LHC Experiments and Computing

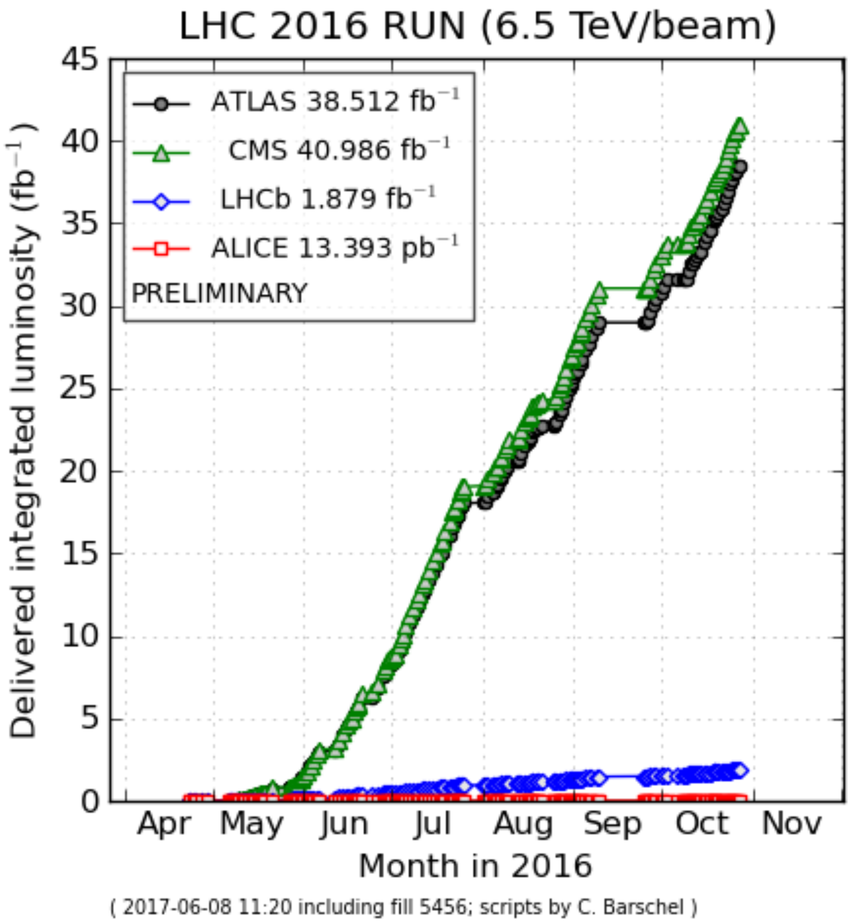
E.Elsen

CERN Council, 185th Session, June 15-16, 2017

a few physics results from the 2016 harvest…

Searches at the highest energy

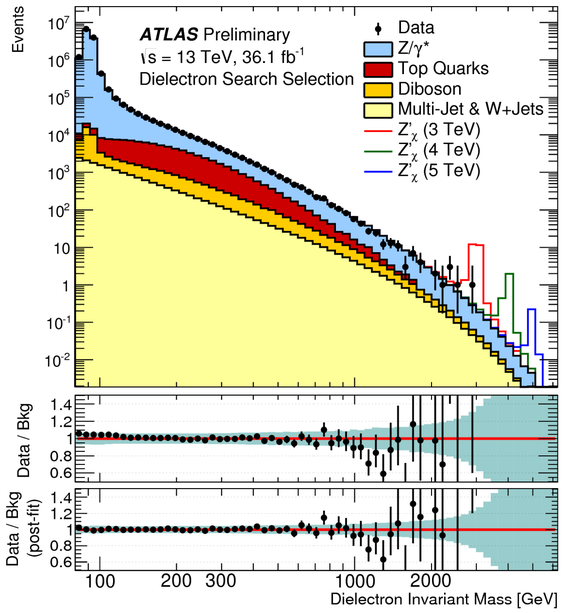
- Increased energy of 13 TeV in run 2 and the large statistics of the 2016 allow for searches at the highest energy / masses
  - Probing the TeV region
- Many new results presented at Moriond and LHCP in Shanghai

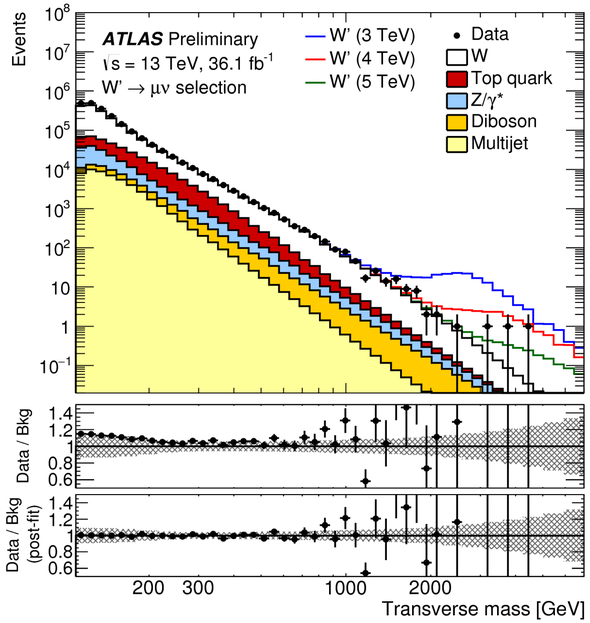


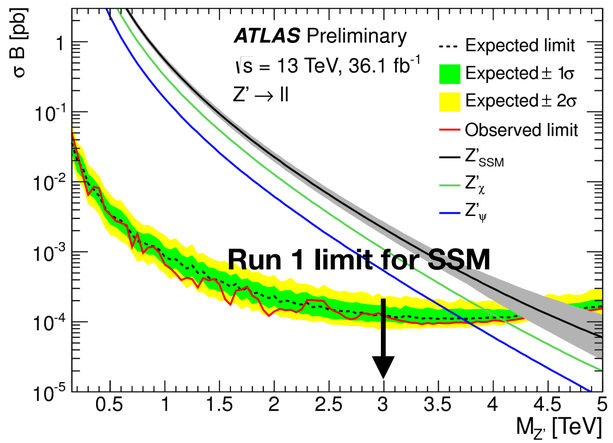
Di-lepton and lepton + E_T^{miss} searches

ATLAS-CONF-2017-016 ATLAS-CONF-2017-027

- **Resonance** search on top of **Drell-Yan or W background**
  - Main predicted with Powheg (NLO) and include NNLO QCD and NLO EW corrections.
- **No excess over SM predictions** →Limits extracted in various Z' and W' scenarios.



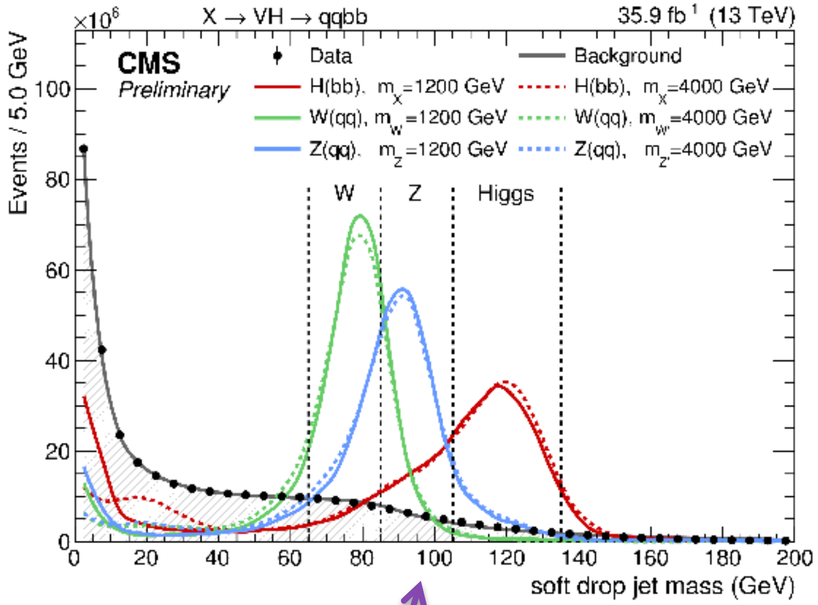




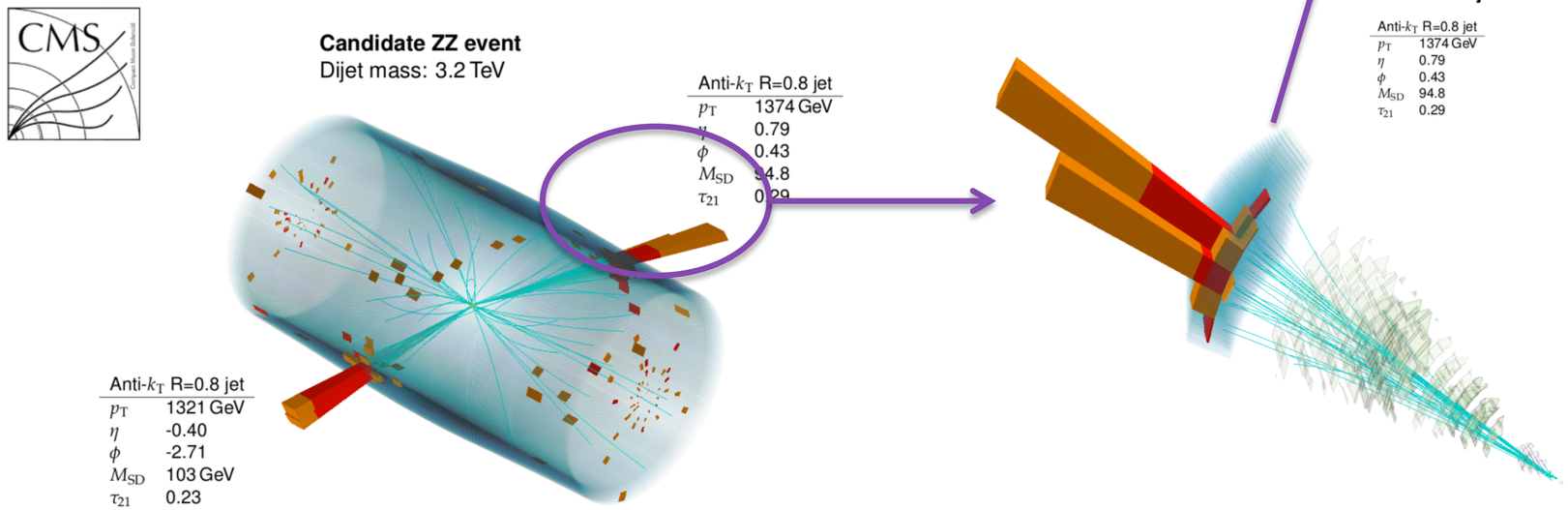
SSM: same couplings as in SM assumed

Searches with boosted objects

- Search for resonances that decay into heavy bosons: X → VV, VH, qV
  - Use jet substructure & boosted double-b tag

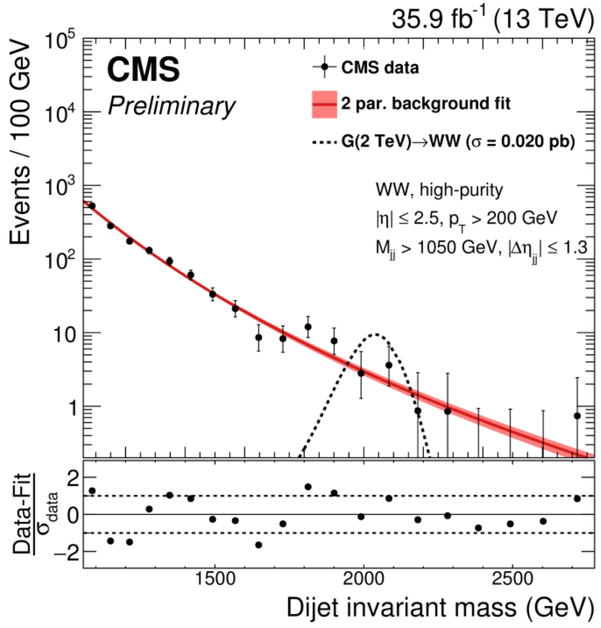


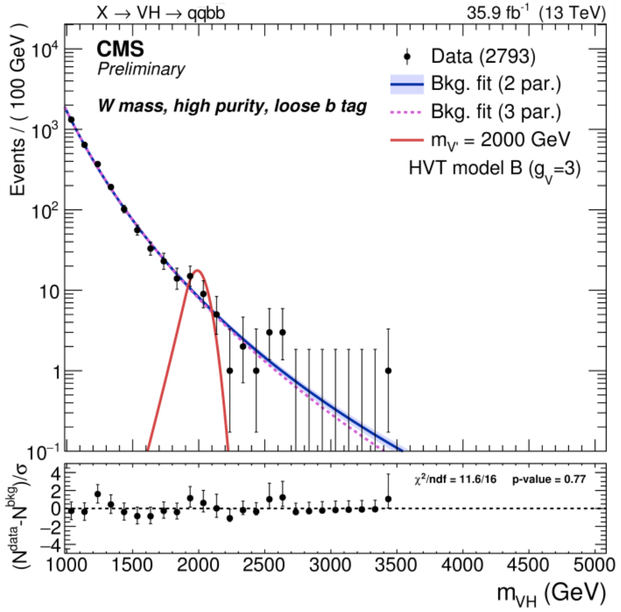
CMS PAS B2G-17-001, 17-002

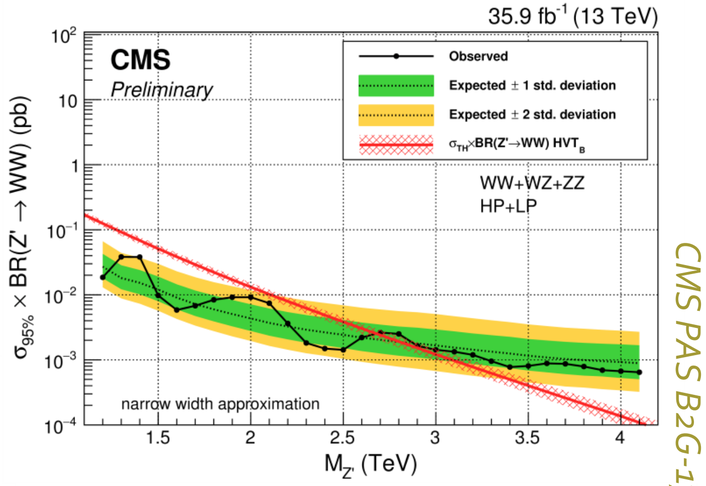


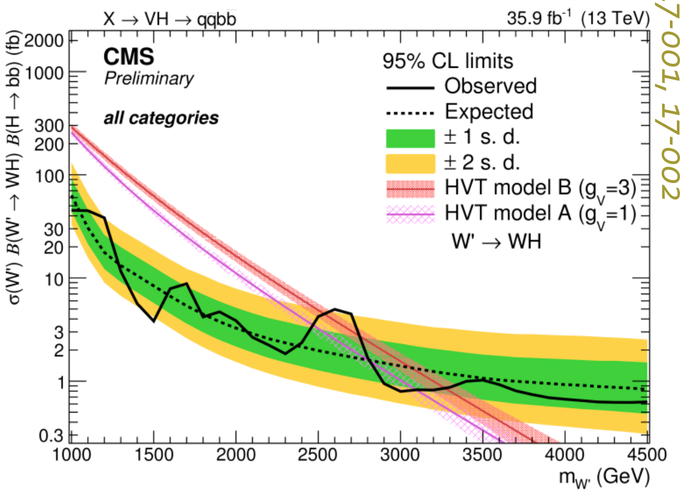
Searches with boosted objects

- Background fitted directly from data using analytic funtions
- Sensitivity to diboson resonances up to ~3 TeV









CMS PAS B2G-17-001, 17-002

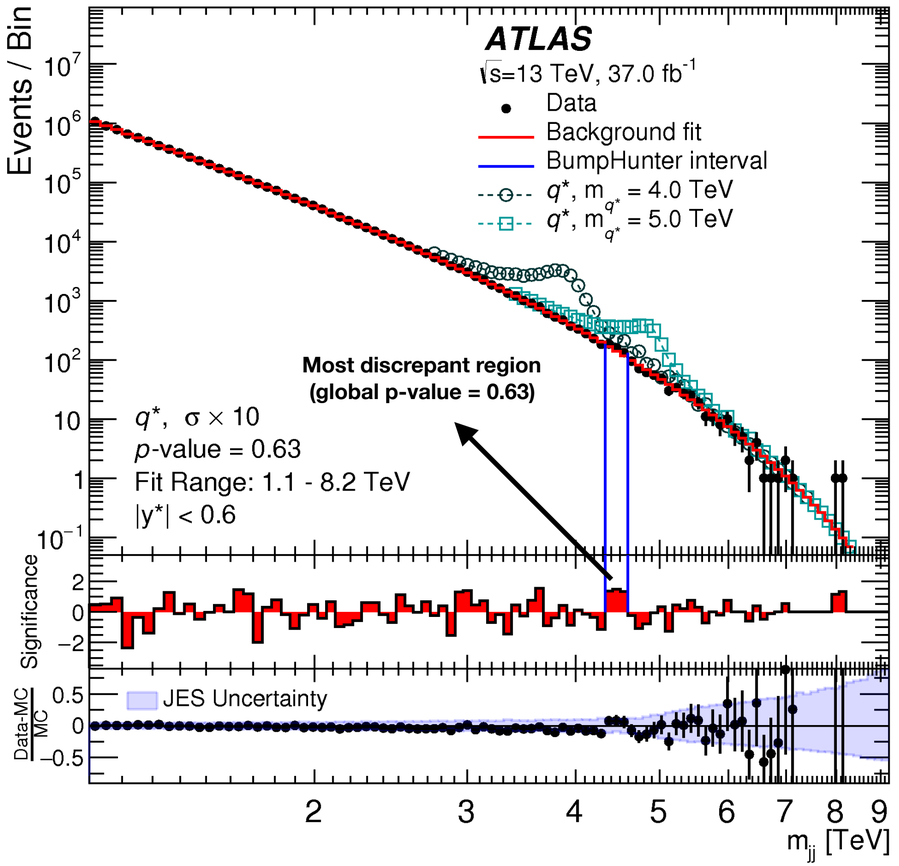
Searches in di-jet final states

arXiv:1703.09127

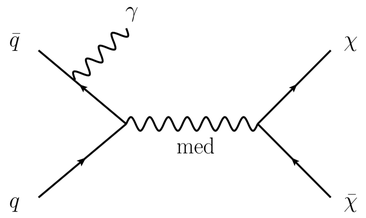
- **Di-jet mass** and **angular searches** (focus on the former)
- Trigger: **single jet** (p_T^{offline} > 440 GeV).
- **Background fit** with a **parametric function in sliding windows**

$$f(z) = p_1(1-z)^{p_2} z^{p_3}$$

  - Interpretations in **excited quark, ADD, W', Z' models**.
    - Results given also for generic gaussian resonances of variable width to ease recasting.
  - **Excited quark limits at m_{q^*} = 6 TeV (was 4 TeV in Run 1).**



$\gamma + E_T^{miss}$



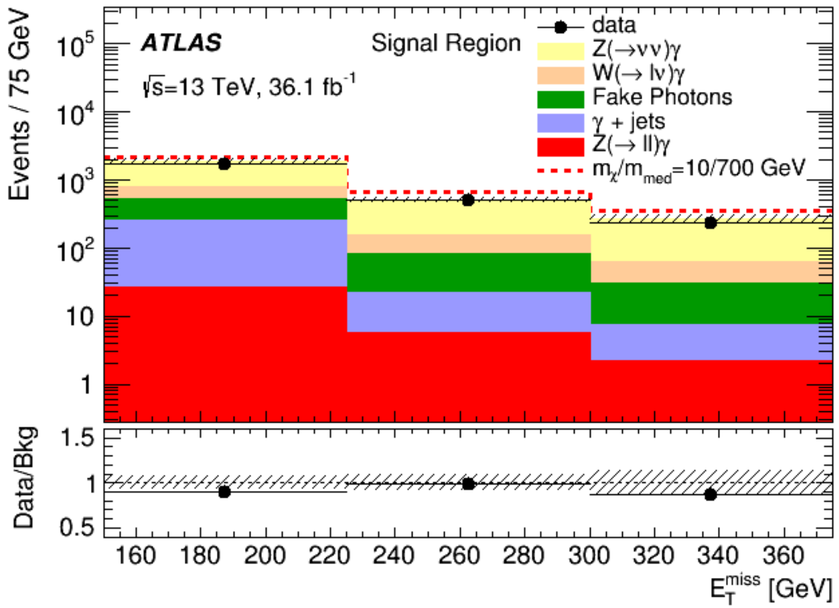
ATLAS EXPERIMENT

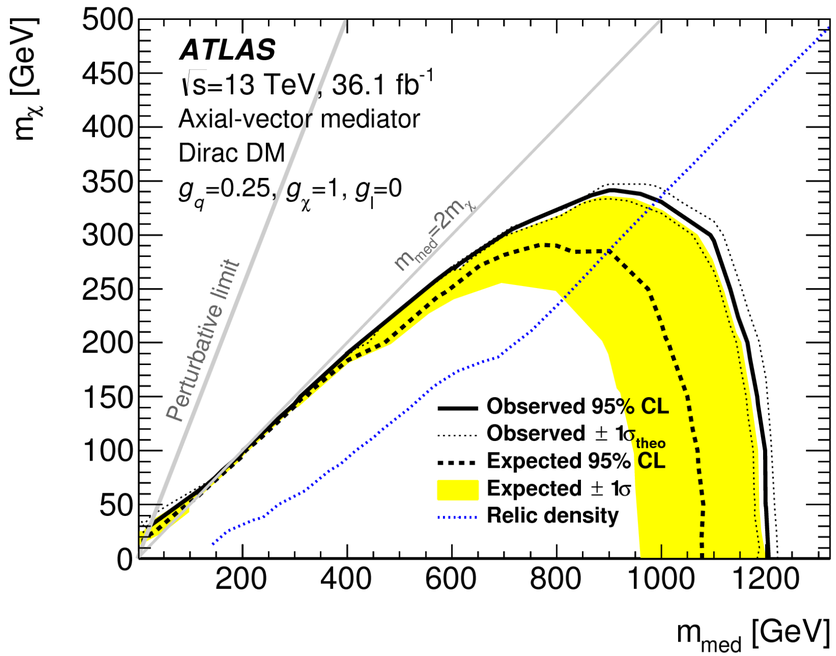
ATLAS

arXiv:1704.03848

- Search for an excess of events with a **high-p_T γ and large E_T^{miss}.**
  - Dominant background SM $Z\gamma \rightarrow \nu\nu\gamma$, normalised in dedicated ee(μμ)γ control regions.
- Results interpreted in **simplified DM models** (for several assumptions).

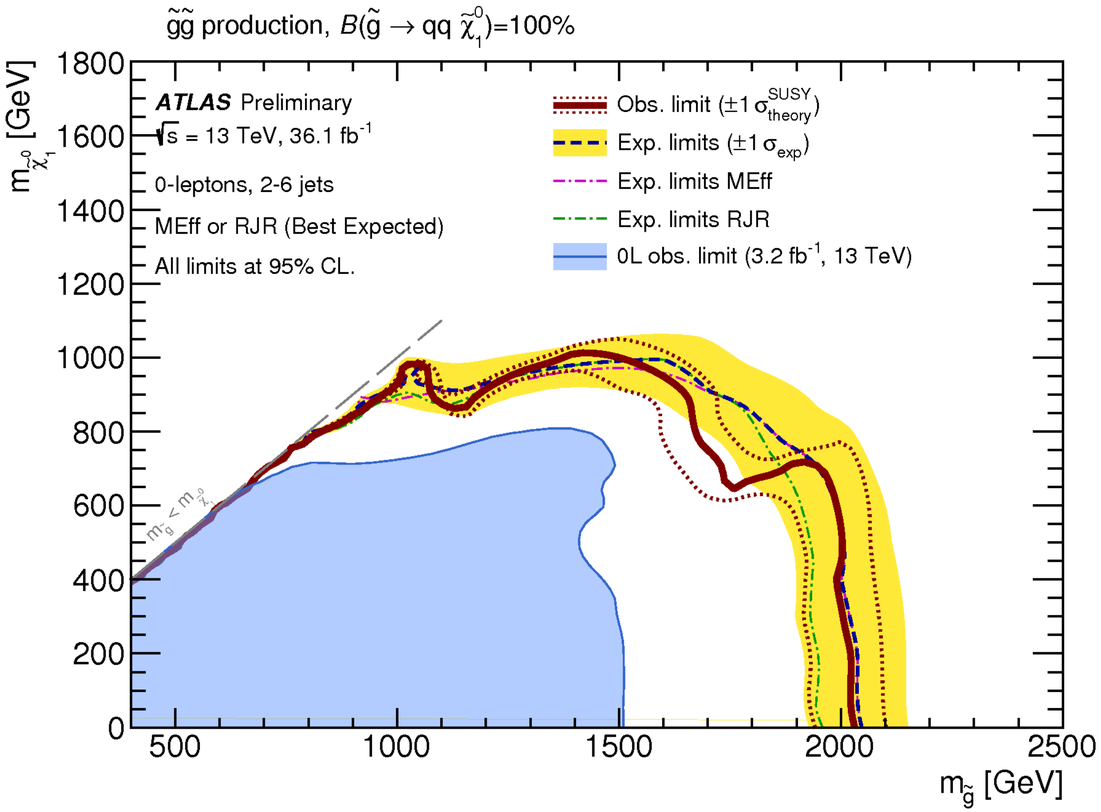
Dark Matter Search



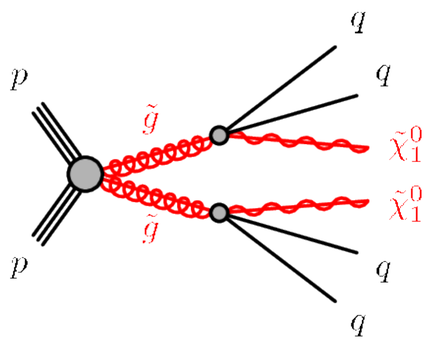


Breaking the 2 TeV scale for gluinos

- Vanilla SUSY in **jets +E_T^{miss} signatures.**

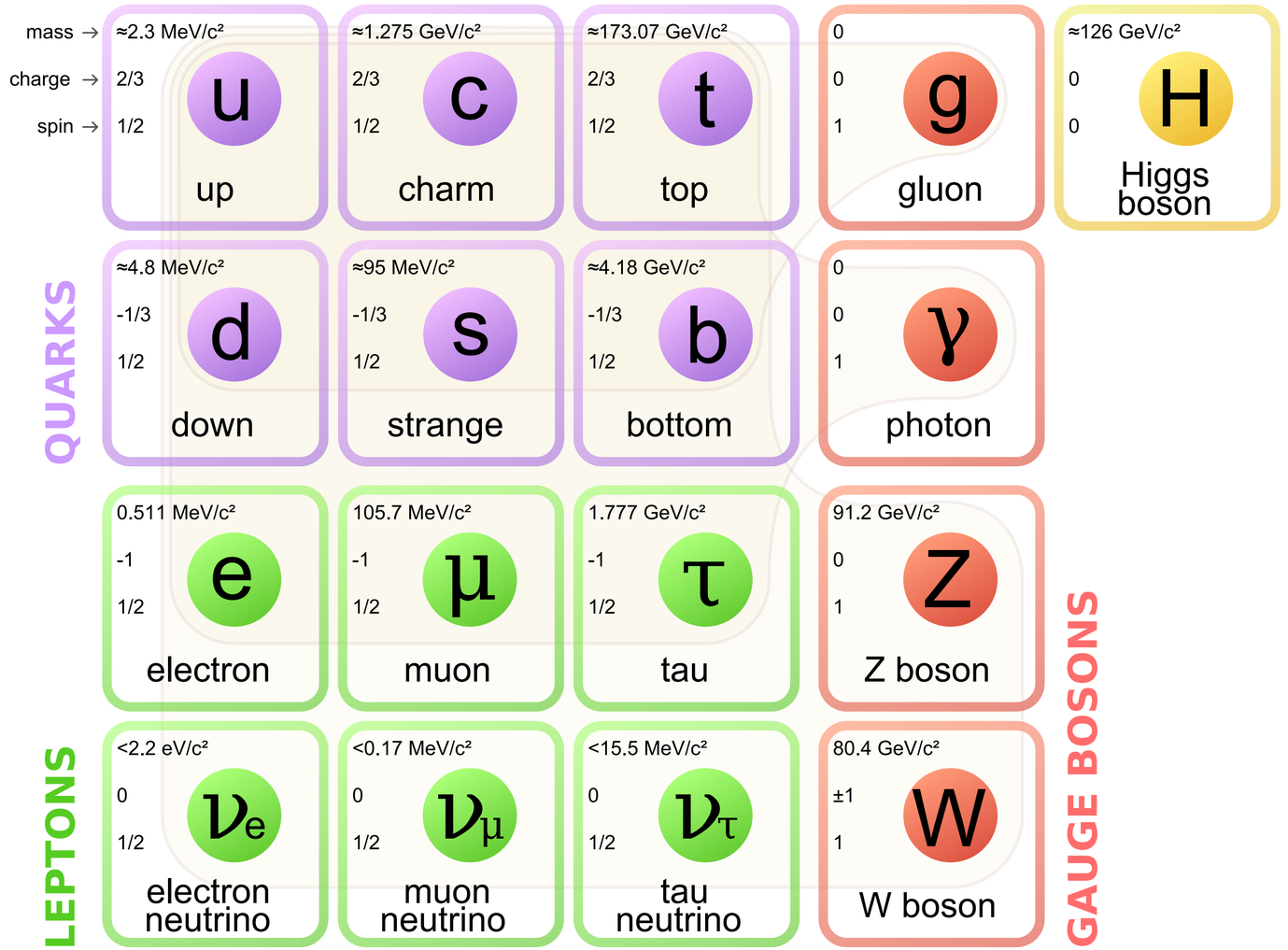


ATLAS-CONF-2017-022



Lepton Universality

- Couplings of leptons should be identical (ℓ = e, μ, τ)
  - apart from calculable mass effects
  - $B \rightarrow K\,ee = B \rightarrow K\,\mu\mu$



Measurement of R_{K^*}

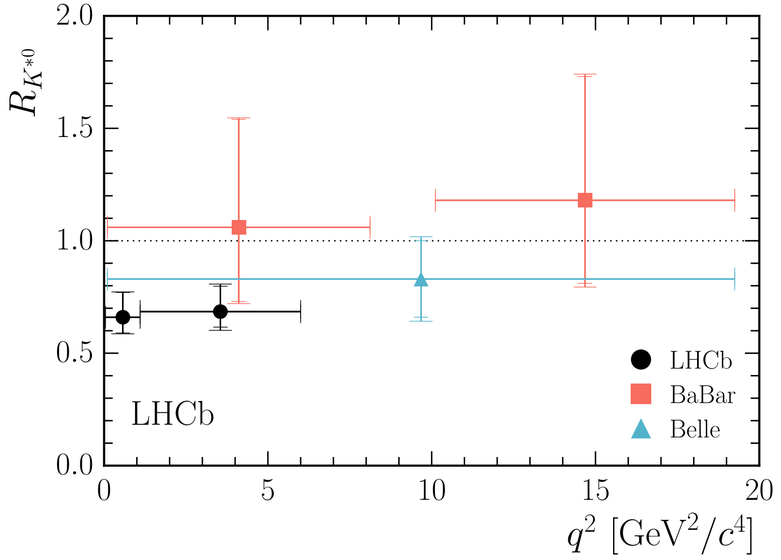
Expect μμ and ee-branchings to be the same – apart from well understood mass contributions

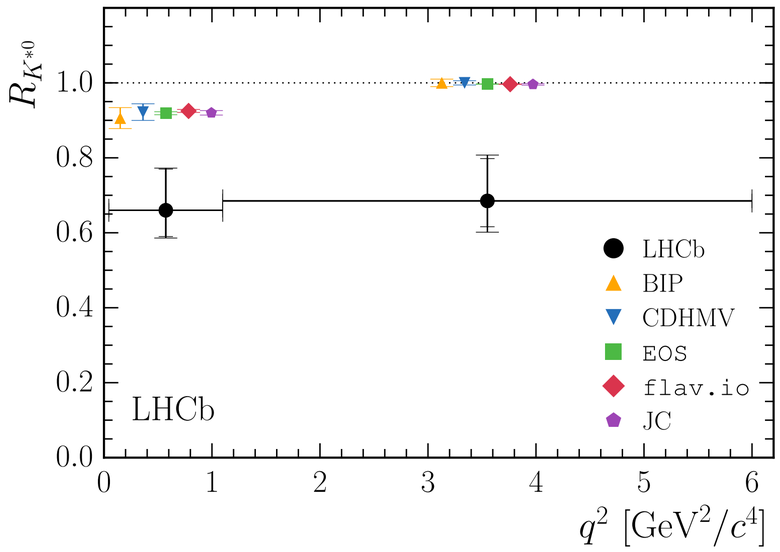
$B^0 \to K^{*0}\,\ell\ell$

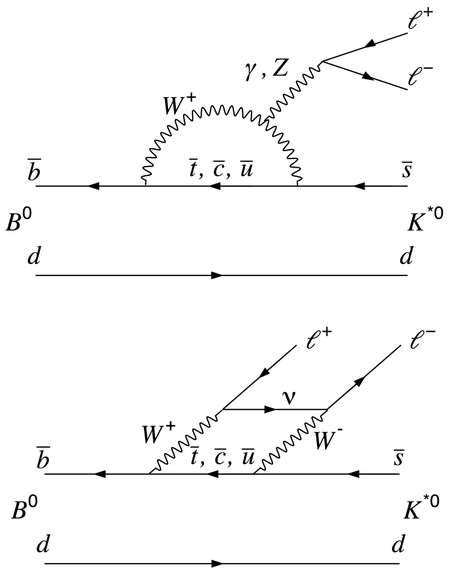
LHCb-Paper-2017-013

So far a ~2.5 σ effect (Run 1 data only)

$$R_{K^{*0}} = \frac{\mathcal{B}(B^0 \to K^{*0}\mu^+\mu^-)}{\mathcal{B}(B^0 \to K^{*0}J/\psi(\to \mu^+\mu^-))} \Big/ \frac{\mathcal{B}(B^0 \to K^{*0}e^+e^-)}{\mathcal{B}(B^0 \to K^{*0}J/\psi(\to e^+e^-))}$$



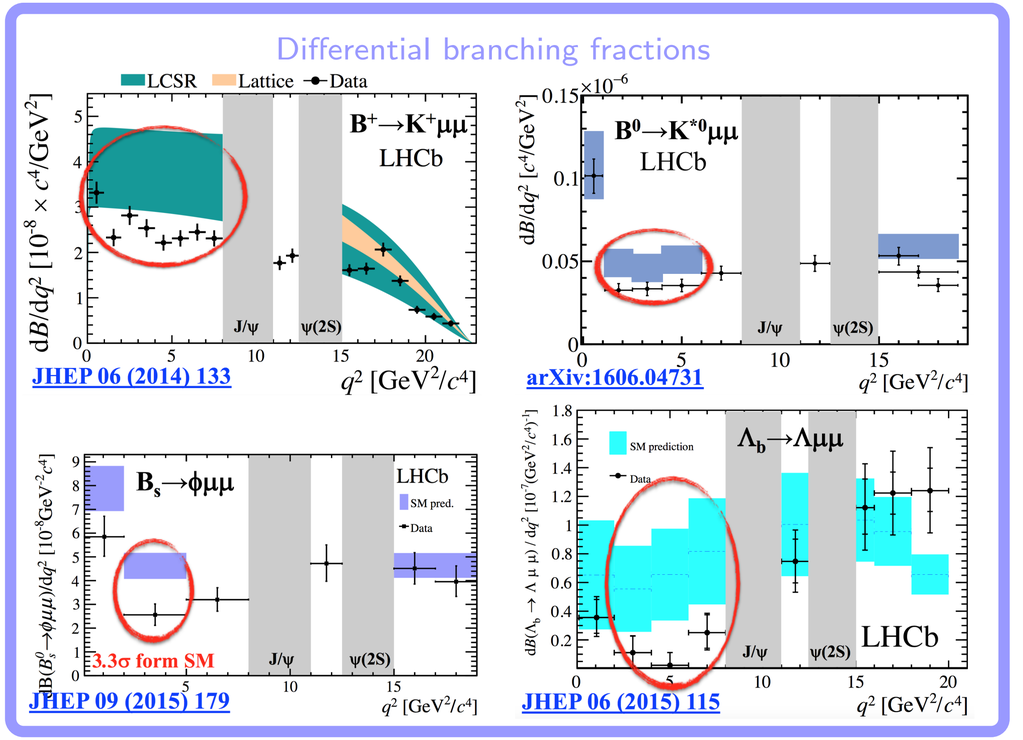


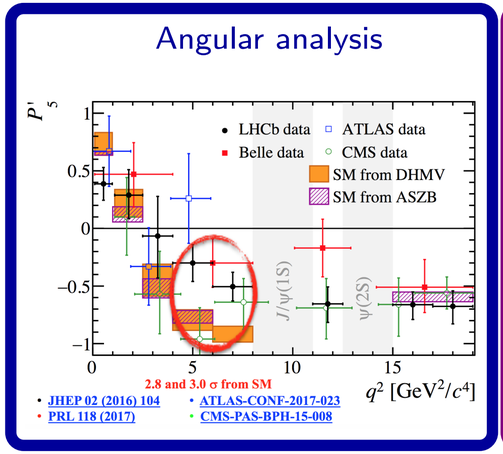


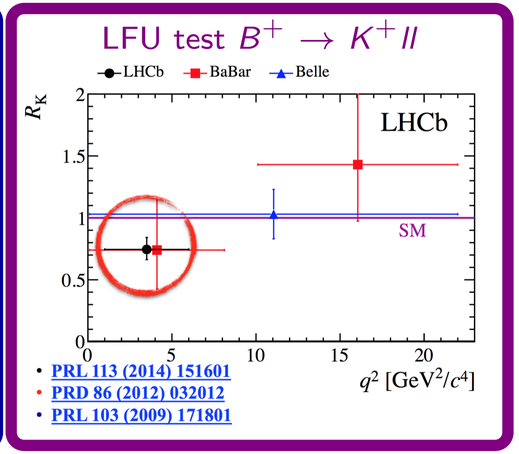
Other related anomalies

LHCb

- The result is interesting in context of other measurements:
  - test of LFU with $B^+ \to K^+ ll$
  - differential branching fractions
  - angular analyses
- First week after CERN $R_{K^{*0}}$ seminar: 15 theory papers.
- More statistics needed.
- Run II analyses are ongoing.
- Stay tuned!







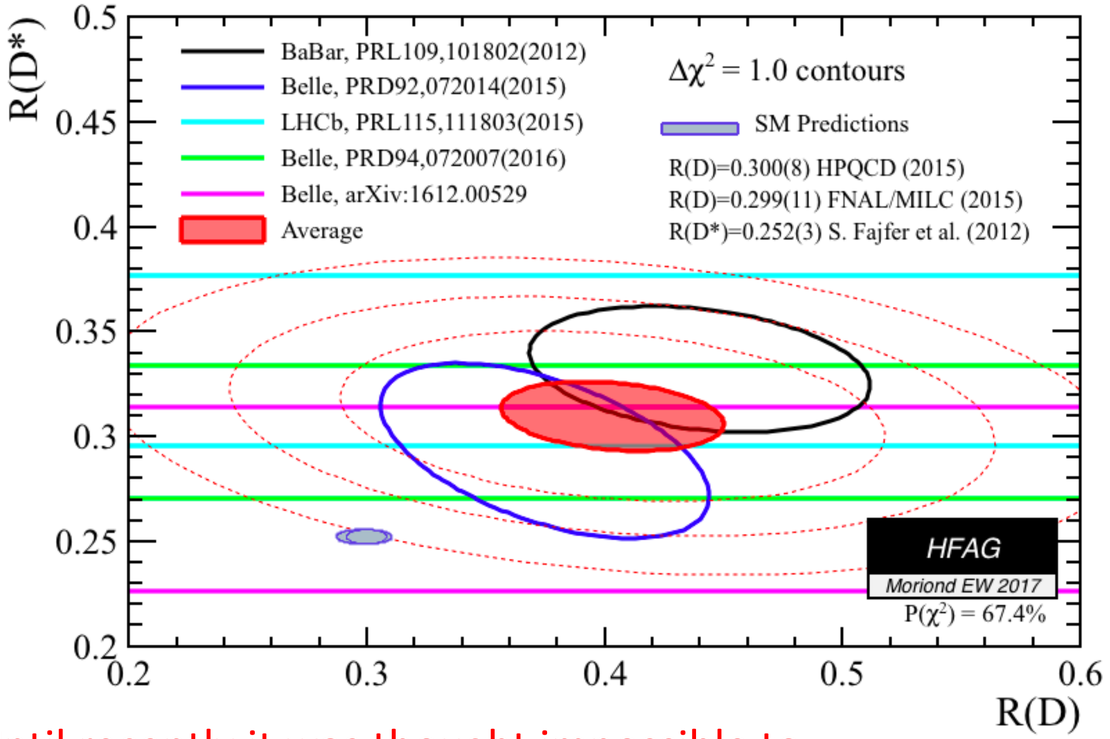
Flavour anomalies: new measurement of R(D*)

[LHCb-PAPER-2017-017]

Long standing discrepancy at B-factories, and more recently LHCb, between measurements of $R(D^{(*)}) = BR(B \to D^{(*)}\tau\nu)/BR(B \to D^{(*)}\mu\nu)$ and theory expectation based on lepton universality.

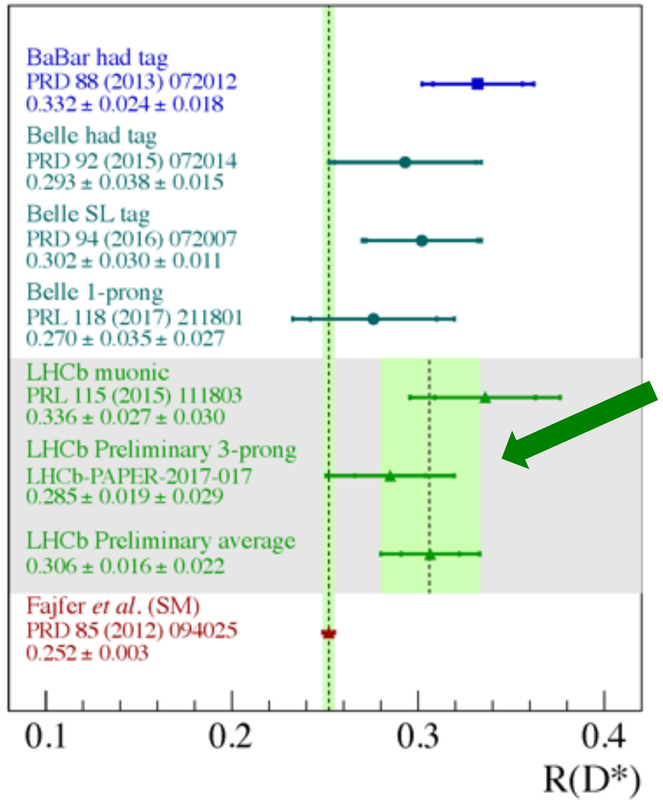
A new measurement by LHCb of R(D*) exploiting, for the first time, the 3-prong decay of the τ adds to the puzzle.

Situation before recent LHCb update: 3.9 σ tension.



Until recently it was thought impossible to measure these quantities at a hadron collider !

New result is ~1 sigma above SM, & consistent with past measurements. With this the global picture remains unchanged.



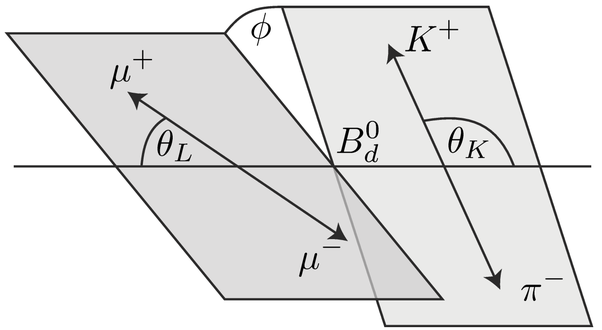
New result

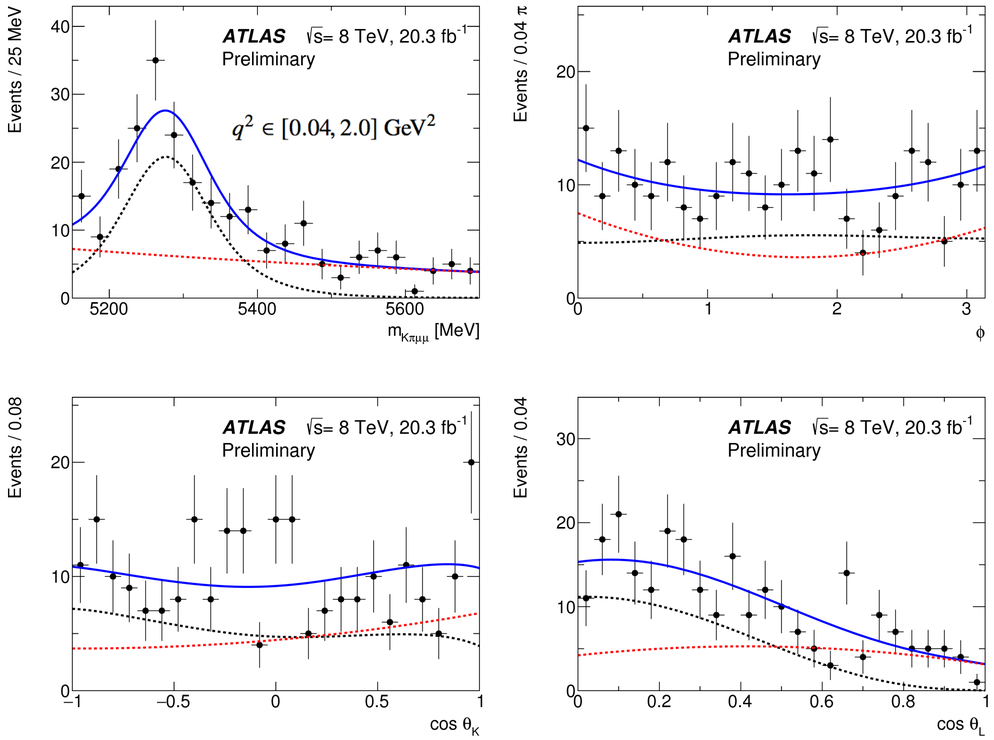
More LHCb measurements of $R(D^{(*)})$ coming soon !

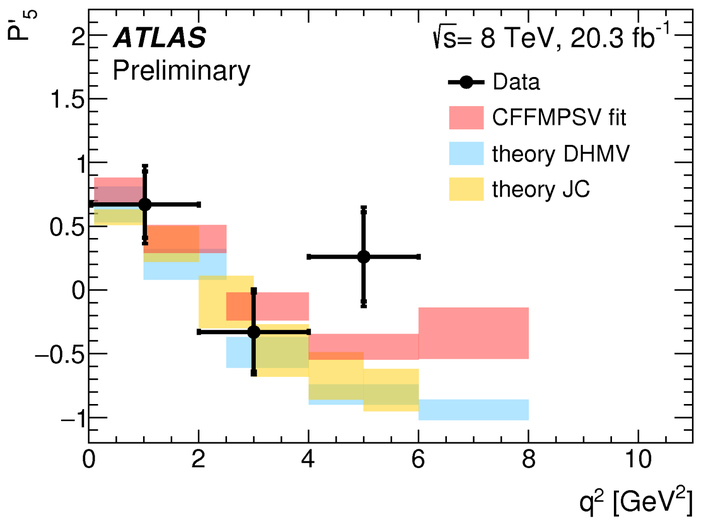
Run 1: Angular analysis of $B_d \to K^* \mu\mu \to K\pi\mu\mu$

ATLAS-CONF-2017-023

- Use Belle/LHCb variables: study **angular distributions** in bins of the **dimuon invariant mass** for θ_L, θ_K,Φ.
- Measurement **statistically limited.** Agreement with SM is found.





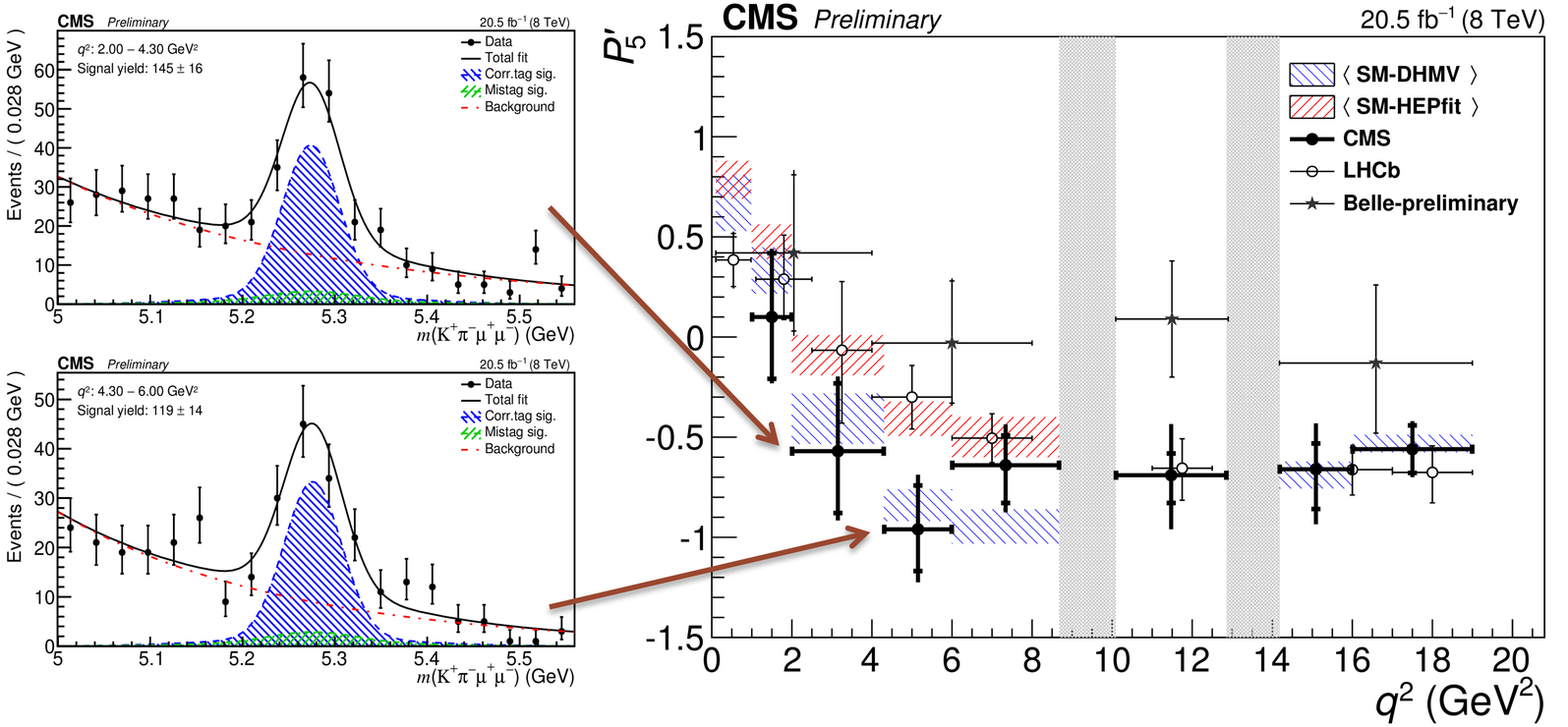


CMS

Run 1 measurements: $B^0 \to K^{*0} \mu^+\mu^-$

- 4D unbinned fit for angular parameters in B^0 decay
  - Try to address the tension between P_5' measurements in LHCb & Belle and the a-priori SM predictions (DHMV)
  - CMS result more SM-like, but compatible with both

S. Descotes-Genon, L. Hofer, J. Matias, J. Virto



CMS PAS BPH-15-008

Snapshot of Lepton Flavour Analyses

- Interesting hints or fluctuations in data
  - more data available (2016) and new data to come in 2017
  - all experiments are analysing

We are just at the beginning of exploring unknown territory

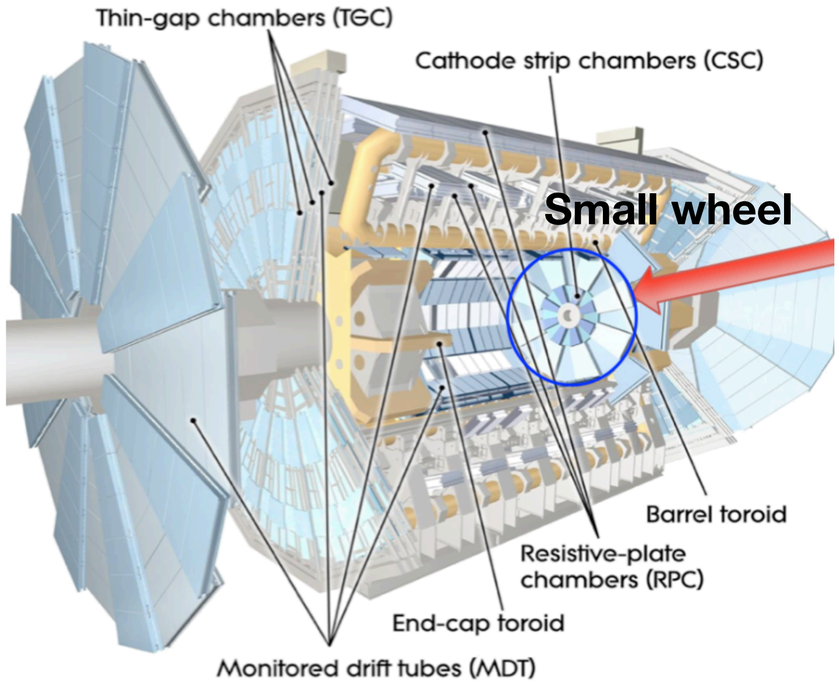
ATLAS – upgrades

Phase 1

ATLAS

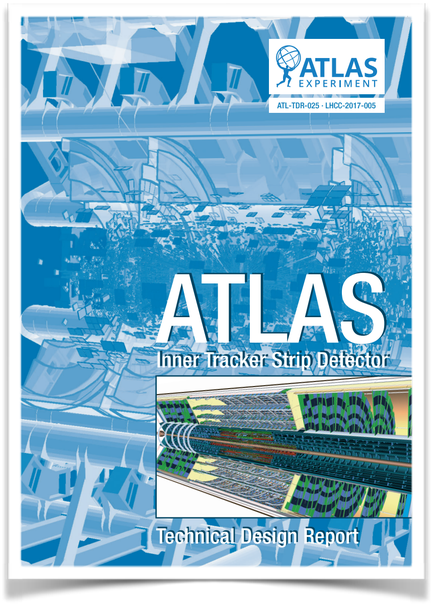
ATLAS New Small Wheel still on critical path for LS2 installation

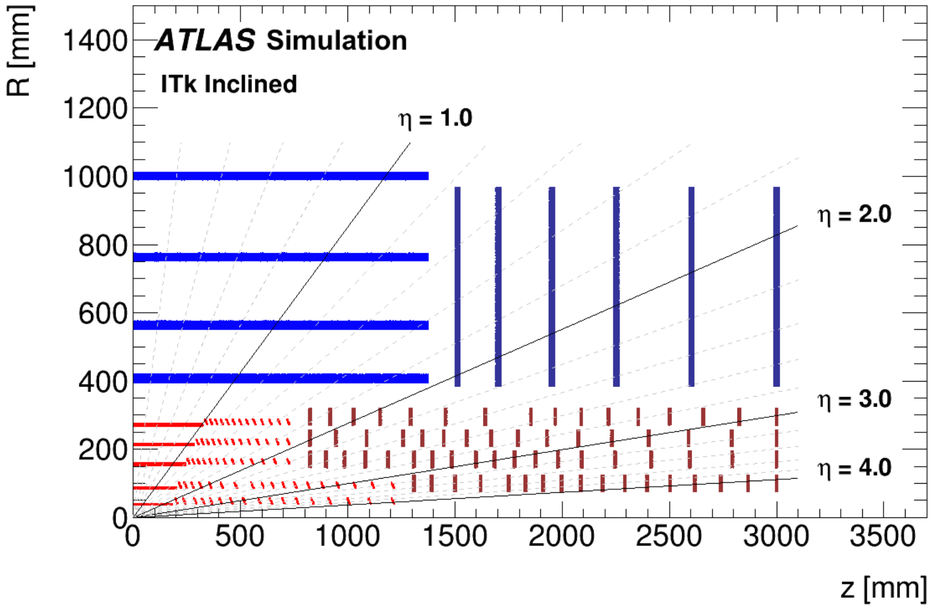
- sTGCs
  - (previous) single vendor hired additional staff; close monitoring by ATLAS experts
  - 1/6 of production to second supplier
- Issues with Micromegas PCB production largely resolved
- ASICs: TDS2 and ART2 ok → FDR
  - VMM3 and ROC need further testing; possibly another submission needed before FDR

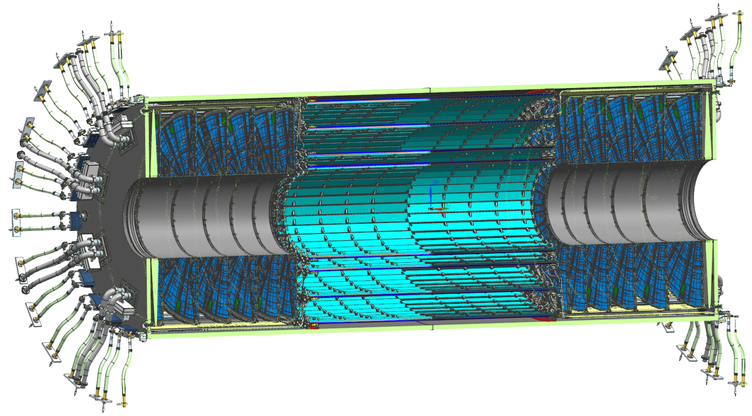


ATLAS ITk strips TDR (Phase II Upgrade)

- Settled on 5 pixel + 4 strips system
- Only the strips are evaluated in TDR – although status of pixel mentioned
- The pixel TDR will follow at the end of 2017
- Large document (>500 pages)







ATLAS ITk strips TDR – Review process

- Setup an augmented reviewers panel (+3 members from other experimens); setup UCG panel
  - P. Burrows, F. Forti, A. Honma, W. Klempt, F. Kunne, M. Moll, S. Nahn, P. Petagna, A.J.S. Smith, C. Touramanis, W. Wisniewski
- Several versions
  - First draft Nov 9
  - Final technical draft Dec 16 – without performance chapter
  - Final complete draft Jan 20 – with performance chapter and detailed package for UCG review
  - Final UCG Package Apr 14
- LHCC Technical and scientific review
  - Several intermediate meetings, back and forth of questions / answers
  - Provisional approval on Feb 23
- UCG Cost, Schedule and Management Review
  - Kick-off session on Feb 21
  - Several intermediate meetings, with back and forth of questions/answers
  - Formal review on 8-9/5/17

	Strip Detector	
WBS	**Description**	**CORE cost [MCHF]**
2.2.1	Sensors	23.66
2.2.2	FE electronics read-out chips	3.72
2.2.3	Modules	9.60
2.2.4	Local support electronics	3.67
2.2.5	Local support assemblies	4.76
2.2.6	Global mechanics	7.83
2.2.7	Services	3.63
2.2.8	Off detector electronics (incl PS + DCS)	3.45
	Sub-total	60.32
	Pixel Detector	
2.1.1	Sensors	7.87
2.1.2	FE chips	3.11
2.1.3	Hybridisation and module assembly	10.39
2.1.4	Services	6.67
2.1.5	Local supports	5.27
2.1.7	Integration and system test	2.52
2.1.8	Off detector electronics	7.24
	Sub-total	43.07
	ITK common items	
2.3	Common mechanics	12.80
2.4	Common electronics	3.45
	Sub-total	16.25
Grant total		**119.64**

ATLAS ITk strip TDR Chronicles

The ATLAS Itk-Strip TDR Chronicles I

- 20/11/16: An internal ATLAS TDR draft version was shared with the LHCC ATLAS referee team. Though largely complete, several chapters were missing from the document at that stage.
- 29/11/16: The ATLAS referees provided informal feedback on the internal draft at their regular LHCC Week meeting with the ATLAS management.
- Several external experts were added to the LHCC ATLAS referee team for the purpose of reviewing the TDR. The LHCC is grateful to Alan Honma, Steve Nahn and Paolo Petagna for serving in this capacity. The LHCC Chair and UCG Chair were also included to complete the membership of the LHCC ITk Strip TDR Review Team (the 'Review Team').
- 16/12/16: An updated draft TDR version was submitted to the Review Team. This was complete in layout with the exception of the chapter on Performance & Physics.
- 20/12/16: The Review Team met to agree the timetable for the subsequent review and to assign responsibilities among the Team members.
- 20/1/17: A complete draft TDR version, including the chapter on Performance & Physics, was submitted to the Review Team.
- 30/1/17: The Review Team met to discuss the draft TDR and identify a first round of issues requiring clarification and/or discussion. A list of questions was subsequently supplied to ATLAS.

The ATLAS Itk-Strip TDR Chronicles II

- 8/2/17: The Review Team met with ATLAS ITk system representatives and ATLAS management to discuss the issues raised and the ATLAS responses, and to identify further items requiring clarification. A subsequent list of topics and suggestions for the format and scope of the formal LHCC review, was sent to the ATLAS management.
- 21/2/17: The Review Team conducted a formal review of the draft TDR. Detailed presentations were received from ATLAS on: 1) overview and rationale for the Strips (and implications for the Pixels) system layout; 2) performance and physics; 3) sensors and modules; 4) mechanics and cooling; 5) electronics, power supplies and cables; 6) integration and installation; 7) [with the UCG] management, schedule, risks, and finance.
- **23/2/17**: The Review Team findings were presented to the LHCC in closed session. It was found that the TDR is a monumental document that contains a wealth of detail and represents the reference design for the ITk Strips system. The Strip tracker as proposed was found to be of a sound design. In conjunction with the proposed Pixel system the complete tracker will address the tracking performance required to do physics in the high-luminosity LHC era. The design will maintain the current tracker performance levels in an environment with event-pileup values as large as 200, as well as extending tracking coverage into the forward regions. While there are many technical issues and associated risks to be overcome, no 'show-stoppers' were identified.
- However, **a number of presentational issues were identified** and ATLAS was requested to make corresponding improvements for incorporation into the final TDR. The most important of these was a request for a clearer presentation of the performance in terms of measurement capability in benchmark physics channels and in the context of representative models of Beyond-SM physics.
- LHCC gave its provisional approval of the draft TDR and recommended that the UCG review should proceed. It was agreed that, subject to satisfactory completion of the LHCC's requests, and subject to the findings of the UCG, the final TDR would be considered for approval at the May LHCC meeting.
- 7/4/17: The final version of the Strip TDR was made publicly available by ATLAS.

LHCC and UCG analysis

The ATLAS Itk-Strip TDR Chronicles III

- 14/4/17: A package of additional materials to support the UCG review was made available by ATLAS to the UCG review team.
- 24/4/17: The UCG review team met with ATLAS ITk system representatives and ATLAS management for first-round discussions. Questions and comments were fed back to ATLAS in preparation for the formal review at the May LHCC week.
- 8-9/5/17: The UCG review team held a formal review of the Strip TDR. They concluded that the cost estimate, resources, schedule, and risk level are reasonable for the current stage of the project. They recommended Step 2 approval by the RB and RRB to allow resources to become available and MOUs to be signed. They recommended that, to ensure success, ATLAS, the LHCC and CERN management must closely monitor the funding situation and technical progress of this extremely complex project.
- 11/5/17: The LHCC, having satisfied itself that its requests for clarifications had been incorporated into the final TDR version, and noting that the UCG review had not identified any additional issues beyond those normal for a large project at this stage, formally **recommended for approval the ITk-Strip TDR**. The LHCC thanked and congratulated ATLAS for their achievement and for their prompt and constructive engagement with the review process.

UCG Comments

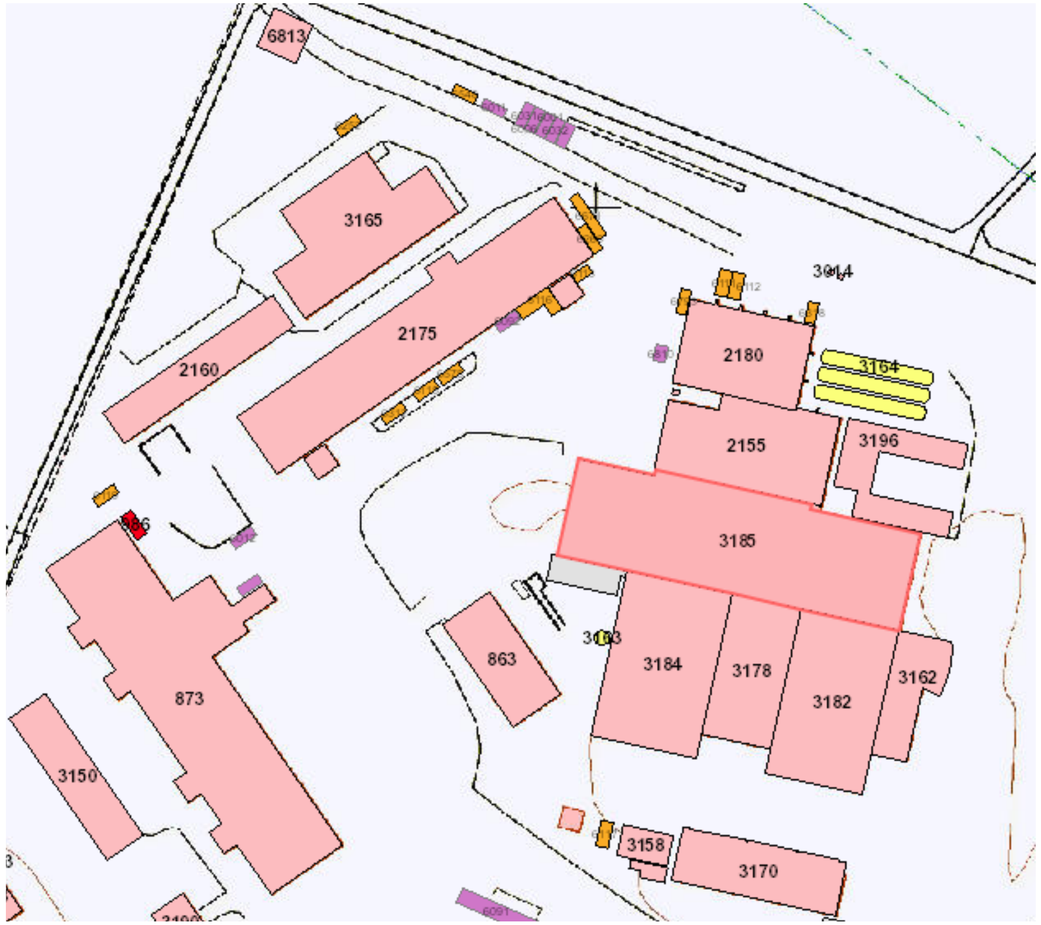
- In the report there are specific comments on
  - The Project and its Management
  - Sensors
  - Modules
  - ASICS
  - Local Supports
  - Off-Detector and Common Electronics
  - Costing & Industry
  - Schedule
  - Plans for QA/QC and testing
  - Risk Management
- Largest single risk element
  - Procurement of sensors

UCG Conclusions

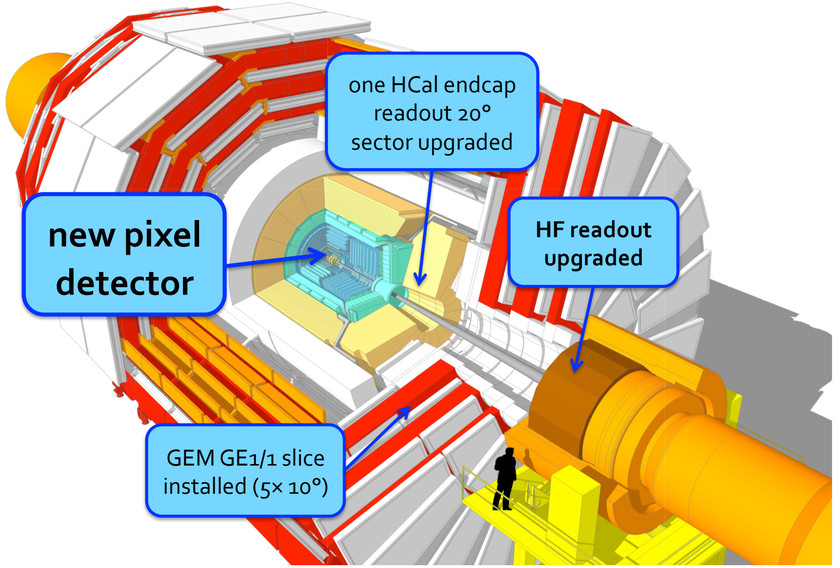
- The cost estimate, resources, schedule, and risk level are reasonable for this stage of the project.
- The ITk group has strong management in place, with appropriate oversight from central ATLAS management.
- This is an exceedingly complex project. To ensure success, ATLAS, the LHCC and CERN management must closely monitor the funding situation and technical progress.
- UCG recommends Step 2 approval by the RB to allow resources to become available and MOU's to be signed.

Approval in CERN Research Board

- Research Board approved TDR in session of 9.6.2017
  - eager to see impact of all TDRs on CERN resources
- Will clarify with experiments how to deal with radioactive waste generated during operation of (eventually) extracted Phase I components and the load during Phase II operation

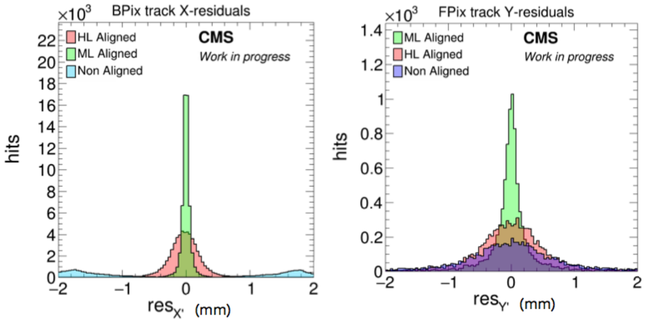


CMS


one HCal endcap
readout 20°
sector upgraded
new pixel
detector
HF readout
upgraded
GEM GE1/1 slice
installed (5× 10°)

CMS

- EYETS activities completed successfully
  - Pixel detector operational and aligned
  - Forward Hadron Calorimeter upgrade (MAPMTs) completed
    Hadron Endcap Calorimeter upgrade postponed to the 2017/18 YETS,
    one new readout box in place for 2017 running to gain experience with the new electronics.



HL = alignment of high level structures only; ML = module-level aligment

- The cold box of the magnet cryogenics system shows evidence of a small amount of contamination, possibly a residual effect of the contamination issues successfully addressed last year.
  - Contamination is expected to be cleared out of the system over the next few regeneration cycles without any additional measures needed, but will be monitored carefully.
- CMS computing and MC production is on track to provide the resources required for 2017.

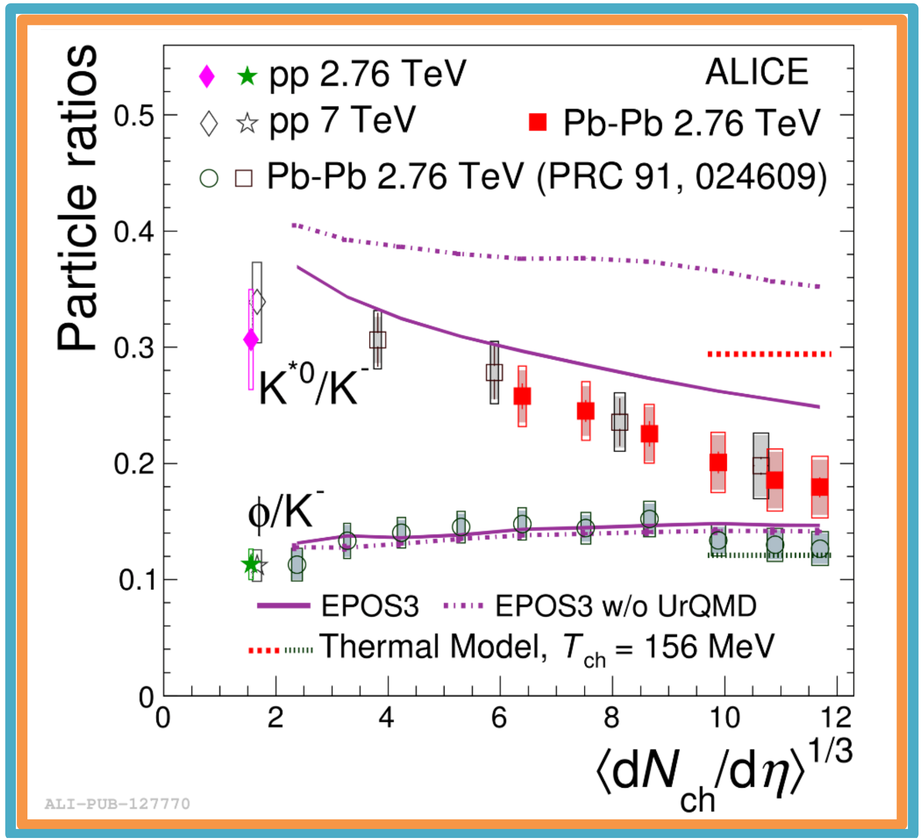
ALICE

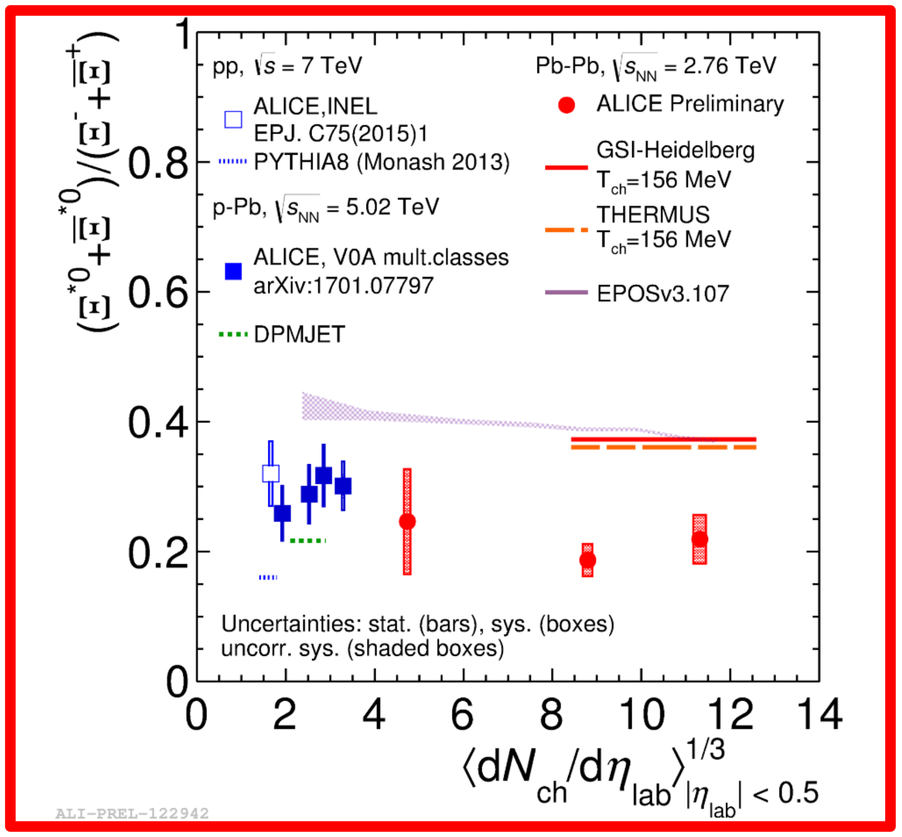
Resonances in Pb-Pb

Resonances are powerful tools to probe the hadronic phase after chemical freeze-out

Short-lived resonances exhibit suppression.
Suggests elastic scattering dominant mechanism

Lifetime [fm/c] : ρ [1.3] < K* [4.2] < Λ* [12.6] < Ξ^{0}* [21.7] < ϕ [46.2]

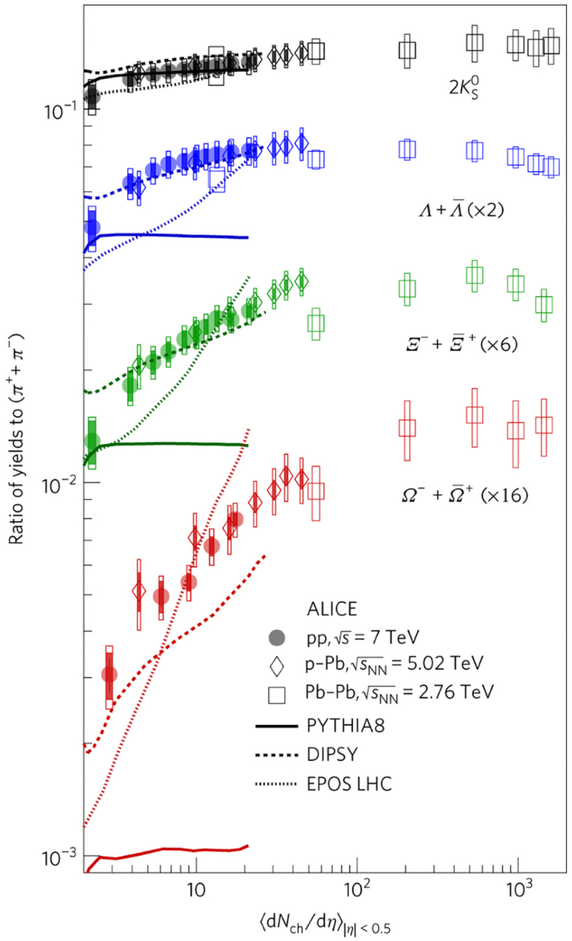


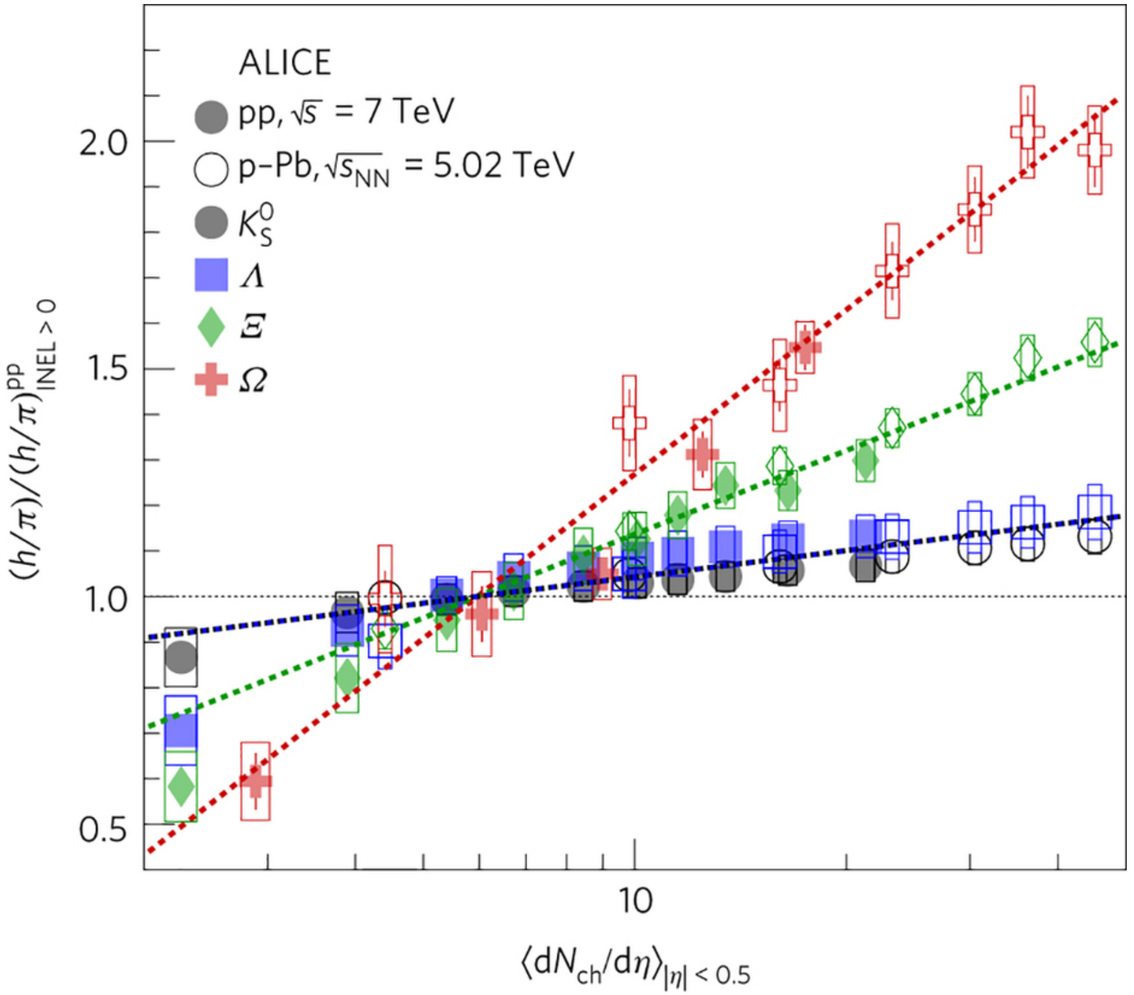


Strangeness production in high-energy pp

Strangeness increases in high-multiplicity pp-collisions

Evidence for Quark-Gluon plasma in pp collisions

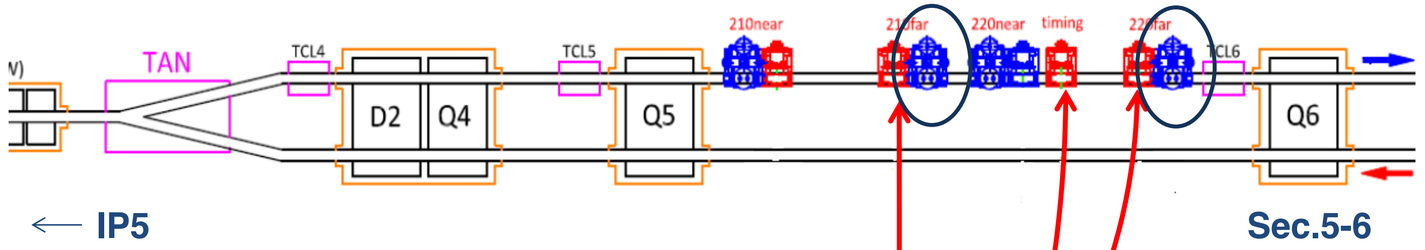




TOTEM

EYETS Activities

- RP220-FAR removal, exchange ferrites, install RF shields and reinstallation
  - remove all detector packages → inspection at SX5



Extend the successful experience of 2016 with CT-PPS

- Insertion of 3 Horiz. RP for each side with 4 detector technologies:
  - 2 tracking: Si-Strip (210-FAR), Pixel (220-FAR)
  - 2 timing: hybrid Diamond + UFSD (cylindrical pot)
- Preparatory dedicated run for alignment and validation
  - 4 additional vertical pots inserted (in blue) to align the sensors w.r.t. the beam (elastic scattering events)
  - RP-210 NEAR insertion validation

Phase II upgrades
LHCC Reviews

TDRs planned submission dates and CORE values

Experiment	System	Date	CORE MCHF	SOURCE
ATLAS	ITkStrip	Dec-16	61	TDR ITkStrip
ATLAS	Muon	Jun-17	34	SD
ATLAS	LAr	Sep-17	36	SD - sFCal
ATLAS	Tile	Sep-17	9	SD
ATLAS	TDAQ	Dec-17	43	SD
ATLAS	ITkPixel	Dec-17	59	SD([2])
CMS	Tracker	Jul-17	112	SD
CMS	Barrel Cal	Sep-17	11	SD
CMS	Muon	Sep-17	25	SD
CMS	Endcap Cal	Nov-17	64	SD
CMS	Trigger DAQ/HLT([1])	>2019	24	SD

SD = Scoping Documents

ATLAS
Letter of Intent + Scoping Document
CERN-LHCC-2012-022
CERN-LHCC-2015-020

CMS
Technical Proposal + Scoping Document
CERN-LHCC-2015-010
CERN-LHCC-2015-019

([1]) Interim document in September 2017

([2]) As modified in ITkStrip TDR

Review panels proposal

- Form a separate review panel for each of TDRs (9)
- Composition:
  - 1(2) referees from the LHCC team of the experiment
  - 1 referee from the LHCC teams of ALICE+LHCb
  - 1(2) recalled previous LHCC members
  - 3(4) external experts
- 2-3 Scrutiny group members
- (parenthesis number maybe for larger TDRs)
- Load is only 1-2 TDR / referee
  - Need to have good panel chairs → selection is in progress
  - Try to have some overlap (but not too much)

LHCC review

UCG review

Panels being set-up

Review Timeline

- TDR deluge at the end of 2017 can only be handled over several months.
- Strong push from the experiments and Funding Agencies to have almost complete financial closure by Apr 2018
- Need to setup complex review operation
  - Ensure proper review
  - Avoid excessive referee load
  - Bring in enough technical expertise
- Separate the Phase II reviews from the regular LHCC business

Timeline

TDR	COST	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18
						RRB	Special		Special		Special	RRB
ATLAS Strip ITK	61	RB										
ATLAS Muon	34		Draft		UCGP	LHCCR	Pub	UCGR		RB		
ATLAS LAr	36				Draft		UCGP	LHCCR	Pub	UCGR	RB	
ATLAS pixel ITk	59							Draft	UCGP	LHCCR	Pub	UCGR RB
ATLAS Tile	9				Draft		UCGP	LHCCR	Pub	UCGR	RB	
ATLAS TDAQ	43							Draft	UCGP	LHCCR	Pub	UCGR RB
CMS Tracker	112	Preview	Draft		UCGP	LHCCR	Pub	UCGR	RB			
CMS Barrel Cal	11				Draft		UCGP	LHCCR	Pub	UCGR	RB	
CMS End Cap Cal	64							Draft	UCGP	LHCCR	Pub	UCGR RB
CMS Muon	25				Draft		UCGP	LHCCR	Pub	UCGR	RB	
CMS TDAQ	24					IntDoc						

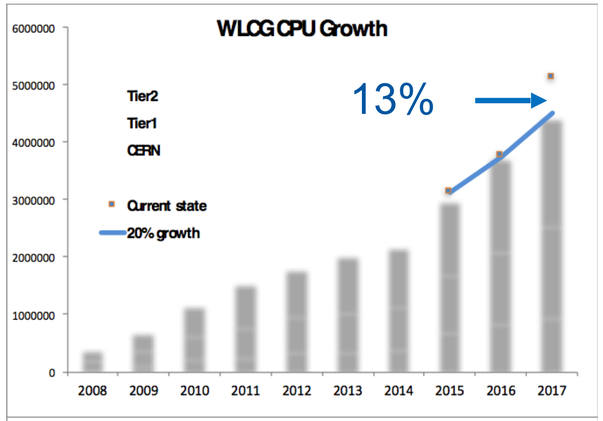
codes

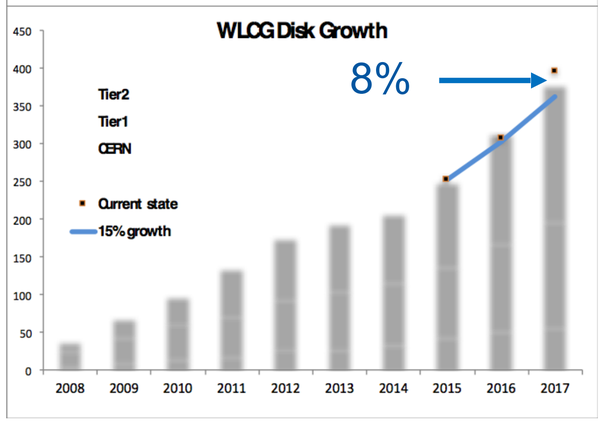
LHCC review	LHCCR	Preview TDR	Preview
UCG Review	UCGR	Final Draft TDR	Draft
RB Submission	RB	Public TDR	Pub
		UCG Package	UCGP

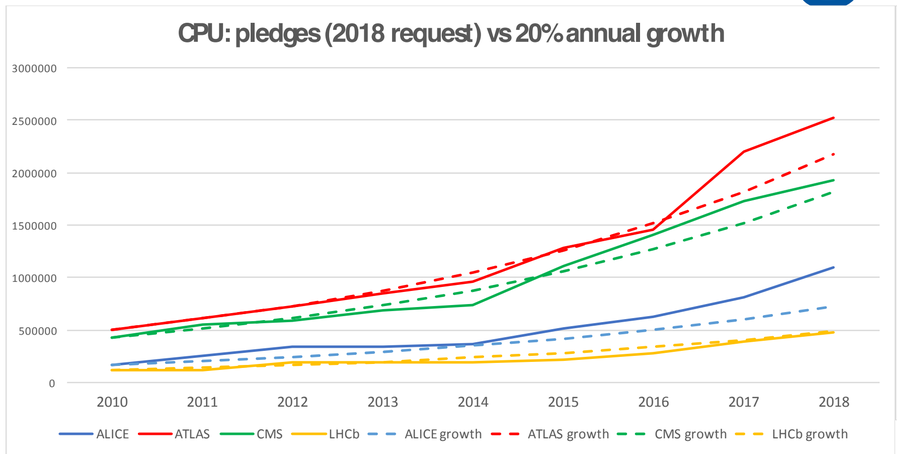
Experiment		ATLAS		ATLAS		ATLAS		ATLAS		ATLAS		CMS		CMS		CMS		CMS	
System		Muon		LAr		Tile		TDAQ		ITKPixel		Tracker		Barrel Cal		Muon		Endcap Cal	
CORE		34		36		9		43		59		112		11		25		64	
Week	Comments	LHCC	UCG	LHCC	UCG	LHCC	UCG	LHCC	UCG	LHCC	UCG	LHCC	UCG	LHCC	UCG	LHCC	UCG	LHCC	UCG
26-Jun-17		TDR 30-Jun										TDR 1-Jul							
3-Jul-17																			
10-Jul-17		Koff 15-Jul										Koff 16-Jul							
17-Jul-17																			
24-Jul-17																			
31-Jul-17																			
7-Aug-17																			
14-Aug-17													UCGP 14-Aug						
21-Aug-17																			
28-Aug-17		Iter 1-Sep	UCGP 1-Sep									Iter 2-Sep							
4-Sep-17																			
11-Sep-17	Sep LHCC	Rev 11-Sep App 14-Sep	Koff 12-Sep									Rev 11-Sep App 14-Sep	Koff 12-Sep	TDR 12-Sep		TDR 12-Sep			
18-Sep-17																			
25-Sep-17				TDR 30-Sep		TDR 30-Sep													
2-Oct-17																			
9-Oct-17														Koff 9-Oct		Koff 10-Oct			
16-Oct-17				Koff 16-Oct		Koff 16-Oct									UCGP 16-Oct		UCGP 16-Oct		
23-Oct-17	Oct RRB		Iter 26-Oct										Iter 27-Oct						
30-Oct-17														Iter 30-Oct		Iter 31-Oct			
6-Nov-17				Iter 6-Nov	UCGP 11-Nov	Iter 6-Nov	UCGP 11-Nov												
13-Nov-17																			
20-Nov-17																			
27-Nov-17	Nov LHCC		Rev 28-Nov	Rev 27-Nov App 30-Nov	Koff 1-Dec	Rev 27-Nov App 30-Nov	Koff 1-Dec						Rev 27-Nov	Rev 28-Nov App 30-Nov	Koff 1-Dec	LHCC-R 29-Nov LHCC-A 30-Nov	Koff 1-Dec	TDR 28-Nov	
4-Dec-17	Dec RB	RB 6-Dec										RB 6-Dec							
11-Dec-17								TDR 15-Dec		TDR 15-Dec									
18-Dec-17														Iter 18-Dec		Iter 19-Dec		Koff 18-Dec	
25-Dec-17	Christmas																		
1-Jan-18																			
8-Jan-18					Iter 8-Jan		Iter 8-Jan	Koff 10-Jan		Koff 10-Jan								Iter 11-Jan	
15-Jan-18																			UCGP 15-Jan
22-Jan-18	Jan P-II Mtg				Rev 25-Jan		Rev 25-Jan		UCGP 26-Jan		UCGP 26-Jan				Rev 23-Jan		Rev 24-Jan	Rev 26-Jan	Koff 26-Jan
29-Jan-18																			
5-Feb-18								Iter 5-Feb		Iter 5-Feb									
12-Feb-18																			
19-Feb-18																			
26-Feb-18	Feb LHCC							Rev 17-Feb App 1-Mar	Koff 2-Mar	Rev 27-Feb App 1-Mar	Koff 2-Mar							App 1-Mar	
5-Mar-18				RB 7-Mar		RB 7-Mar								RB 7-Mar		RB 7-Mar			
12-Mar-18									Iter 14-Mar		Iter 15-Mar								
19-Mar-18																			
26-Mar-18	Easter week																		
2-Apr-18																			
9-Apr-18	Apr P-II Mtg								Rev 12-Apr		Rev 13-Apr								Rev 11-Apr
16-Apr-18								RB 18-Apr		RB 18-Apr								RB 18-Apr	

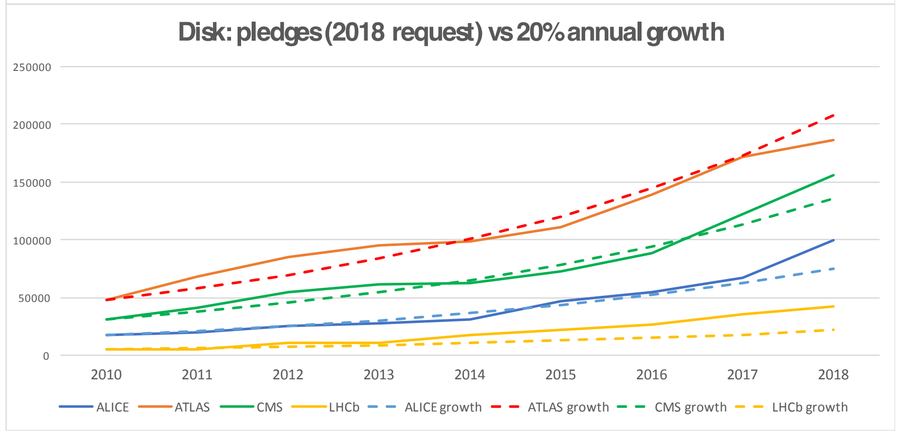
WLCG

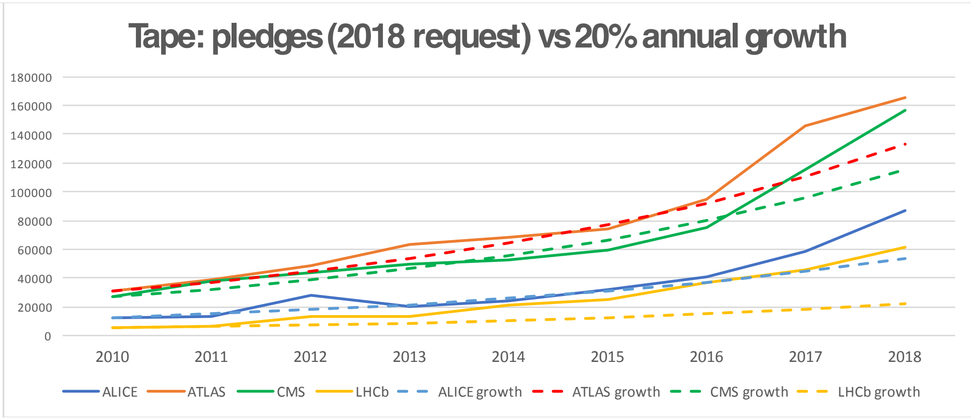
Comments on flat budgets











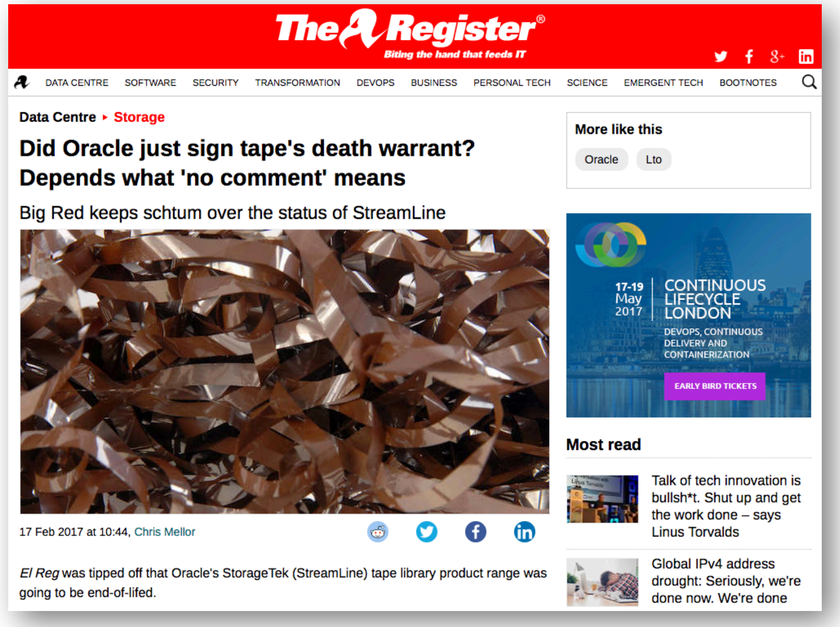
Extrapolations from 2010:

- Ignore no investment in 2013,14
- Deviations from “flat budget” are generally not enormous, and are corrected
- Jump in 2017 – LHC performance
- Tape needs still increase

- We need to clarify what is meant by flat budgets:
  - We assume: constant budget/investment even in long shutdown years
  - This did not happen in LS1

Concerns over tapes

- Oracle will no longer produce “enterprise” class drives/media
  - Focus on Linear Tape Open (LTO)
- Not a huge impact on most Tier 1s
  - Use LTO, IBM
  - Some plan LTO migration
- Has cost implication for CERN (~40 PB cut from costed plan);
  - mitigate with IBM, and introduction of LTO (investment)
  - However, long term concern is that IBM now dominates the tape market



Prévessin Computing Centre

Prévessin Computing Centre (PCC)

- We had explored the option of a new computing centre in Prévessin to
  - house the online needs of ALICE and LHCb (2x2 MW installation)
    - requires provision of high bandwidth data link from LHCb and ALICE to Prévessin
  - serve future computing needs of CERN (expandable to 12 MW total)
- Tendering process ended in April and showed that a very attractive solution seems feasible.

Decision on Prévessin Computing Centre

- Directorate decided to build the PCC on a **delayed** schedule (completion ~2021) so as
  - to remove the scheduling risk for ALICE and LHCb. They will now use original solution (TDR) based on containers
  - not to impact the CERN cumulative budget deficit in its peak
- The new computing centre will serve the LHC computing needs and lead to savings that compensate the investments over a period of ten years

Summary

- Steady publication flow from all experiments
  - LHCP conference and upcoming summer confs
- EYETS successfully completed, experiments ready
- Preparation of LS2 proceeding well
  - ATLAS NSW
- Phase II
  - ATLAS Inner Tracker Strip detector TDR approved