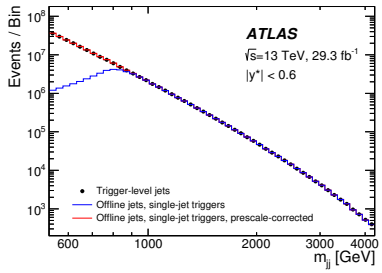
New search results for low-mass dijet resonances using trigger-level jets

Search for low-mass dijet resonances using trigger-level jets with the ATLAS detector in pp collisions at $\sqrt{s}$ = 13 TeV, arXiv:1804.03496 [hep-ex]

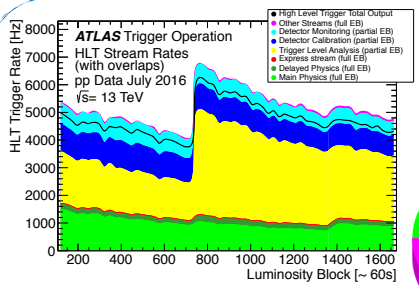


Trigger bandwidth limitations -> ~40 Hz for single jet trigger -> offline m_{jj} > 1 TeV

CMS [1,3] and LHCb [2]: trigger reconstructs lots of event, use for analysis!

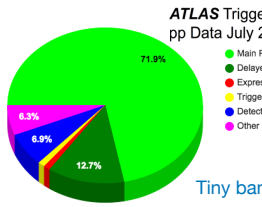
collect data

New stream in 2016: record HLT jets (0.5% of full event size)



Very high rate compared to main physics stream

L1 E_T	p_T	Analysis m_{jj}	Data
75	185	400 (|y*|<0.3)	3.6 fb⁻¹
100	220	531 (|y*|<0.6)	29.3 fb⁻¹



Tiny bandwidth impact

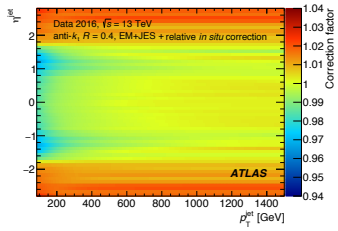
calibrate the jets

EM-scale jets → Jet-area based pileup correction → Absolute MC-based calibration → Global sequential calibration → Eta intercalibration → Trigger-to-offline data-derived correction → Residual *in-situ* calibration

- *Jet finding applied to topological clusters at the electromagnetic scale*
- *Applied as a function of event pileup p_T density and jet area only*
- *Corrects the jet 4-momentum to the particle-level energy scale. Both the energy and direction are calibrated*
- *Reduces flavor dependence and energy leakage using calorimeter variables only*
- *Corrects the scale of forward jets in data to that of central jets, using the p_T balance ratio between data and simulation, applied only to data*
- *Corrects trigger-level jets to the scale of offline jets, applied only to data*
- *A smooth residual calibration is derived by fitting in-situ measurements and applied only to data*

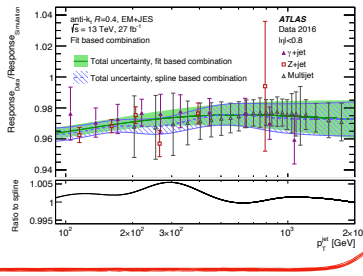
——— *Derived for offline jets*

····· *Derived specifically for trigger jets*



2: trigger to offline **scale factors**

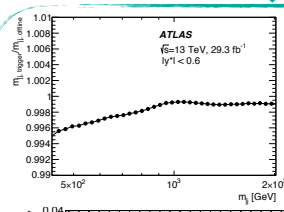
3: Higher statistical precision than in-situ combination: **new smoothing procedure** (see E. Hansen's poster!)



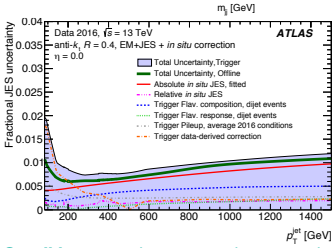
Save enough HLT information to **calibrate jets** - as close as possible to offline

1: **don't have tracks**: substitute calorimeter information in GSC

check it worked!

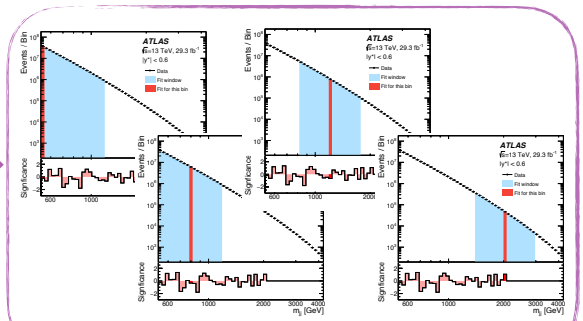


Excellent agreement with offline dijet mass after calibration



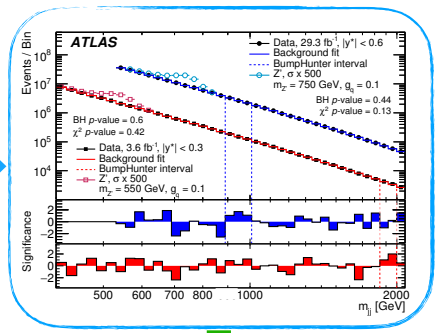
Small increase in systematic uncertainty

background estimate: fit



3×10^7 events in first bin: fit sub-ranges with sliding window

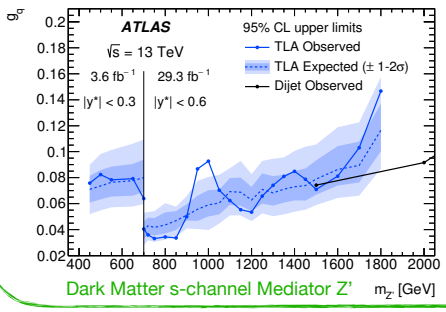
look for bump



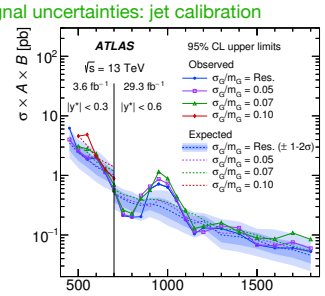
set limits

Bayesian method to set limits: refit, including signal shape with floating normalisation

Background uncertainties: function choice, Signal uncertainties: jet calibration

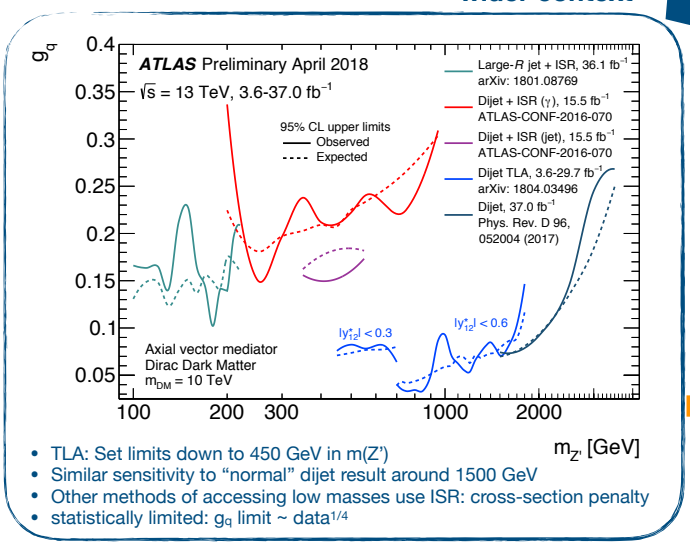


Dark Matter s-channel Mediator Z'



Gaussian

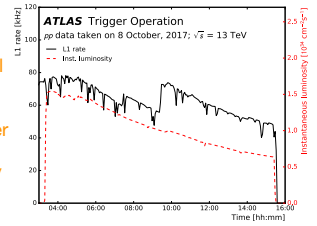
wider context

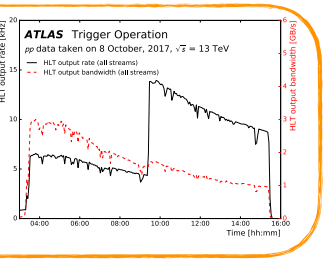


- TLA: Set limits down to 450 GeV in m(Z')
- Similar sensitivity to "normal" dijet result around 1500 GeV
- Other methods of accessing low masses use ISR: cross-section penalty
- statistically limited: g_q limit ~ data$^{1/4}$

future

Make use of L1 rate at end of fill (below 10^{34} cm^{-2}s^{-1}) to run extra TLA trigger (J50) -> will allow sensitivity to even lower masses





William Kalderon (Lund University), on behalf of the ATLAS Collaboration

[1] CMS, *Search for narrow resonances in dijet final states at $\sqrt{s}$ = 8 TeV with the novel CMS technique of data scouting*, Phys. Rev. Lett. 117 (2016) 031802
[2] LHCb, *Tesla : an application for real-time data analysis in High Energy Physics*, Comput. Phys. Commun. 208 (2016) 35
[3] CMS, *Search for dijet resonances in proton–proton collisions at $\sqrt{s}$ = 13 TeV and constraints on dark matter and other models*, Phys. Lett. B 769 (2017) 520