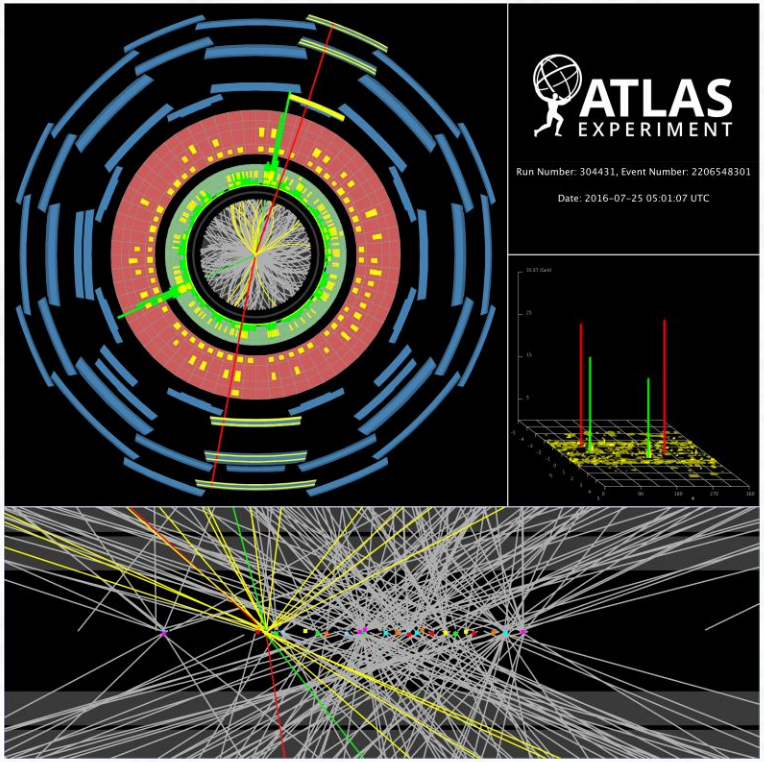
Status of the ATLAS Experiment



Karl Jakobs
University of Freiburg / Germany

44th Meeting of the ATLAS RRB, 25th April 2017

Status of the ATLAS Experiment

- Collaboration and Management matters
- Physics Highlights (short summary)
- Towards Running in 2017 (Offline)
- Phase-II Upgrade
  Status of TDRs, Approval process

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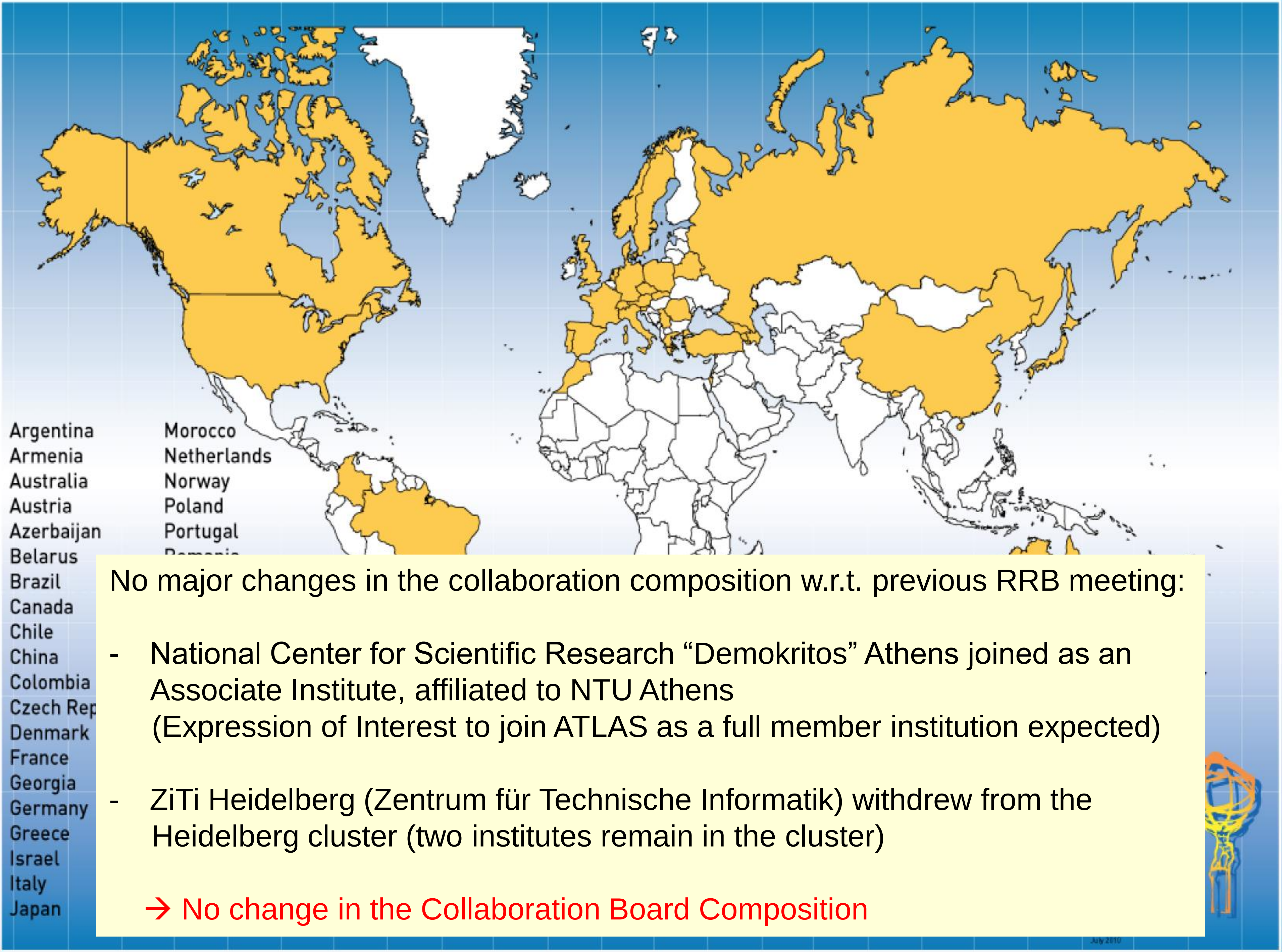
University of Freiburg / Germany

44^{th} Meeting of the ATLAS RRB, 25^{th} April 2017

Collaboration

and

Management Matters



No major changes in the collaboration composition w.r.t. previous RRB meeting:

- National Center for Scientific Research “Demokritos” Athens joined as an Associate Institute, affiliated to NTU Athens (Expression of Interest to join ATLAS as a full member institution expected)

- ZiTi Heidelberg (Zentrum für Technische Informatik) withdrew from the Heidelberg cluster (two institutes remain in the cluster)

→ No change in the Collaboration Board Composition

Argentina	Morocco
Armenia	Netherlands
Australia	Norway
Austria	Poland
Azerbaijan	Portugal
Belarus	Romania
Brazil	Russia
Canada	Serbia
Chile	Slovakia
China	Slovenia
Colombia	South Africa
Czech Republic	Spain
Denmark	Sweden
France	Switzerland
Georgia	Taiwan
Germany	Turkey
Greece	UK
Israel	USA
Italy	CERN
Japan	JINR

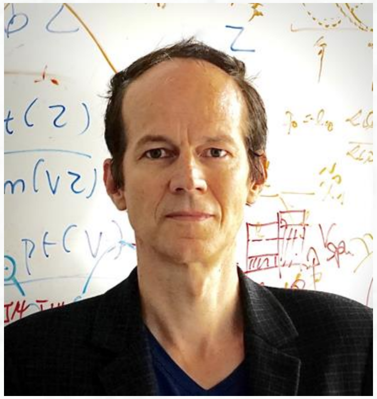
- 182 Institutions in 38 Countries
- ~ 2.900 Scientific Authors
  ~ 1.900 with PhD, contributing to M&O share
  ~ 1.000 Students

July 2010

ATLAS Management Team

March 2017 – February 2019

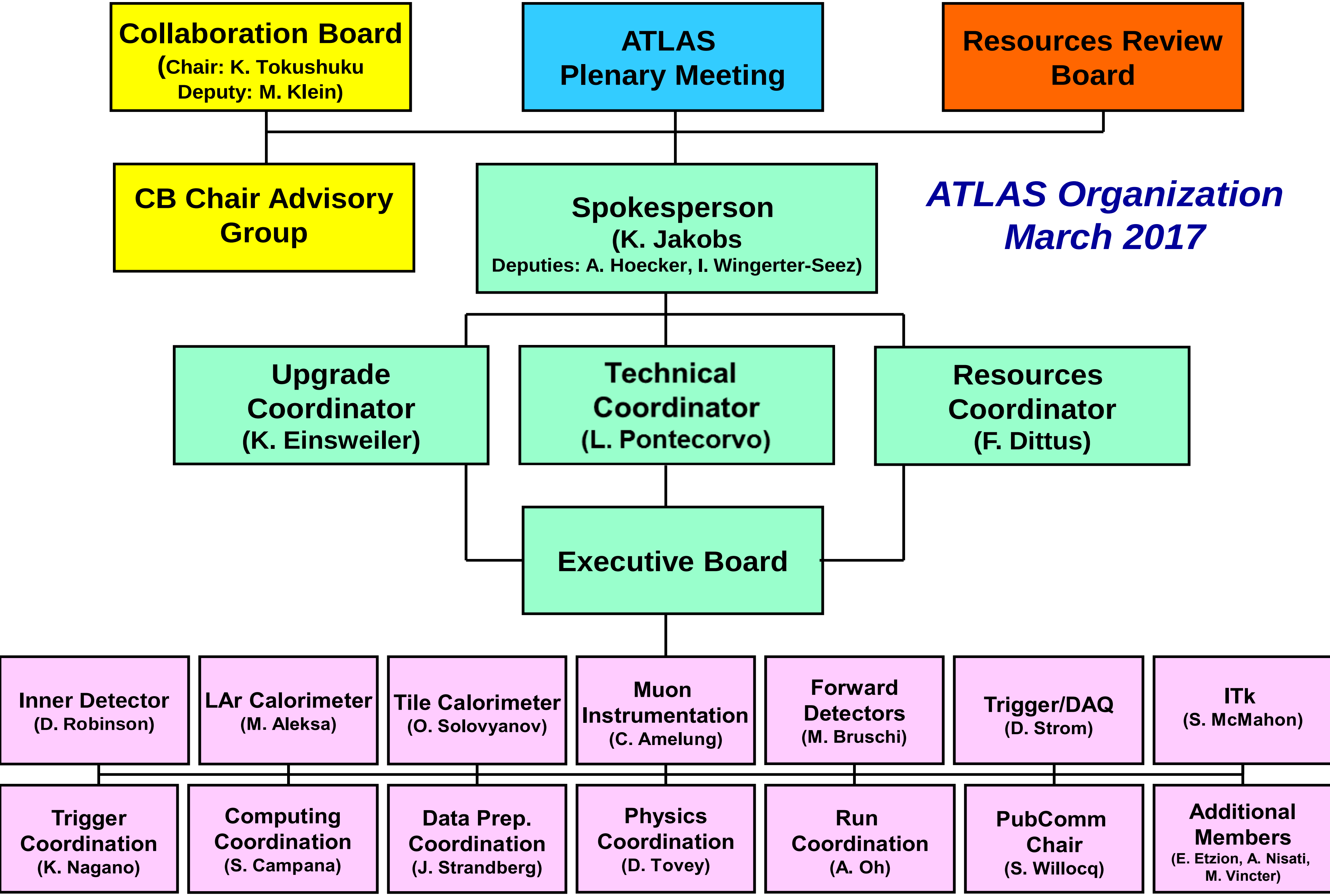
Spokesperson: Karl Jakobs (Freiburg)



Deputy Spokespersons:
- Andreas Hoecker (CERN)
- Isabelle Wingerter-Seez (Annecy LAPP)

Technical Coordinator: Ludovico Pontecorvo (CERN / INFN)
Resources Coordinator: Fido Dittus (CERN)
Upgrade Coordinator: Kevin Einsweiler (Berkeley LBNL)

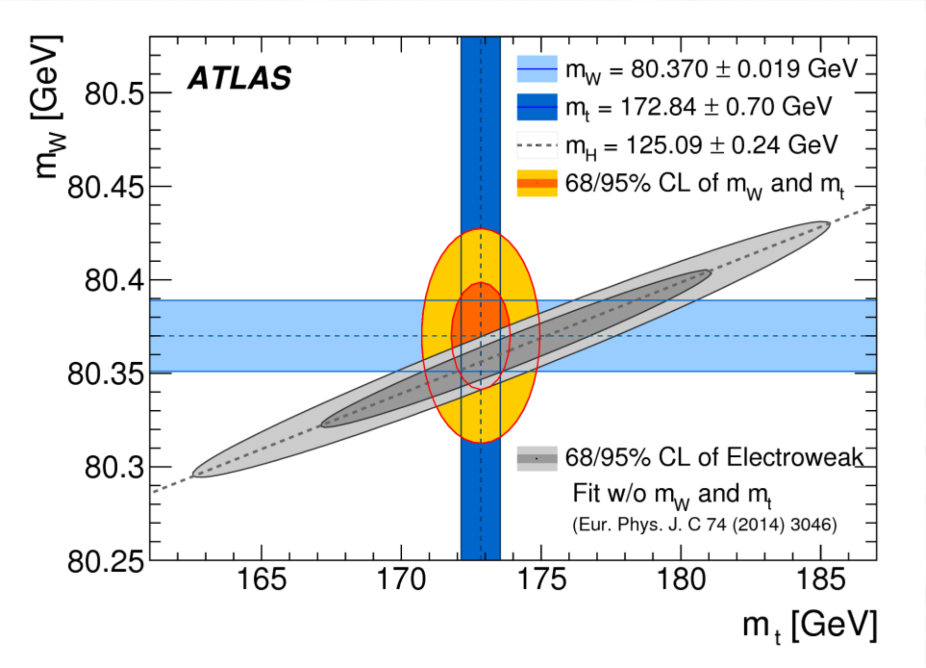
ATLAS Organization March 2017



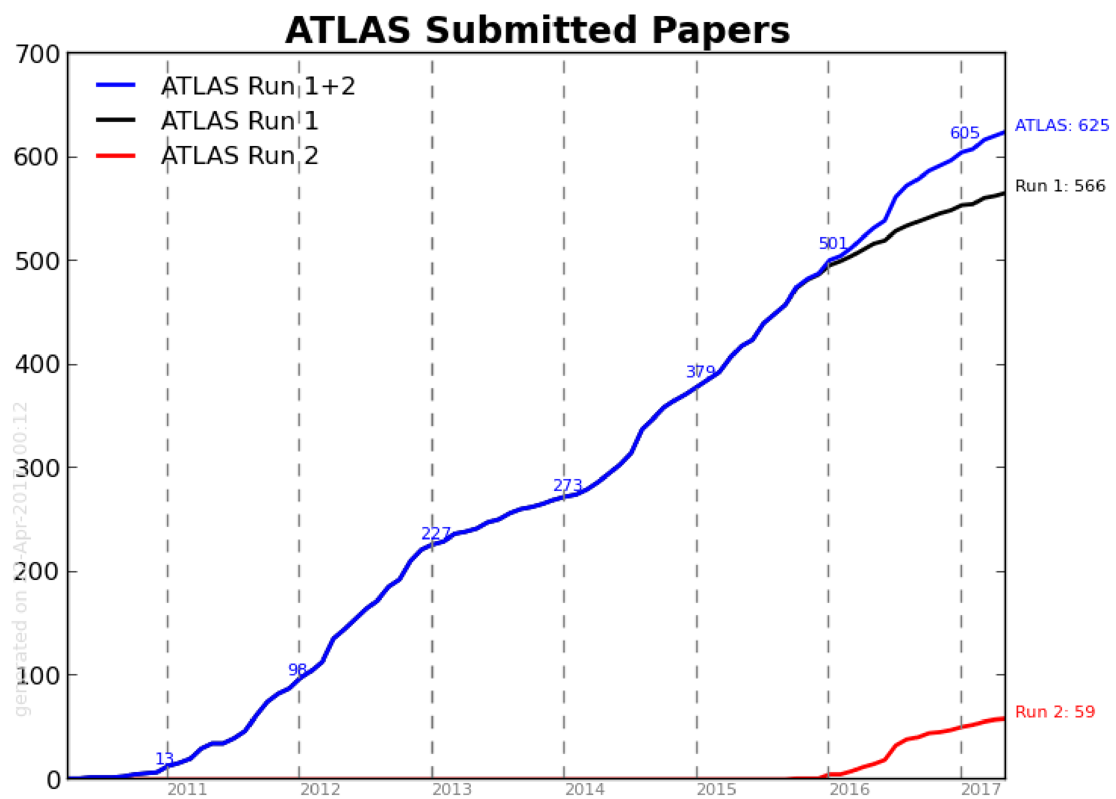
A few Highlights from Physics Analysis

- Precision measurements
  (based on Run-1 data)

- Searches for BSM Physics
  (based on complete Run-2 dataset,
  2015/16 data)



ATLAS Publication Statistics



- 625 Journal publications submitted or published

- 17 Conference notes based on complete 2015/16 dataset

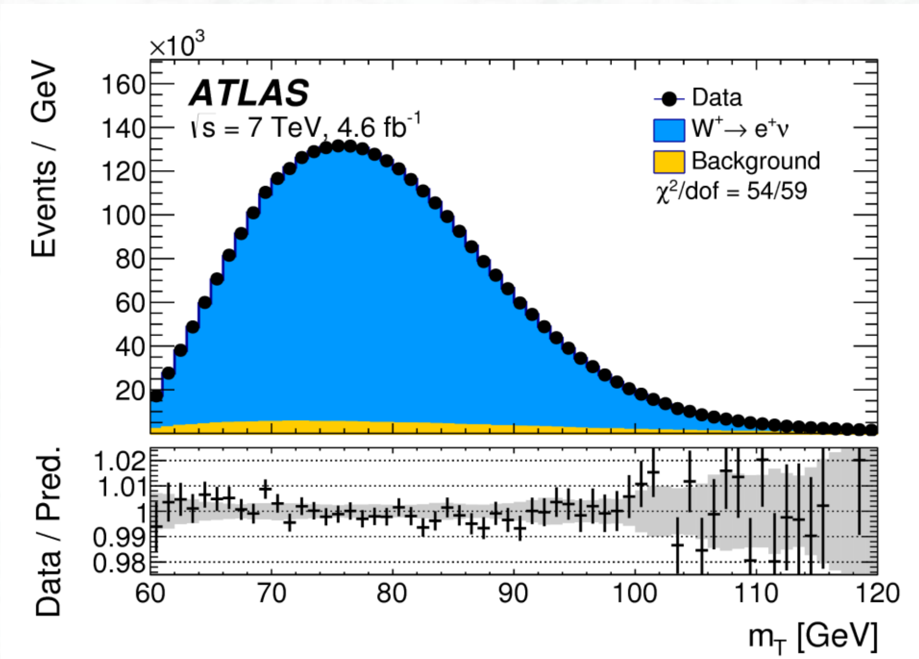
- Run-1 papers: publications continue, now focus on precision measurements (well calibrated and understood dataset)

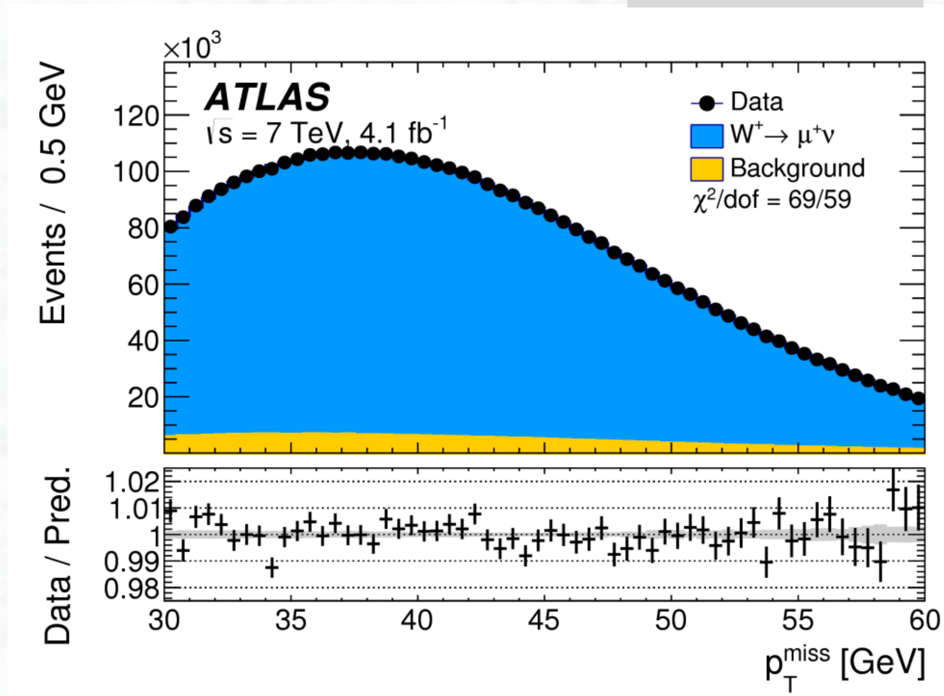
- Run-2 papers: focus is now on the publication of searches and measurements (e.g. in the Higgs area) based on the full 2015 + 2016 dataset so far: 2 papers published and 17 CONF notes (Winter conferences) released on the full Run-2 dataset

Measurement of the W-boson mass

- Based on early data (2011) at $\sqrt{s}$ = 7 TeV (4.6 fb^{-1})
- Huge amount of work to understand detector response and the modelling of kinematic quantities (relies on large Z → ℓℓ sample)
- High quality analysis in W → eν and W → μν channels

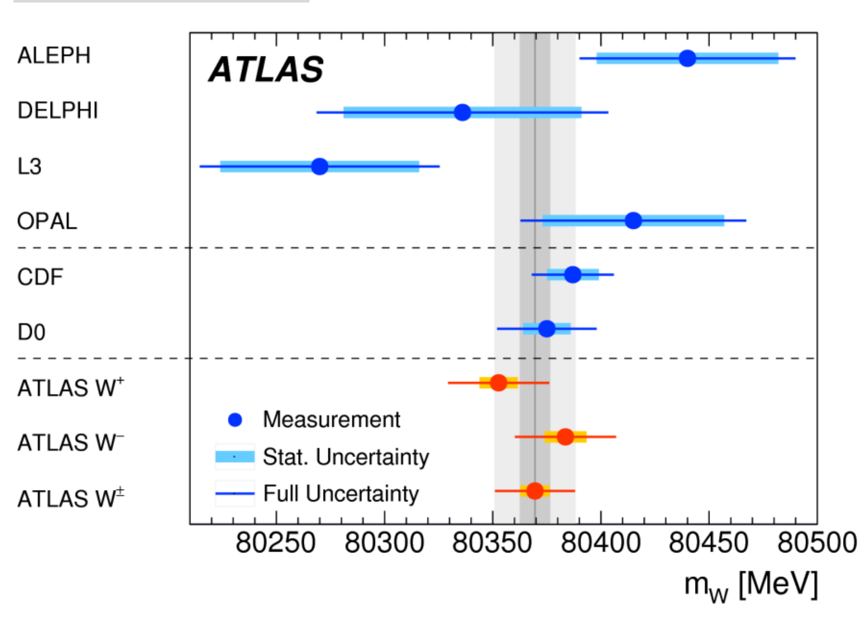
arXiv:1701.07240

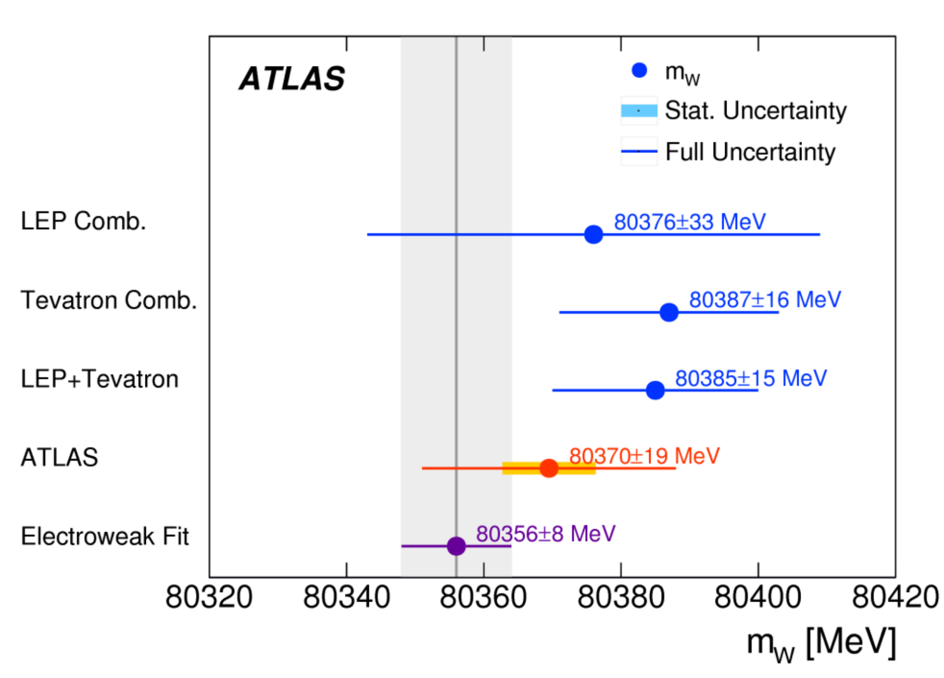




Measurement of the W-boson mass (cont.)

arXiv:1701.07240





Same precision reached as for current best measurement from the CDF experiment

$m_W = 80.370 \pm 0.019$ GeV

$\pm$ 7 MeV statistical

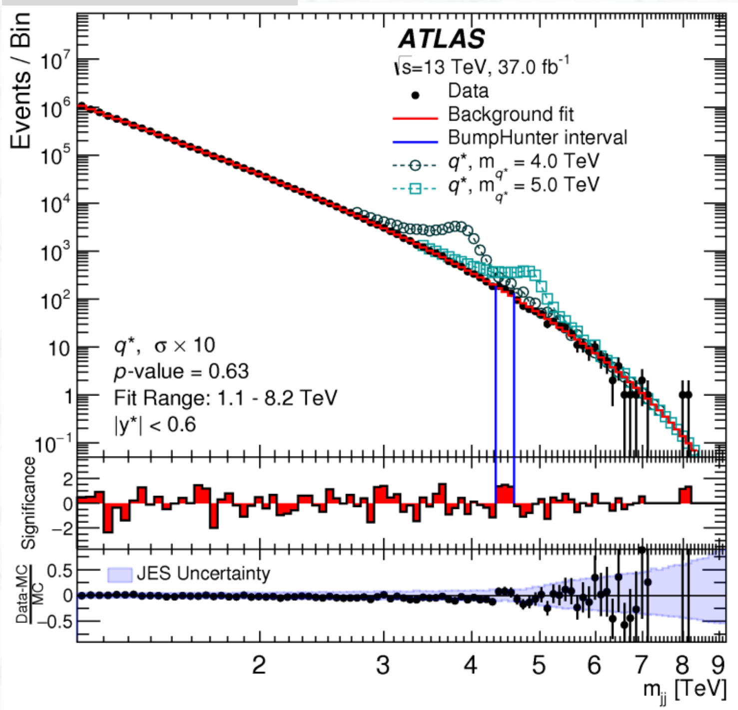
$\pm$ 11 MeV systematic

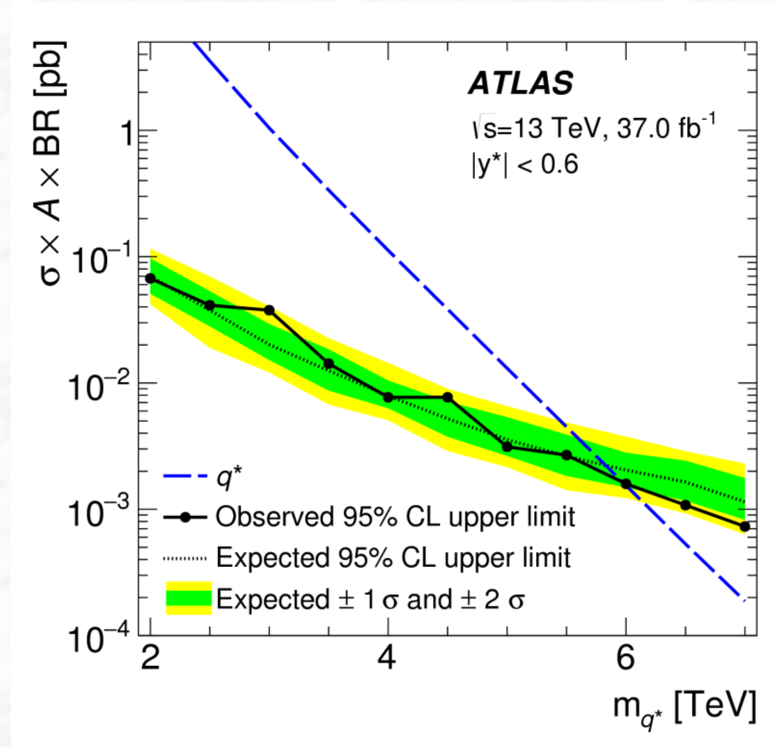
$\pm$ 14 MeV modeling

Search for new phenomena in di-jet events

- First publication on complete Run-2 (2015+2016) dataset: 37.0 fb^{-1} at $\sqrt{s}$ = 13 TeV

arXiv:1703.09127





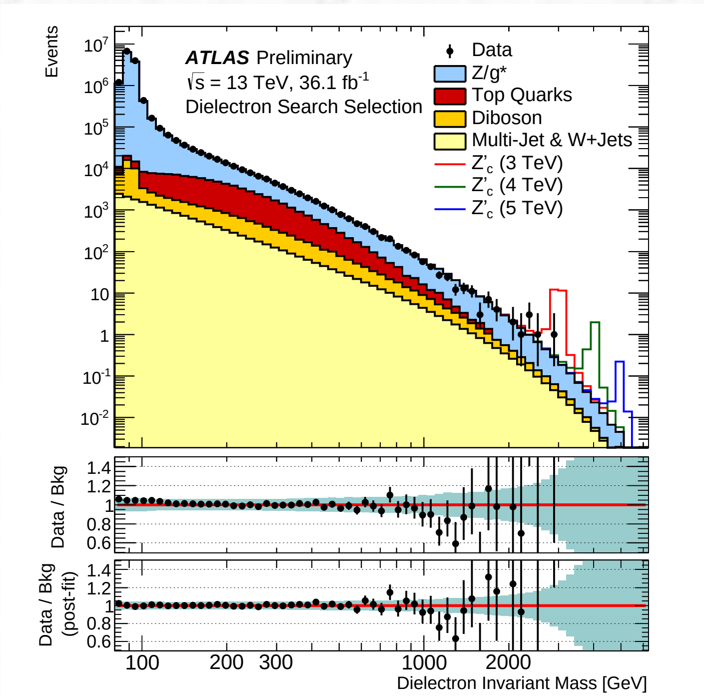
- 95% CL exclusion limits:

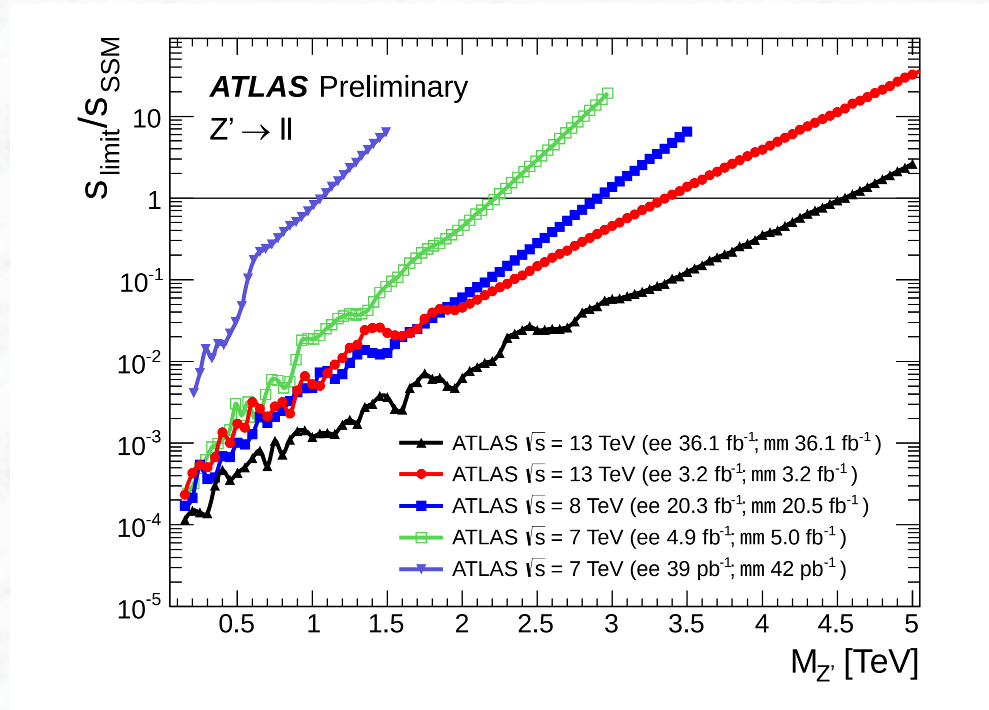
Excited quarks	m_{q^*} > 6.0 TeV	(5.8 TeV exp.)
Add. gauge bosons:	$m_{W'}$ > 3.6 TeV	(3.7 TeV exp.)
Quantum Black Holes:	m_{BH} > 8.9 TeV	(8.9 TeV exp.)
Contact Interactions:	Λ > 13.1 TeV (η_{LL} = +1)	
	Λ > 21.8 TeV (η_{LL} = -1)	

Search for di-lepton resonances

- Search is based on complete Run-2 (2015+2016) dataset: 36.1 fb^{-1} at $\sqrt{s}$ = 13 TeV

ATLAS-CONF-2017-027

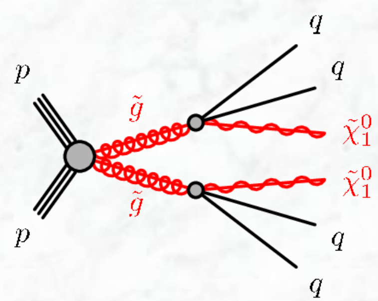




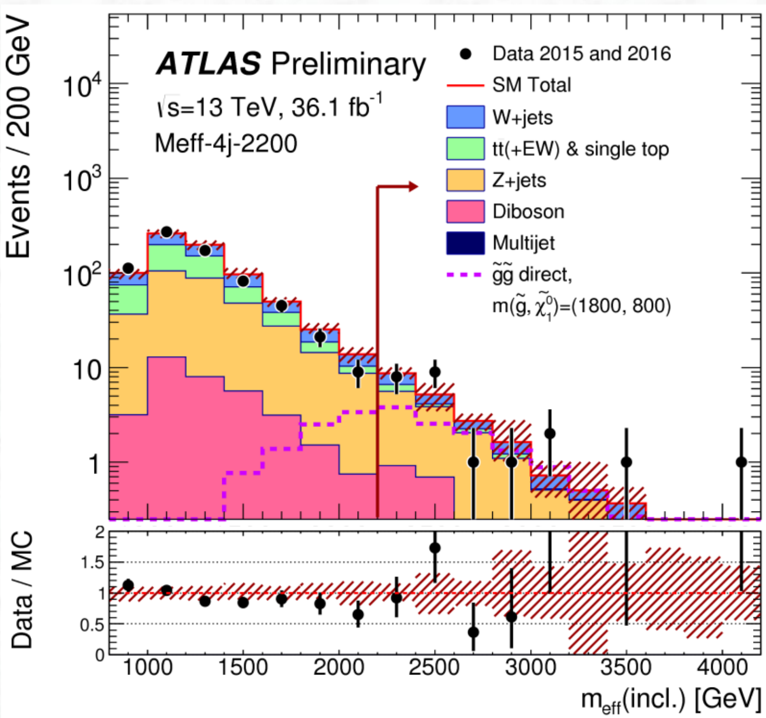
- No significant deviations from the Standard Model expectations observed
  → resulting lower mass limits, e.g. m(Z'_{SSM}) > 4.5 TeV (95% C.L.)
  significant improvement w.r.t. Run 1 (due to higher energy)
- In addition: no indication of contact interactions, energy scale $\Lambda_{\ell\ell qq}$ > 23.5 - 40.1 TeV

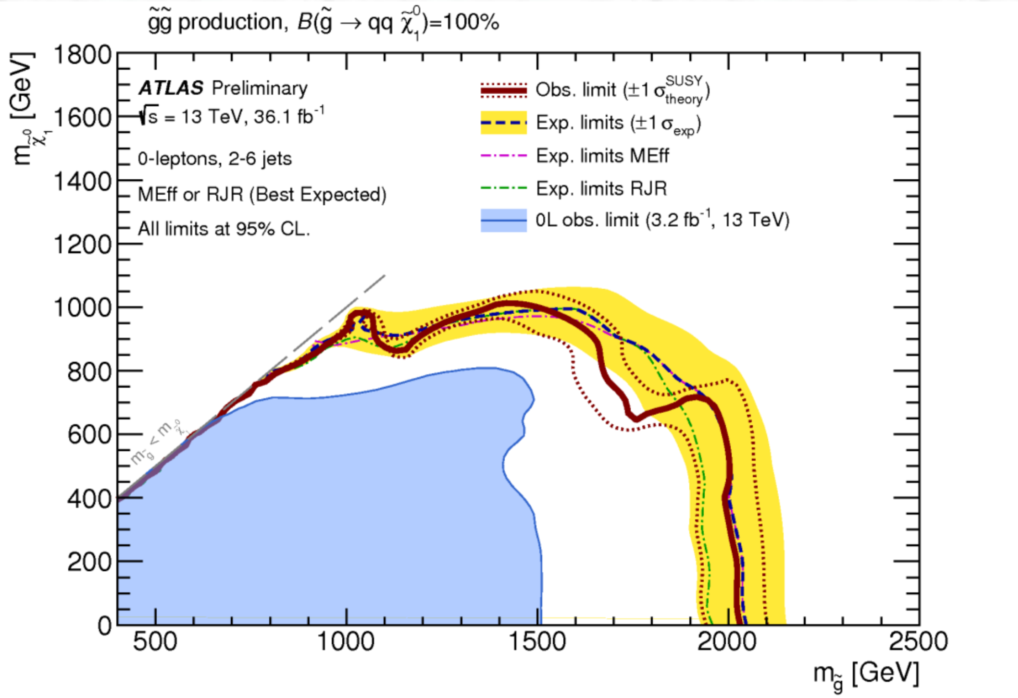
Search for Supersymmetry

-Important new results with complete Run-2 dataset-



ATLAS-CONF-2017-022



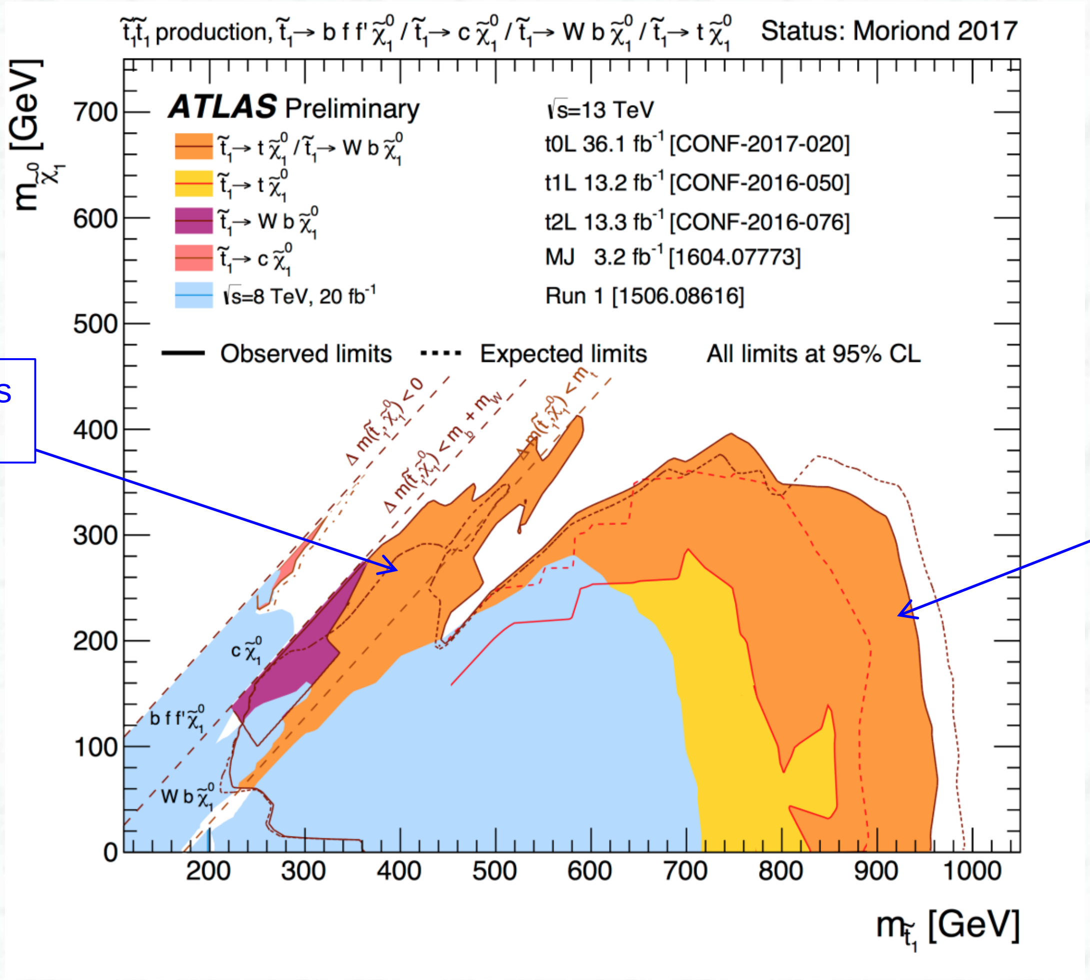


Data well described by expectations from SM processes

Gluino mass limit beyond 2 TeV, $m(\chi^0) = 0$

Search for Supersymmetry

-update on searches for the top squark (stop)-



- Stop mass limit beyond 0.9 TeV, $m(\chi^0) = 0$
- Some difficult parameter regions at low mass still uncovered

ATLAS SUSY Searches* - 95% CL Lower Limits

Status: March 2017

ATLAS Preliminary

$\sqrt{s}$ = 7, 8, 13 TeV

$\sqrt{s}$ = 7, 8 TeV | $\sqrt{s}$ = 13 TeV

	Model	e, μ, τ, γ	Jets	E_T^{miss}	$\int \mathcal{L}\, dt [fb^{-1}]$	Mass limit		Reference
Inclusive Searches	MSUGRA/CMSSM	0-3 e,μ/1-2 τ	2-10 jets/3 b	Yes	20.3	$\tilde{q},\tilde{g}$ 1.85 TeV	$m(\tilde{q})=m(\tilde{g})$	1507.05525
	$\tilde{q}\tilde{q}, \tilde{q}\to q\tilde{\chi}_1^0$	0	2-6 jets	Yes	36.1	$\tilde{q}$ 1.57 TeV	$m(\tilde{\chi}_1^0)$<200 GeV, m(1st gen. $\tilde{q}$)=m(2nd gen. $\tilde{q}$)	ATLAS-CONF-2017-022
	$\tilde{q}\tilde{q}, \tilde{q}\to q\tilde{\chi}_1^0$ (compressed)	mono-jet	1-3 jets	Yes	3.2	$\tilde{q}$ 608 GeV	$m(\tilde{q})-m(\tilde{\chi}_1^0)$<5 GeV	1604.07773
	$\tilde{g}\tilde{g}, \tilde{g}\to q\bar{q}\tilde{\chi}_1^0$	0	2-6 jets	Yes	36.1	$\tilde{g}$ 2.02 TeV	$m(\tilde{\chi}_1^0)$<200 GeV	ATLAS-CONF-2017-022
	$\tilde{g}\tilde{g}, \tilde{g}\to qq\tilde{\chi}_1^\pm\to qqW^\pm\tilde{\chi}_1^0$	0	2-6 jets	Yes	36.1	$\tilde{g}$ 2.01 TeV	$m(\tilde{\chi}_1^0)$<200 GeV, $m(\tilde{\chi}^\pm)=0.5(m(\tilde{\chi}_1^0)+m(\tilde{g}))$	ATLAS-CONF-2017-022
	$\tilde{g}\tilde{g}, \tilde{g}\to qq(\ell\ell/\nu\nu)\tilde{\chi}_1^0$	3 e,μ	4 jets	-	13.2	$\tilde{g}$ 1.7 TeV	$m(\tilde{\chi}_1^0)$<400 GeV	ATLAS-CONF-2016-037
	$\tilde{g}\tilde{g}, \tilde{g}\to qqWZ\tilde{\chi}_1^0$	2 e,μ (SS)	0-3 jets	Yes	13.2	$\tilde{g}$ 1.6 TeV	$m(\tilde{\chi}_1^0)$ <500 GeV	ATLAS-CONF-2016-037
	GMSB ($\tilde{\ell}$ NLSP)	1-2 τ + 0-1 ℓ	0-2 jets	Yes	3.2	$\tilde{g}$ 2.0 TeV		1607.05979
	GGM (bino NLSP)	2 γ	-	Yes	3.2	$\tilde{g}$ 1.65 TeV	$c\tau$(NLSP)<0.1 mm	1606.09150
	GGM (higgsino-bino NLSP)	γ	1 b	Yes	20.3	$\tilde{g}$ .37 TeV	$m(\tilde{\chi}_1^0)$<950 GeV, $c\tau$(NLSP)<0.1 mm, μ<0	1507.05493
	GGM (higgsino-bino NLSP)	γ	2 jets	Yes	13.3	$\tilde{g}$ 1.8 TeV	$m(\tilde{\chi}_1^0)$>680 GeV, $c\tau$(NLSP)<0.1 mm, μ>0	ATLAS-CONF-2016-066
	GGM (higgsino NLSP)	2 e,μ (Z)	2 jets	Yes	20.3	$\tilde{g}$ 900 GeV	m(NLSP)>430 GeV	1503.03290
	Gravitino LSP	0	mono-jet	Yes	20.3	$F^{1/2}$ scale 865 GeV	$m(\tilde{G})>1.8\times10^{-4}$ eV, $m(\tilde{g})=m(\tilde{q})$=1.5 TeV	1502.01518
3rd gen. $\tilde{g}$ med.	$\tilde{g}\tilde{g}, \tilde{g}\to b\bar{b}\tilde{\chi}_1^0$	0	3 b	Yes	36.1	$\tilde{g}$ 1.92 TeV	$m(\tilde{\chi}_1^0)$<600 GeV	ATLAS-CONF-2017-021
	$\tilde{g}\tilde{g}, \tilde{g}\to t\bar{t}\tilde{\chi}_1^0$	0-1 e,μ	3 b	Yes	36.1	$\tilde{g}$ 1.97 TeV	$m(\tilde{\chi}_1^0)$<200 GeV	ATLAS-CONF-2017-021
	$\tilde{g}\tilde{g}, \tilde{g}\to b\bar{t}\tilde{\chi}_1^+$	0-1 e,μ	3 b	Yes	20.1	$\tilde{g}$ .37 TeV	$m(\tilde{\chi}_1^0)$<300 GeV	1407.0600
3rd gen. squarks direct production	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1\to b\tilde{\chi}_1^0$	0	2 b	Yes	3.2	$\tilde{b}_1$ 840 GeV	$m(\tilde{\chi}_1^0)$<100 GeV	1606.08772
	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1\to t\tilde{\chi}_1^\pm$	2 e,μ (SS)	1 b	Yes	13.2	$\tilde{b}_1$ 325-685 GeV	$m(\tilde{\chi}_1^0)$<150 GeV, $m(\tilde{\chi}_1^\pm)=m(\tilde{\chi}_1^0)$+100 GeV	ATLAS-CONF-2016-037
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to b\tilde{\chi}_1^\pm$	0-2 e,μ	1-2 b	Yes	4.7/13.3	$\tilde{t}_1$ 117-170 GeV, 200-720 GeV	$m(\tilde{\chi}_1^\pm)=2m(\tilde{\chi}_1^0)$, $m(\tilde{\chi}_1^0)$=55 GeV	1209.2102, ATLAS-CONF-2016-077
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to Wb\tilde{\chi}_1^0$ or $t\tilde{\chi}_1^0$	0-2 e,μ	0-2 jets/1-2 b	Yes	20.3	$\tilde{t}_1$ 90-198 GeV, 205-950 GeV	$m(\tilde{\chi}_1^0)$=1 GeV	1506.08616, ATLAS-CONF-2017-020
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to c\tilde{\chi}_1^0$	0	mono-jet	Yes	3.2	$\tilde{t}_1$ 90-323 GeV	$m(\tilde{t}_1)-m(\tilde{\chi}_1^0)$=5 GeV	1604.07773
	$\tilde{t}_1\tilde{t}_1$ (natural GMSB)	2 e,μ (Z)	1 b	Yes	20.3	$\tilde{t}_1$ 150-600 GeV	$m(\tilde{\chi}_1^0)$>150 GeV	1403.5222
	$\tilde{t}_2\tilde{t}_2, \tilde{t}_2\to\tilde{t}_1+Z$	3 e,μ (Z)	1 b	Yes	36.1	$\tilde{t}_2$ 290-790 GeV	$m(\tilde{\chi}_1^0)$=0 GeV	ATLAS-CONF-2017-019
	$\tilde{t}_2\tilde{t}_2, \tilde{t}_2\to\tilde{t}_1+h$	1-2 e,μ	4 b	Yes	36.1	$\tilde{t}_2$ 320-880 GeV	$m(\tilde{\chi}_1^0)$=0 GeV	ATLAS-CONF-2017-019
EW direct	$\tilde{\ell}_{L,R}\tilde{\ell}_{L,R}, \tilde{\ell}\to\ell\tilde{\chi}_1^0$	2 e,μ	0	Yes	20.3	$\tilde{\ell}$ 90-335 GeV	$m(\tilde{\chi}_1^0)$=0 GeV	1403.5294
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to\tilde{\ell}\nu(\ell\tilde{\nu})$	2 e,μ	0	Yes	13.3	$\tilde{\chi}_1^\pm$ 640 GeV	$m(\tilde{\chi}_1^0)$= GeV, $m(\tilde{\ell},\tilde{\nu})=0.5(m(\tilde{\chi}_1^\pm)+m(\tilde{\chi}_1^0))$	ATLAS-CONF-2016-096
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to\tilde{\tau}\nu(\tau\tilde{\nu})$	2 τ	-	Yes	14.8	$\tilde{\chi}_1^\pm$ 580 GeV	$m(\tilde{\chi}_1^0)$=0 GeV, $m(\tilde{\tau},\tilde{\nu})=0.5(m(\tilde{\chi}_1^\pm)+m(\tilde{\chi}_1^0))$	ATLAS-CONF-2016-093
	$\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to\tilde{\ell}_L\nu\tilde{\ell}_L\ell(\tilde{\nu}\nu), \ell\tilde{\nu}\tilde{\ell}_L\ell(\tilde{\nu}\nu)$	3 e,μ	0	Yes	13.3	$\tilde{\chi}_1^\pm,\tilde{\chi}_2^0$ 1.0 Te	$m(\tilde{\chi}_1^\pm)$= $(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)$=0, $m(\tilde{\ell},\tilde{\nu})=0.5(m(\tilde{\chi}_1^\pm)+m(\tilde{\chi}_1^0))$	ATLAS-CONF-2016-096
	$\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to W\tilde{\chi}_1^0 Z\tilde{\chi}_1^0$	2-3 e,μ	0-2 jets	Yes	20.3	$\tilde{\chi}_1^\pm,\tilde{\chi}_2^0$ 425 GeV	$m(\tilde{\chi}_1^\pm)=m(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)$=0, $\tilde{\ell}$ decoupled	1403.5294, 1402.7029
	$\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to W\tilde{\chi}_1^0 h\tilde{\chi}_1^0, h\to b\bar{b}/WW/\tau\tau/\gamma\gamma$	e,μ,γ	0-2 b	Yes	20.3	$\tilde{\chi}_1^\pm,\tilde{\chi}_2^0$ 270 GeV	$m(\tilde{\chi}_1^\pm)=m(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)$=0, $\tilde{\ell}$ decoupled	1501.07110
	$\tilde{\chi}_2^0\tilde{\chi}_3^0, \tilde{\chi}_{2,3}^0\to\tilde{\ell}_R\ell$	4 e,μ	0	Yes	20.3	$\tilde{\chi}_{2,3}^0$ 635 GeV	$m(\tilde{\chi}_2^0)$= $(\tilde{\chi}_3^0)$, $m(\tilde{\chi}_1^0)$=0, $m(\tilde{\ell},\tilde{\nu})=0.5(m(\tilde{\chi}_2^0)+m(\tilde{\chi}_1^0))$	1405.5086
	GGM (wino NLSP) weak prod.	1 $e,\mu+\gamma$	-	Yes	20.3	$\tilde{W}$ 115-370 GeV	$c\tau$<1 mm	1507.05493
	GGM (bino NLSP) weak prod.	2 γ	-	Yes	20.3	$\tilde{W}$ 590 GeV	$c\tau$<1 mm	1507.05493
Long-lived particles	Direct $\tilde{\chi}_1^+\tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^\pm$	Disapp. trk	1 jet	Yes	36.1	$\tilde{\chi}_1^\pm$ 430 GeV	$m(\tilde{\chi}_1^\pm)-m(\tilde{\chi}_1^0)$~160 MeV, $\tau(\tilde{\chi}_1^\pm)$=0.2 ns	ATLAS-CONF-2017-017
	Direct $\tilde{\chi}_1^+\tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^\pm$	dE/dx trk	-	Yes	18.4	$\tilde{\chi}_1^\pm$ 495 GeV	$m(\tilde{\chi}_1^\pm)-m(\tilde{\chi}_1^0)$~160 MeV, $\tau(\tilde{\chi}_1^\pm)$<15 ns	1506.05332
	Stable, stopped $\tilde{g}$ R-hadron	0	1-5 jets	Yes	27.9	$\tilde{g}$ 850 GeV	$m(\tilde{\chi}_1^0)$=100 GeV, 10 μs<$\tau(\tilde{g})$<1000 s	1310.6584
	Stable $\tilde{g}$ R-hadron	trk	-	-	3.2	$\tilde{g}$ 1.58 TeV		1606.05129
	Metastable $\tilde{g}$ R-hadron	dE/dx trk	-	-	3.2	$\tilde{g}$ 1.57 TeV	$m(\tilde{\chi}_1^0)$=100 GeV, τ>10 ns	1604.04520
	GMSB, stable $\tilde{\tau}$, $\tilde{\chi}_1^0\to\tilde{\tau}(\tilde{e},\tilde{\mu})+\tau(e,\mu)$	1-2 μ	-	-	19.1	$\tilde{\chi}_1^0$ 537 GeV	10<tanβ<50	1411.6795
	GMSB, $\tilde{\chi}_1^0\to\gamma\tilde{G}$, long-lived $\tilde{\chi}_1^0$	2 γ	-	Yes	20.3	$\tilde{\chi}_1^0$ 440 GeV	1<$\tau(\tilde{\chi}_1^0)$<3 ns, SPS8 model	1409.5542
	$\tilde{g}\tilde{g}, \tilde{\chi}_1^0\to ee\nu/e\mu\nu/\mu\mu\nu$	displ. $ee/e\mu/\mu\mu$	-	-	20.3	$\tilde{\chi}_1^0$ 1.0 Te	7 <$c\tau(\tilde{\chi}_1^0)$< 740 mm, $m(\tilde{g})$=1.3 TeV	1504.05162
	GGM $\tilde{g}\tilde{g}, \tilde{\chi}_1^0\to Z\tilde{G}$	displ. vtx + jets	-	-	20.3	$\tilde{\chi}_1^0$ 1.0 Te	6 <$c\tau(\tilde{\chi}_1^0)$< 480 mm, $m(\tilde{g})$=1.1 TeV	1504.05162
RPV	LFV $pp\to\tilde{\nu}_\tau+X, \tilde{\nu}_\tau\to e\mu/e\tau/\mu\tau$	$e\mu,e\tau,\mu\tau$	-	-	3.2	$\tilde{\nu}_\tau$ 1.9 TeV	λ'_{311}=0.11, $\lambda_{132/133/233}$=0.07	1607.08079
	Bilinear RPV CMSSM	2 e,μ (SS)	0-3 b	Yes	20.3	$\tilde{q},\tilde{g}$ 1.45 TeV	$m(\tilde{q})=m(\tilde{g})$, $c\tau_{LSP}$<1 mm	1404.2500
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to W\tilde{\chi}_1^0, \tilde{\chi}_1^0\to ee\nu, e\mu\nu, \mu\mu\nu$	4 e,μ	-	Yes	13.3	$\tilde{\chi}_1^\pm$ 1.14 eV	$m(\tilde{\chi}_1^0)$>400GeV, $\lambda_{12k}\neq0$ (k = 1, 2)	ATLAS-CONF-2016-075
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to W\tilde{\chi}_1^0, \tilde{\chi}_1^0\to\tau\tau\nu_e, e\tau\nu_\tau$	3 $e,\mu+\tau$	-	Yes	20.3	$\tilde{\chi}_1^\pm$ 450 GeV	$m(\tilde{\chi}_1^0)>0.2\times m(\tilde{\chi}_1^\pm)$, $\lambda_{133}\neq0$	1405.5086
	$\tilde{g}\tilde{g}, \tilde{g}\to qqq$	0	4-5 large-R jets	-	14.8	$\tilde{g}$ 1.08 V	BR(t)=BR(b)=BR(c)=0%	ATLAS-CONF-2016-057
	$\tilde{g}\tilde{g}, \tilde{g}\to qq\tilde{\chi}_1^0, \tilde{\chi}_1^0\to qqq$	0	4-5 large-R jets	-	14.8	$\tilde{g}$ 1.55 TeV	$m(\tilde{\chi}_1^0)$=800 GeV	ATLAS-CONF-2016-057
	$\tilde{g}\tilde{g}, \tilde{g}\to t\bar{t}\tilde{\chi}_1^0, \tilde{\chi}_1^0\to qqq$	1 e,μ	8-10 jets/0-4 b	-	36.1	$\tilde{g}$ 2.1 Te	$m(\tilde{\chi}_1^0)$= 1 TeV, $\lambda_{112}\neq0$	ATLAS-CONF-2017-013
	$\tilde{g}\tilde{g}, \tilde{g}\to\tilde{t}_1 t, \tilde{t}_1\to bs$	1 e,μ	8-10 jets/0-4 b	-	36.1	$\tilde{g}$ 1.65 TeV	$m(\tilde{t}_1)$= 1 TeV, $\lambda_{323}\neq0$	ATLAS-CONF-2017-013
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to bs$	0	2 jets + 2 b	-	15.4	$\tilde{t}_1$ 410 GeV, 450-510 GeV		ATLAS-CONF-2016-022, ATLAS-CONF-2016-084
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to b\ell$	2 e,μ	2 b	-	20.3	$\tilde{t}_1$ 0.4-1.0 Te	BR($\tilde{t}_1\to be/\mu$)>20%	ATLAS-CONF-2015-015
Other	Scalar charm, $\tilde{c}\to c\tilde{\chi}_1^0$	0	2 c	Yes	20.3	$\tilde{c}$ 510 GeV	$m(\tilde{\chi}_1^0)$<200 GeV	1501.01325

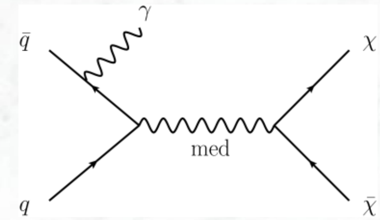
10^{-1} 1 Mass scale [TeV]

*Only a selection of the available mass limits on new states or phenomena is shown. Many of the limits are based on simplified models, c.f. refs. for the assumptions made.

"The 2 TeV line has been reached for some scenarios"

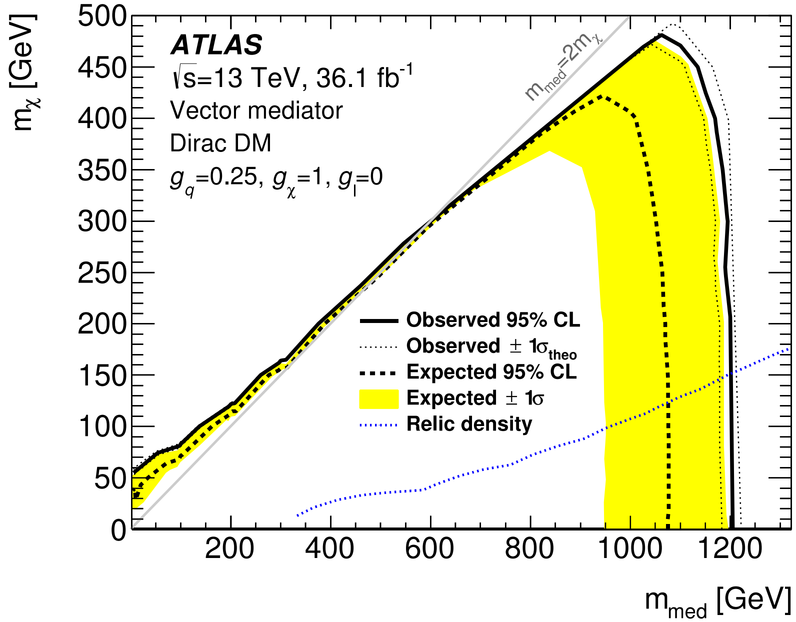
Search for Dark Matter

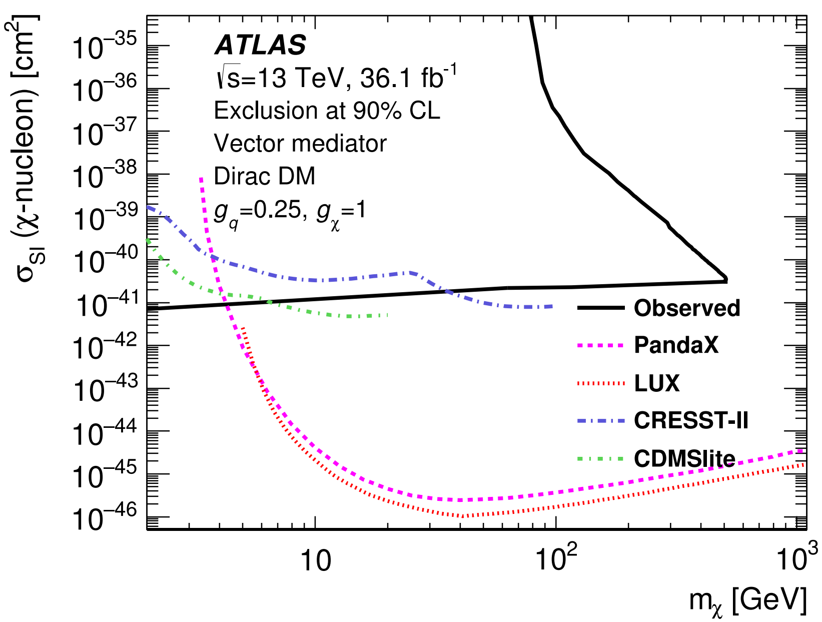
- Search in final states containing an energetic photon and large E_T^{miss} (2015+2016) dataset: 36.1 fb^{-1} at $\sqrt{s}$ = 13 TeV



- No excess above expectations from Standard model processes observed
  → Interpretation in Simplified Dark Matter models (Dirac fermion DM, s-channel mediator with vector / axial-vector couplings) → Excluded regions (m_{med} versus m_χ)

  → Interpretation in excluded χ-proton spin-dependent and spin-independent scattering cross sections for different mediator models → link to direct DM search experiments

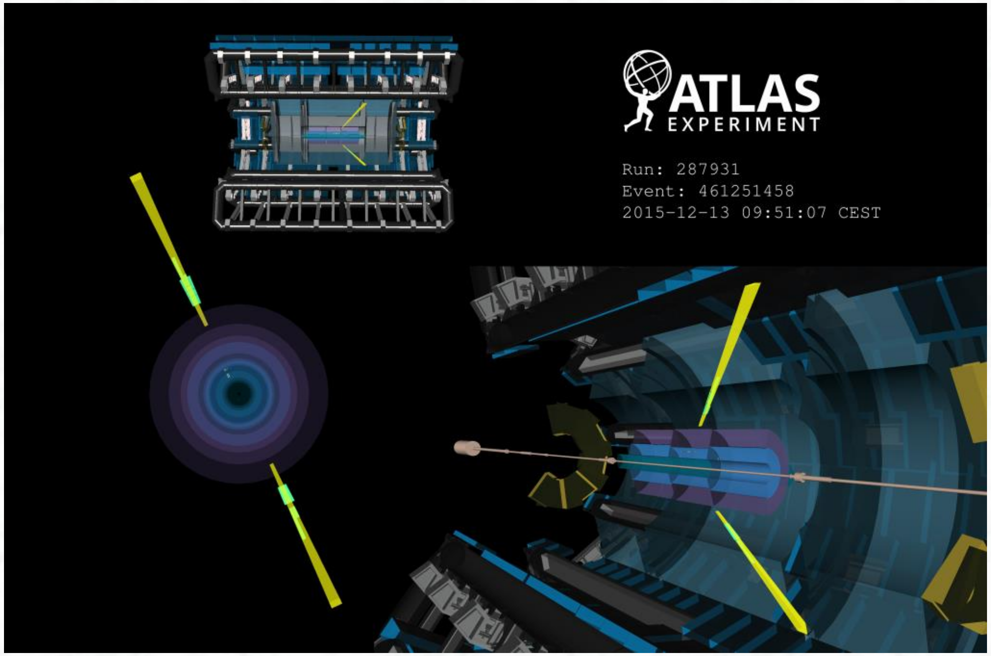




- Interesting limits obtained, extend to low masses of Dark matter particles

Heavy Ion Physics in ATLAS

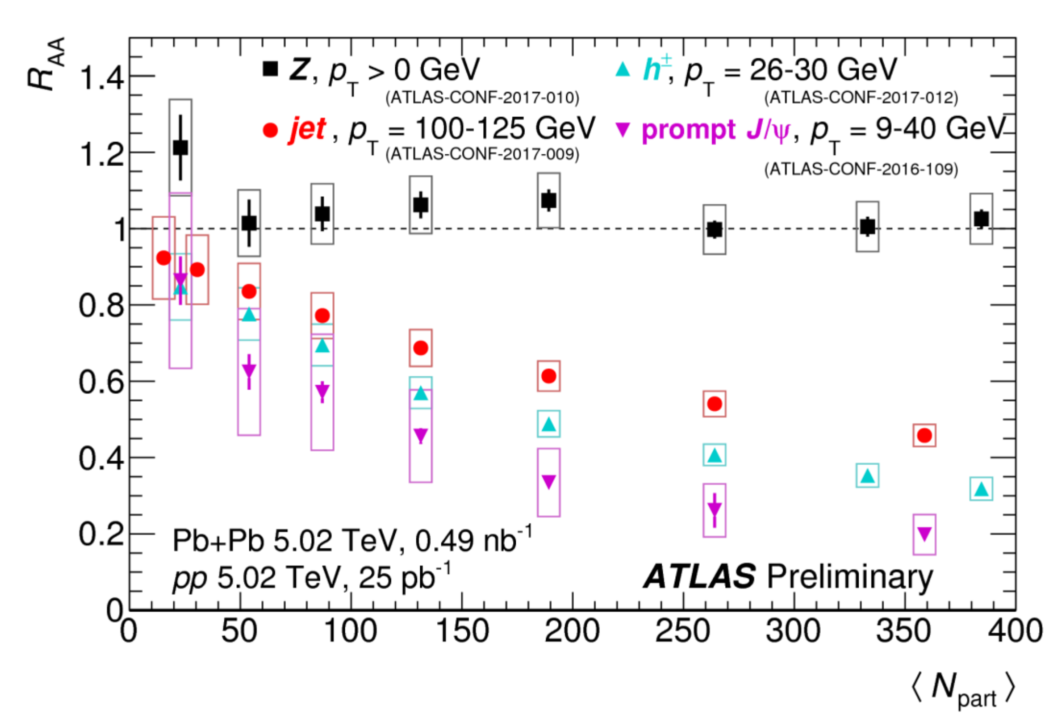
- Evidence for light-by-light scattering $\gamma\gamma \rightarrow \gamma\gamma$ in 5 TeV Pb-Pb collision data (2015)
  (submitted to Nature Physics, arXiv:1702.01625)

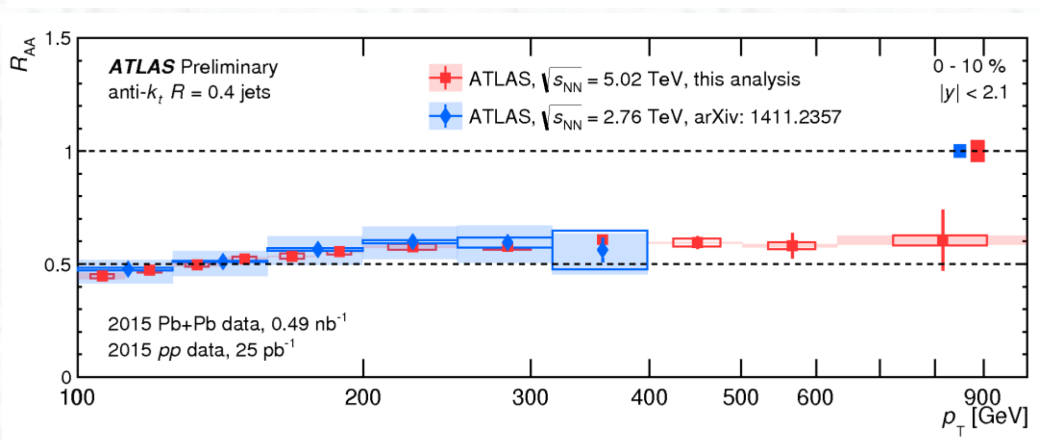


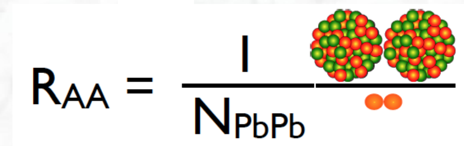
- At Quark Matter 2017:
  - 11 preliminary results (conference notes), including 8 TeV p-Pb collision data
  - 2 journal papers

Main highlights: Jet production, flow in small system

Results on Heavy Ion Physics in ATLAS



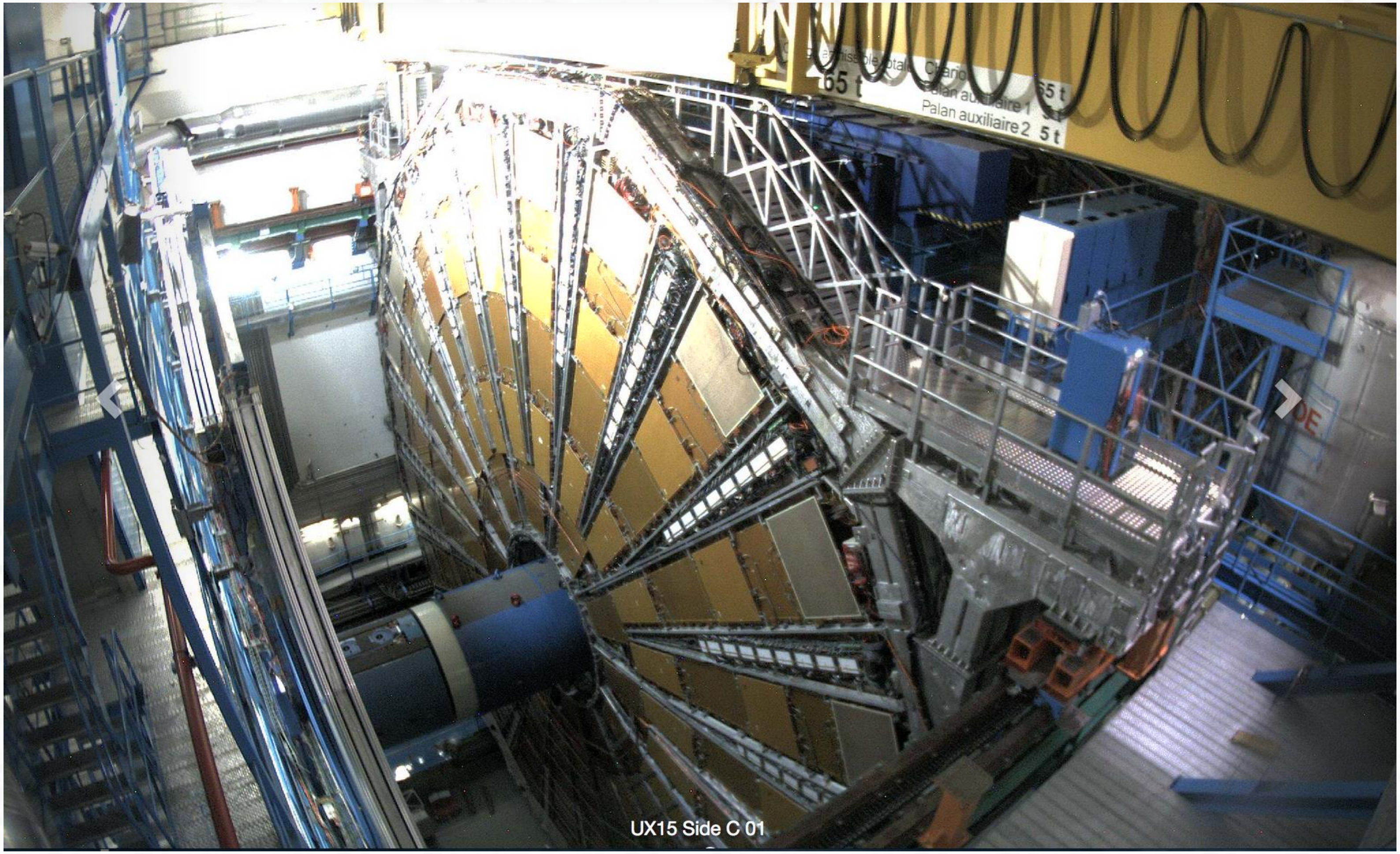




- Strongly interacting particles are increasingly suppressed as the density of the nuclear medium increases

- With Run-2 data, jets up to p_T~1 TeV can be assessed

Work during Extended Year End Technical Stop (EYETS)



Side C
4th April 2017

The 2017 EYETS programme has been successfully completed;

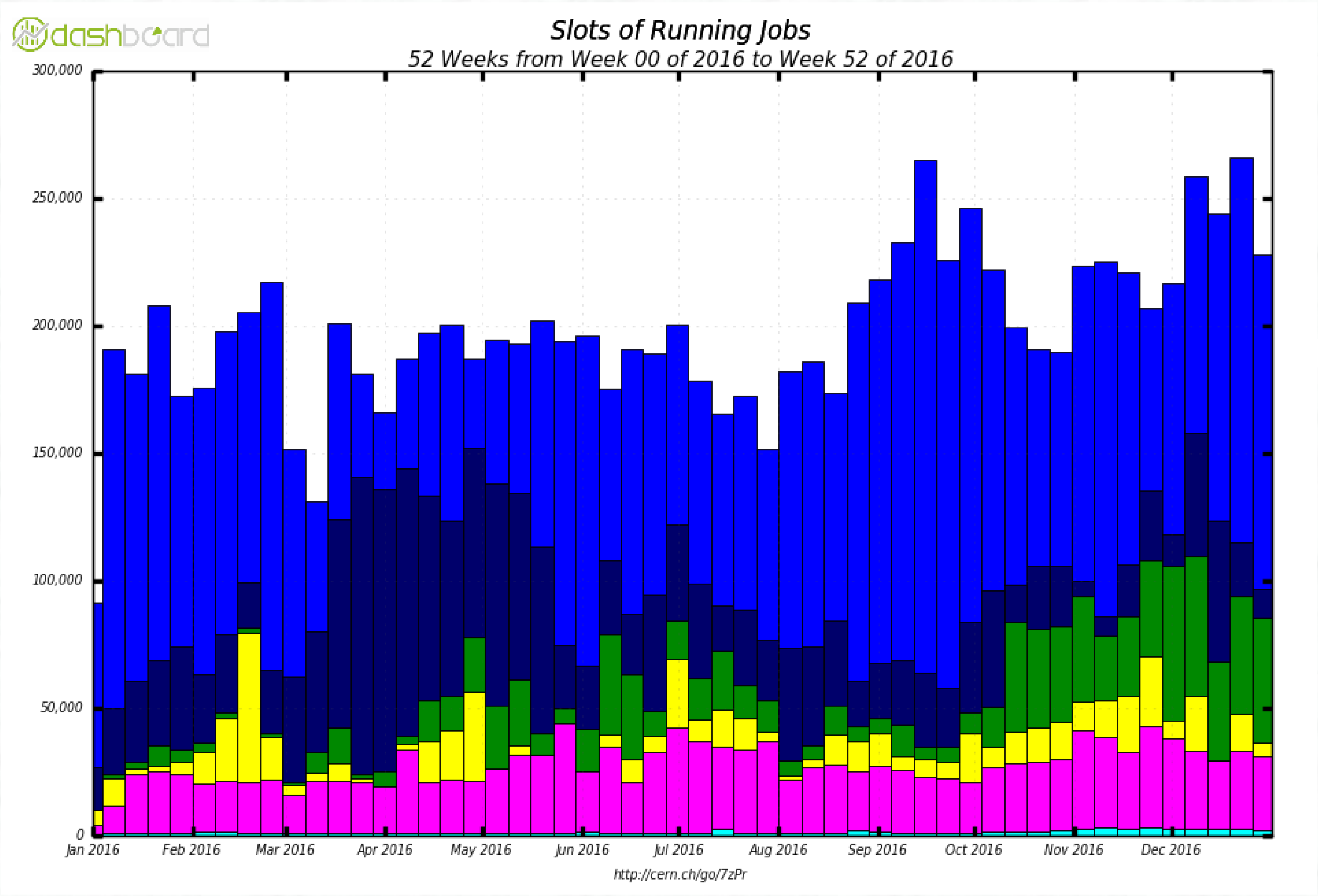
ATLAS is ready for data taking in 2017

(more details in the talk by Ludovico Pontecorvo)

Computing

As always, the WLCG has been fundamental to ATLAS physics analysis

- Fully leverage all pledged resources
- Aggressively use non-pledged CPU resources



MC Simulation

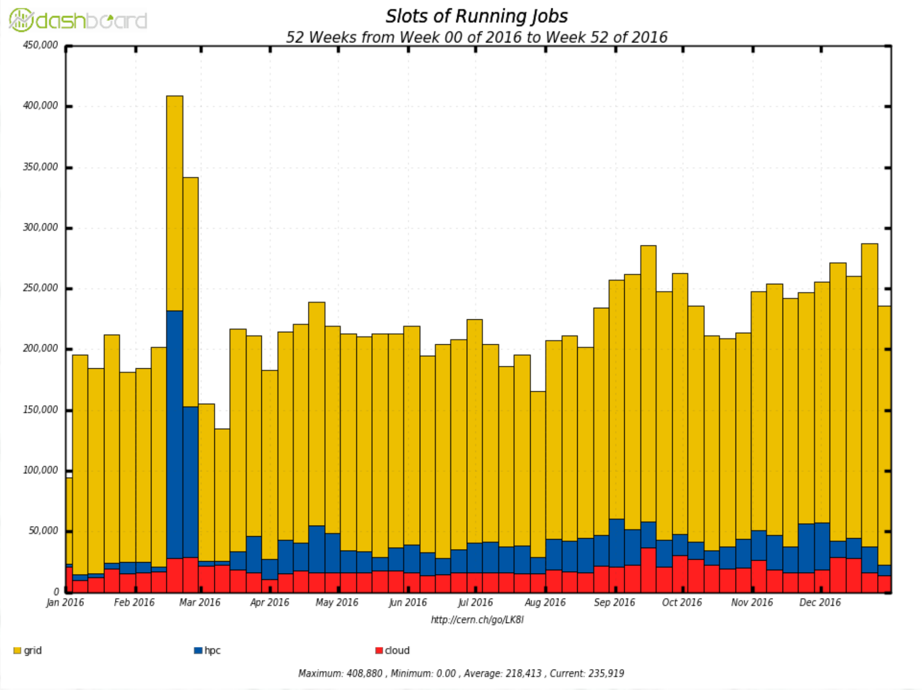
MC Reconstruction

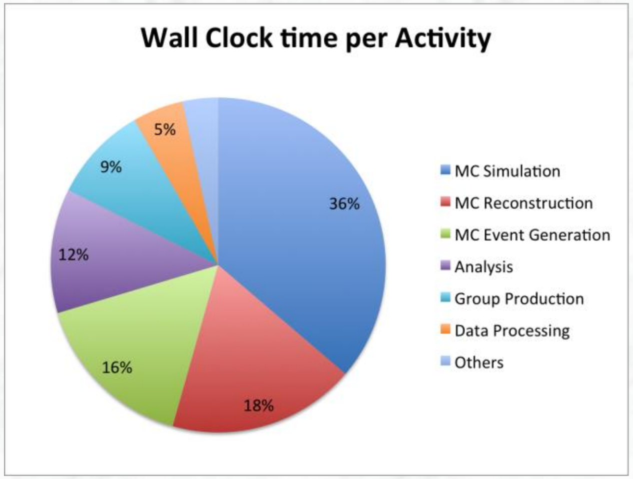
Group production

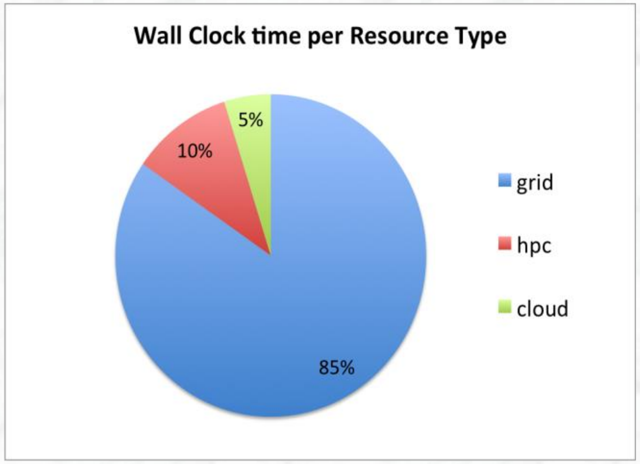
Data Processing

Analysis

Computing (cont.)





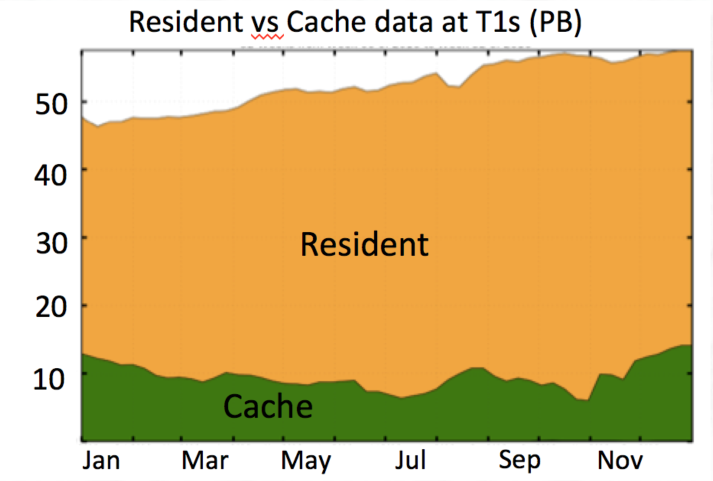


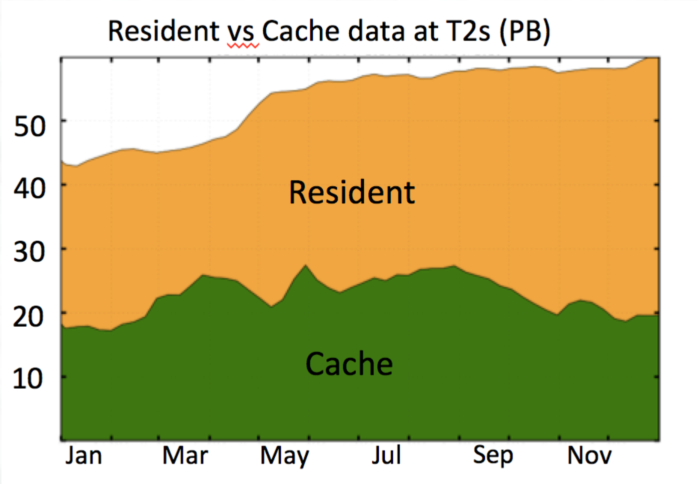
- Increasing opportunistic use of clouds and HPCs (~15%); HPCs especially for event generators and Monte Carlo production;

- Integration of non-Grid resources in ATLAS is a big investment with a big return

Resources are needed in Run 2 to exploit the excellent LHC performance, which is expected to continue

- Tier-1 and Tier-2 CPU fully used, supplemented by opportunistic resources
- Tier-1 and Tier-2 disks are full
  Aggressive use of “lifetime” deletion model
- Reprocessing of 2015+2016 data with new release
- In addition: more Monte Carlo events are needed
- ATLAS has taken measures to optimize resources, e.g. reduce AOD, DAOD file sizes, or speed-up of simulation (→ next slides)
- ATLAS relies on development of tools to exploit new computing resources





Thanks to the continuous strong Computing support; ATLAS’ success relies heavily on it !

Trigger and DAQ: getting ready for 2 •10^{34} cm^{-2} s^{-1}

- Level 1: Topological Trigger

  - Apply real-time kinematic and angular cuts at L1 → reduction of L1 rate, critical for high-luminosity running

  - Hardware stable for a year, expanded menu and firmware for 2017 ready

- High-Level Trigger

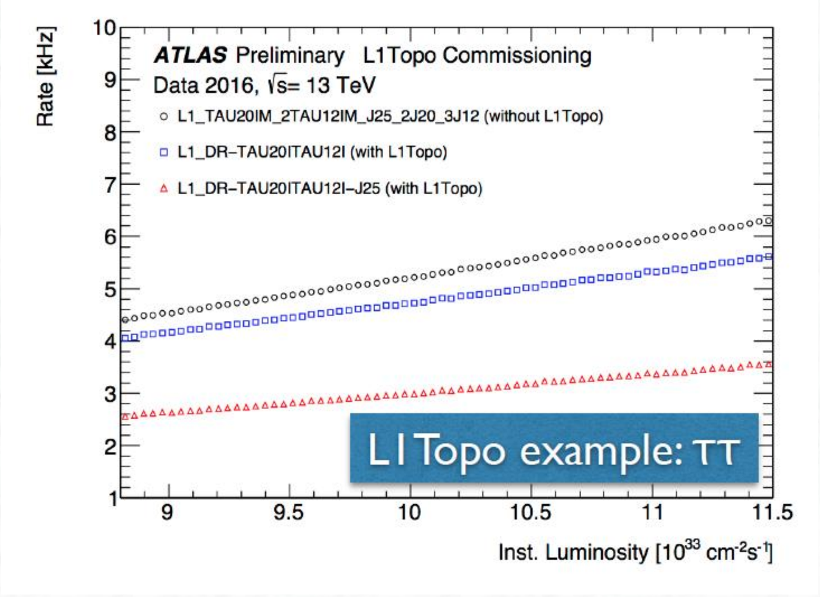
  - Keep thresholds as low as possible

  - Work done to reduce HLT CPU use by 15-20%

- Operation of the Inner Detector (Tracking) at high luminosity

  - Significant upgrade of readout hardware (Pixel DAQ)

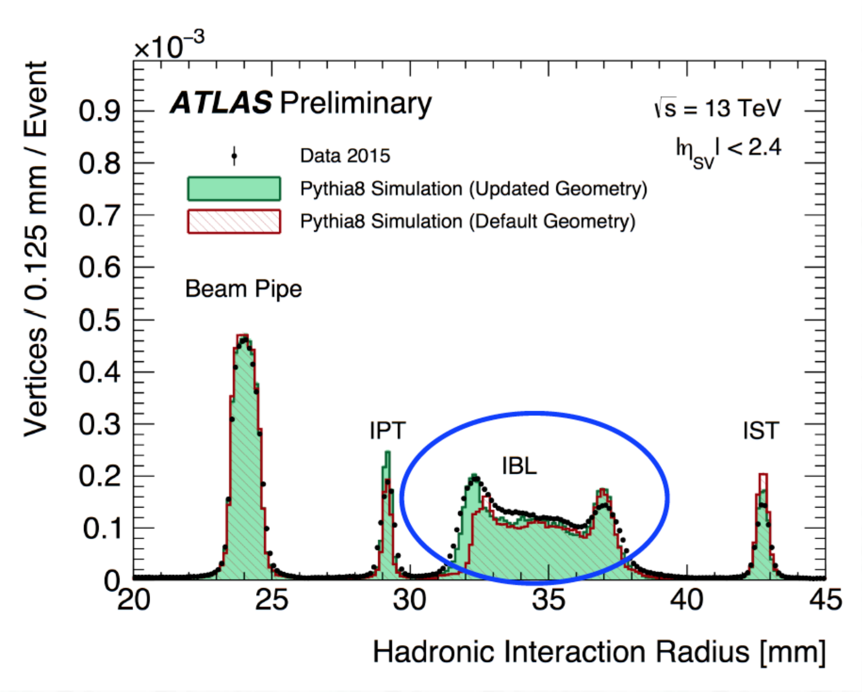
  - Inner Detector can run at 100 kHz and pile-up level up to μ ~ 60 (~ 2 10^{34} cm^{-2} s^{-1})



Simulation and Reconstruction

- Software for Run 2: Release 21
  - Release 21 commissioned and validated
  Stable release for Run 2 → reprocessing of earlier Run-2 data

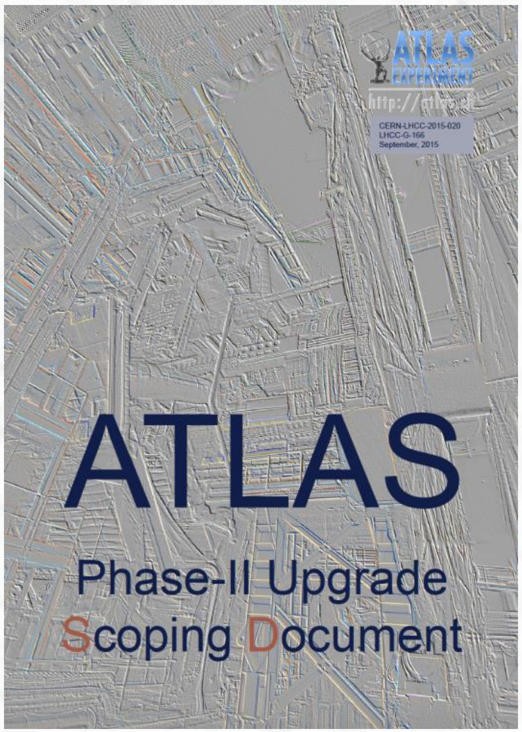
- Simulation
  - 15% speed-up w.r.t. previous release for full detector simulation (incl. new Geant4 version, updated geometry, ...)
  - Further development of Fast Simulation is a high-priority item



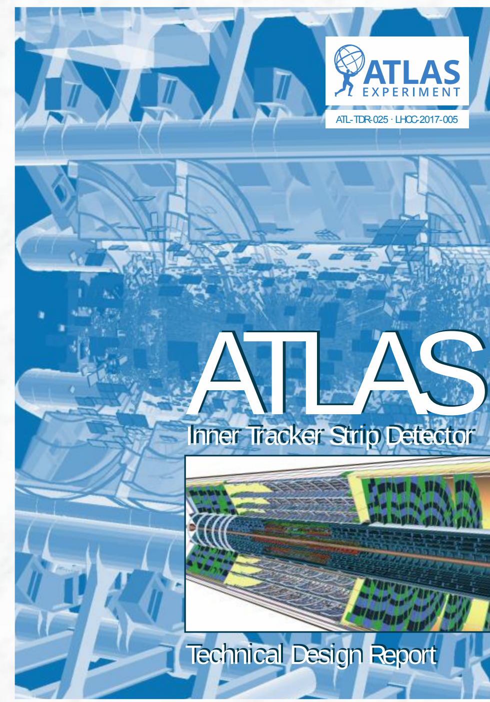
- Reconstruction
  - Numerous changes and improvements to the software, calibration and alignment
  - Content of reconstruction output (AOD) carefully optimized to reduce the size (20% for data)
    → helps to mitigate 2018 storage requests by moving some CPU-light reconstruction into the analysis-format building step (DAODs)

Phase-II Detector Upgrade

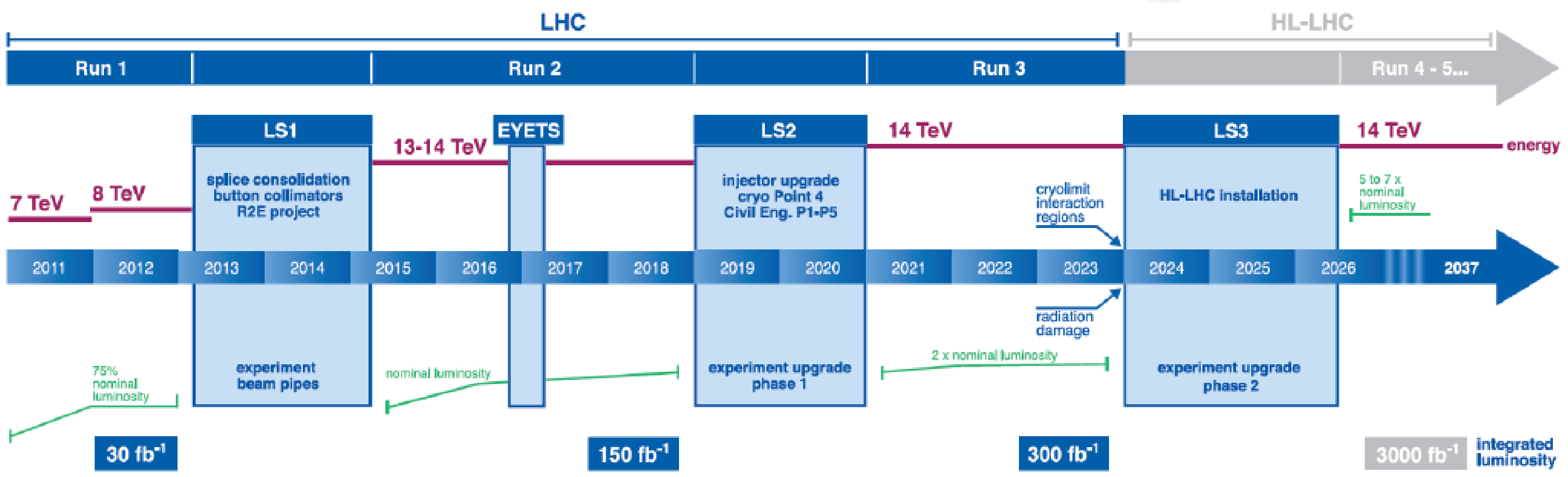
-From the Scoping Document to the Technical Design Reports-



→



LHC Schedule



Phase-I upgrades to be installed by end of LS2, i.e. end of 2020

- Parts already installed (LS1) or coming during Run 2 (FTK)
- Larger parts to come in LS2 (NSW, LAr electronics, L1 Calo, L1 Muon, and FELIX)
- 14 TeV running after LS2 (in Run 3)

Phase-II upgrades for installation in LS3 in 2024-2026

- TDR preparation in full swing
- R&D activities in all Phase-II areas

ITk: The new ATLAS Inner Tracker

Motivation:

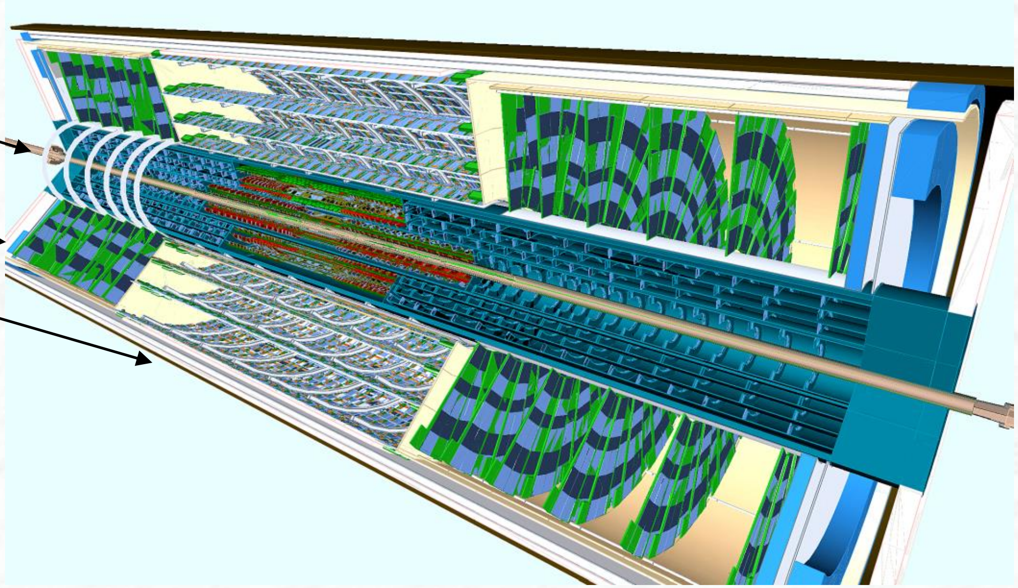
- Replacement of the central tracking detector in ATLAS;
  Major component of the Phase-II upgrade, ~50% of the total cost

- Essential to manage radiation damage and instantaneous luminosity at HL-LHC

- Layout Task Force has converged on a silicon pixel (5 layers in the barrel) + silicon strip (4 outer layers in the barrel) system;
  Pixel system is confined to a cylinder around the beam pipe, R = 34.5 cm

Pixel Tracker

Strip Tracker (Barrel and Endcaps)



ITk: The new ATLAS Inner Tracker (cont.)

Status of the ITk Strip Detector TDR:

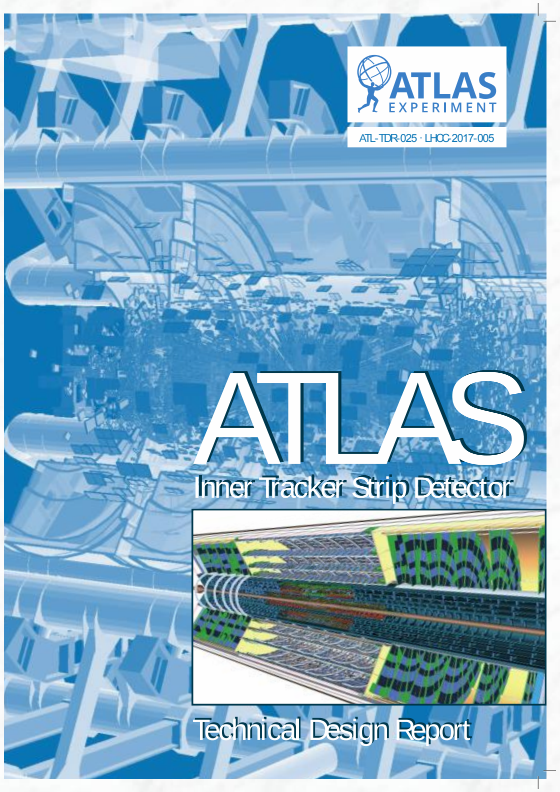
- The first Phase-II TDR, covering the outer part of the tracker (based on Silicon Strips) has been submitted to the LHCC

  550 pages, printed copies available for RRB

- LHCC has given preliminary approval at its meeting in February 2017
  "ITk strip tracker as proposed is a sound design and, with the pixels system being considered, addresses the tracker performance required for HL-LHC. No show stoppers were identified."

- Next step: Approval by Upgrade Cost Group (UCG)

  Separate UCG material for cost, schedule, risk and resources was submitted in Jan 2017;
  Updated version submitted on 9th April 2017



ITk: The new ATLAS Inner Tracker (cont.)

- In-depth UCG review (chaired by Stewart Smith) planned for 8th/9th May 2017 (beginning of next LHCC week)

  Very detailed review, on costs (uncertainties, quality factors), schedule, sharing of work, resources (at institutes), and risk analysis

  Present cost estimates: 60 MCHF in Strip Tracker, 40 MCHF in Pixel Tracker, 20 MCHF in Common ITk Items.
  (total in agreement with estimates given in the Scoping Document for the inner tracker system in the reference scenario)

  ITk is a central and essential part of the Upgraded ATLAS detector
  → no large cost saving or down-scoping possible (especially not for strip detector)

- Hope to get approval by UCG and LHCC, followed by approval of CERN Research Board on 9th June 2017

- Prepare iMoU for final ASIC and sensor prototypes in 2017/18 for ITk Strip detector

- Second part of the ITk TDR (Pixel detector system) will be finalized in Dec 2017

Remaining Elements of ATLAS Phase-II upgrade

- Every major system in ATLAS requires significant upgrades for HL-LHC
- The Phase-I upgrades form the foundation for Phase-II upgrades
- The TDRs will be finalized throughout this year

Muon Spectrometer

Electronics replacements, plus upgrade of chambers in the inner barrel layer

TDR submission: 30th June 2017

Calorimeters

- Electronics replacements for LAr and Tile calorimeters;

- ATLAS decided not to upgrade the forward calorimeter (sFCAL);
  (-10 MCHF w.r.t reference scenario in Scoping Document)

- High Granularity Timing Detector (HGTD) in forward region seriously considered;
  R&D progressing well;
  Internal review to decide whether to proceed to TDR planned for Sept 2017;
  If agreed, HGTD will be presented in preliminary form in the LAr TDR and followed up with a separate TDR in 2018

TDR submission: 30th September 2017

Remaining Elements of ATLAS Phase-II upgrade

Trigger and DAQ

Major upgrade of Trigger and DAQ systems to provide more than a factor of ten increase in trigger rate capability

TDR submission: 15^{th} December 2017

(together with ITk Pixel detector TDR)

Update on Phase-II TDR Approval Process

We are planning for convergence of the scientific/technical reviews of all Phase-II projects (complete program) in the first half of 2018

Target date: RRB in April 2018

→ **ATLAS clearly prefers the "Fast Forward" review schedule**
(however, we are not suggesting to reduce the level of scrutiny;
this probably calls for an optimization of the review process and more reviewers)

- We consider this critical to achieve readiness for LS3 installation

- First CORE money has to be spent during 2017/18 and this will require (i)MoUs

Summary

- ATLAS continues to produce high-quality physics results

  - Precision phase entered on some measurements, e.g m_W
  - Results for many searches for BSM physics are based on complete Run-2 dataset
  - Aim for updates on Higgs boson studies and parameter measurements for Summer 2017

- Detector Consolidation successfully mastered during Extended Year End Technical Stop
  → ATLAS is ready for Data Taking in 2017

- First Technical Design Report (ITk Strip detector) presented and first approval steps taken;
  They will be followed by the submission of the remaining Phase-II TDRs throughout 2017

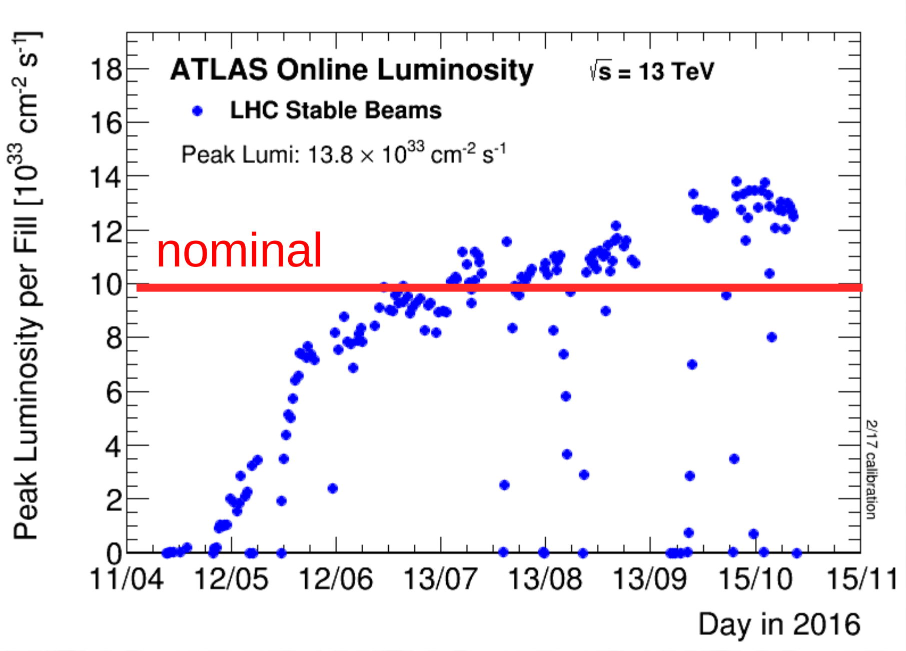
We have an intense year ahead of us!

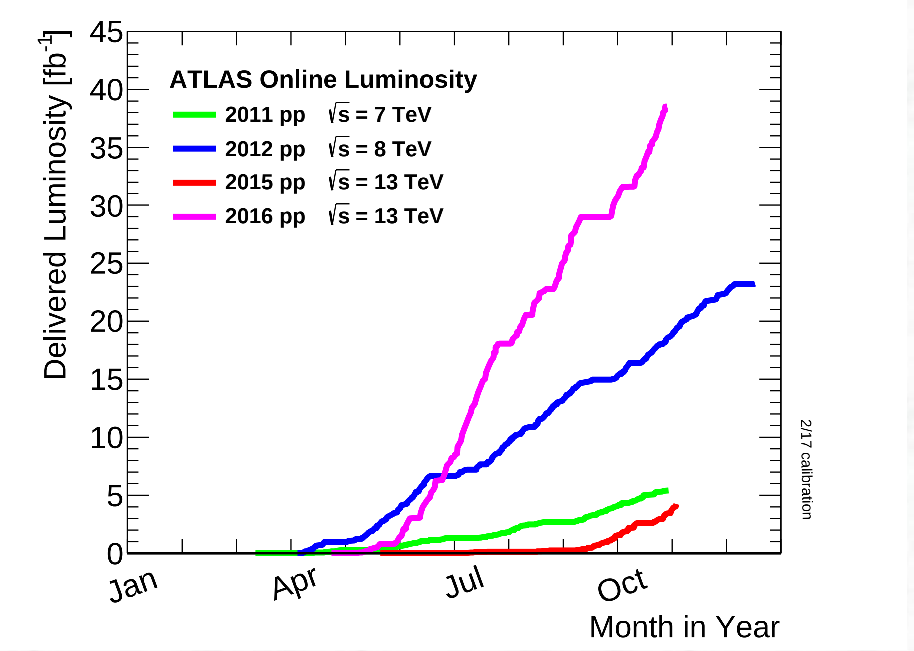
The strong support of the ATLAS Funding Agencies over the last decades has been, and continues to be, fundamental to the success of the experiment

Thank you!

Backup Slides

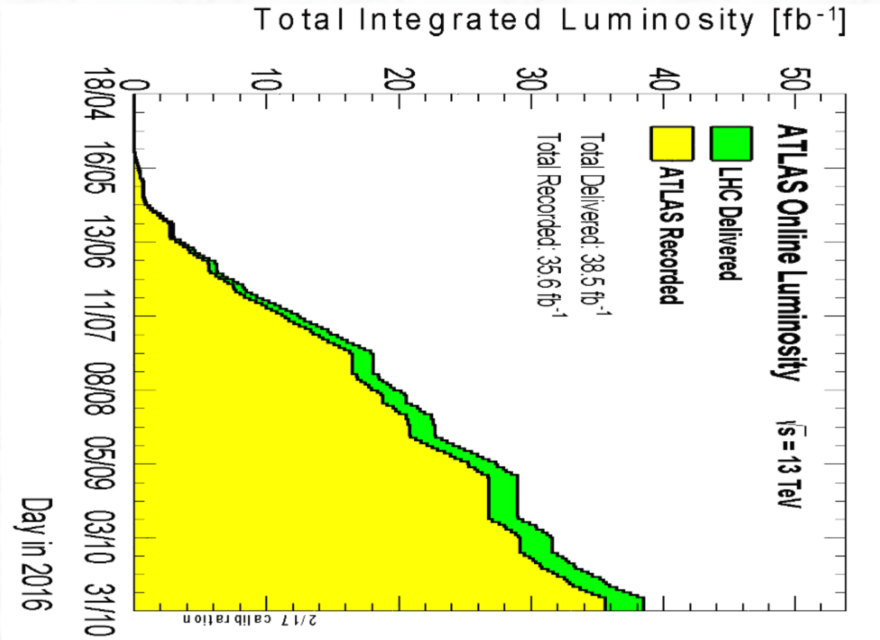
Recall of the excellent 2016 LHC performance





- Excellent LHC performance in 2016 at √s = 13 TeV
- Peak luminosities ~ 1.4 10^{34} cm^{-2} s^{-1}
- High level of pileup: mean of ~25 interactions / beam crossing in 2016

Recall of the excellent 2016 ATLAS performance



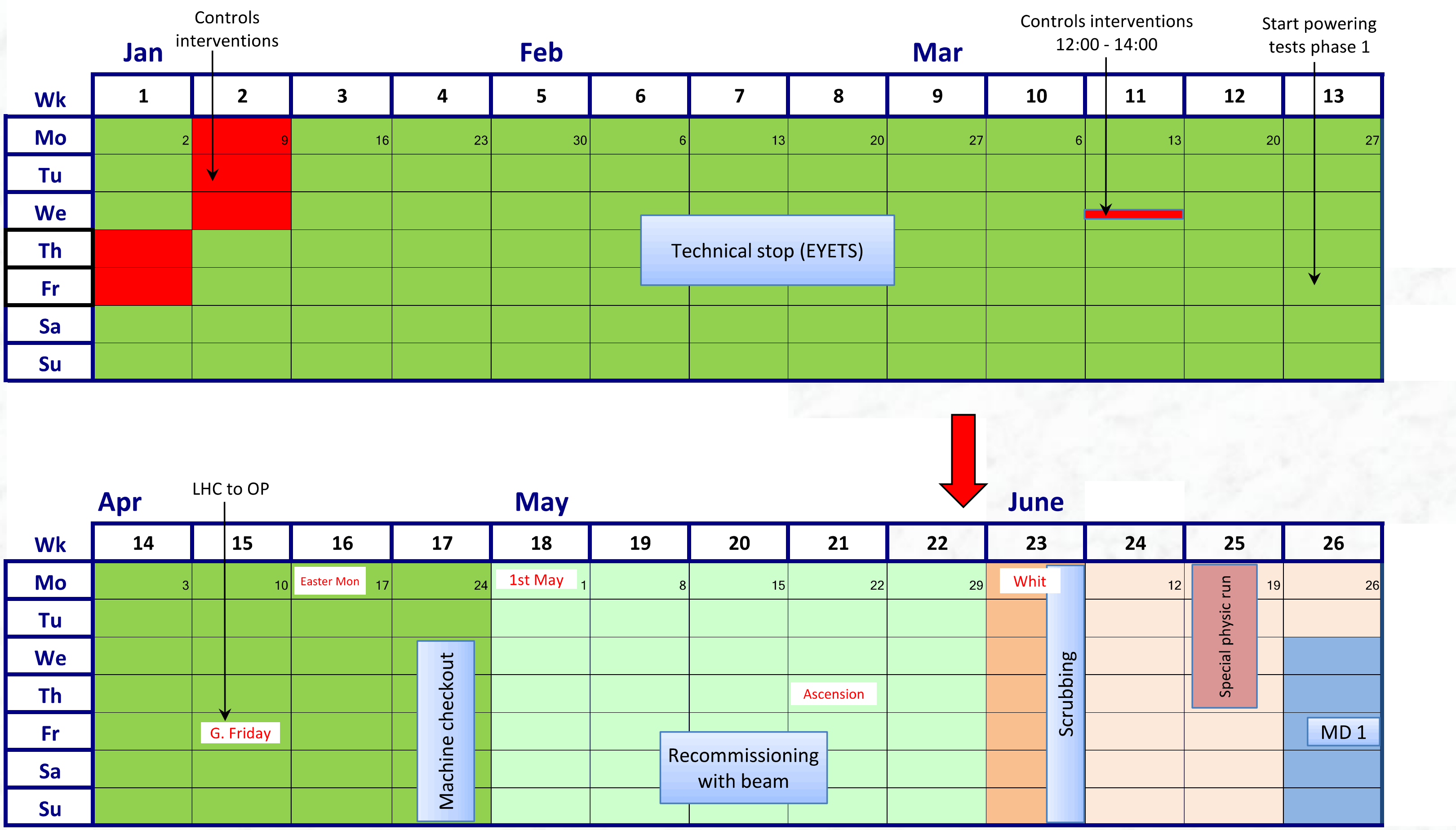
ATLAS pp 25ns run: April-October 2016											
Inner Tracker			Calorimeters		Muon Spectrometer				Magnets		Trigger
Pixel	SCT	TRT	LAr	Tile	MDT	RPC	CSC	TGC	Solenoid	Toroid	L1
98.9	99.9	99.7	99.3	98.9	99.8	99.8	99.9	99.9	99.1	97.2	98.3
Good for physics: 93-95% (33.3-33.9 fb^{-1})											

Luminosity weighted relative detector uptime and good data quality efficiencies (in %) during stable beam in pp collisions with 25ns bunch spacing at √s=13 TeV between April-October 2016, corresponding to an integrated luminosity of 35.9 fb^{-1}. The toroid magnet was off for some runs, leading to a loss of 0.7 fb^{-1}. Analyses that don't require the toroid magnet can use that data.

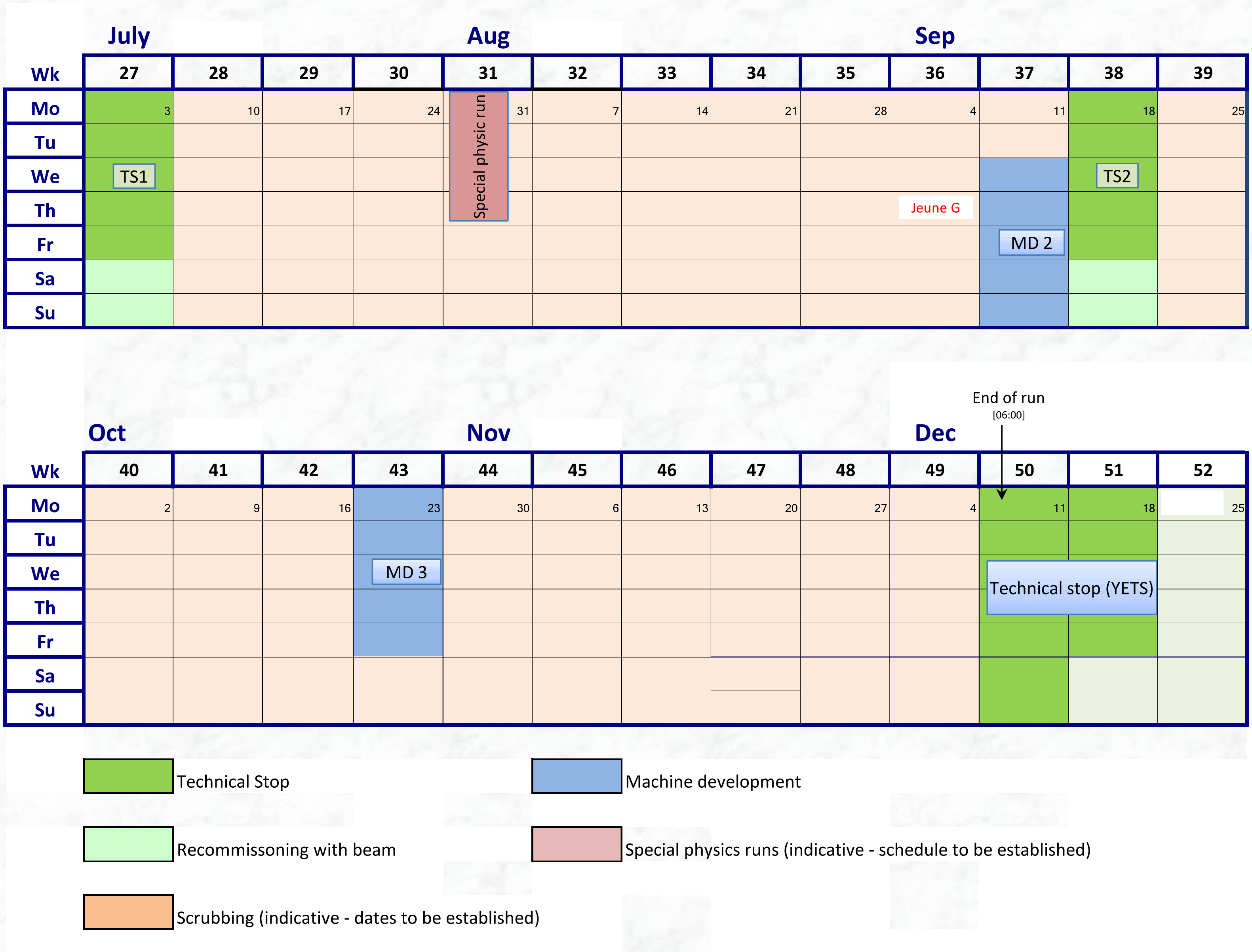
- Data taking efficiency: 92.4 %
  (even with peak luminosity well above LHC design)
- High operational fractions for all detector systems
- High data quality: Integrated luminosity good for physics: 33.3 – 33.9 fb^{-1}

LHC Schedule 2017

Approved by the Reseach Board, 8 March 2017



First collisions may come in week 22, i.e. 29th May 2017


July
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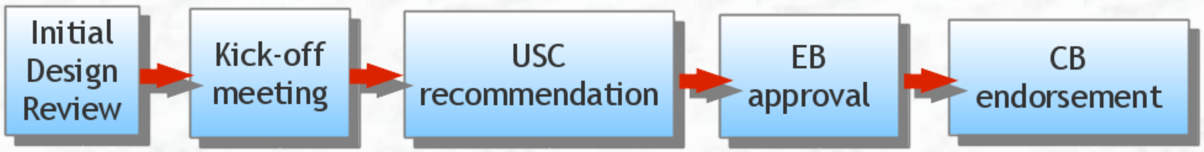
Special physic run
TS1
TS2
Jeune G
MD 2
Oct
Nov
Dec
End of run
[06:00]
40 41 42 43 44 45 46 47 48 49 50 51 52
2 9 16 23 30 6 13 20 27 4 11 18 25
MD 3
Technical stop (YETS)
Technical Stop
Machine development
Recommissoning with beam
Special physics runs (indicative - schedule to be established)
Scrubbing (indicative - dates to be established)

Remaining Elements of ATLAS Phase-II upgrade (cont.)

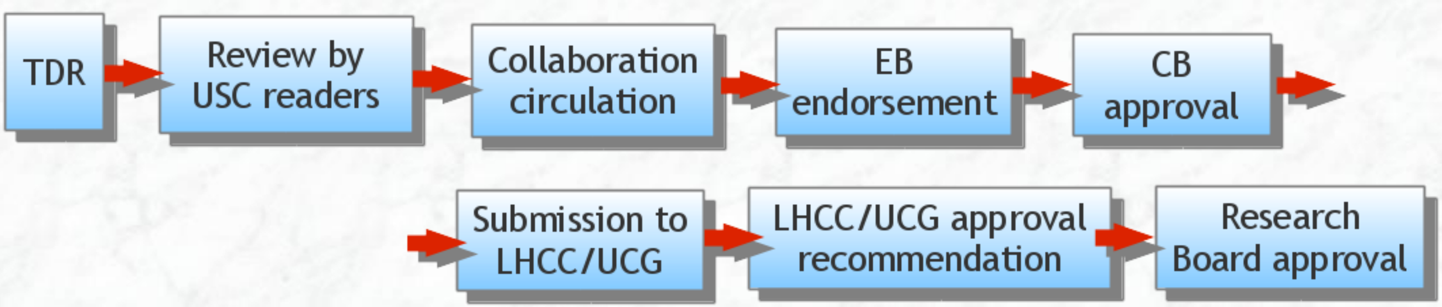
Present Status:

- Internal process (IDR = Initial Design Reviews) and Kick-off meetings for all Phase-II projects have been completed



→ ATLAS formal approval of scope and status of projects to proceed to complete and submit their TDRs.

- Remaining projects (Pixel part of ITk, LAr and Tile calorimeters, Muon spectrometer, and TDAQ system) working on TDRs, with submissions targeting the LHCC weeks in Sept. 2017, Nov. 2017 and Feb. 2018.



ITk: The new ATLAS Inner Tracker (cont.)

Details on UCG review (chaired by Stewart Smith, Princeton), planned for 8./9. May 2017:

0845	(15 +5)	Overall ITk Project Overview and Organization
0905	(15 +5)	Strip Project Organization
0925	(10 +5)	Common Mechanics: WBS and current best estimate of sub-project cost
0940	(10 +5)	Common Electronics: WBS and current best estimate of sub-project cost
0955	(15 +10)	Pixel Detector: WBS and current best estimate of sub-project cost
1020	(15 +10)	Strip Sensors (2.2.1)
1045	(15)	Break
1100	(10 +10)	Strip ASICs (2.2.2)
1120	(15 +10)	Strip Modules (2.2.3)
1145	(10 +10)	Strip Local Support Electronics and Off-Detector Electronics (2.2.4 + 2.2.9)
1205	(10 +10)	Strip Local Supports (2.2.5)
1225	(10 +10)	Strip Global Mechanics, Services, and Integration (2.2.6-2.2.8)
1245	(20)	Discussion

1400 Breakout sessions

Session 1:	(1400 – 1700)	Drilldown of costs, etc. for the strip modules and sensors
Session II a.	(1400 – 1530)	ASICS
Session II b.	(1530 – 1700)	Local Supports, Off-Detector Electronics
Session III a.	(1400 – 1600)	Local Support Mechanics, Global Mechanics, Services and Integration
Session III b.	(1600 – 1700)	Common Electronics, Common Mechanics and Pixels)