 246 GeV

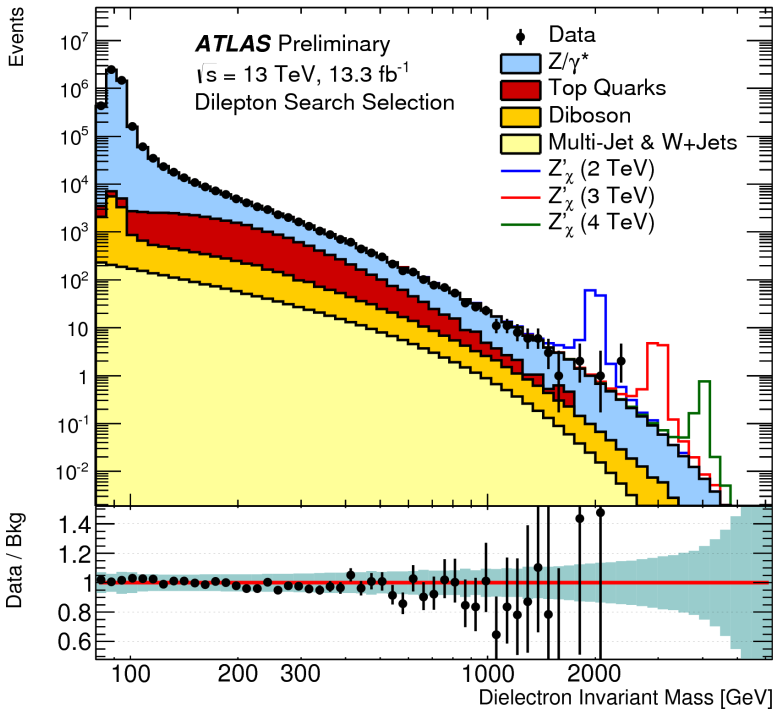
m_{ee} = 1.8 TeV

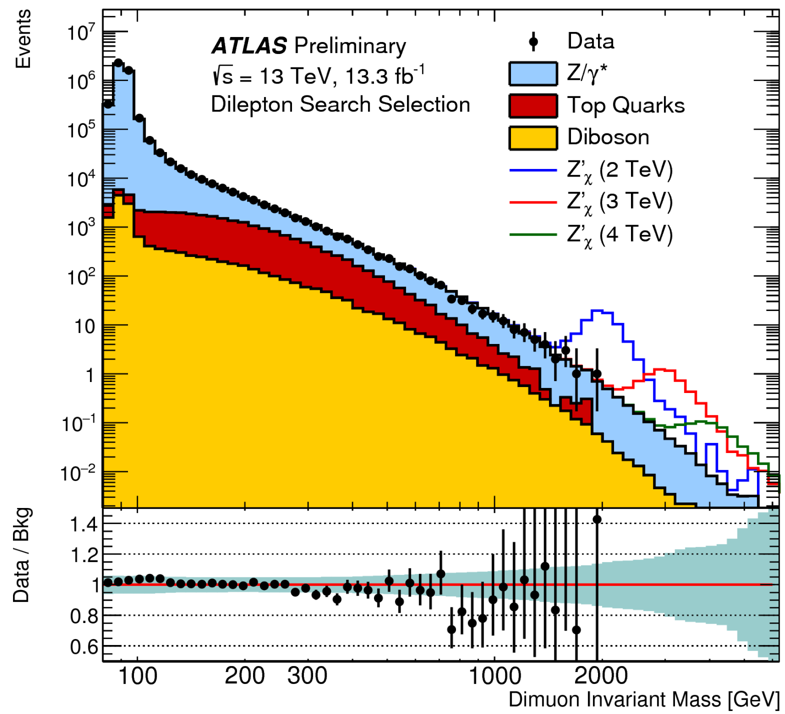
ATLAS EXPERIMENT



Search for High Mass Z’

ATLAS-CONF-2016-045





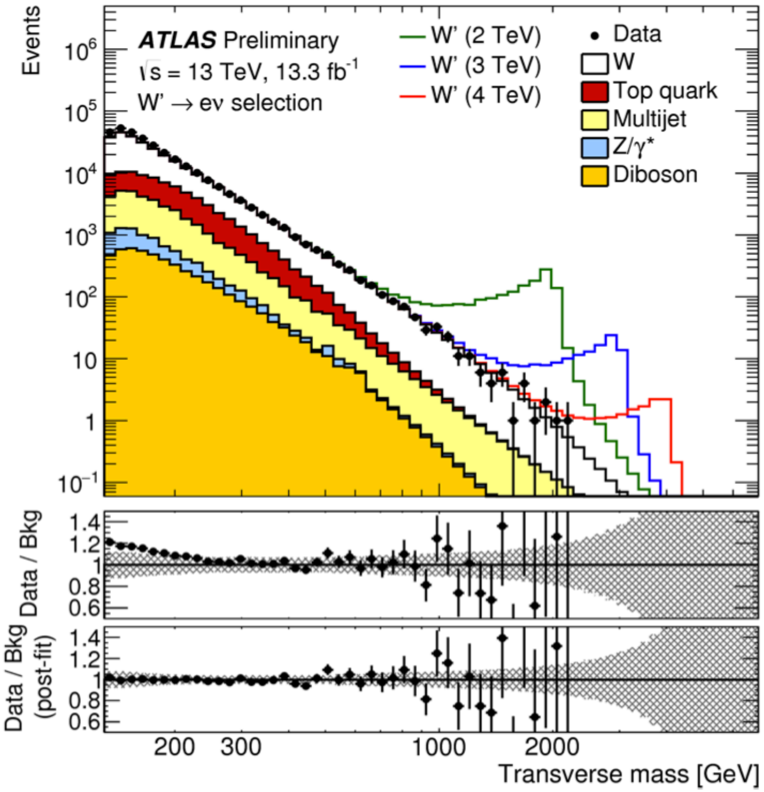
- Modeling of the DY (PowhegBox v2 – Pythia 8.186 and CT10)
- Understanding extrapolation of the calibration and the reconstruction efficiency at very high transverse momentum is critical.
- Limits at 4 TeV (compared to Run 1 limits of 2.9 TeV).

Search for High Mass W’

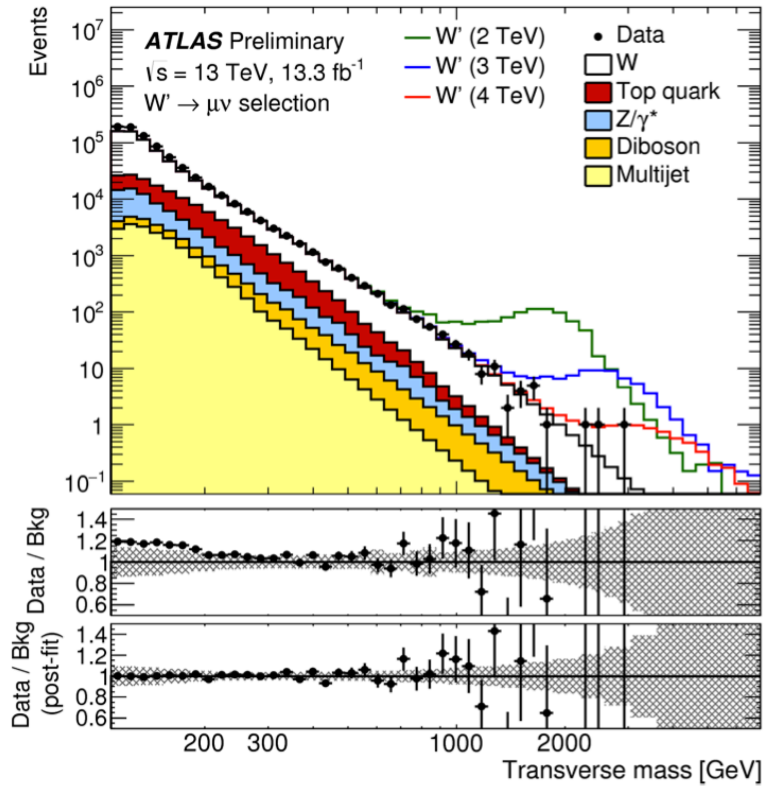
ATLAS-CONF-2016-061

$$m_T = \sqrt{2 p_T \not{E}_T (1 - cos\Delta\phi_{\ell,\not{E}_T})}$$

In practice (unless large jet activity) approximately twice the transverse momentum of the lepton



Electron channel

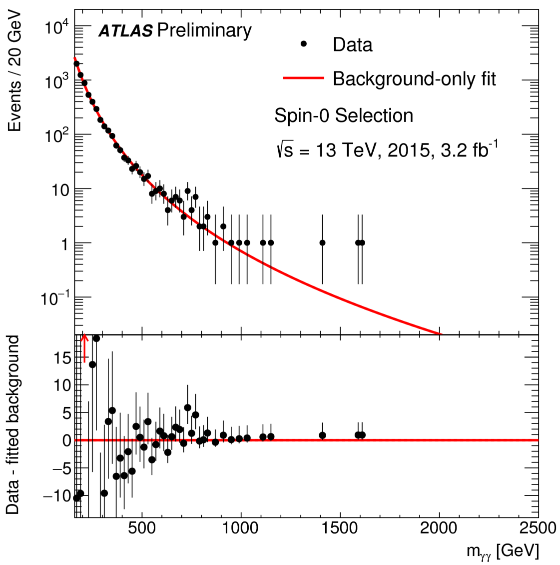


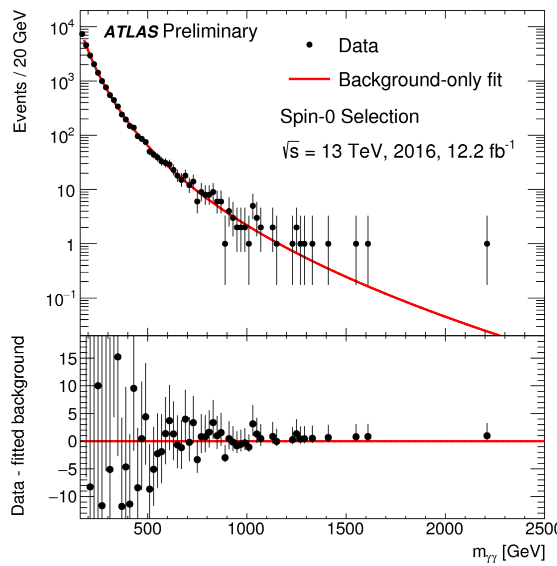
Muon channel

- Importance of systematic uncertainty related to MET in the low mass.
- Similarly the extrapolation of the efficiencies and the calibration at very high pT (up to a TeV) is very important: not a low hanging fruit!
- Limits at 4.74 TeV (compared to Run 1 limits of 3.2 TeV).

Diphoton Search

ATLAS-CONF-2016-059





The 750 GeV Excess

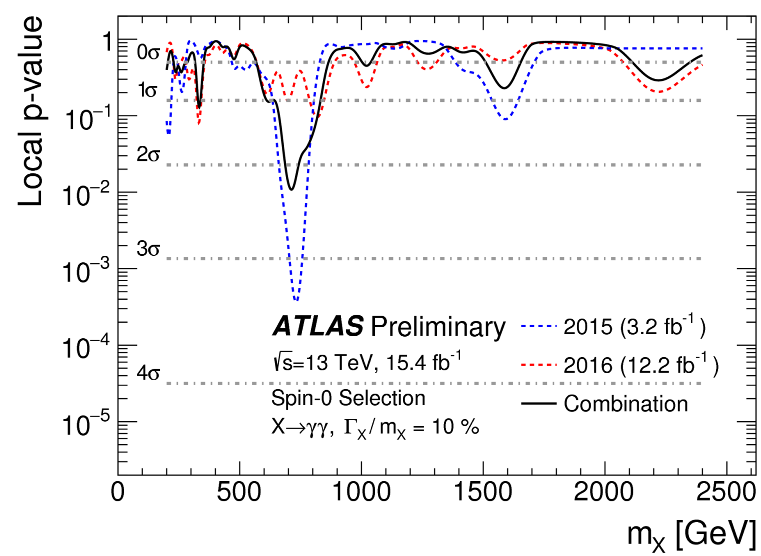
- Background estimate from fit of analytical shape.
- No excess observed in the 2016 data.
- No (global) significant excess in the combination of 2015 and 2016 data.

* Definitely most interesting + likely LHC anomaly – Exciting!

[* Run 1 vs Ru2 tension, "other channels look elsewhere", width issue; also big co-incidence that S/B ~ few with O(10) events (but just where syst/background fluct. hurt!)]

* I give it a ~ 10% chance of being real (= betting odds)

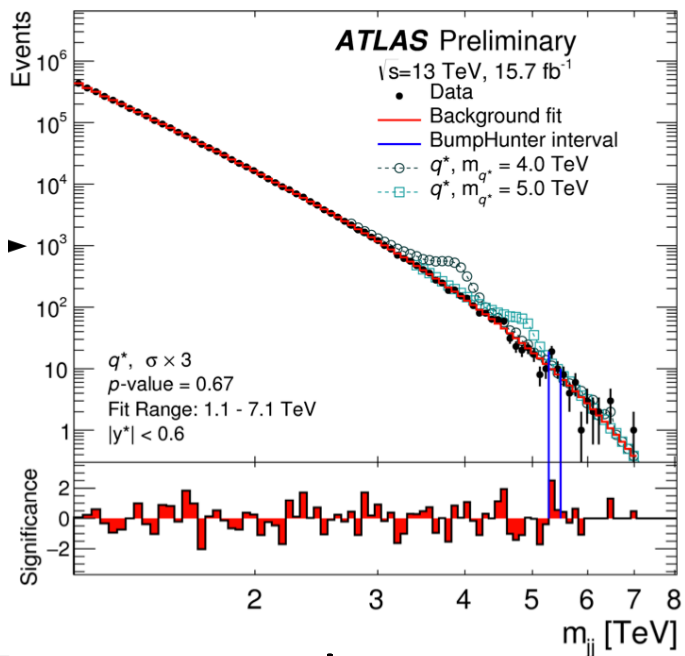
Nima Arkani Hamed (Aspen 2016)

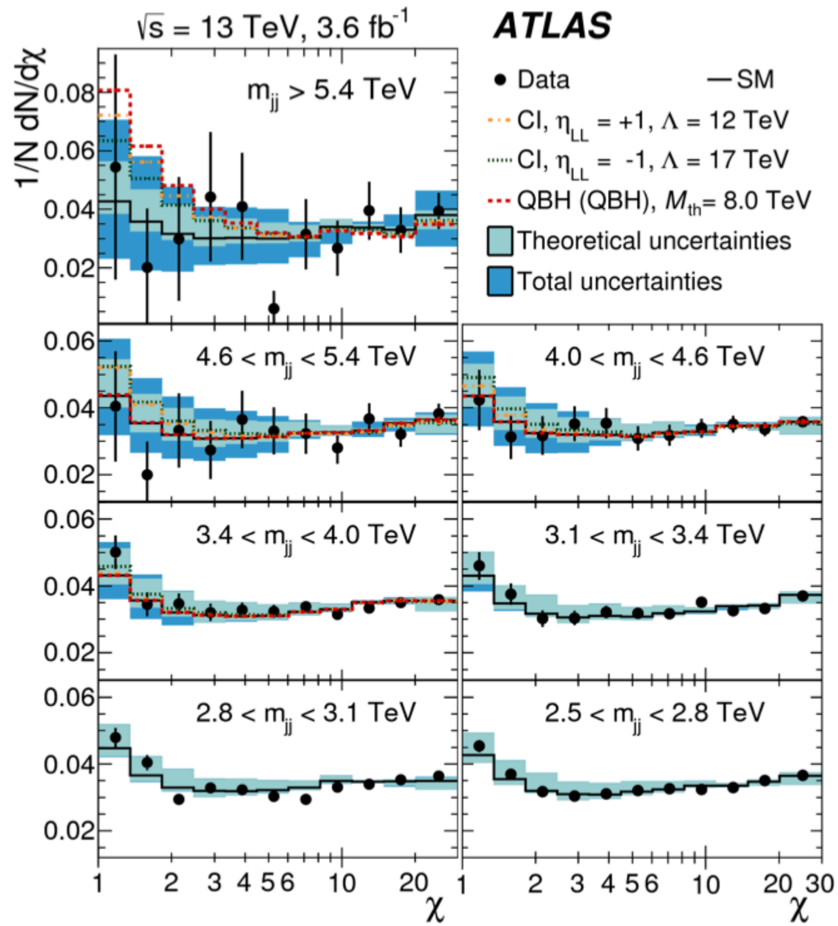


Di-jet Searches

Resonant and non resonant search

ATLAS-CONF-2016-069





Resonant search

Hunt for a bump, if none interpret in terms of limits using specific signal models.

Non-resonant search

Search for distortions of the fijet angular distributions in bins of di-jet mass.

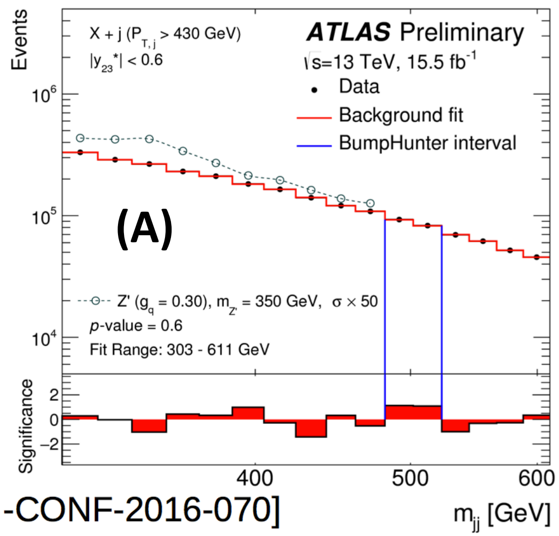
Interpret in terms of limits on Contact interaction.

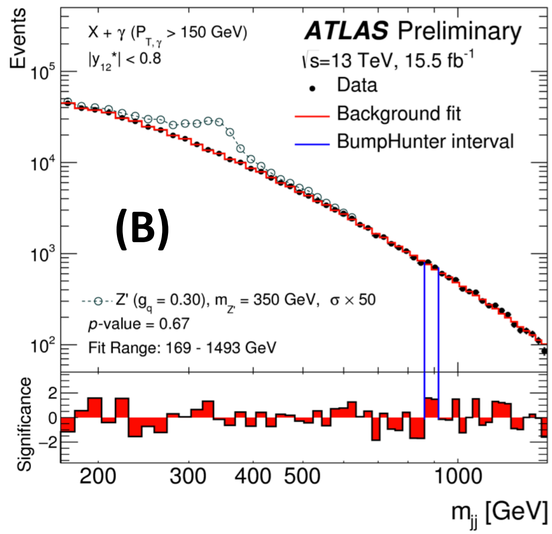
$$\chi = e^{2|y^*|} \sim \frac{1 + \cos\theta^*}{1 - \cos\theta^*}$$

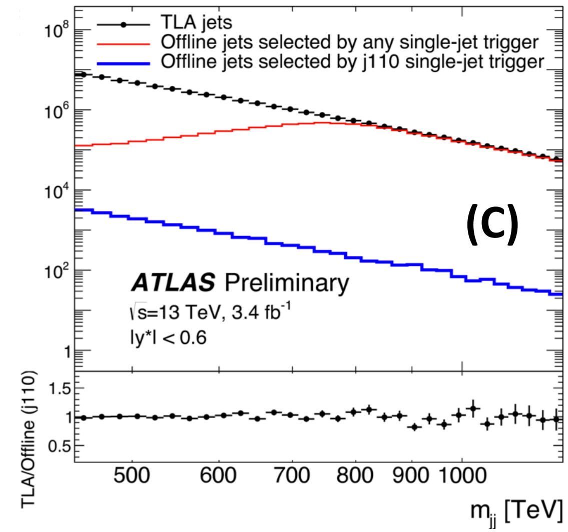
Limits on CI mass scale of up to 20 TeV

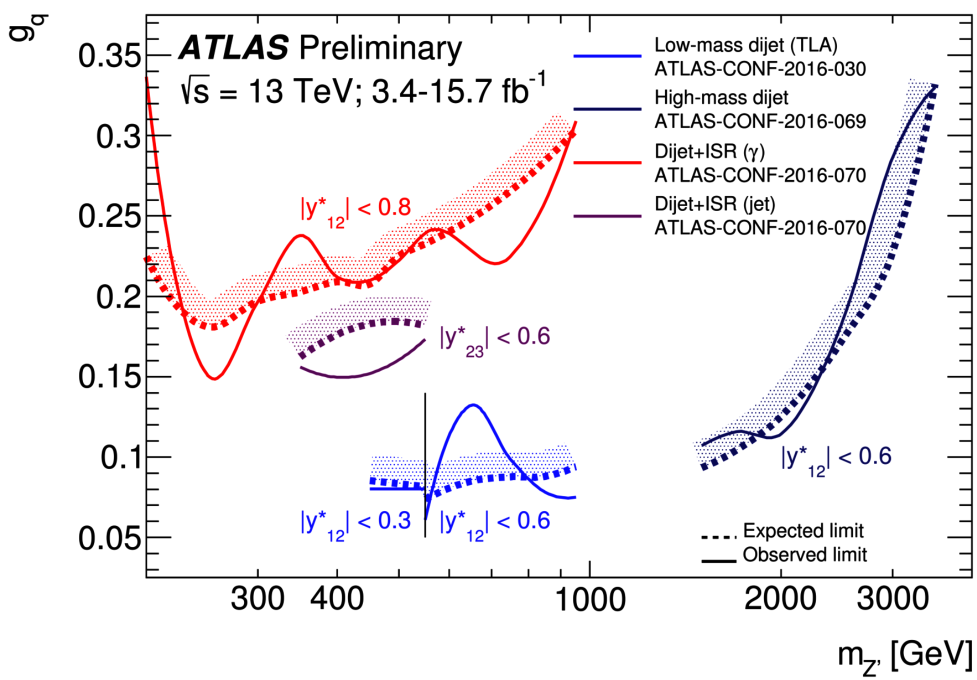
Di-jet Searches

Investigating the intermediate mass range









(A) Trigger Level Analysis

Only small necessary information is stored and the analysis is done at trigger level, calibration is particularly non trivial in this case.

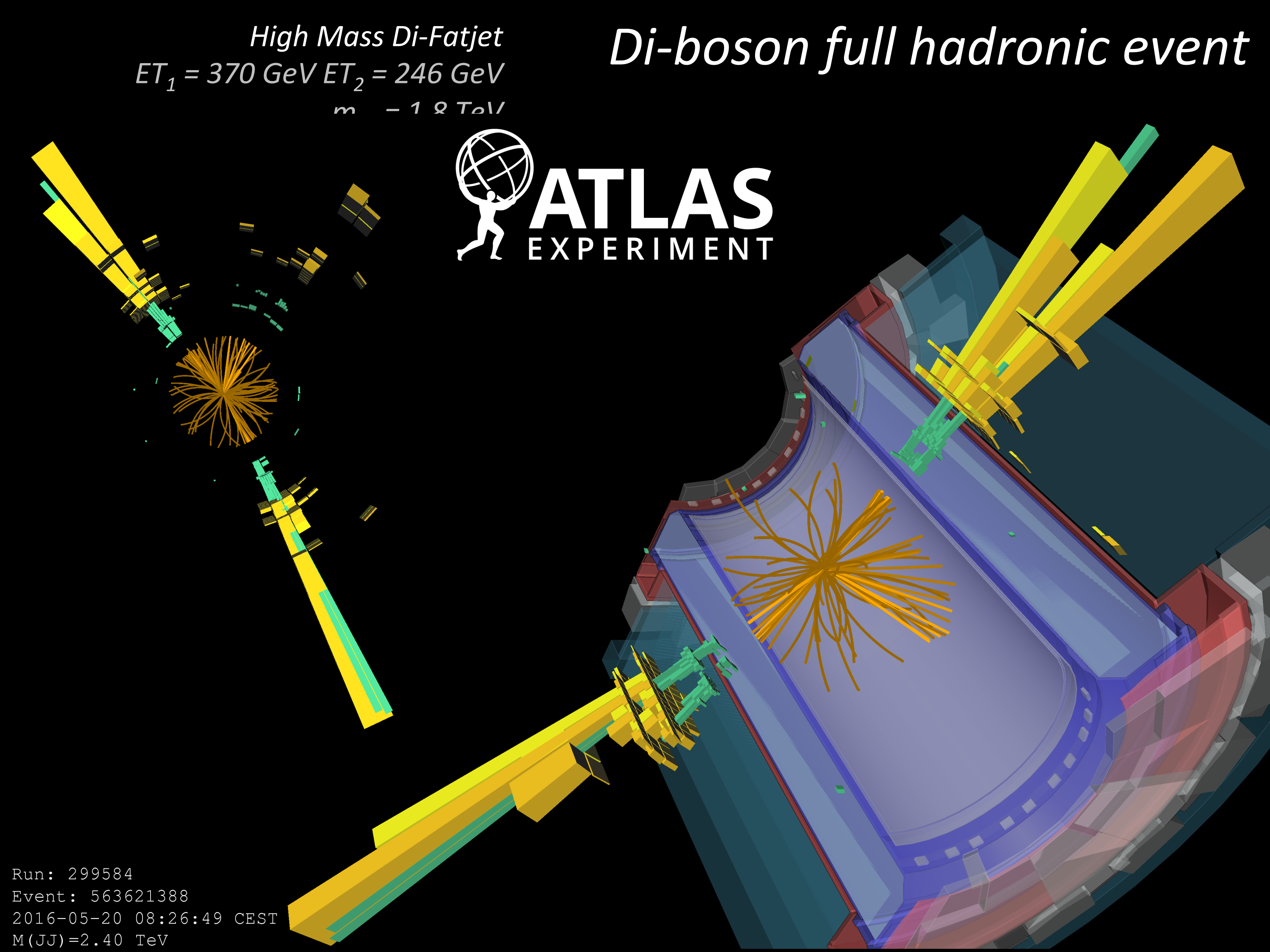
ATLAS-CONF-2016-030

(B) ISR with photon ATLAS-CONF-2016-070

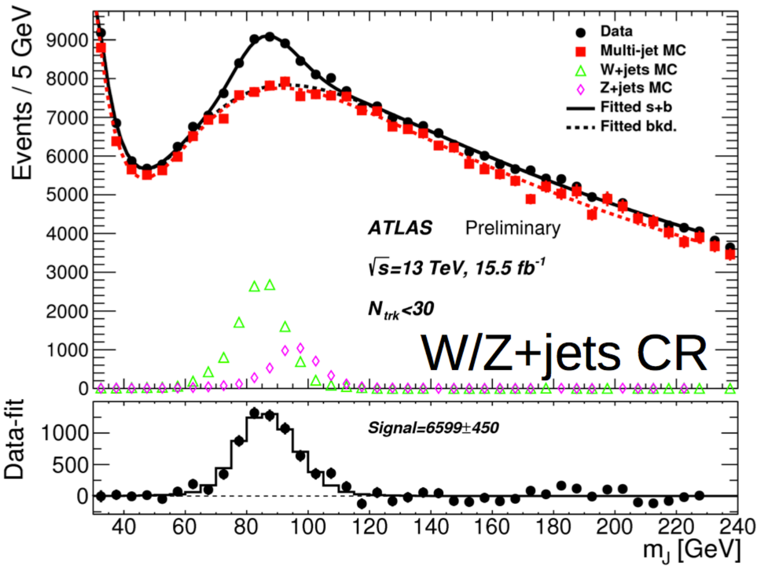
Use ISR photon for triggering and look at recoiling jet pairs

(C) ISR with jet ATLAS-CONF-2016-070

Use higher jet activity to reach lower masses using an ISR jet


Di-boson full hadronic event
High Mass Di-Fatjet
ET1 = 370 GeV ET2 = 246 GeV
ATLAS
EXPERIMENT
Run: 299584
Event: 563621388
2016-05-20 08:26:49 CEST
M(JJ)=2.40 TeV

Jet Substructure



Simple selection of inclusive jet!

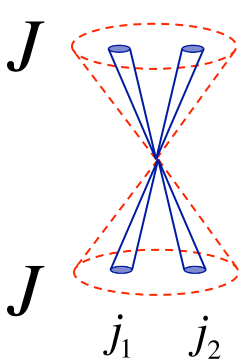
Nominal boson tagging algorithm

- Large R-jet algorithms used to tag hadronic decays of particles such as W, Z, Higgs and the t
- Algorithms use substructure of jets.
- Pileup subtraction is very important, and a large number algorithms have been developed.
- Excellent overall performance

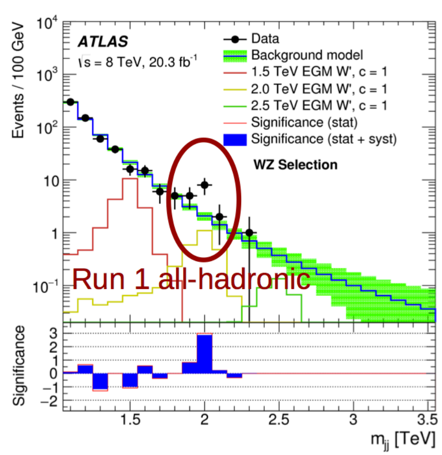
- Anti-kT R=1.0
- Trimming: fcut = 5% and Rsub = 0.2
- pT dependent (energy correlation ratio) D2 selections for W and Z separately (Multijet reduction by 40 – 70)

Diboson search

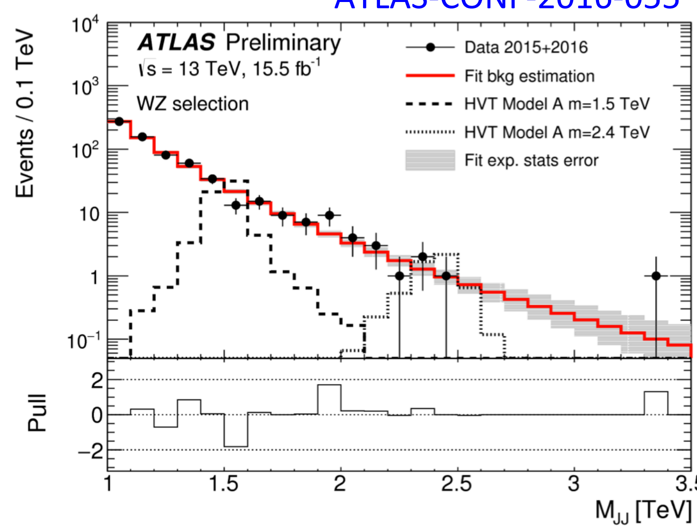
VV to JJ



Modest excess Run-1
observed at Run 1

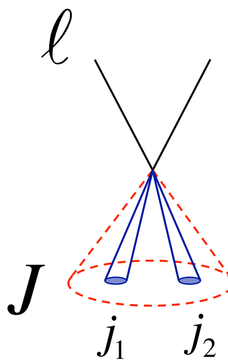


ATLAS-CONF-2016-055



Searches for a **Resonance** in **Diboson VV** Final States

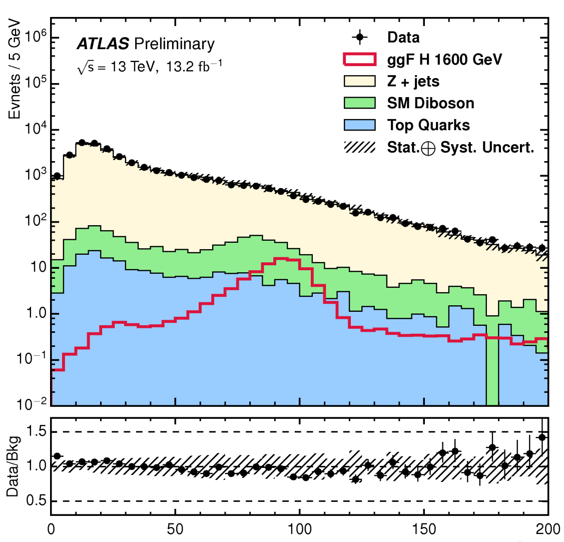
ZV (with Z to **dilepton**)



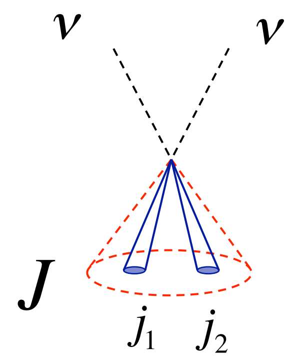
Backgrounds

Z-jets is the main background, estimated using MC and normalised to mJ sidebands

Diboson and top from MC

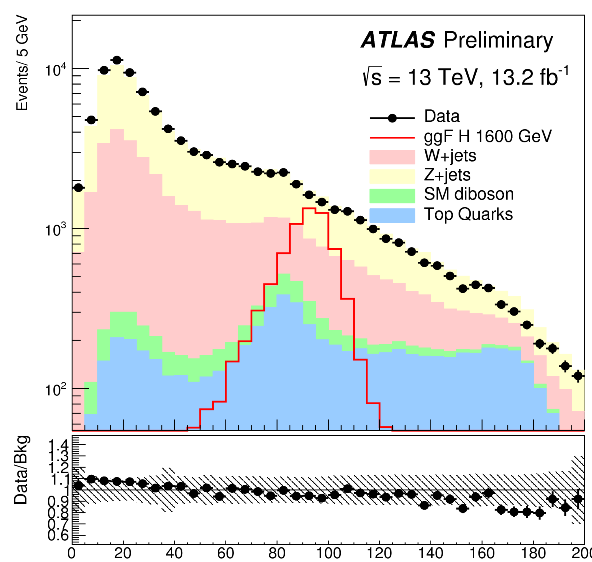


ZV (with Z to **νν**)

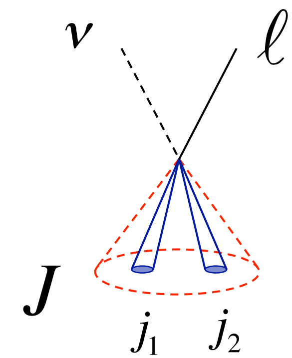


Backgrounds

Z-jets main background, W-jets and top are not negligible, these are estimated using CRs with 1 or 2 muons and one b-tag for the Top CR.



WV (with W to **lν**)

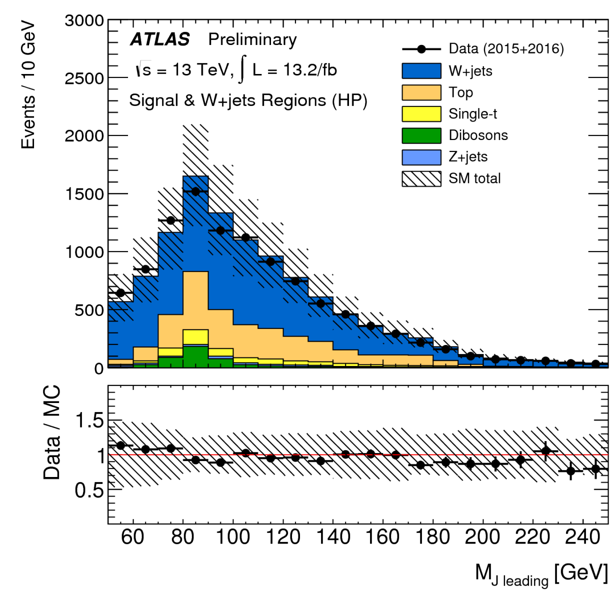


Backgrounds

Z, W and top shapes from MC

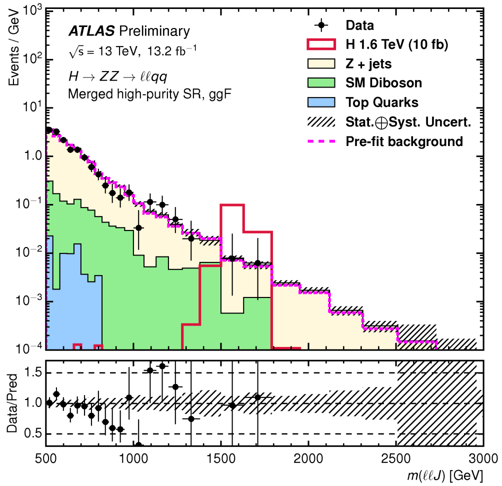
Diboson fully from MC

Multijet shape from loose lepton ID

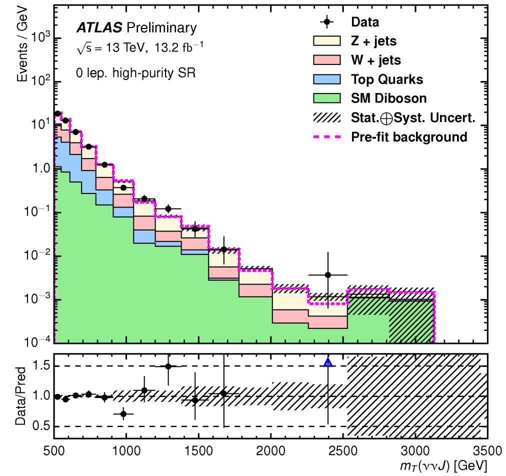


Searches for a **Resonance** in **Diboson VV** Final States

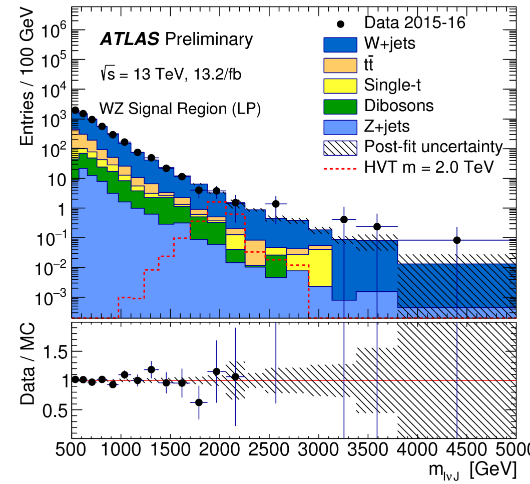
ZV (with Z to **dilepton**)

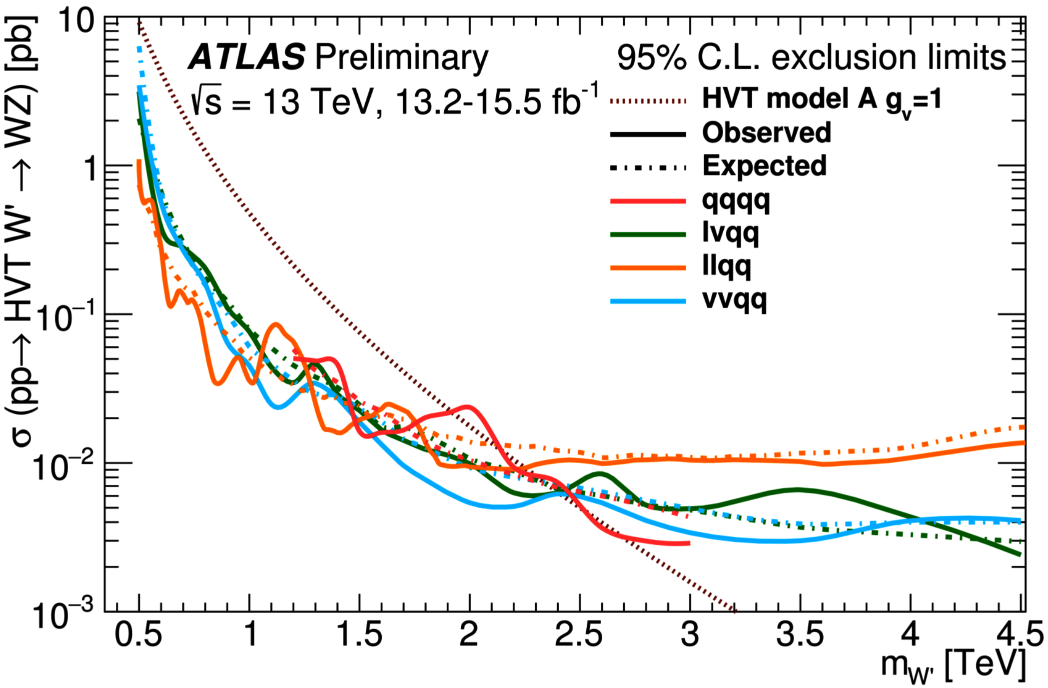


ZV (with Z to **vv**)



WV (with W to **lv**)





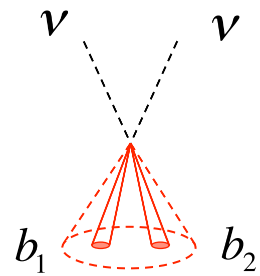
Results

Analyses have similar sensitivities ranging between **2.2 TeV** and **2.5 TeV** for HVT additional vector bosons

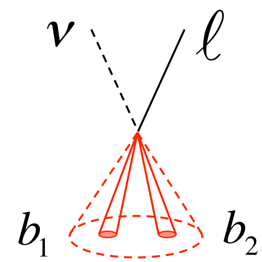
- No significant excess observed, limits are set in these scenarios
- Interpretations also in Higgs and Graviton hypotheses

Searches in **Diboson VH** Final States

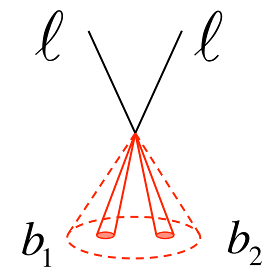
Leptonic channels: 6 regions 0L, 1L-MET and 2L-MET with at least two jets and 1 or 2 b-tags (2 b-tags harder to distinguish at high pT) – done with 2015 data.



ZH (with **Z to vv**)

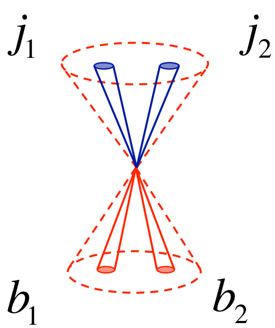


WH (with **W to lv**)



ZH (**Z to ll**)

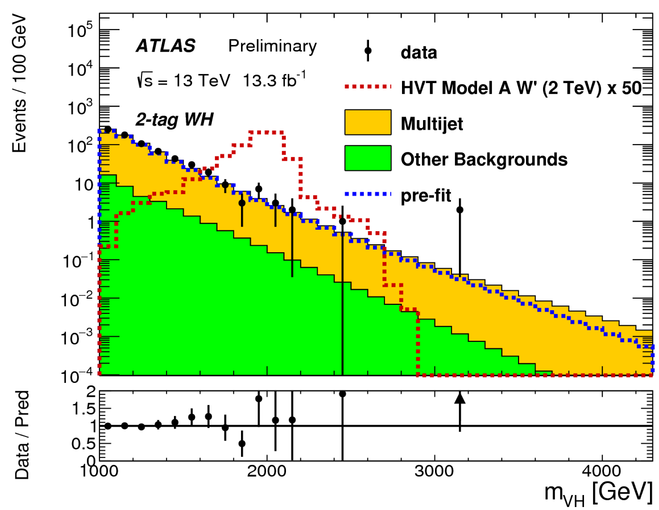
Fully hadronic channel:

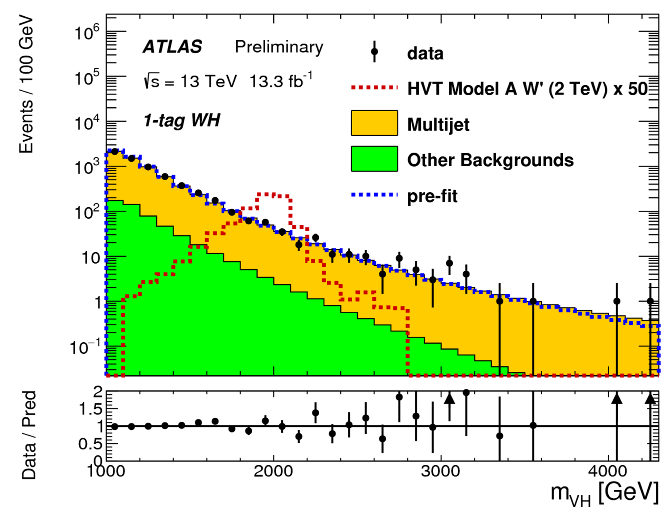


ATLAS-CONF-2016-020

In boosted regime: W/Z tagging on one side and Higgs tagging on the other

Slight excess observed in WH selection 3.5σ local and 2.5σ global at a mass near 3 TeV (for the time being it is the gathering of a few events near the tails of the distribution)





Searches for Vector Like Quarks

Nano overview of motivation

- Motivated as required in models where the Higgs is a pseudo Goldstone boson (e.g. in Composite Higgs and little Higgs models).
- Additional (sequential) 4th generation is ruled out by the Higgs couplings.
- Mass terms for fermions strongly interacting, i.e. Quarks which transform as $SU(2)_L$ are gauge invariant and therefore do not need to couple to the Higgs.

Large variety of complex channels

- Complex channels looking for T(2/3), B(1/3): Ht+X, Wt+X, Wb+X, Zb+X, Zt+X (Performed at Run 2) so far and T(5/3) 4tops final state.

Complex search performed with 2015 data

ATLAS-CONF-2016-020

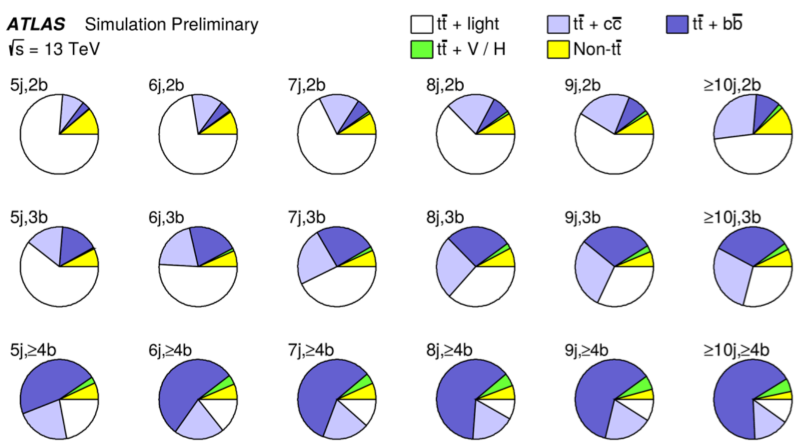
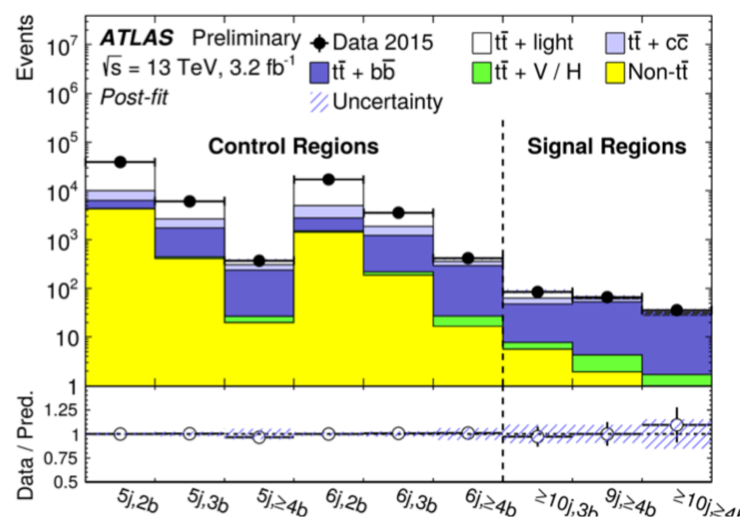


Illustration of the reach in complexity of signature with up to 10 jets with 4 b-tags.

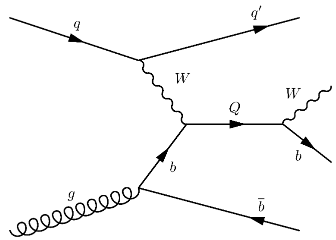


VLQ Searches with the 2016 dataset

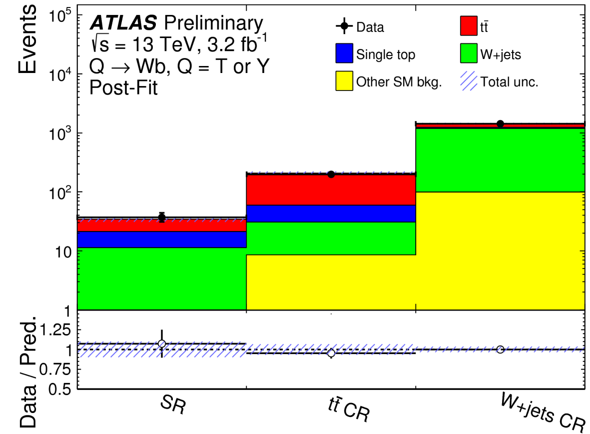
Q (Wb) Channel

ATLAS-CONF-2016-072

Selection of one lepton and at least one very high ET jet (in excess of 350 GeV).



Background dominated by top (and W-jets), estimated from control regions.



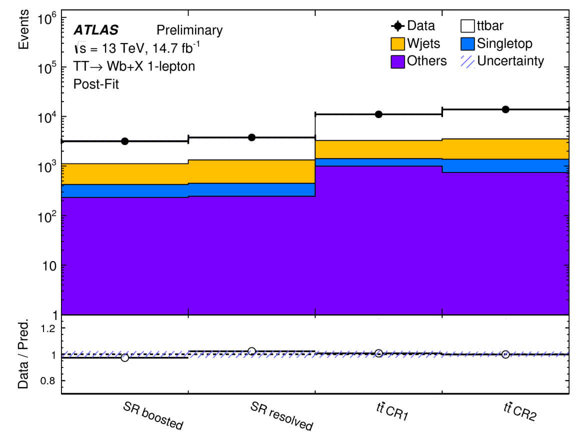
Q pair (Wb) Channel

ATLAS-CONF-2016-102

Complex final state

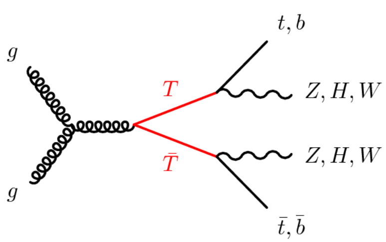
- One lepton
- MET > 60 GeV
- Boosted: 1-Large R jet and 3 Small-R jets
- Resolved: Four Small-R jets

Background Dominated by top events from a control region



Q pair (t,b - Z,H,W) Channel

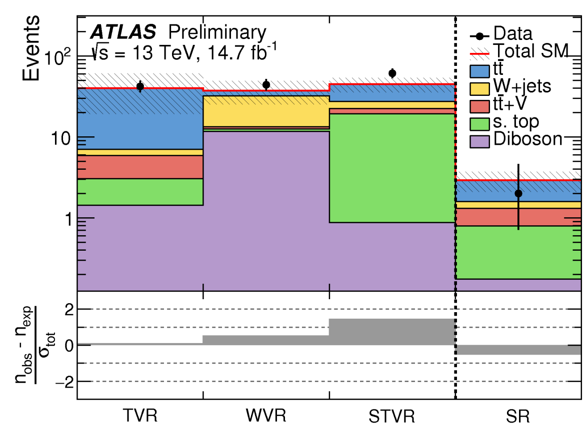
ATLAS-CONF-2016-101



Very complex final state

- One lepton
- MET > 350 GeV
- Four jets small-R jets (one b-tagged)
- Two large-R jets

Background dominated by top and single-top (and W-jets). W and tt from CRs, ST from MC.



Searches for SUSY

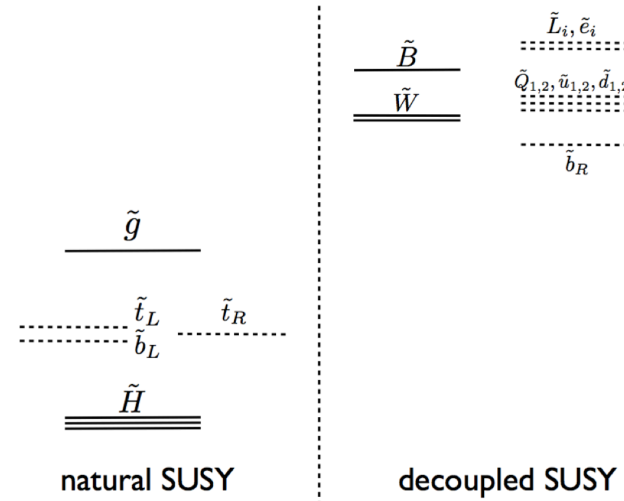
RPC and “Natural” SUSY

Searches

- 3d generation searches for stop and sbottom
- Gluino and squarks searches
- Searches for charginos and neutralinos “EW SUSY searches”
- Compressed scenarios: search for low pT stuff (soft leptons – trigger strategy is important, low pT b’s, etc…)

General Strategy

Use simplified models to cover the widest possible variety of topologies. (Then more rigorously investigate the MSSM parameter space in the pMSSM, using the available searches.

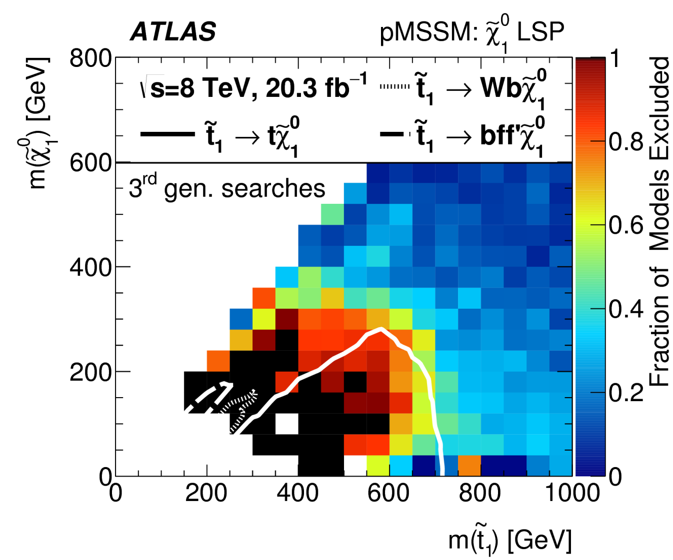


“Natural” SUSY scenario

pMSSM Survey (Run 1 results)

Survey of the 19 MSSM parameters using existing constraints

- 300 k models investigated
- 30 G evts generated
- Signal contamination in background normalization taken into account



SUSY Searches

Illustration SUSY Search Strategy

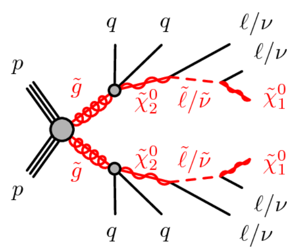
ATLAS SUSY searches

Inspired by simplified models, topology oriented searches with several specific signal regions per channel (then typically event counting analyses).

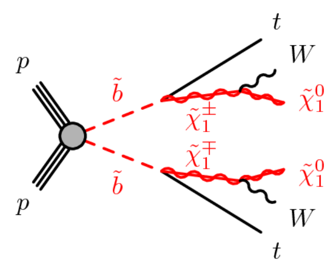
Example of versatile search for SS dilepton, 3 leptons ATLAS-CONF-2016-037

Design analysis with SS 2-leptons (7 signal regions) or 3L (2 signal regions) with varying number of jets and b-jets, and MET cuts

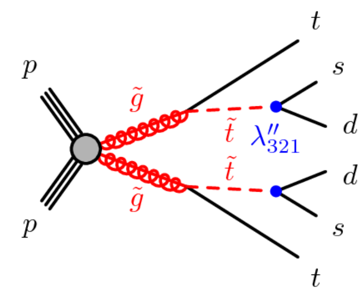
Gluino



sbottom

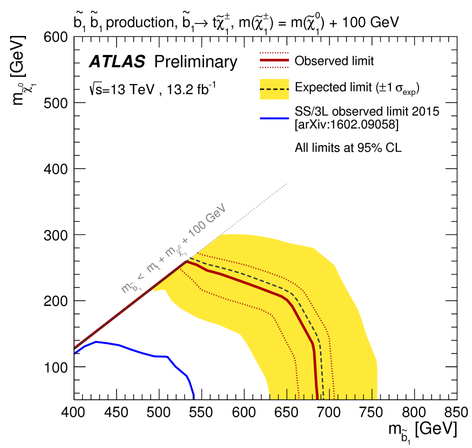


RPV terms in the Baryonic sector



Define specific event counting signal regions e.g.:

	SR1b
Observed	12
Total SM background	11.4 ± 2.8
$t\bar{t}Z$	1.6 ± 0.6
$t\bar{t}W$	2.0 ± 0.7
Diboson	0.5 ± 0.4
Rare	2.7 ± 0.9
Fake/non-prompt leptons	3.3 ± 2.1
Charge-flip	1.43 ± 0.19

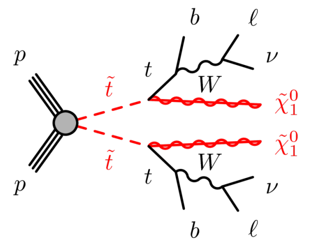


- Give the results in terms of simplified model parameters.
- Also give limits in terms of number of events excluded (or total cross section) for each signal region (requires acceptances and efficiencies to apply to other models)

Main Stop Searches

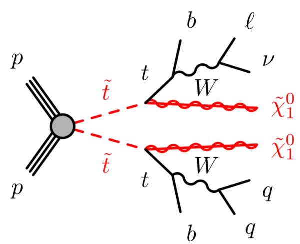
$\tilde{t} \to t\chi$

Stop 2-Leptons



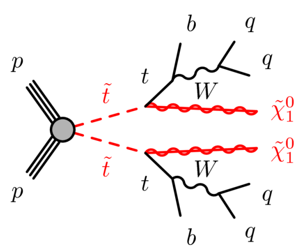
ATLAS-CONF-2016-076

Stop 1-Lepton



ATLAS-CONF-2016-050

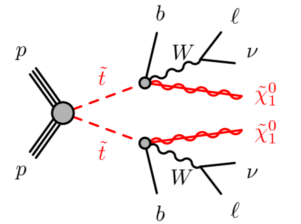
Stop 0-Lepton

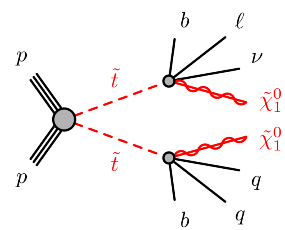


ATLAS-CONF-2016-077

$\tilde{t} \to bW\chi$

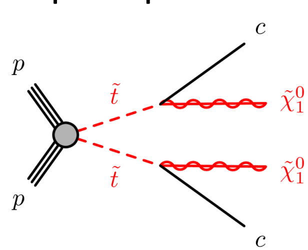
Stop 1,2-Leptons



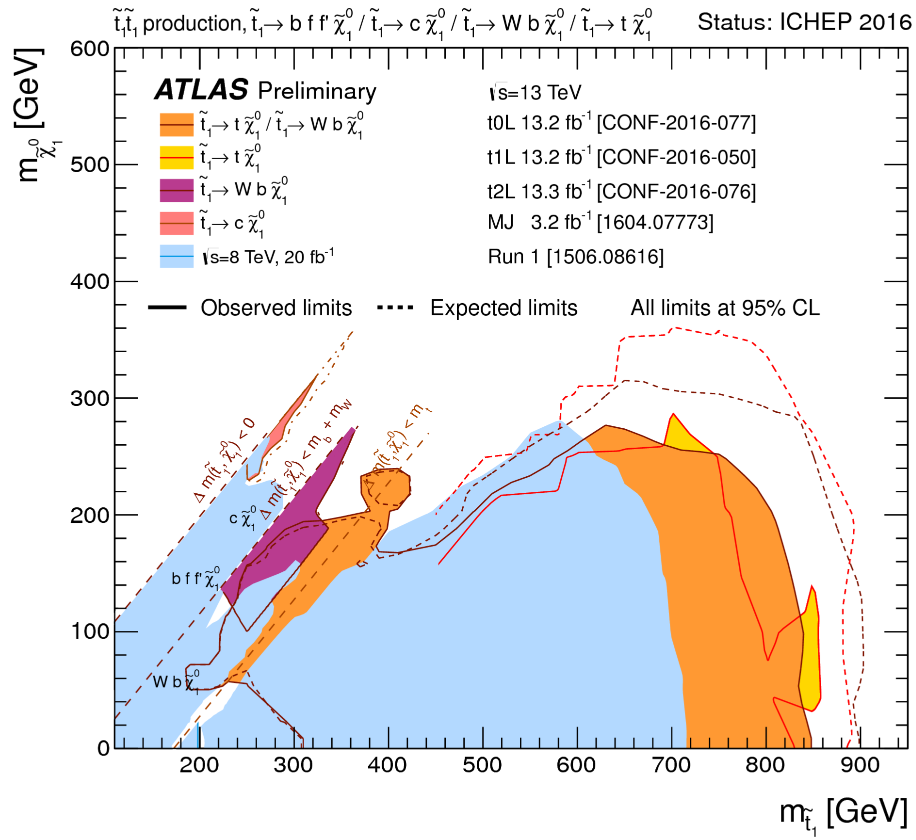


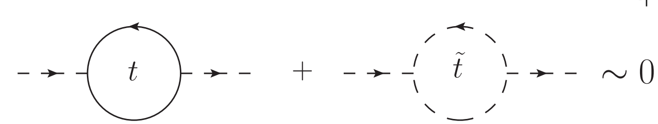
$\tilde{t} \to c\chi$

Stop 0Lepton



Large number of categories searched



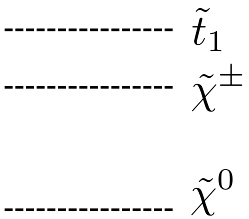


Not so natural SUSY: Stops > 800 GeV ~Tuning of factor 20, but these exclusions are under specific conditions, and there are unexcluded corridors.

Main Stop Searches

More detailed studies of the cases where the chargino is in the decay chain (including scenarios of W and chargino close to neutralino).

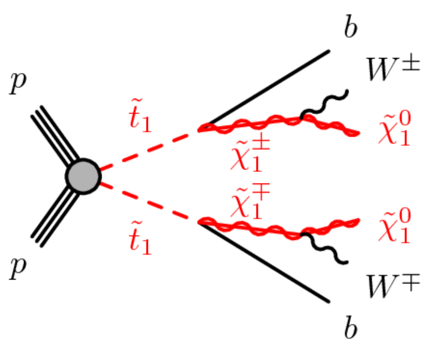
ATLAS-CONF-2016-076
ATLAS-CONF-2016-050
ATLAS-CONF-2016-077

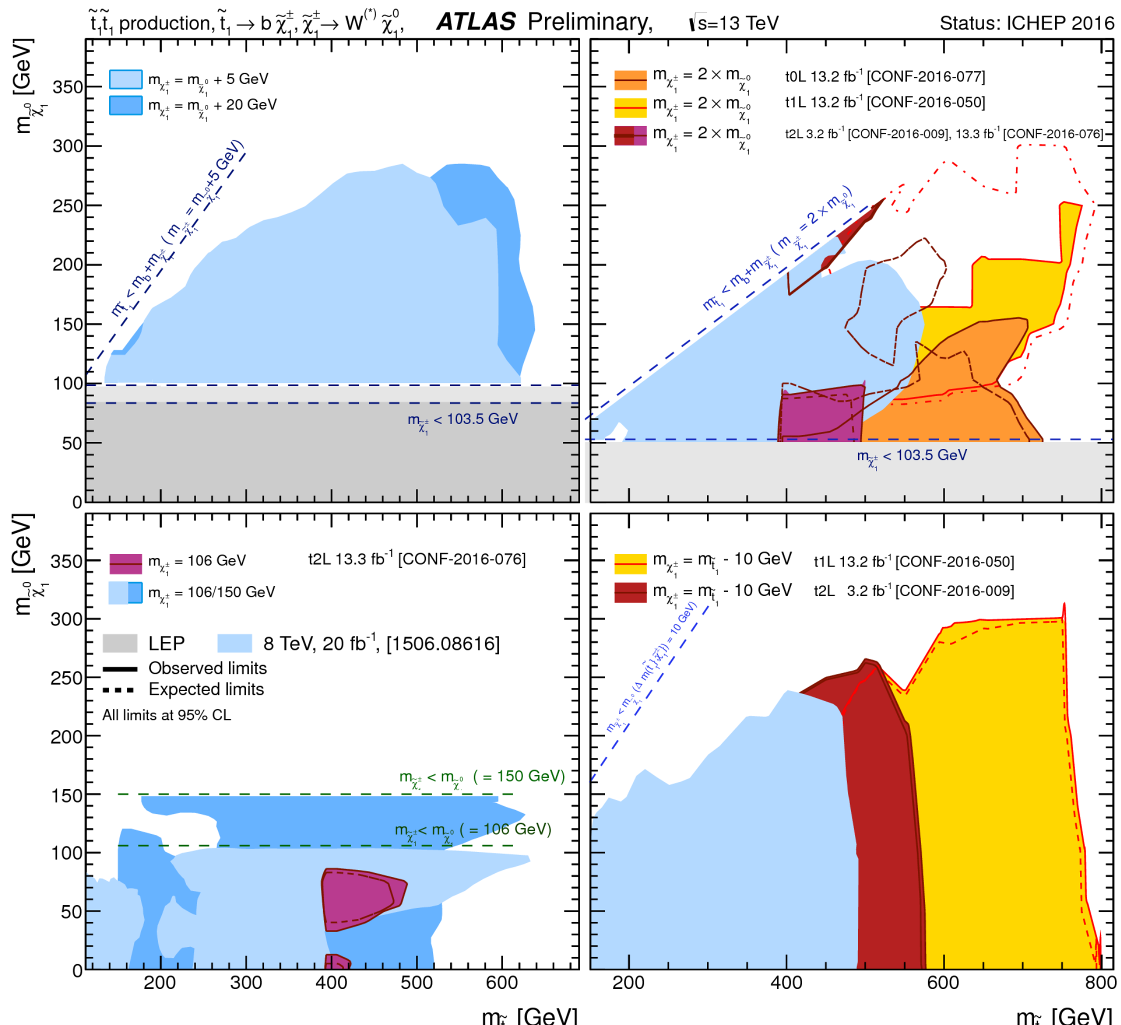


Event topology depend on the precise spectrum

Case used in main 0L, 1L and 2L stop searches:

$$\tilde{t} \rightarrow b(\tilde{\chi}^{\pm} \rightarrow W^{\pm}\tilde{\chi}^{0})$$



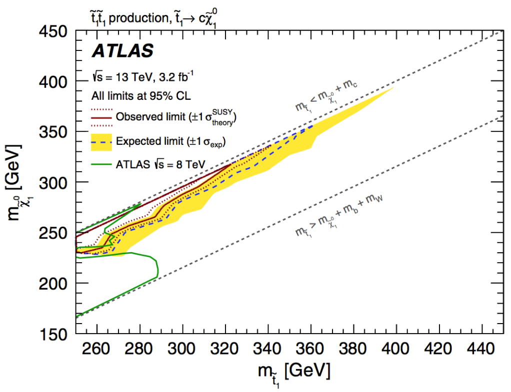


Specific regions designed in analyses based on the difference in terms of number of jets and event kinematics to best cover these scenarii.

Stop compressed scenarios

$$m_{\tilde{t}} \rightarrow m_c + m_\chi$$

Use monjet analysis

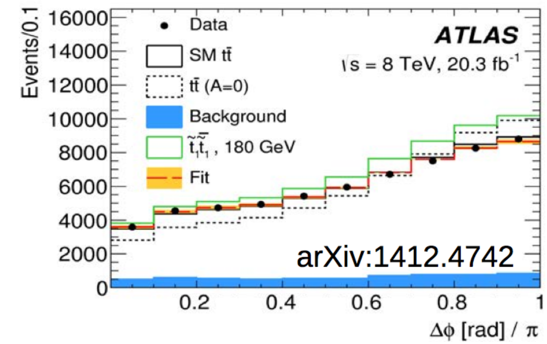


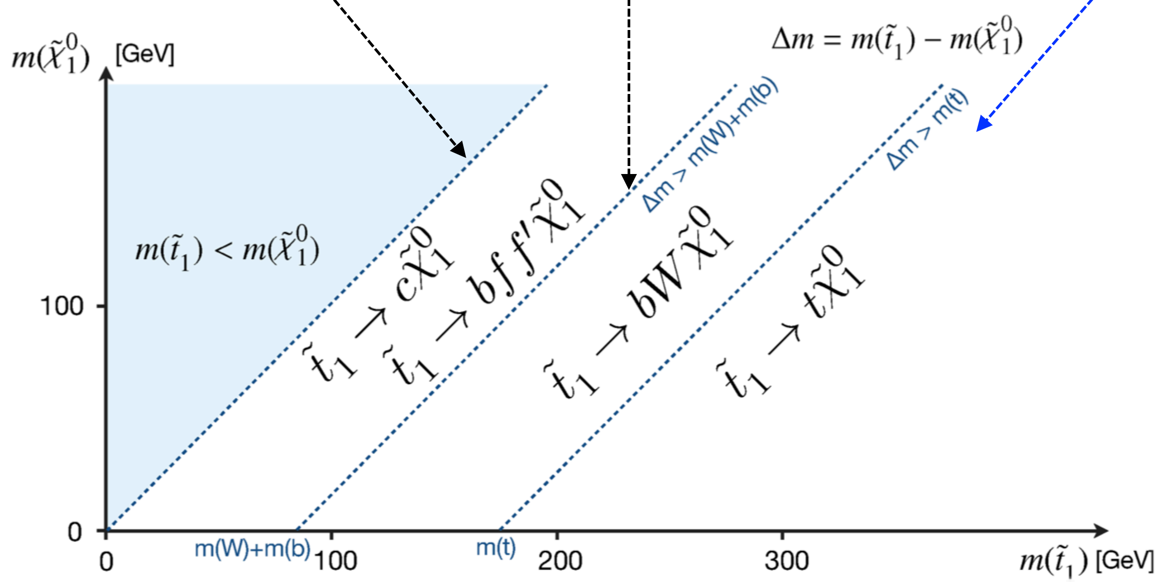
$$m_{\tilde{t}} \rightarrow m_W + m_b + m_\chi$$

Signal difficult to dissociate from WW production

$$m_{\tilde{t}} \rightarrow m_t + m_\chi$$

- Just like top production region
- Use spin correlation in tt prod.
- 0L-with ISR



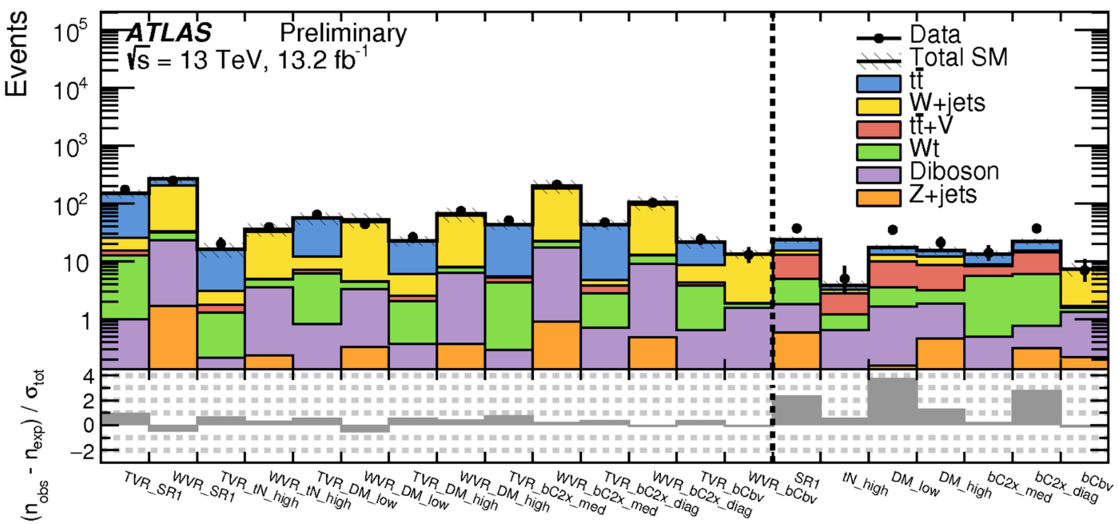


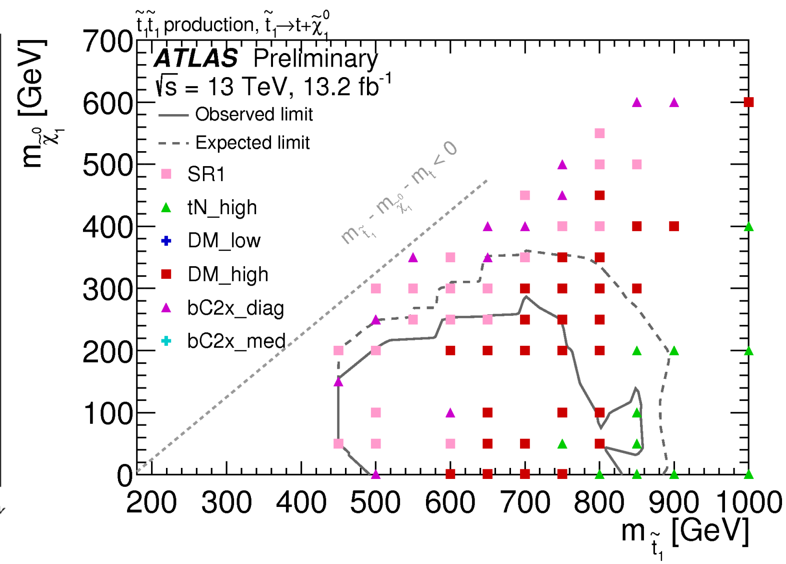
Example SUSY 1L Stop Searches

Analysis strategy: Search done in many categories with different kinematic requirements:

- 1 electron or muon
- 4 jets or more and 1 or 2 b-tags
- Intermediate to large MET and transverse mass
- Several additional kinematic criteria

ATLAS-CONF-2016-050





Backgrounds fairly mixed (top, tt-V and di-bosons)

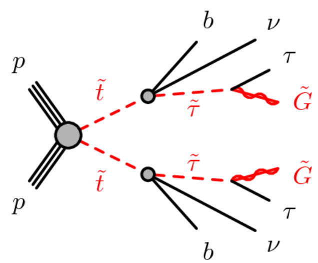
In ATLAS an excess is seen in two regions with four jets (1b) and intermediate/high MET 260-300 GeV with a p-value of 3.3σ

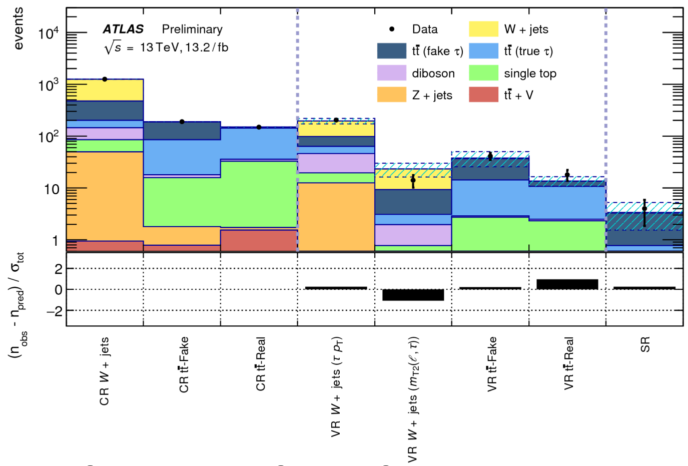
More Specific Stop Searches

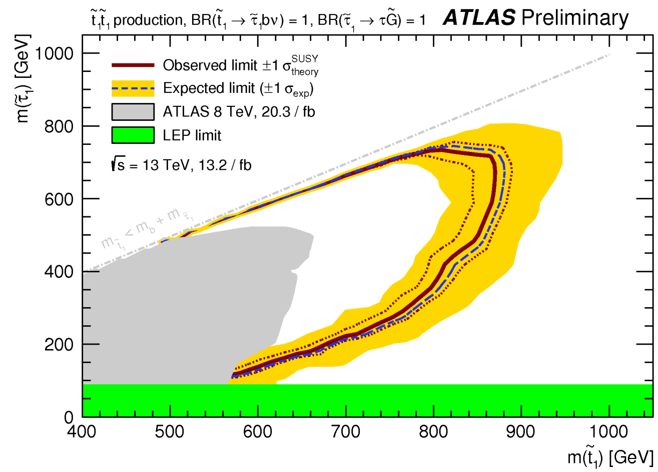
Search for the stop in GMSB (gravitino LSP) models with stau NLSP

- Require one hadronically decaying tau, one lepton, one b-jet.
- The main background is from semi-leptonic top pair production with one fake tau (estimated from two CRs for both real and fake taus based on event kinematices).

ATLAS-CONF-2016-048



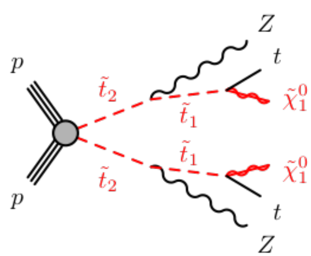


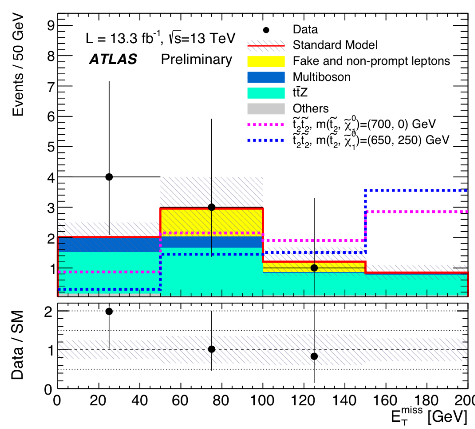


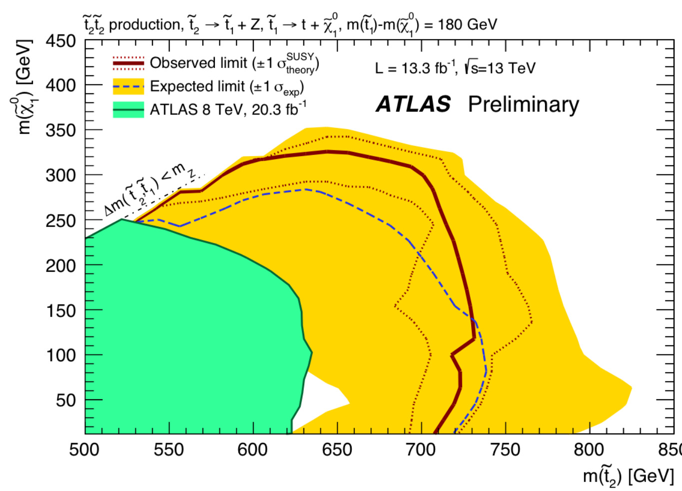
Search for the stop2 in topologies with a Z boson

- Require at least 3 leptons with a pair OS-SF compatible with a Z, at least 5 jets, one b-jet and MET>100 GeV.
- Largest background ttZ production (from CR – lwer MET)

ATLAS-CONF-2016-038

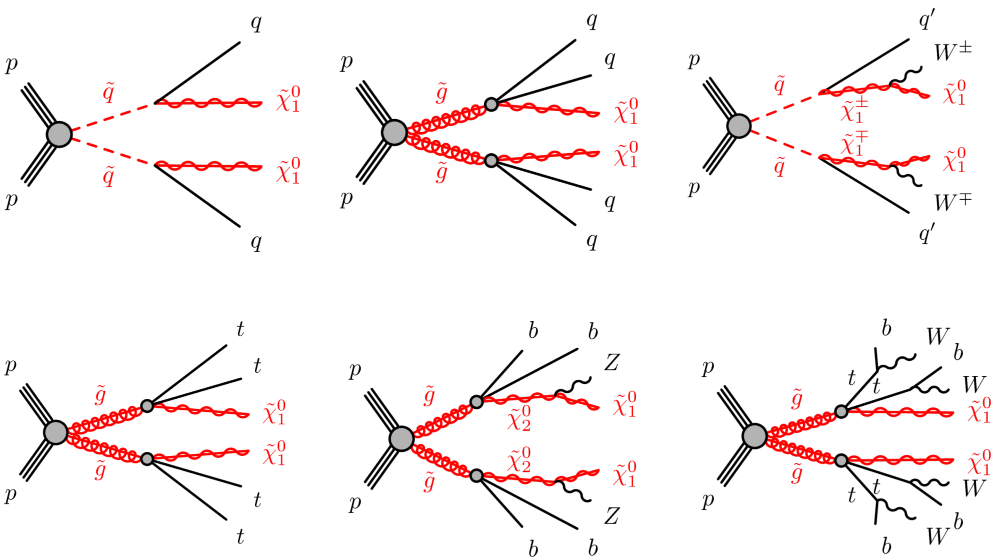


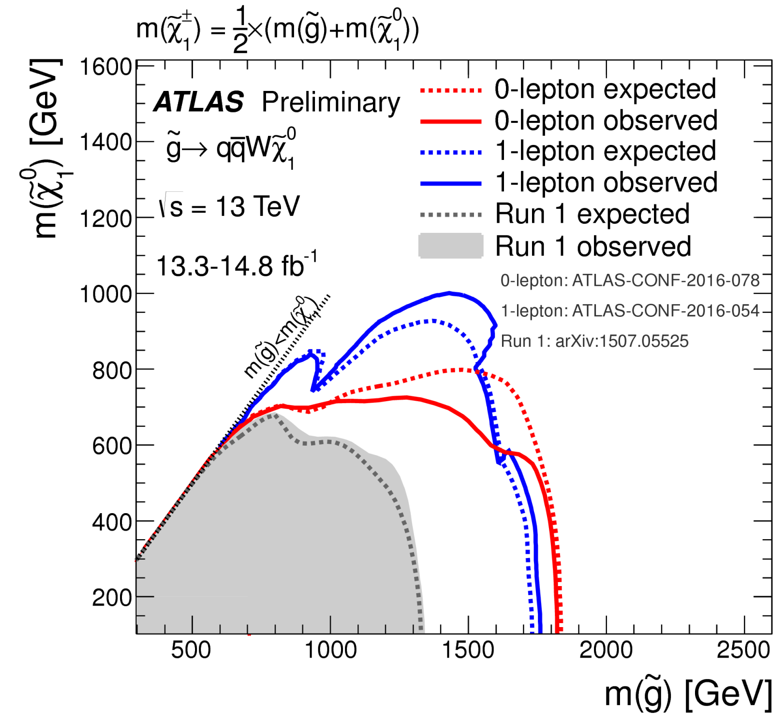




Strong SUSY Searches (Squarks and gluinos)

Very large number of possible topologies in the gluino (or squark) production:





… and many more modes!

Main channels:

- 0L with N-jets (from 2 to 10)
- 1L with N-jets (from 2 to 6)
- 2L (OS and SS), 3L with jets
- Photon-MET (GMSB)
- Multiple b-jets or top

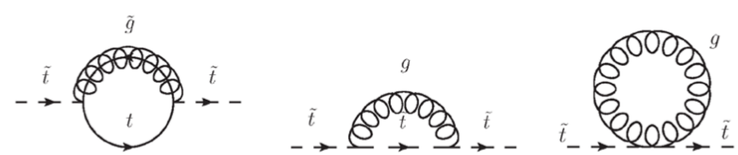
ATLAS-CONF-2016-078
ATLAS-CONF-2016-095

ATLAS-CONF-2016-054

ATLAS-CONF-2016-037
ATLAS-CONF-2016-098

ATLAS-CONF-2016-066

ATLAS-CONF-2016-052

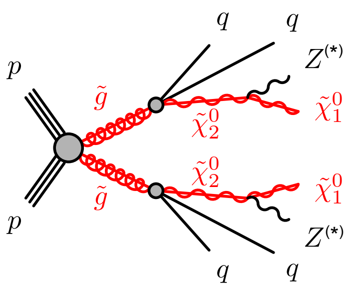


Stop also a scalar requires light gluinos to be light enough: for gluinos > 1.8 TeV ~tuning of Factor of 30

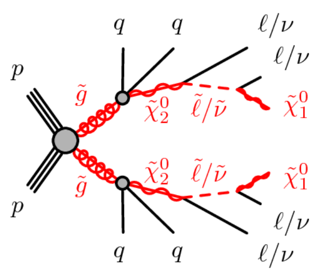
Searches focus on corridors, compressed scenarios, or very specific corners of parameter space (pMSSM)

The 2L (OS-SF) strong production saga

On-Z



Edge



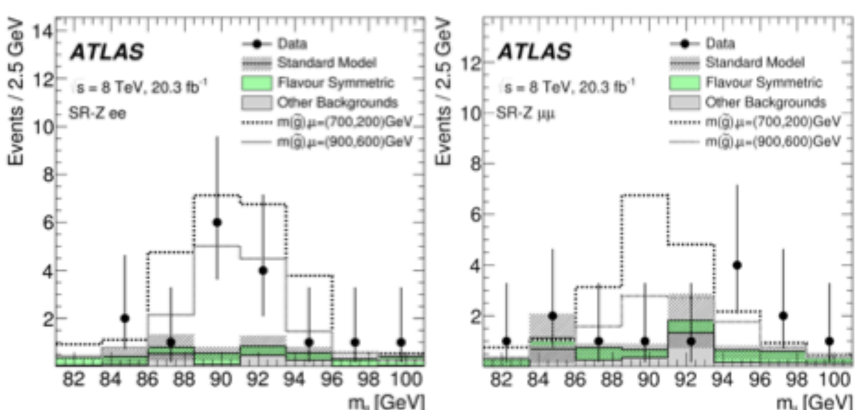
Selection cuts

- Two SS and SF leptons (compatible or not in mass with the Z depending on whether On-Z or edge analysis).
- Two or more jets.
- Large MET >200 GeV (> 225 GeV for On-Z).
- 1 SR for On-Z and 3 SR for Edge.

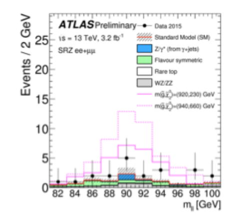
Main backgrounds: (flavor symmetric from DF CR) mostly tt (80%) but also (Wt, WW and Z $\tau\tau$) and WZ and ZZ backgrounds.

Run 1

Run 2

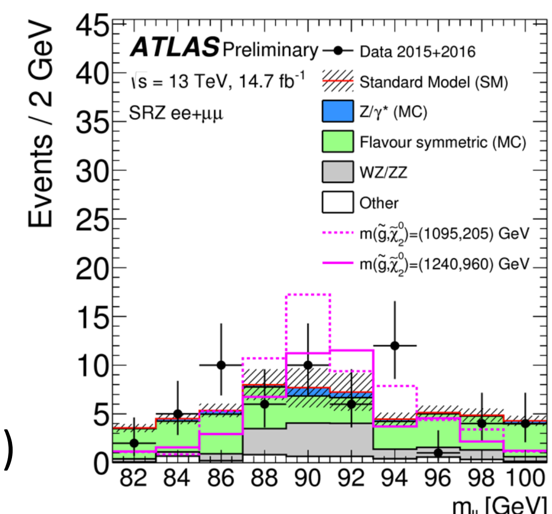


ATLAS On-Z Analysis 3.3σ excess



10 Events expected
20 observed 2.2σ

2015 data
(slight excess)



No excess

ATLAS-CONF-2016-098

Electroweak Production

Search for Neutralinos, Charginos and sleptons:

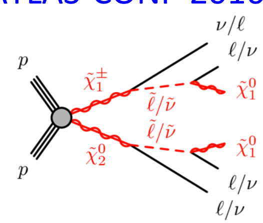
- Production with EW rates.
- In natural scenarios when Higgsinos are decoupled mass differences between χ^2, $\chi^{\pm}$ and χ^0 can be small, typically O(GeV).
- Simplified models consider typically decays of χ^2 and $\chi^{\pm}$ either through slepton or directly to electroweak bosons.

Run 2 searches

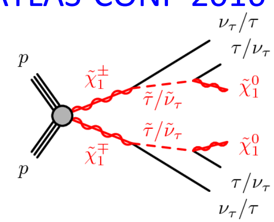
Topologies with 1 or 4 leptons (including taus) in the final state.

Somewhat more accessible through sleptons as 100% branching assumed.

ATLAS-CONF-2016-096

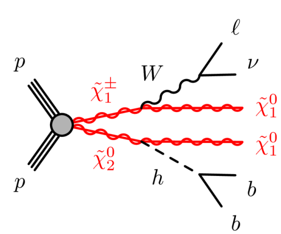


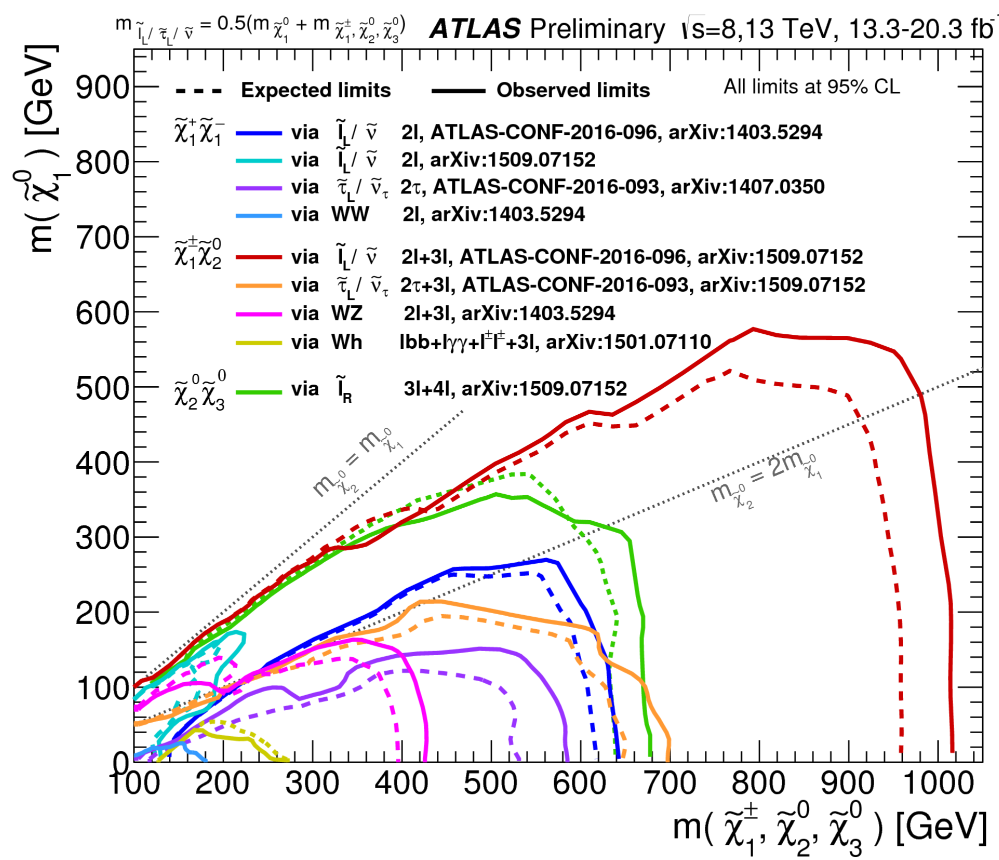
ATLAS-CONF-2016-093



Run 1 searches

Include decays to electroweak bosons (more difficult due to additional leptonic branching)





SUSY RPV

Specific searches in RPV signatures with less (to no significant MET) done

$$\frac{1}{2}\lambda_{ijk}L_iL_j\bar{E}_k + \lambda'_{ijk}L_iQ_j\bar{D}_k + \frac{1}{2}\lambda''_{ijk}\bar{U}_i\bar{D}_j\bar{D}_k + \kappa_iL_iH_2$$

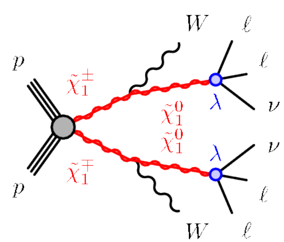
RPV components of superpotential

Search for RPV Charginos in Leptonic sector

4 leptons channel

Selecton on effective mass including leptons jets and MET

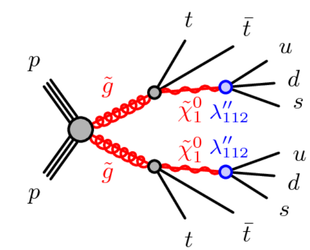
ATLAS-CONF-2016-075



Search for RPV gluinos in lepton-jet in Baryonic RPV

One isolated lepton, high jet mult. and b-jets.

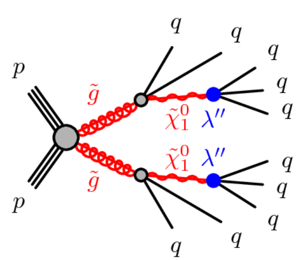
ATLAS-CONF-2016-094



Search for RPV gluinos in multi-jet in Baryonic RPV

Search 4 and 5 jets or more considered.

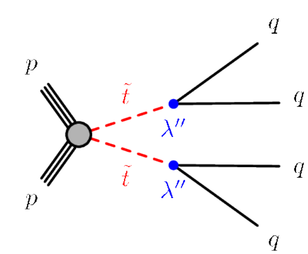
ATLAS-CONF-2016-075



Search for RPV stops high mass dijet pairs in Baryonic RPV

Search for pairs of dijets

ATLAS-CONF-2016-084



Unconventional Signatures

Typical scenarios

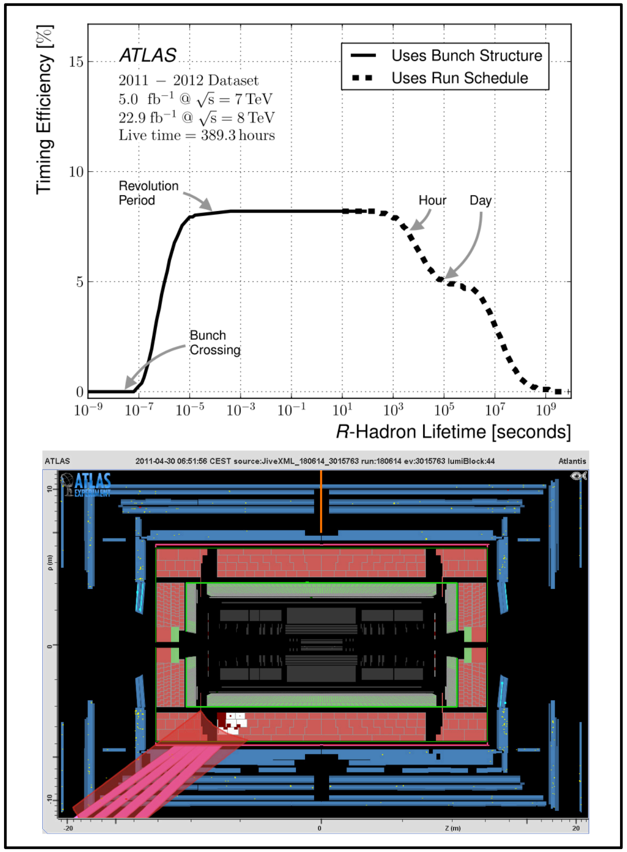
- Split SUSY models
- Hidden valley models

Topologies

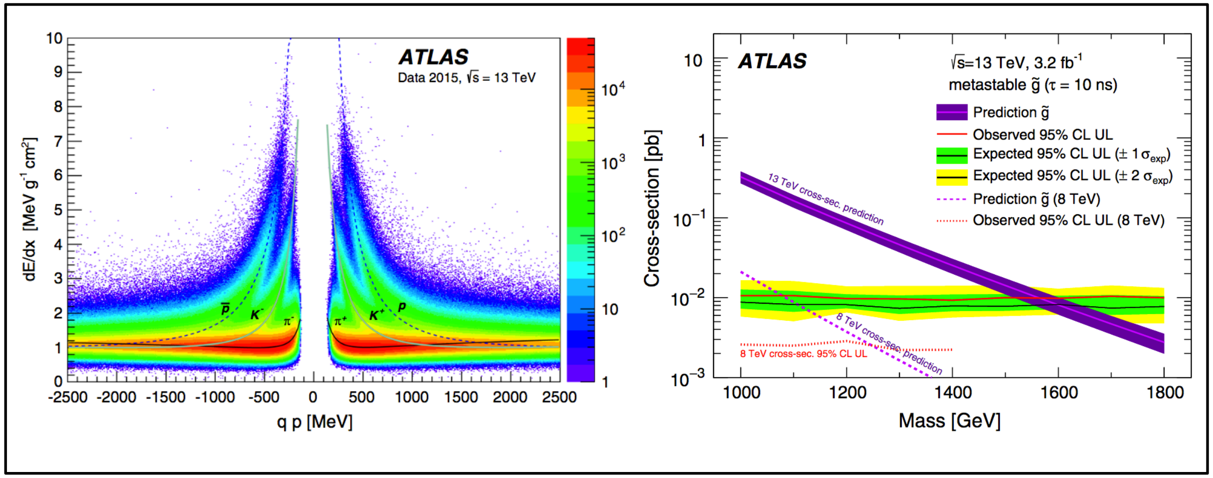
- Highly ionizing particles (using dE/dx)
- Out-of-time jets (R-hadrons)
- Highly displaced vertices
- Kinks in tracks
- Disappearing tracks
- High lepton multiplicities

These are very difficult analyses requiring specific non standard reconstruction algorithms.

Stopped Gluino Search

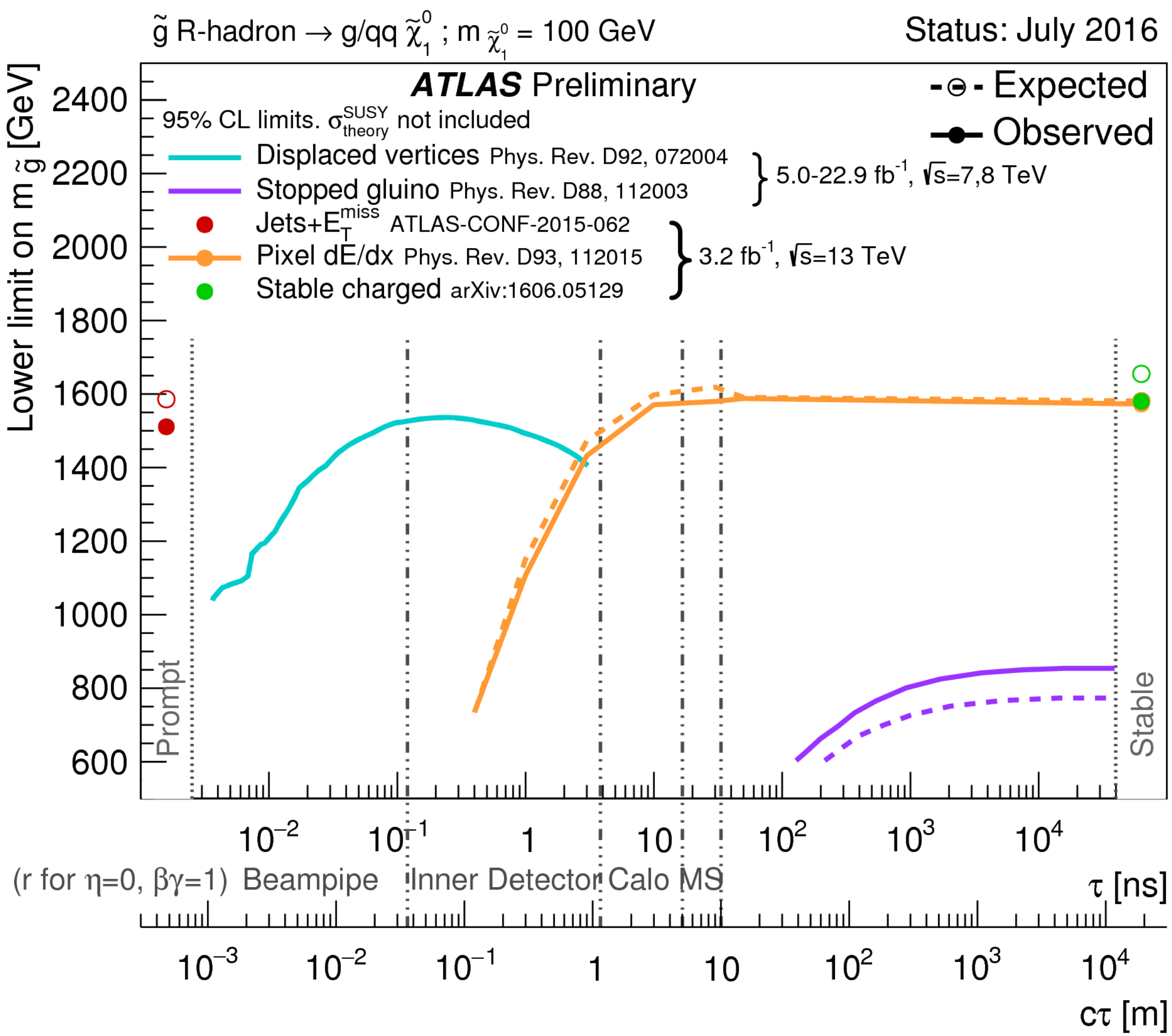


Pixel dE/dx search



Unconventional Signatures

Overview of searches Run 2 in perspective: starting to cover ground for searches for LLP

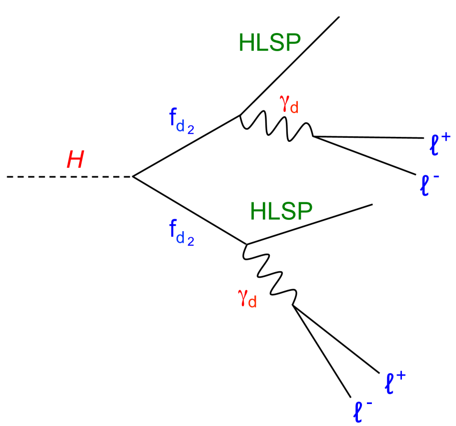


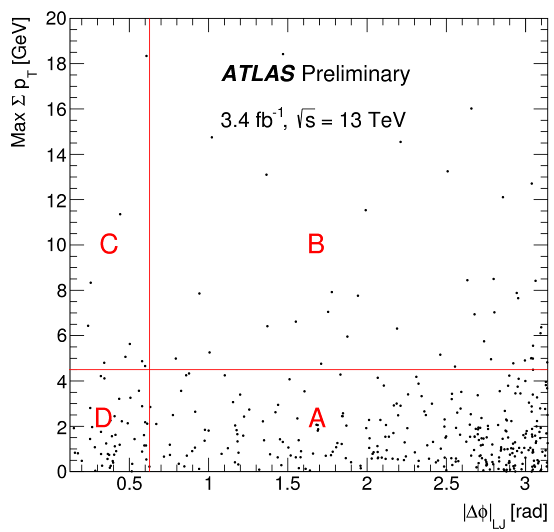
Unconventional Signature
Displaced Lepton Jets

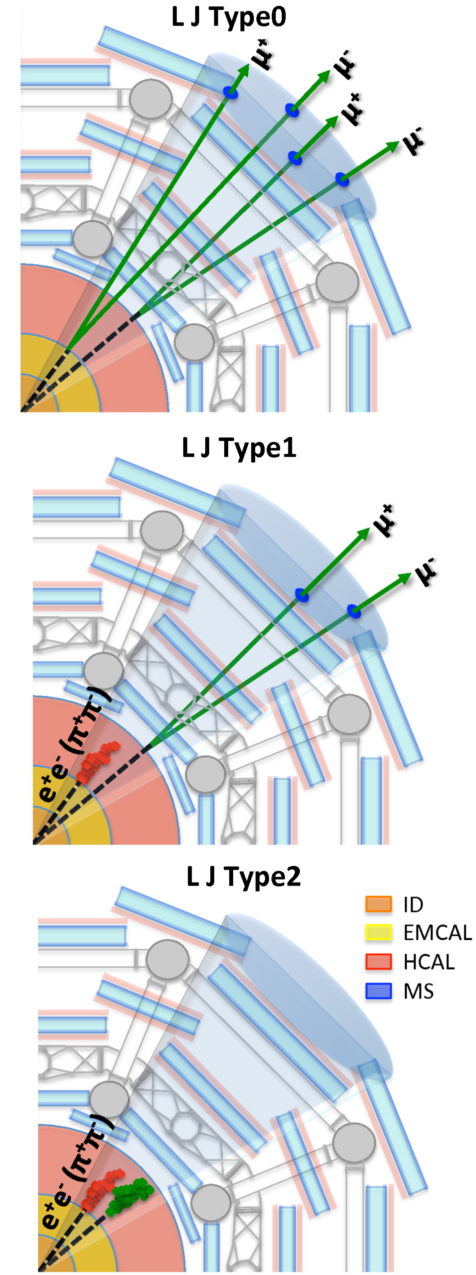
Non-prompt and collimated lepton jets from hidden sector

ATLAS-CONF-2016-042

- Weak coupling to SM particles imply long lifetime
- Search for pair of lepton-jets
- Either displaced muons
- Or imbalanced jets (high Had/EM ratio)
- Require specific reconstruction and trigger (collimated muons trigger as single and require additional HLT selection)
- Signal selected as back-to-back track isolated pairs of lepton jets.



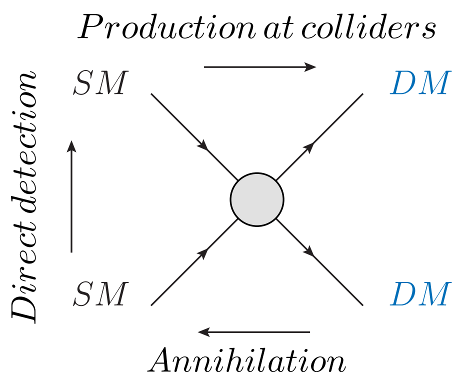




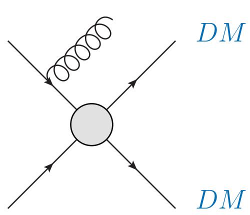
Dark Matter Searches

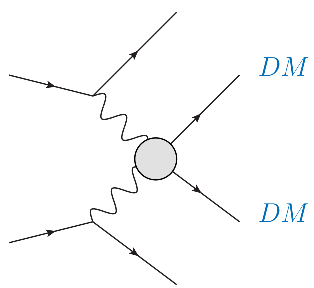
Complementarity

Of course ourstanding if seen in a lab!

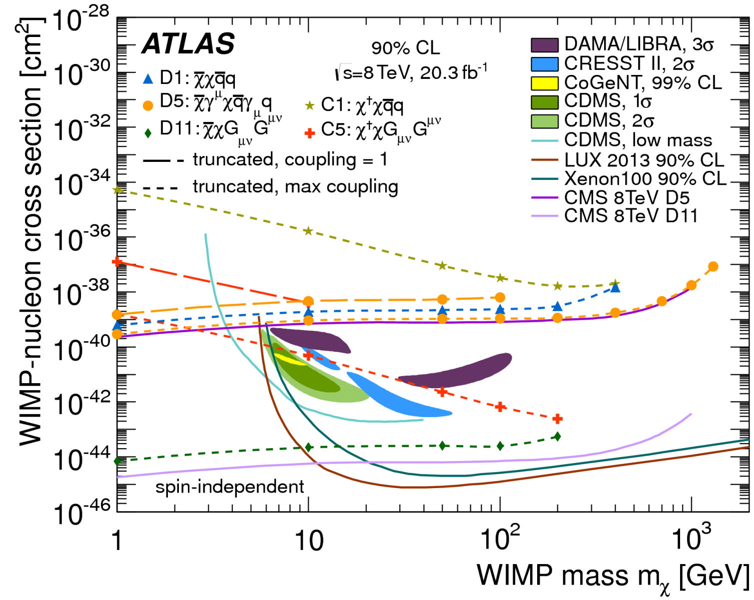


LHC more typical scenarios





At Run 1 extensive use of EFT approach allowing to compare LHC results with direct detection



EFT approach is limited to very heavy mediator masses, above O(fewTeV)

Large effort to extend framework to include accessible mediator, important for optimized/ more specific DM searches.

A successful effort to produce a prioritized and compact set of simplified models:

DM Forum benchmarks (LHC Exp. and Theory): http://arxiv.org/pdf/1507.00966.pdf

Large set of searches at LHC

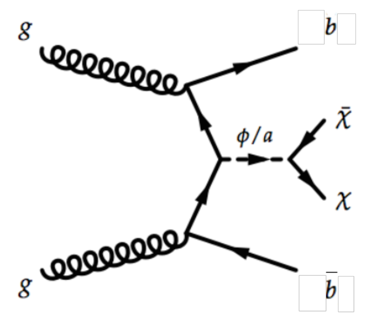
A wealth searches for DM at the LHC:

- Mono-jet, mono-V (leptonic and hadronic), Mono-Higgs (various modes), Mono-photon, Mono-top
- VBF-like signatures
- Associated production-like signatures
- Invisible Higgs searches

With first Run 2 (2015) Data, mono-

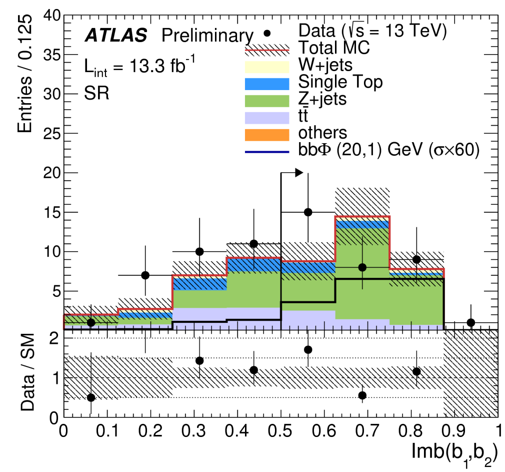
- Photon	JHEP
- Z (ll)	ATLAS-CONF-2016-056
- V (qq)	Phys. Lett. B
- H (bb)	ATLAS-CONF-2016-019

Searches with 2016 data



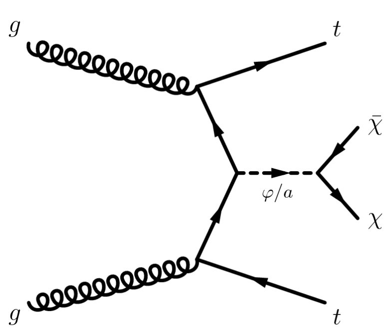
DM with a pair of b-quarks:
ATLAS-CONF-2016-086

- MET Trigger used
- Offline MET>150 GeV



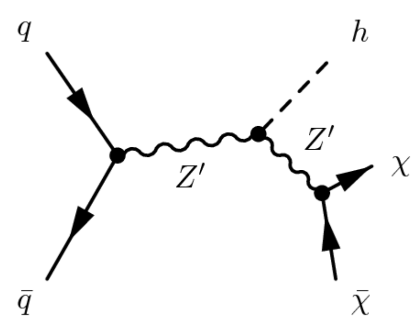
Z-jets background is dominant (from CR with 2 leptons)

Extrapolation requires good (non trivial) modeling!



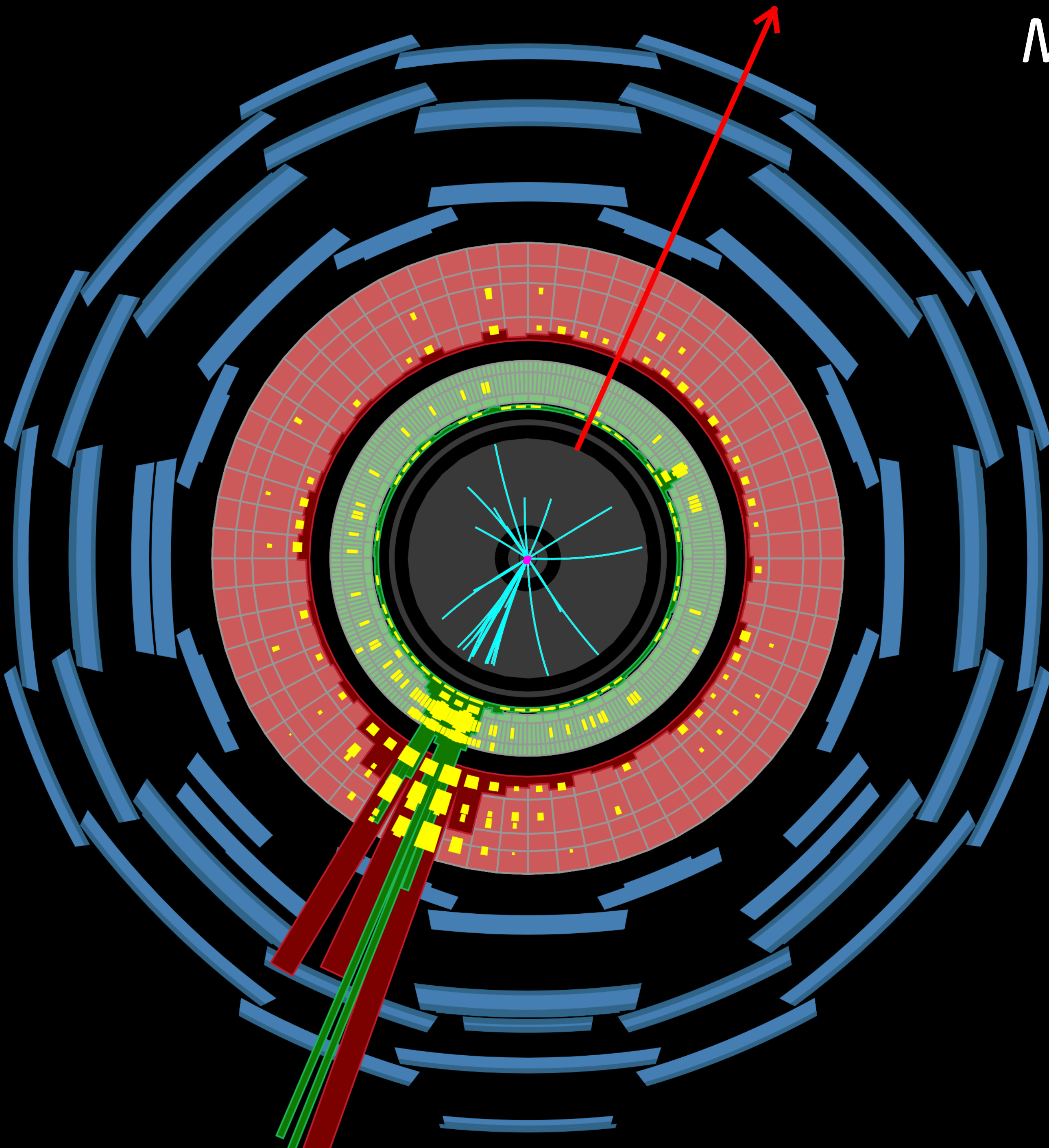
Use SUSY stop search in:

- 2L channel optimized for DM ATLAS-CONF-2016-076
- 1L channel in ATLAS-CONF-2016-050
- 0L channel in ATLAS-CONF-2016-077



Diphoton channel:
ATLAS-CONF-2016-087

Higgs diphoton-tpe analysis with analytical bkg estimate see Florencia's talk



Monojet event

ET_{jet} = 973 GeV

MET = 954 GeV

ATLAS EXPERIMENT

Run Number: 279284, Event Number: 606734214

Date: 2015-09-14 12:05:34 CEST

The Mono-Jet Search

Phs. Rev. D94 032005

Selection requirements

- Trigger in this analysis MET>70 GeV (unprescaled)
- Reconstruction level MET above 250 GeV
- At least one jet of 250 GeV (up to four jets)
- MET should be isolated from the jets

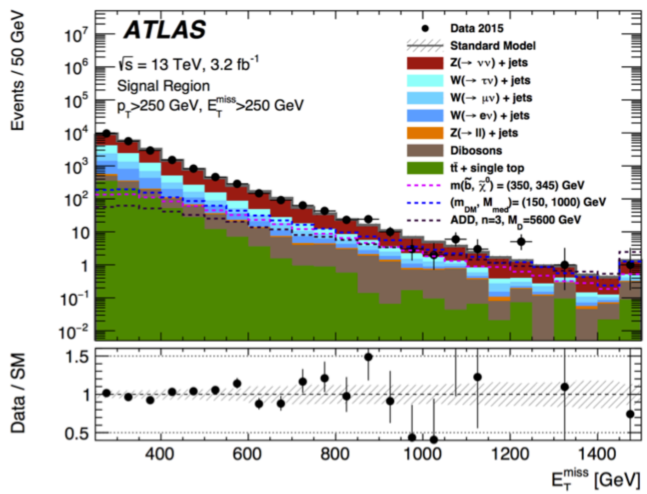
Backgrounds

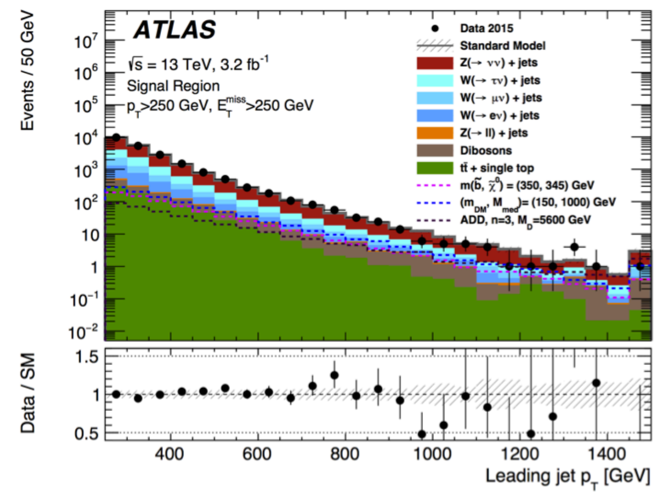
One of the main difficulties is the control of the Z(νν) and W(lν – where the leptons is outside the acceptance)

Signal region

Excellent data-prediction agreement

Main background Z(νν)+jets and W(lν)+jets

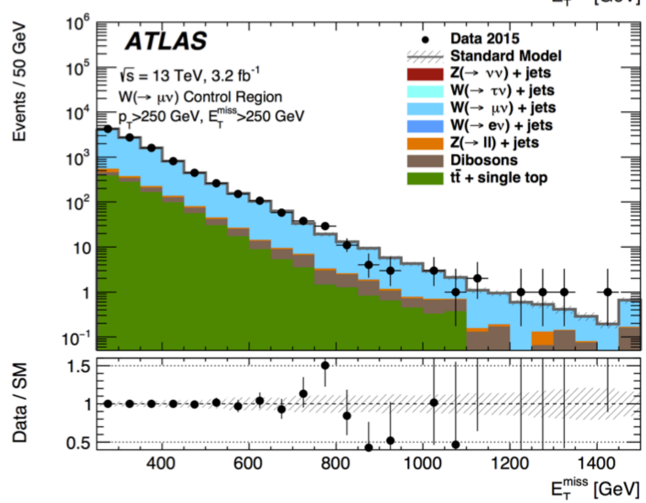


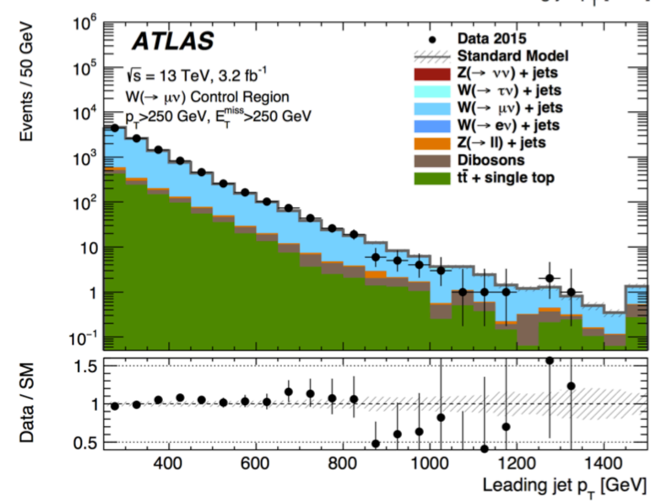


Control region

W+jets control region complements a lower statistics Z(ll) control region

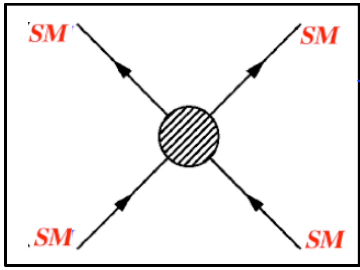
Analysis will rely on the W/Z ratio at high jet mometum



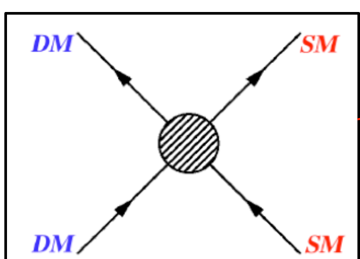


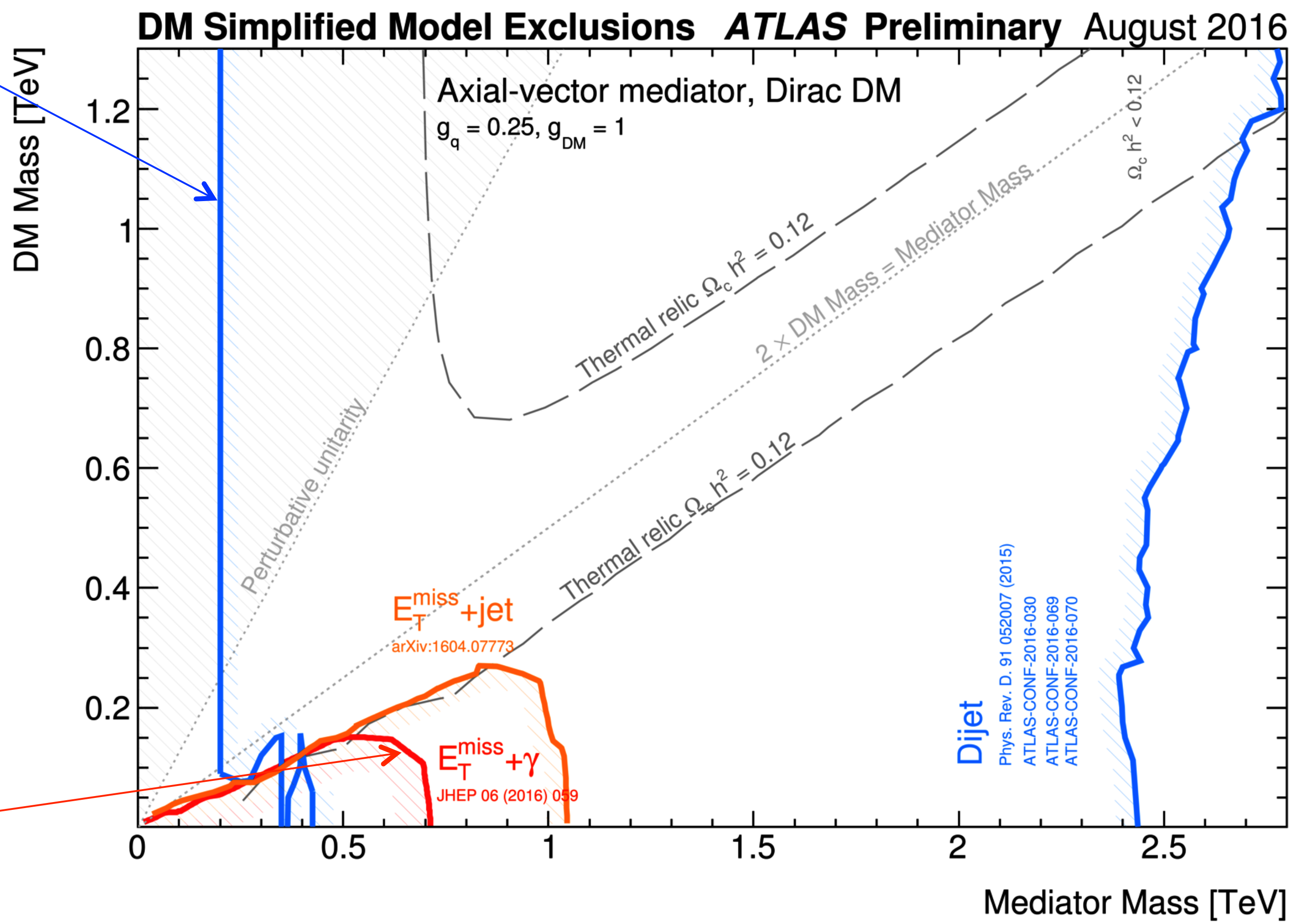
Interplay DM and Mediator Searches

In simplified model and Using the di-jet search down to the low mass range



Limits from direct searches of the mediator are mostly independent of the DM mass





Mini Searches Summary

No significant excess has been observed so far

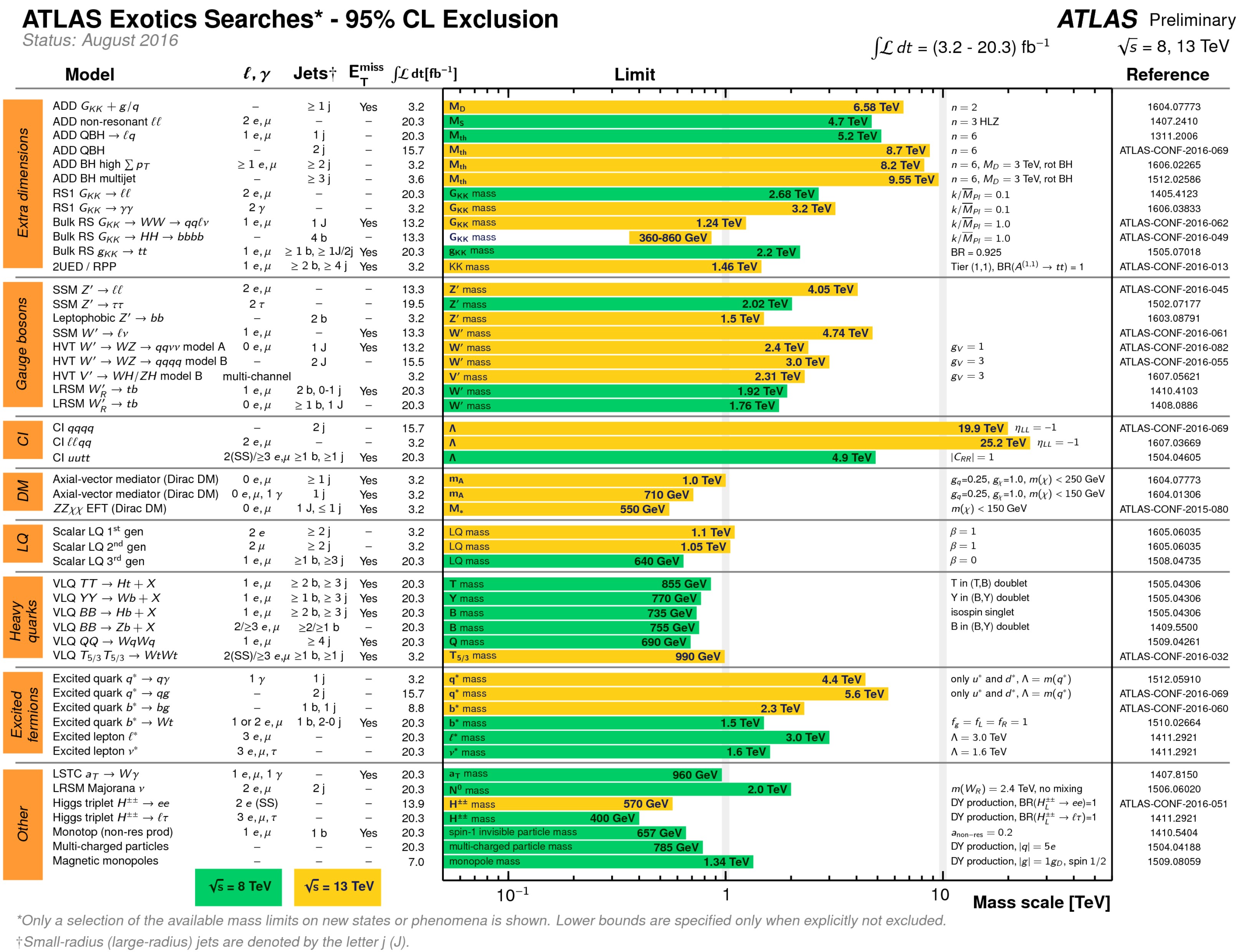
Non significant excesses to keep an eye on:

- ATLAS-CONF-2016-050 Stops 1L: In (4J, 1b, high MET) 3.3σ (No excess in CMS so far)
- ATLAS-CONF-2016-083: V(W)H (Full hadronic boosted): 3.5σ (2.5σ global) at 3 TeV
- ATLAS-CONF-2016-084: Paired dijet local 2.6σ (2.1 σ global) at 870 GeV
- ATLAS-CONF-2016-079: Four leptons high mass 2.9σ (1.9 σ global) at 705 GeV
- ATLAS-CONF-2016-058: ttH ML in SS-0τ and SS-1τ not significant but excesses at Run-1 in ATLAS and CMS
- LFV Higgs decays to $\tau\nu$ (discussed in Florencia's talk)

Exotics Overview

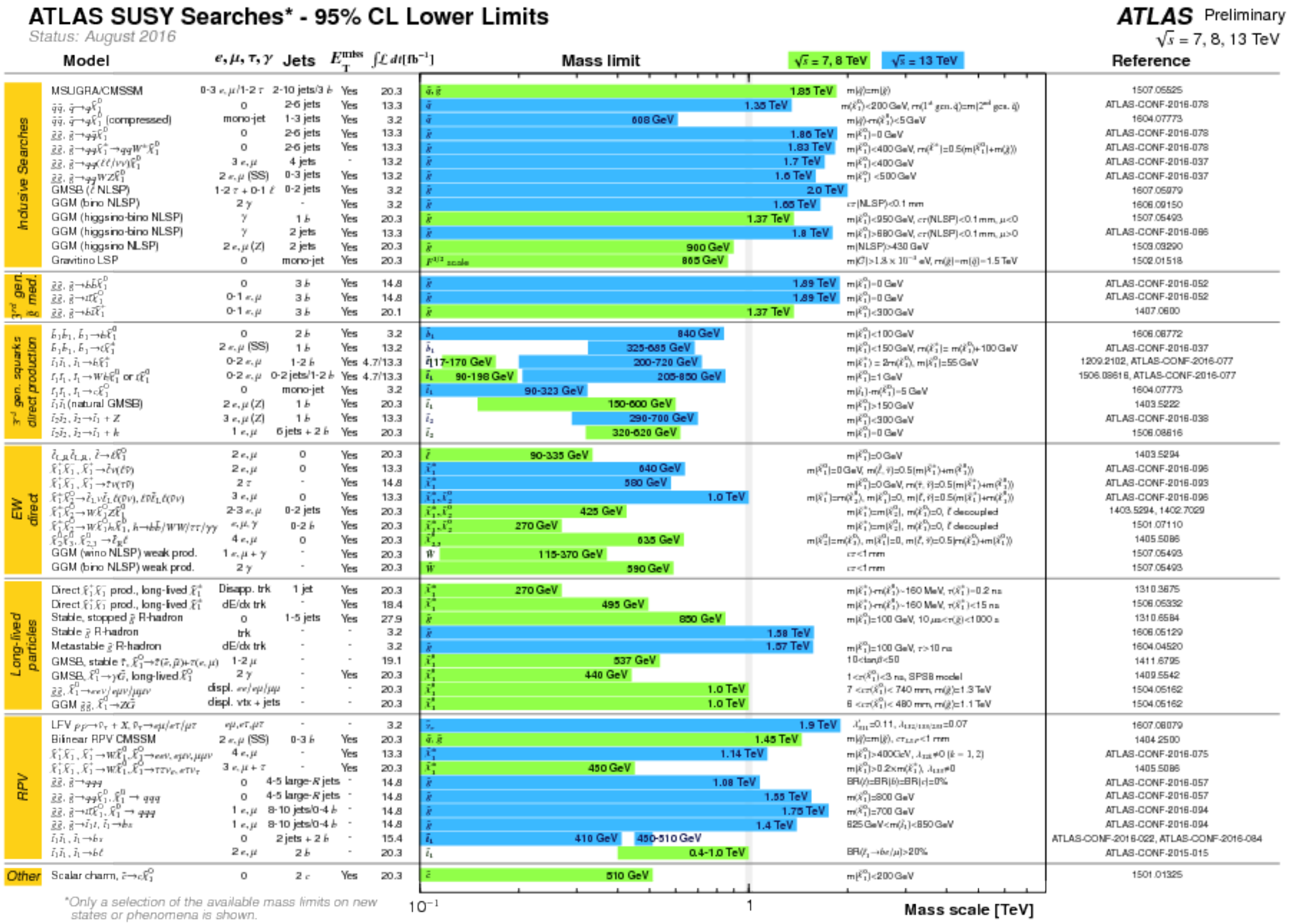
Summary of searches Run 2 in perspective: very large ground covered still more to come!

Also illustrates the large number of searches not covered in this talk



SUSY Overview

Summary of SUSY Run 2 in perspective: very large ground covered still more to come!
Main analyses and in compressed scenarios.



Also illustrates the large number of searches not covered in this talk

Summary and Conclusions

With the higher centre-of-mass energy, the outstanding results expected from the Run 2 are the direct searches for new physics. The strategy is to look exhaustively at all possible scenarios and topologies.

A very large number of event topologies has been studied to search for departures from the SM. No significant ones have been found so far.

The search program at LHC relies greatly on the TH community for two key aspects:

- The modeling of SM processes, ATLAS has moved to state-of-the-art simulation for most processes at Run 2 already.
- Proposing models of theoretical relevance to motivate searches of unexplored domains of phase space.

The LHC is now half way through the Run-2, with approximately 1/4 of the data expected for the entire Run 2 (reappraised goal of 150 fb^{-1}).

This dataset is just a small fraction of the Run 2 dataset (~10%) and very small fraction of the total HL-LHC dataset (~1%). This is just the beginning and there are any more exciting challenges ahead!