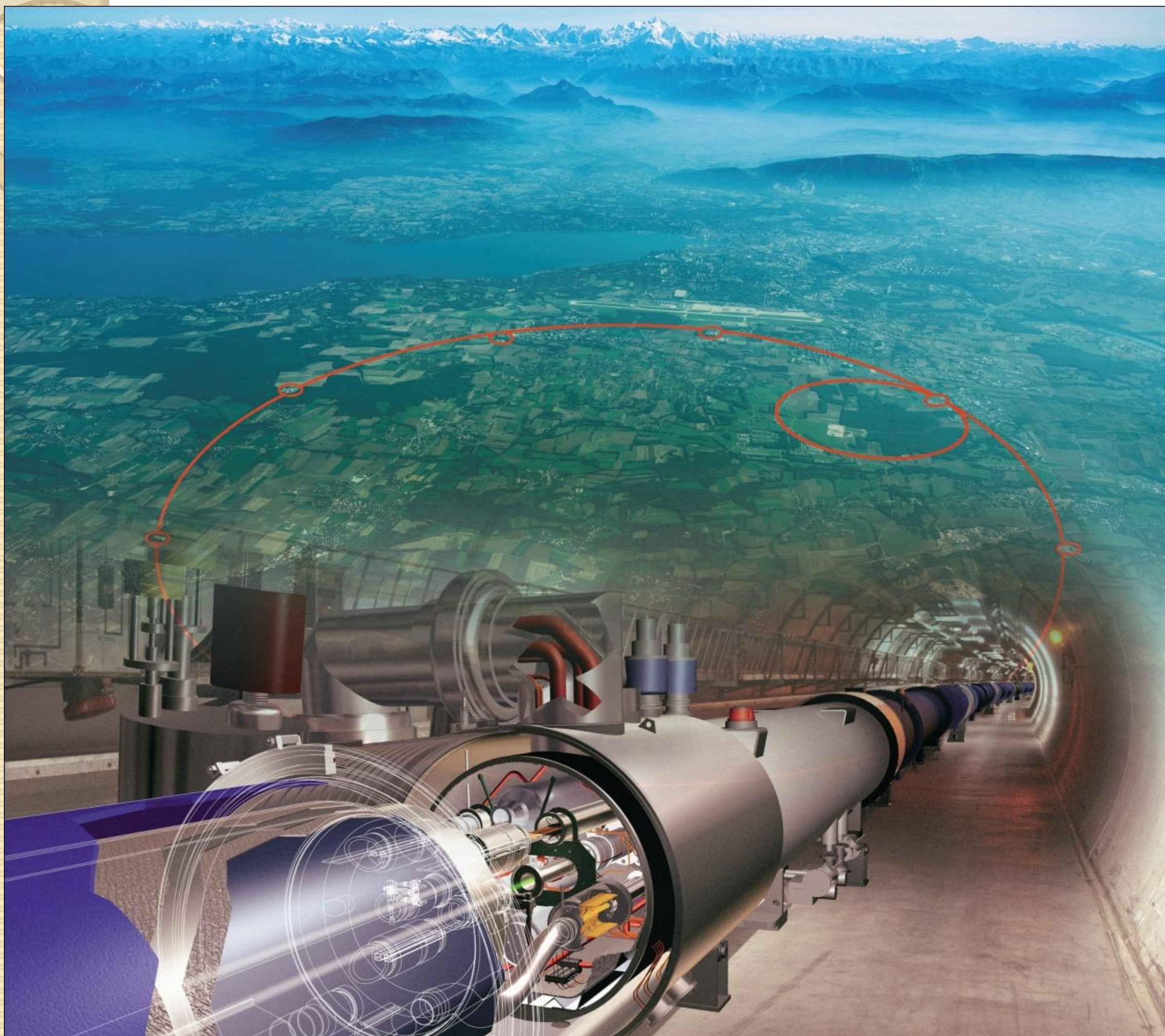
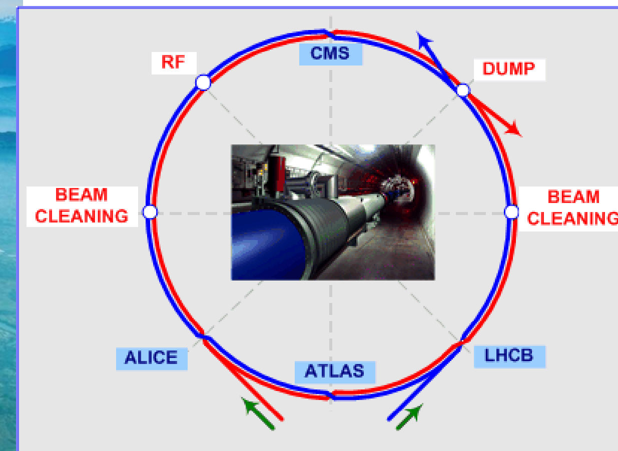
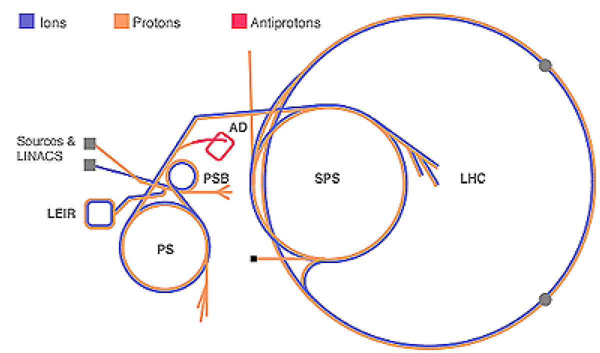
LHC – новый этап работ







Л.Н.Смирнова

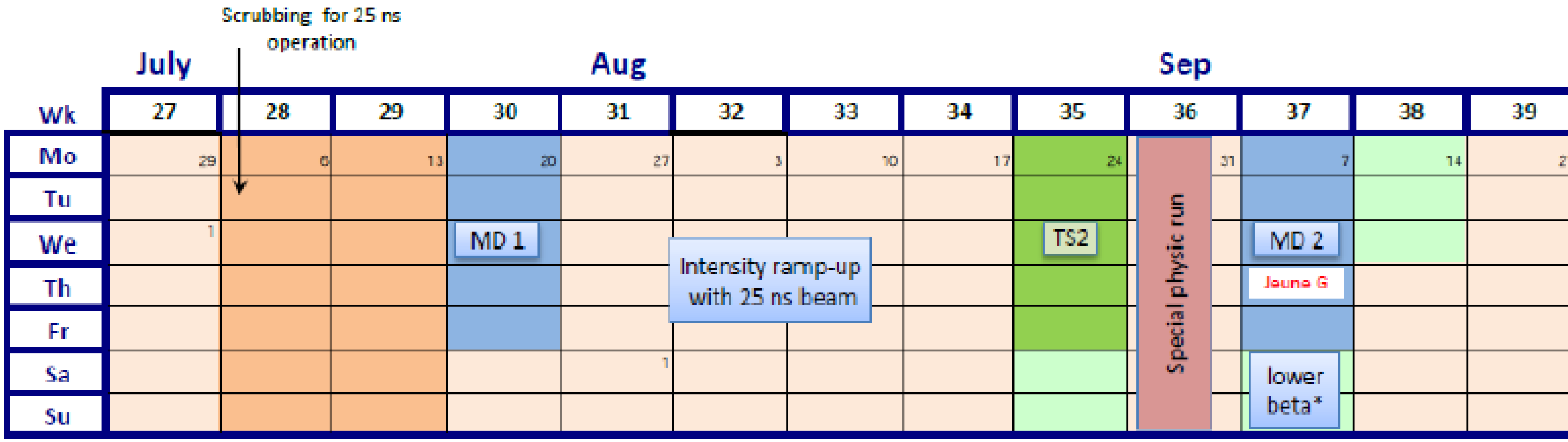
Семинар 10 марта 2015г.

Содержание доклада

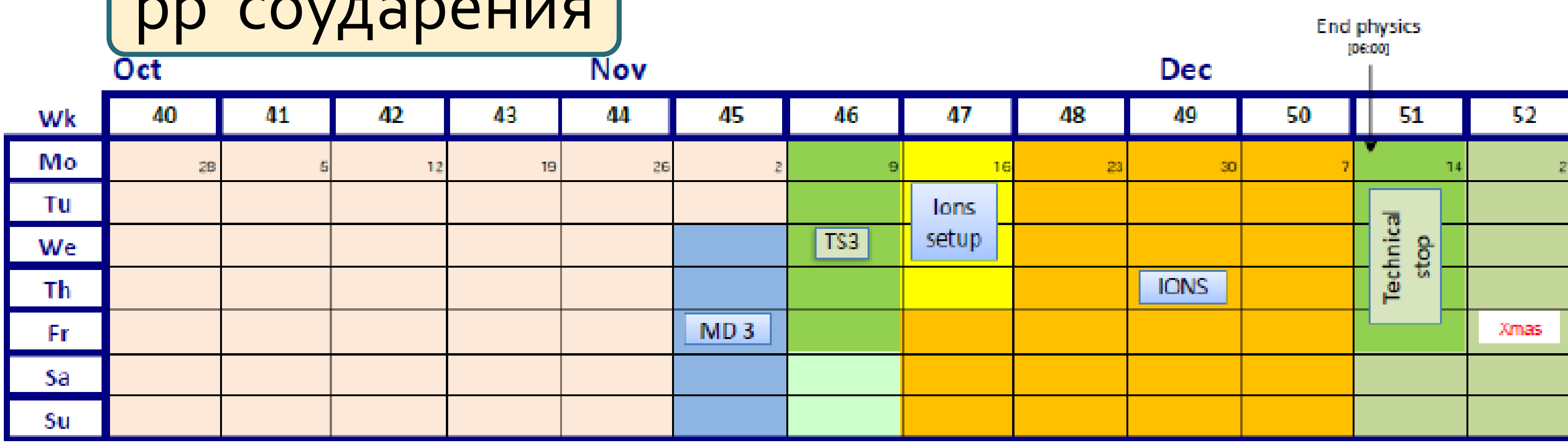
- Статус и планы коллайдера (БАК)
- Основные итоги первого сеанса (Run1)
- Задачи второго сеанса (Run 2)
- Планы на 2015 год
- Участие МГУ

Ход работ в 2015 - 1

Ход работ в 2015 - 2



pp соударения



Тяжелые ионы

The main 2013-14 LHC consolidations

1695 Openings and final reclosures of the interconnections

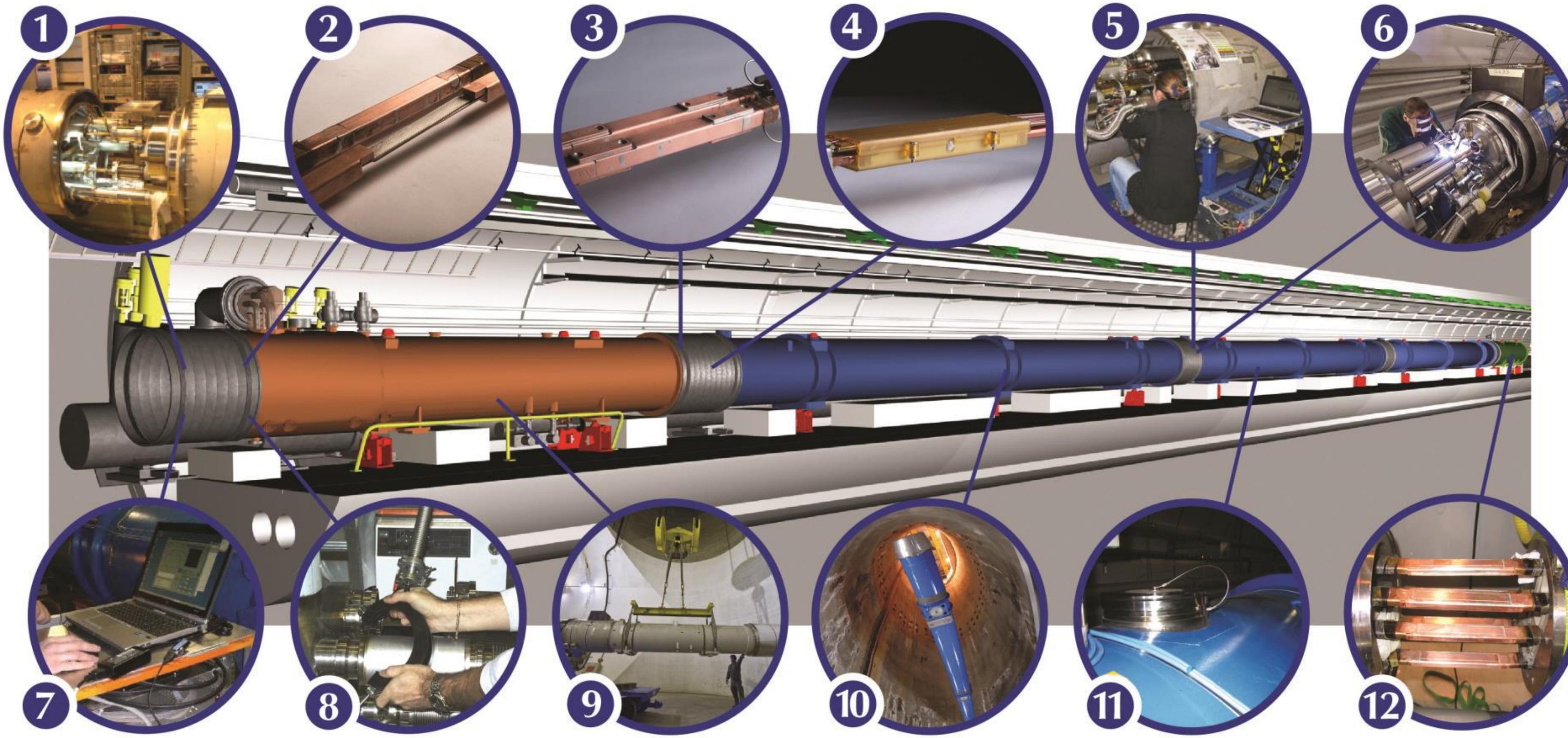
Complete reconstruction of 3000 of these splices

Consolidation of the 10170 13kA splices, installing 27 000 shunts

Installation of 5000 consolidated electrical insulation systems

300 000 electrical resistance measurements

10170 orbital welding of stainless steel lines



18 000 electrical Quality Assurance tests

10170 leak tightness tests

3 quadrupole magnets to be replaced

15 dipole magnets to be replaced

Installation of 612 pressure relief devices to bring the total to 1344

Consolidation of the 13 kA circuits in the 16 main electrical feed-boxes

Этапы работ в днях

LHC schedule 2015 version 1.1

Phase	Days	
Initial Commissioning	56	
Scrubbing (for 50 and 25 ns)	23	
Early LHCf/VdM1	5	
Proton physics 50 ns	**9 + 19**	
Proton physics 25 ns – phase 1	**30**	**- 14**
Change in beta*	**5**	
Proton physics phase 2 (including ramp-up)	**48**	**+ 4**
Special physics runs (TOTEM/VdM2) Intermediate energy run - to be scheduled	7	
MD	15	**- 4**
Technical stops	15	
Technical stop recovery	6	
Ion setup/Ion run	4 + 24	
Total	**266 (38 weeks)**	

LHC goal for 2015 and for Run 2 and 3

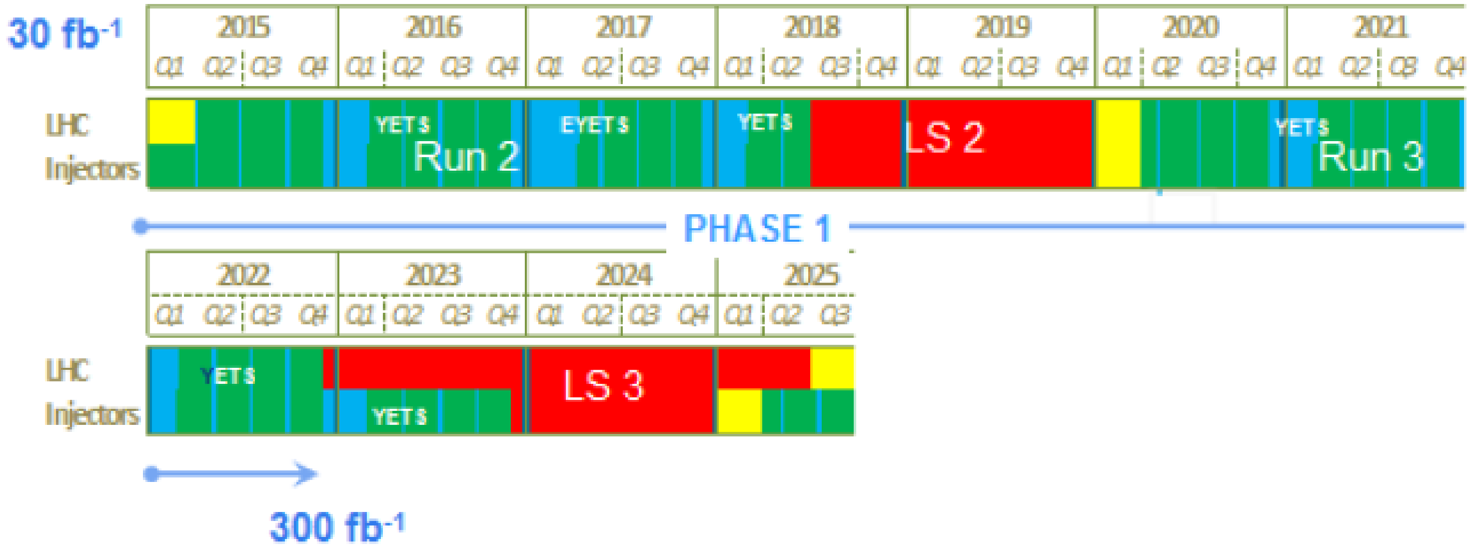
Integrated luminosity goal:

2015 : 10 fb^{-1}

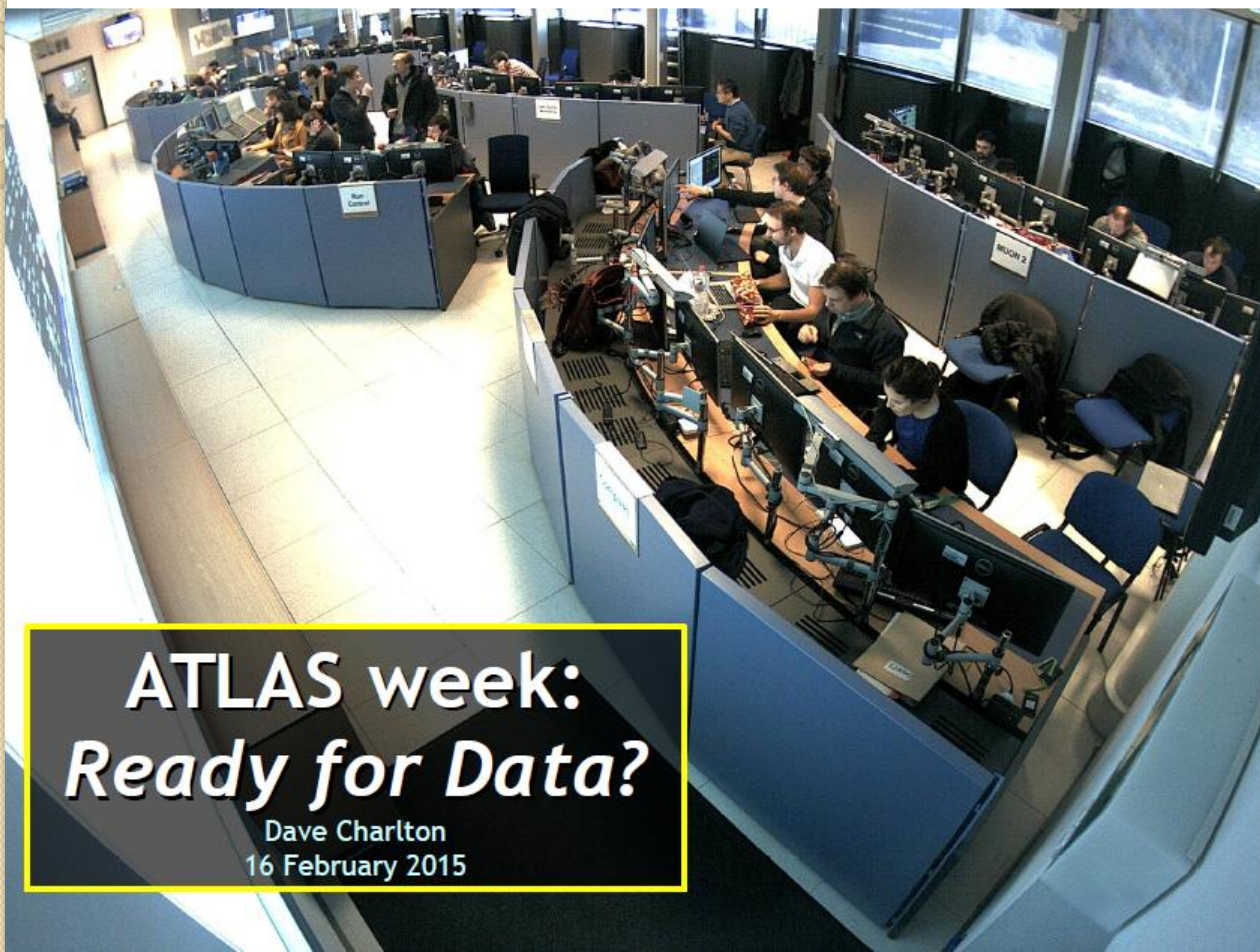
Run2: ~100-120 fb^{-1}

(better estimation by end of 2015)

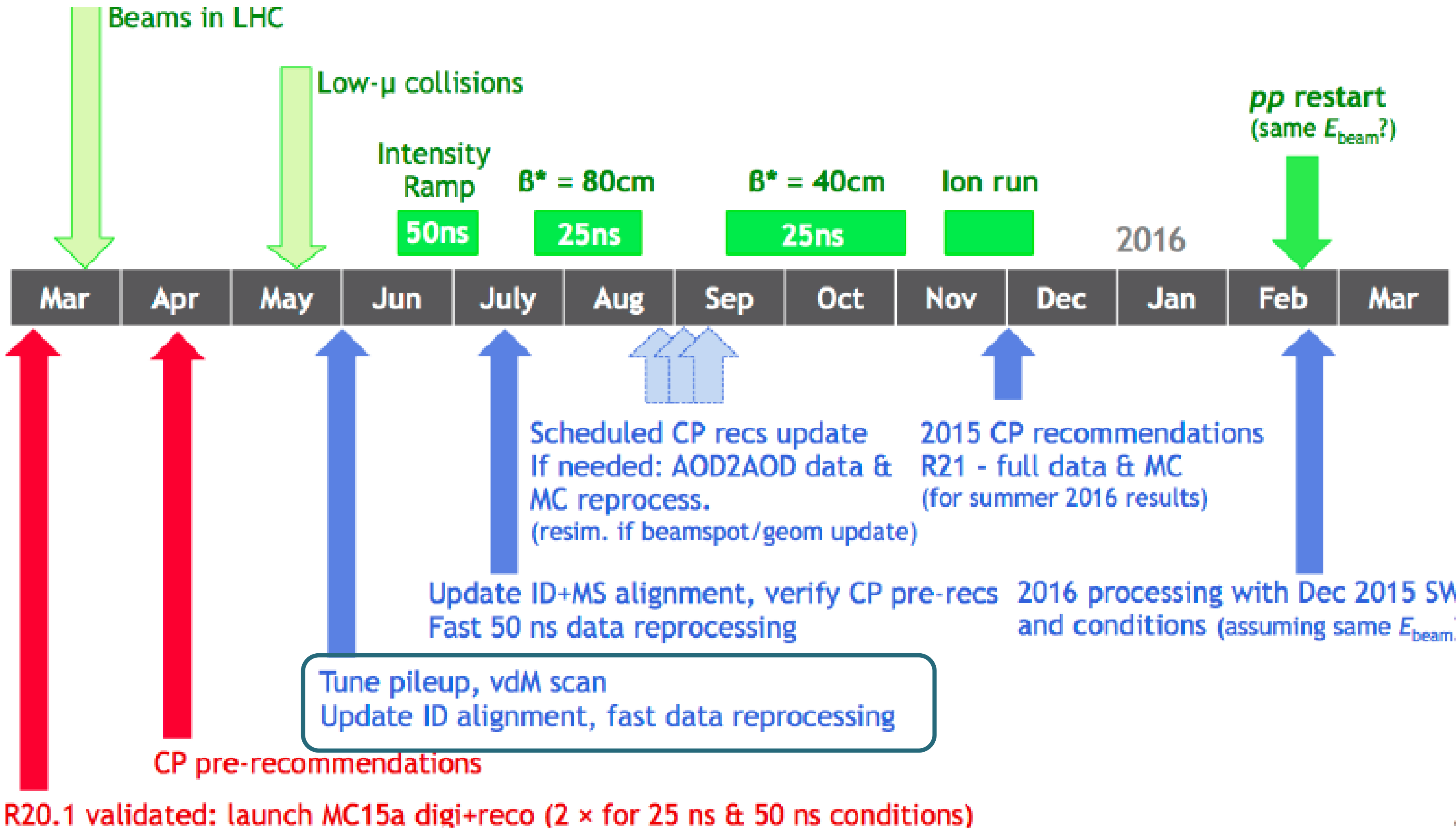
300 fb^{-1} before LS3



Девиз совещания ATLAS в феврале 2015:



Schedule to be ready for data analysis

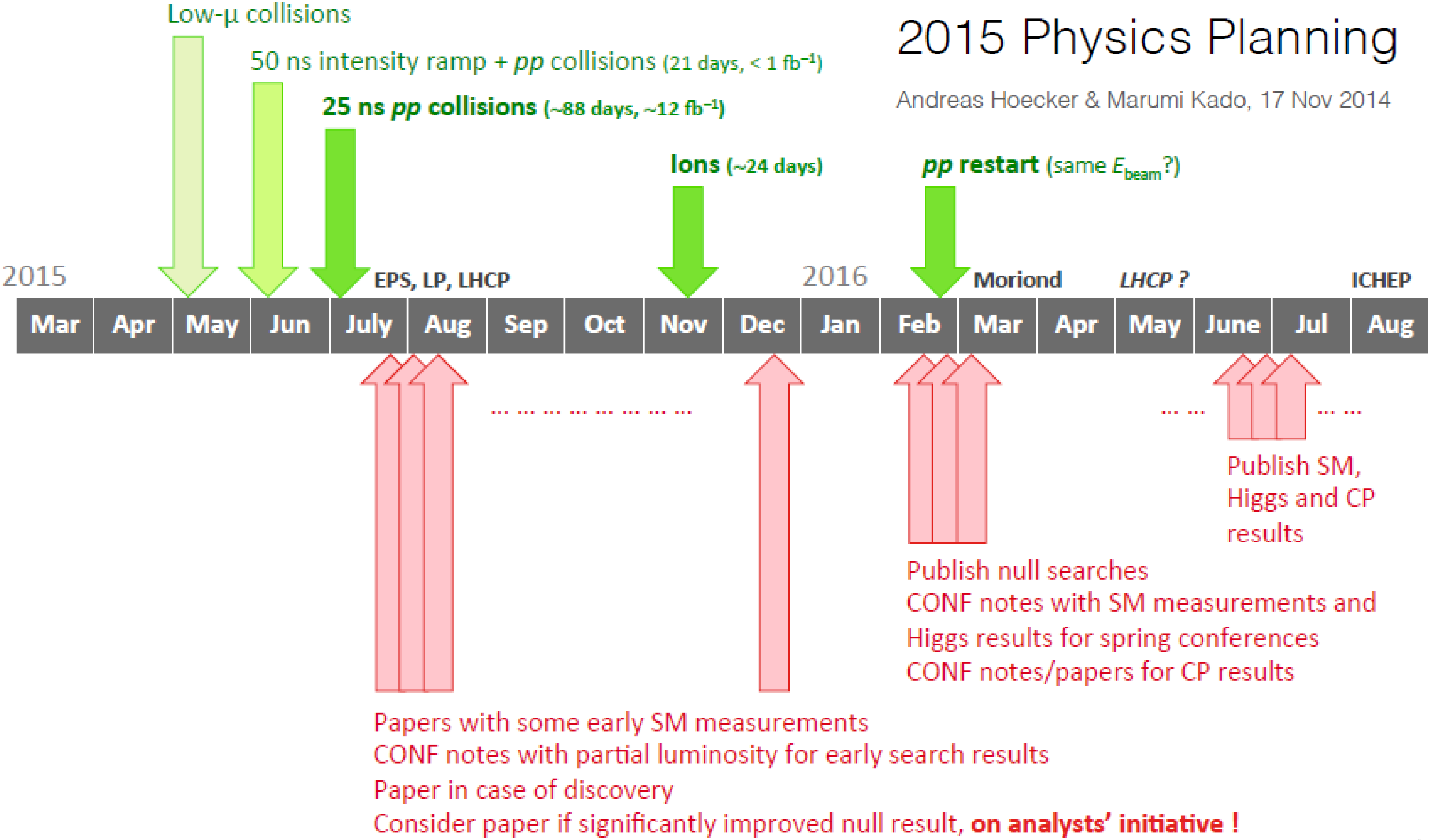


“Away” from Point-1

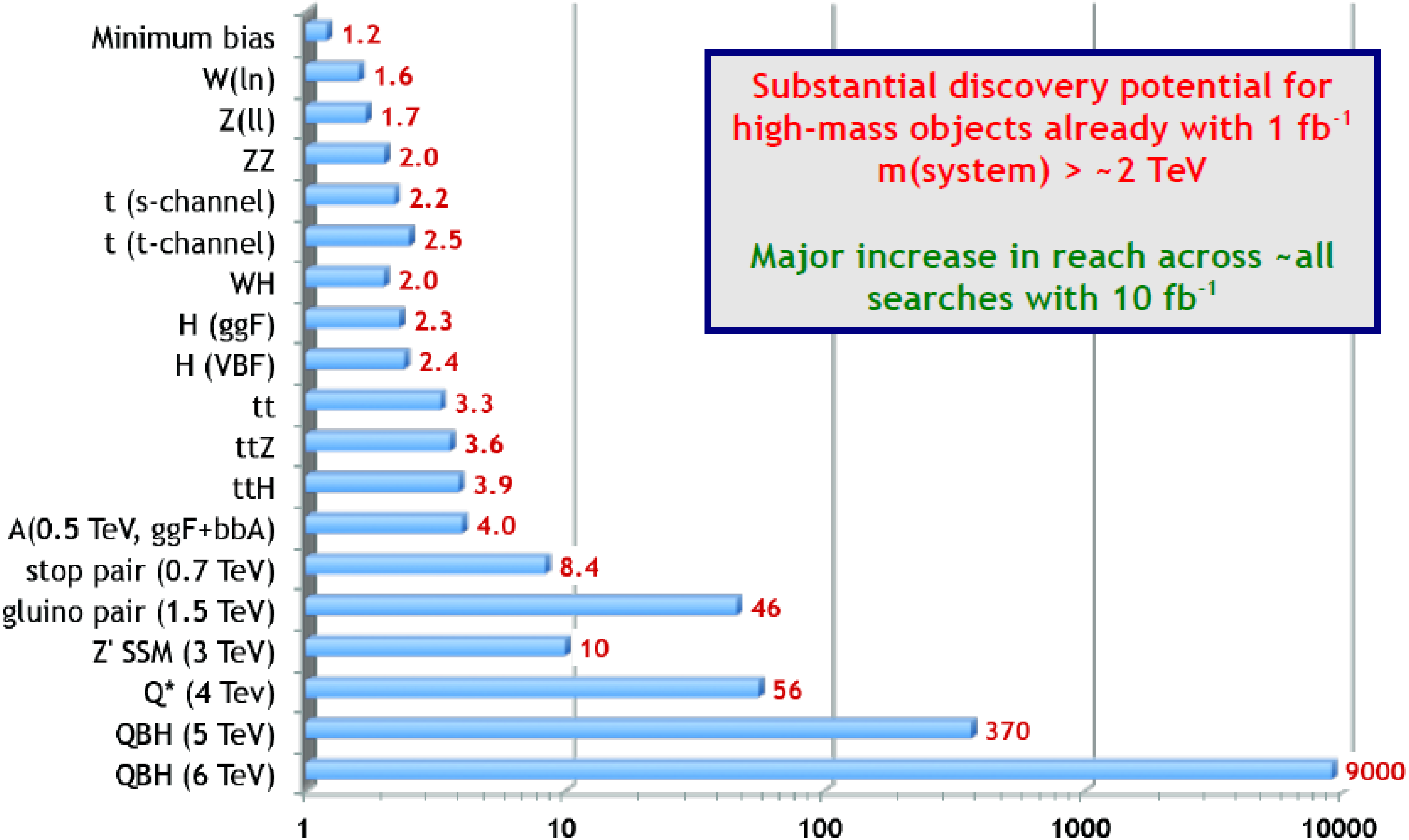
Computing, Software, Analysis

2015 Physics Planning

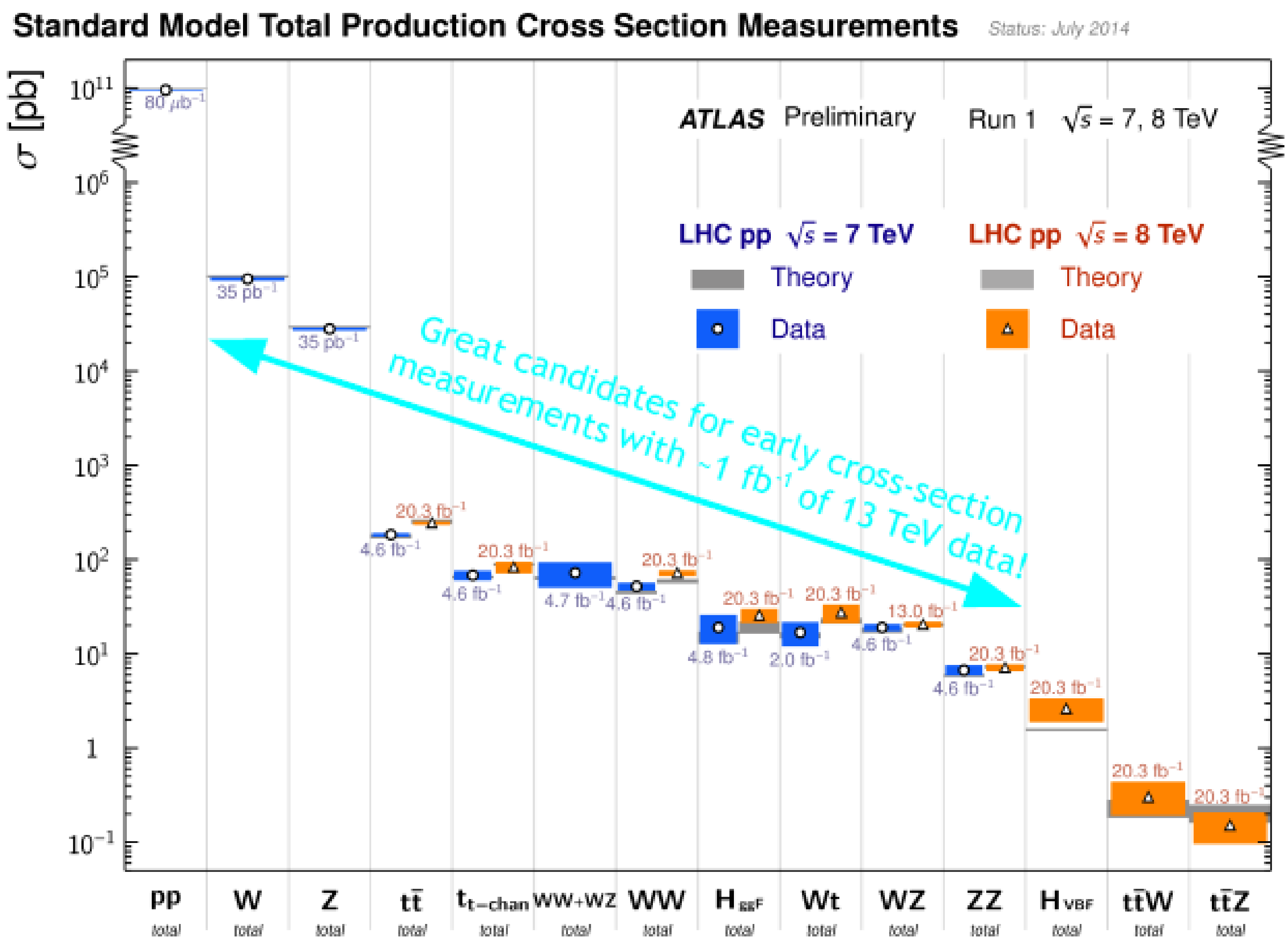
Andreas Hoecker & Marumi Kado, 17 Nov 2014



Cross-section ratio: 13 TeV / 8 TeV

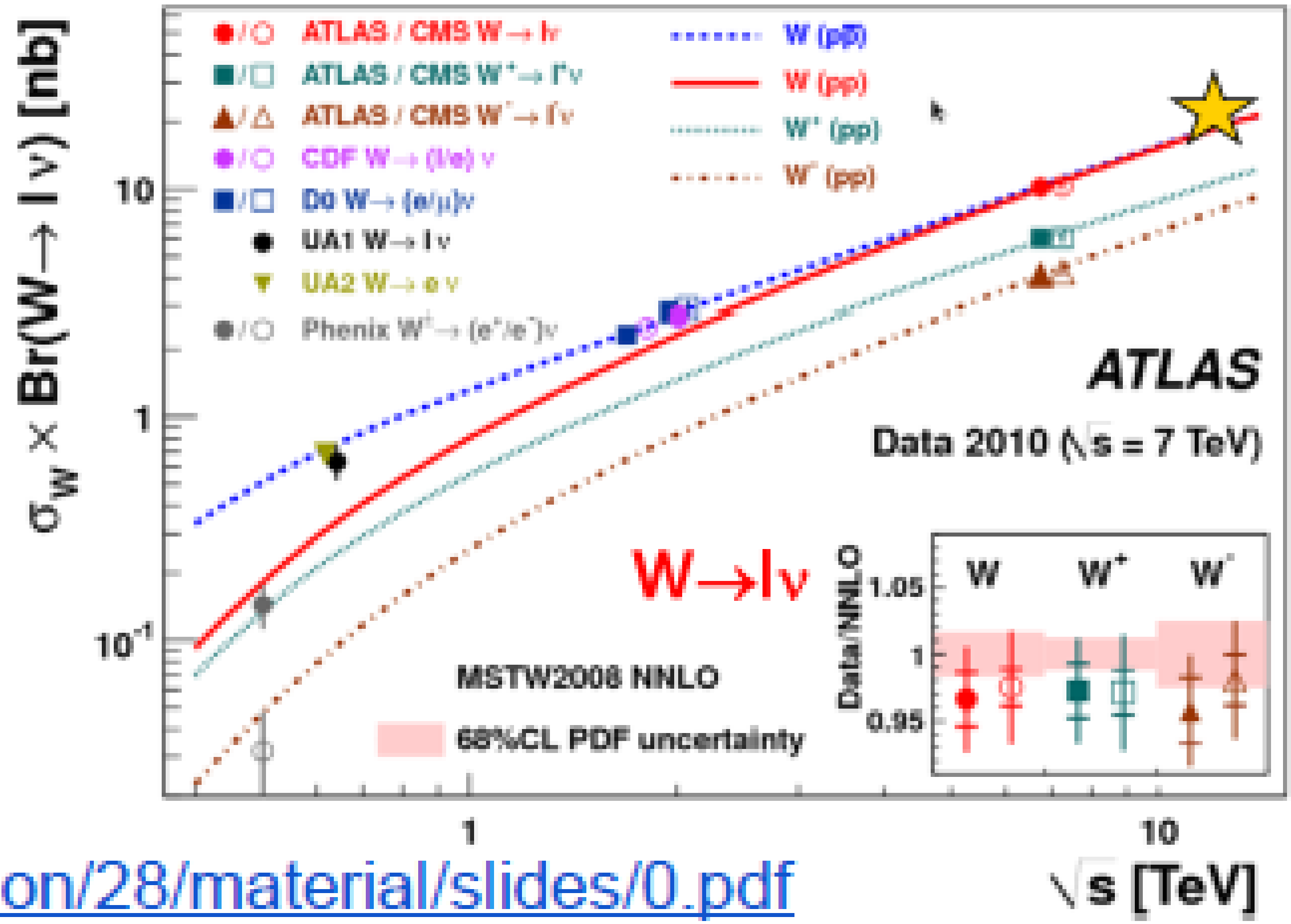


It's not just searches with the first fb^{-1}



Проверка СМ

W, Z ; ZZ ; W/Z + jets – важный тест СМ

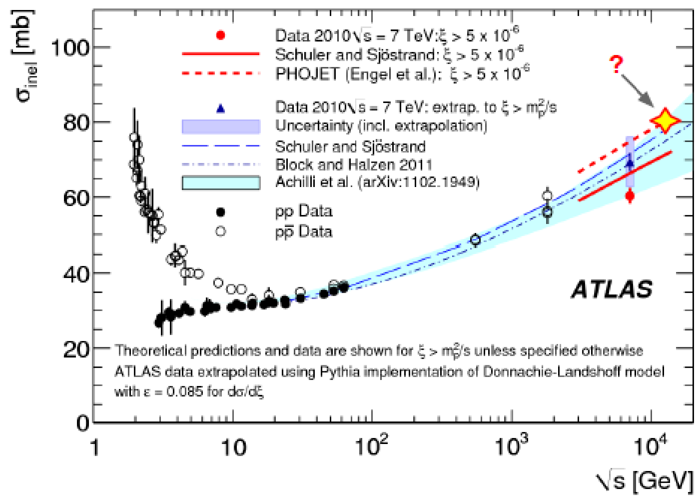


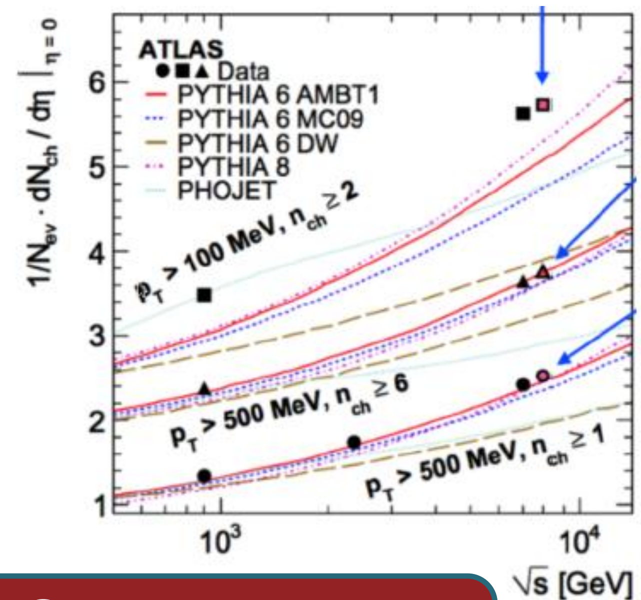
tion/28/material/slides/0.pdf

КХД и стандартная модель

Total Inelastic Cross Section

- Difficult quantity to predict
  - Very useful to measure
- Need 10μb-1@ mu=0.01
- Follow 7 TeV strategy
  - Uses MBTS
- Also special Runs for ALFA
  - Total and Elastic cross section
  - Longer timescale with more runs in the future
- Target Paper(s) as soon as possible





Самые первые измерения

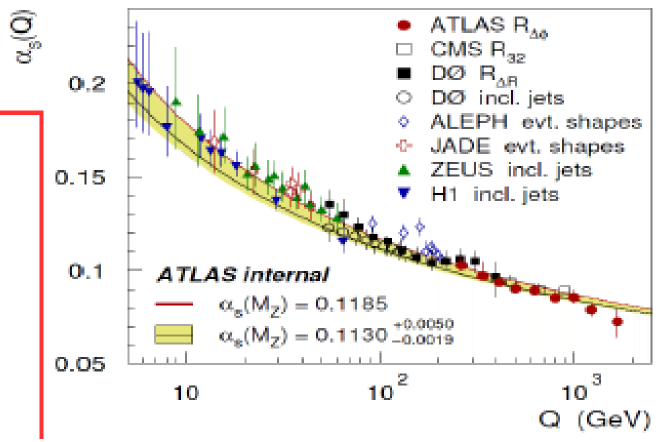
Min Bias, UE, MPI, DIS

Min Bias настройка на описывает UE, их нужно измерить!

КХД

α_s measurements

- Multiple analyses extracting α_s using different techniques



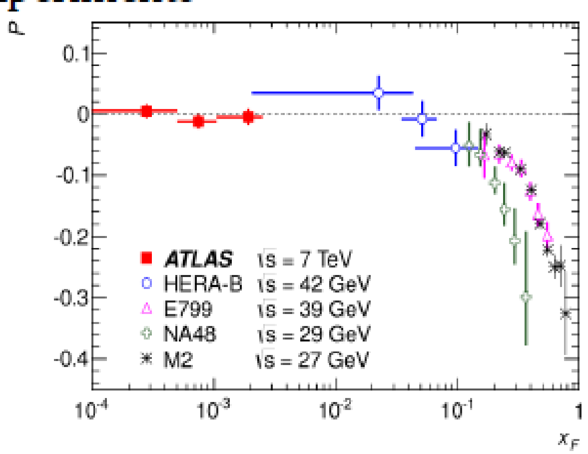
STDM-2012-19

- Azimuthal decorrelations in 8 TeV dijet events, as function of rapidity.
- Measure $\alpha_s(Q)$ up to Q=1.675 TeV

PRD 91, 032004

Λ polarization

Polarization consistent with zero – in agreement with extrapolation from previous experiments



- 90 SM papers from Run 1 so far!

8 TeV data allowing us to go more differential, and see evidence for rare processes never seen before (Vector boson scattering, tri-boson production)

There's still more to come (most 8 TeV analyses not published yet)

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Физика топ-кварка

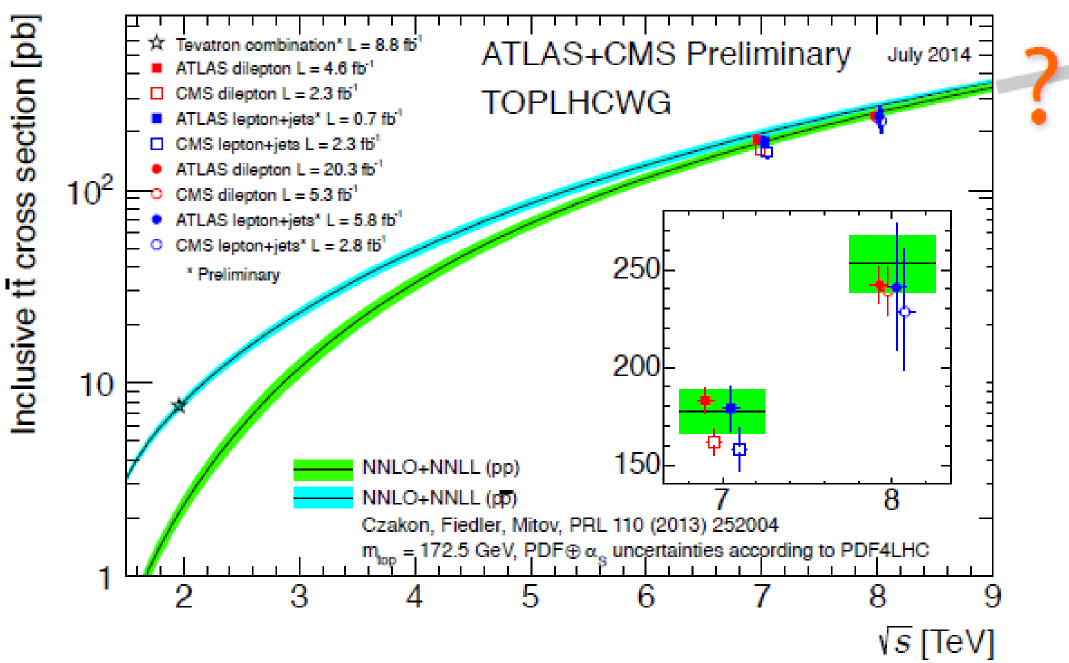
2015 Physics Planning

Andreas Hoecker & Marumi Kado, 17 Nov 2014

Do we understand high-energy top production?

Any surprise ?

Inclusive top pair production cross section versus $p\overset{(-)}{p}$ centre-of-mass energy



Also early fiducial cross-section measurements

Cross section ratios 13 TeV/8 TeV: tt = 3.3, $t_{\text{t-chan}}$ = 2.5

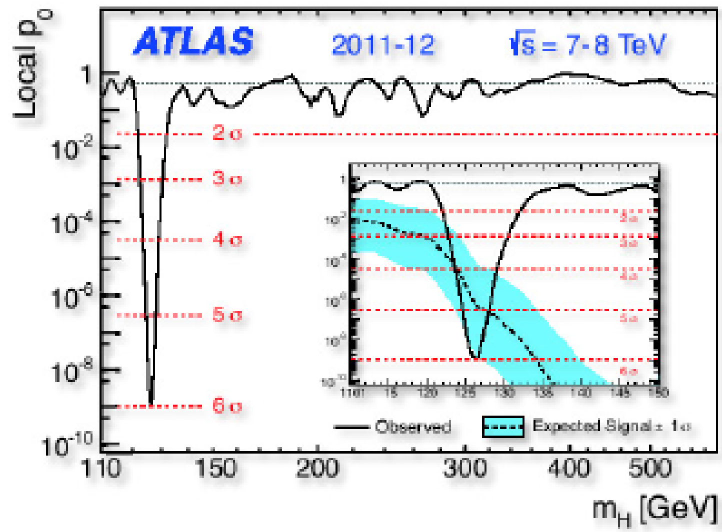
Исследования бозона Хиггса

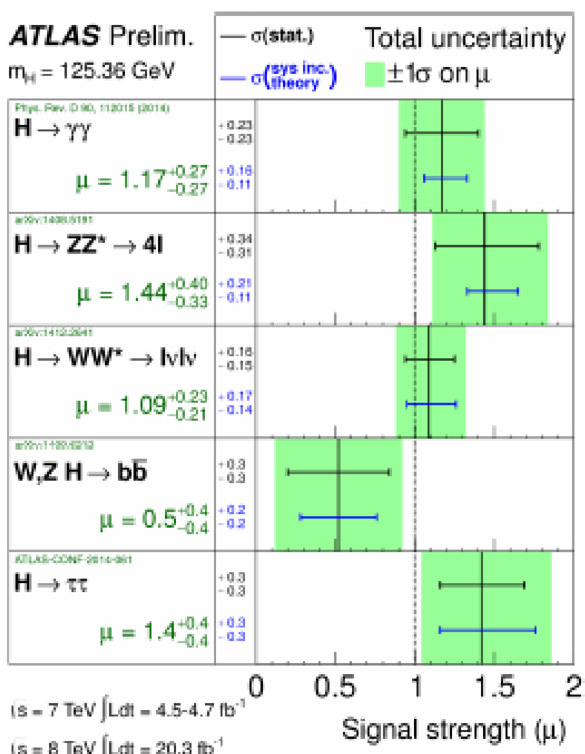
- Результаты первого сеанса
- Задачи второго сеанса в 2015г.

Overview

Great Achievements during Run I

- Discoveries in standalone bosonic channels H→γγ, ZZ (4l), WW (lνlν), and challenging fermionic measurements and evidence VH→bb, H→ττ : **Decay**
- More **production** results (ggF, VH, VBF, ttH)
- First properties measurements (mass, coupling, spin)
  → See new coupling combination results today
- Many BSM analyses carried out





Status of Papers

- 47 Papers out on Run I data. Of which:
  - 41 published, 1 accepted, 4 submitted
  - 18 PLB, 9 JHEP, 8 PRL, 6PRD, 4 EPJC, 1 Science
  - 17 / 21 papers on full 7 / 8 TeV dataset
- On-going: 32 planned papers of which 27 have Editorial Board, and 17 new papers for Moriond (as of today)

→ Today focus on papers still to come and a few of the main new results for Moriond

Differential Cross Section Combination

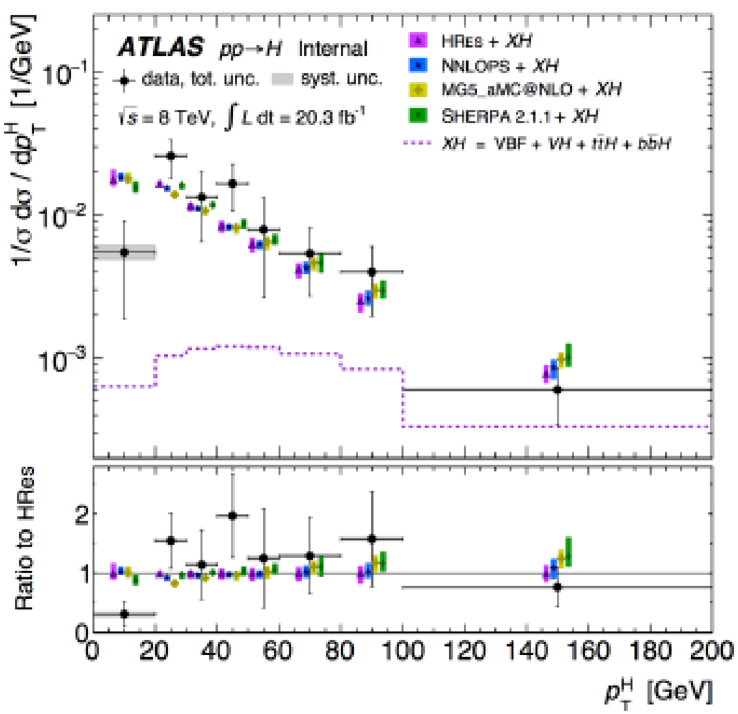
For Moriond !

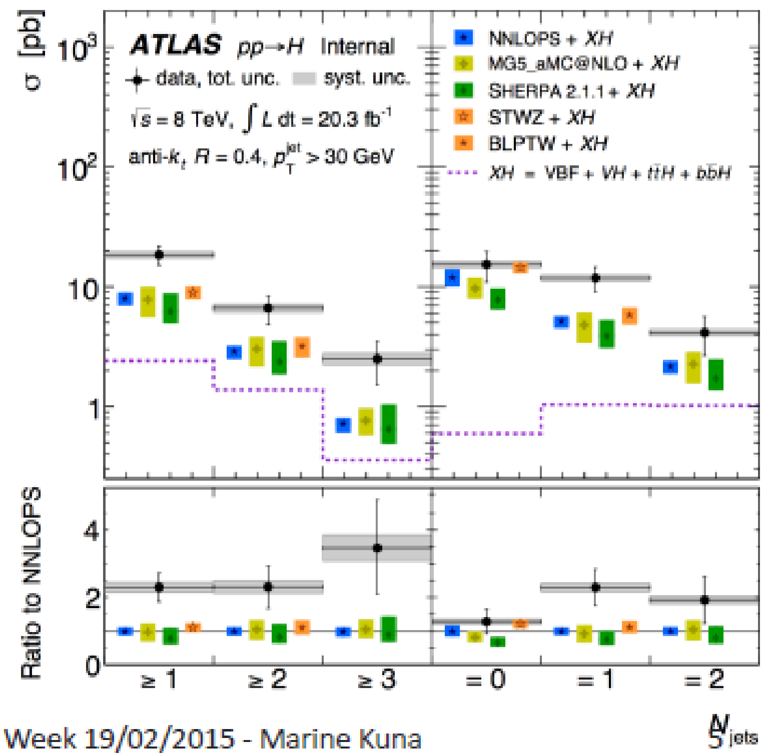
- Combination of H→γγ and H→ZZ channels : 33.0 ± 5.3(stat) ± 1.5(sys) pb →p-value for LHC-XS: ~5%
- Spectra of p_T^H, $|\eta^H|$, N_{jets}, $p_T^{jet,lead}$

(H→WW still in progress)

Overall, normalized shapes agree well with data
Trend: Higgs spectrum more boosted in data

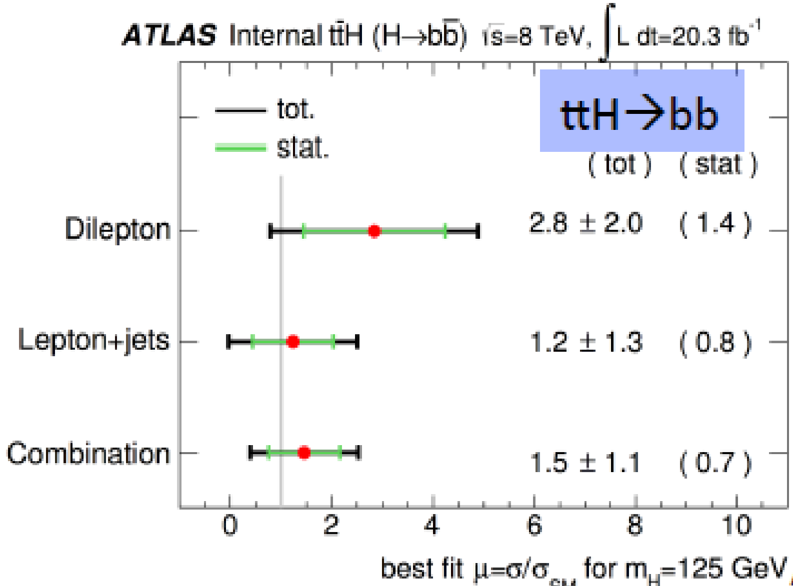
XS in inclusive and exclusive jet bins:
- data higher in all bins
- worst agreement in inclusive and exclusive 1-jet bins

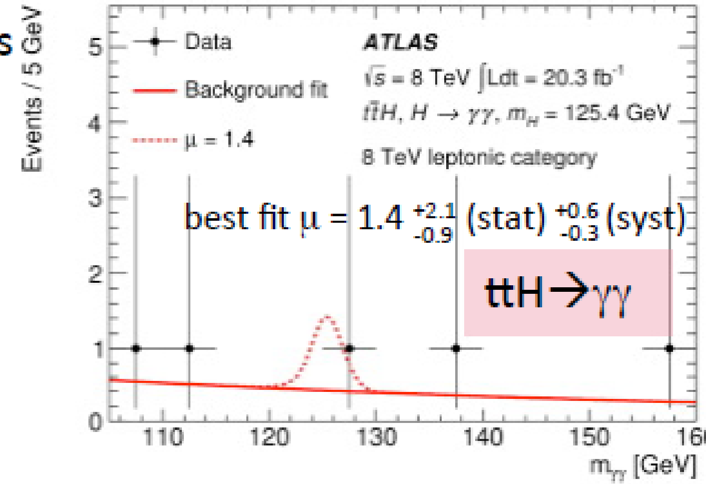


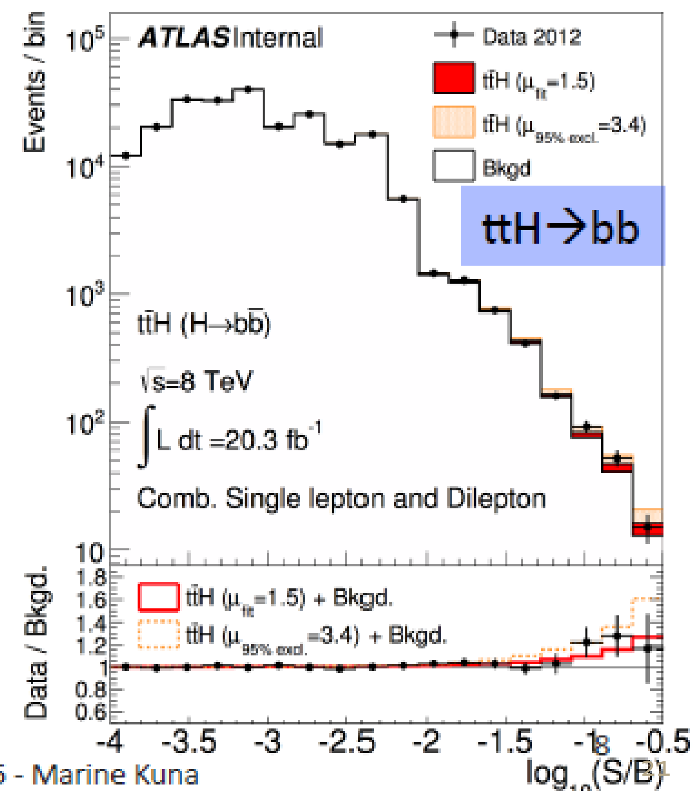


ttH analyses

- Higgs in associated production with a pair of top quarks allows direct measurement of the top Higgs Yukawa coupling.
- Updates in the ttH→γγ and ttH→bb analyses
  - ttH→γγ: 2 categories: leptonic and hadronic.
  - ttH→bb: Neural Network. Improvements w.r.t last year include Matrix Element technique for l+j, improvement in the tt+bb (main background) and new b-tag calibration , out for Moriond
  - ttH→multileptons new for ATLAS, out for Moriond
  - + **Combined ttH** result for Moriond





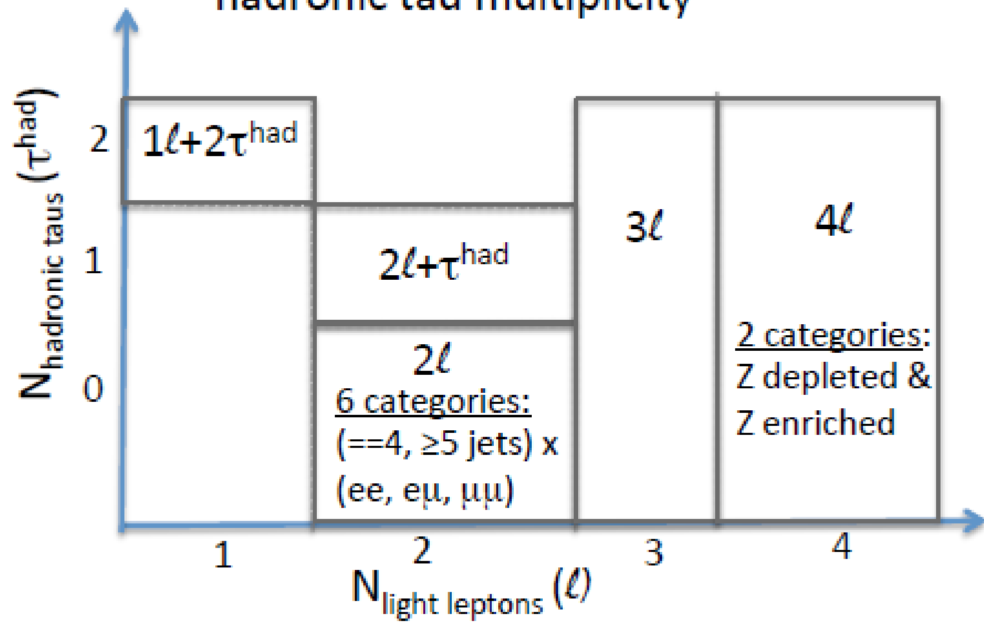


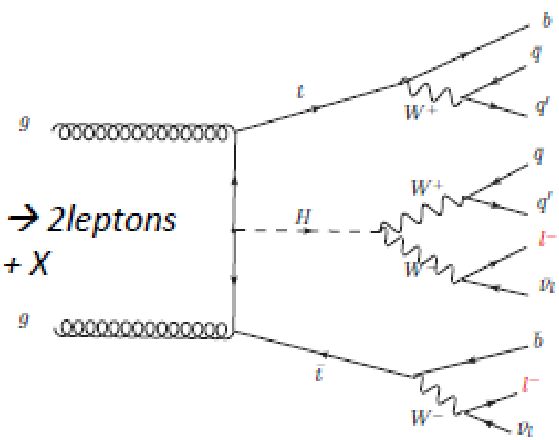
ttH→multileptons (1)

- **Production:**
  - Signal strength measure on ttH
  - tH (tHjb, tHW) is ~5% of higgs signal. Independent parameter in couplings analysis. Set at SM value (k_T=1) background.
- **Decays**: Sensitivity to H→WW, ZZ and ττ

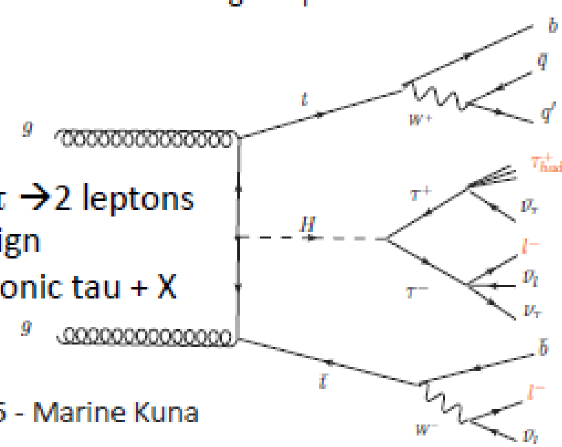
Category	WW	$\tau\tau$	ZZ	other
$2\ell 0\tau_{\mathrm{had}}$	80%	15%	3%	2%
3ℓ	74%	15%	7%	4%
$2\ell 1\tau_{\mathrm{had}}$	35%	62%	2%	1%
4ℓ	69%	14%	14%	4%
$1\ell 2\tau_{\mathrm{had}}$	4%	93%	0%	3%

- **5 Channels:**
  - orthogonal in light leptons and hadronic tau multiplicity





ttH→WW → 2leptons same sign + X

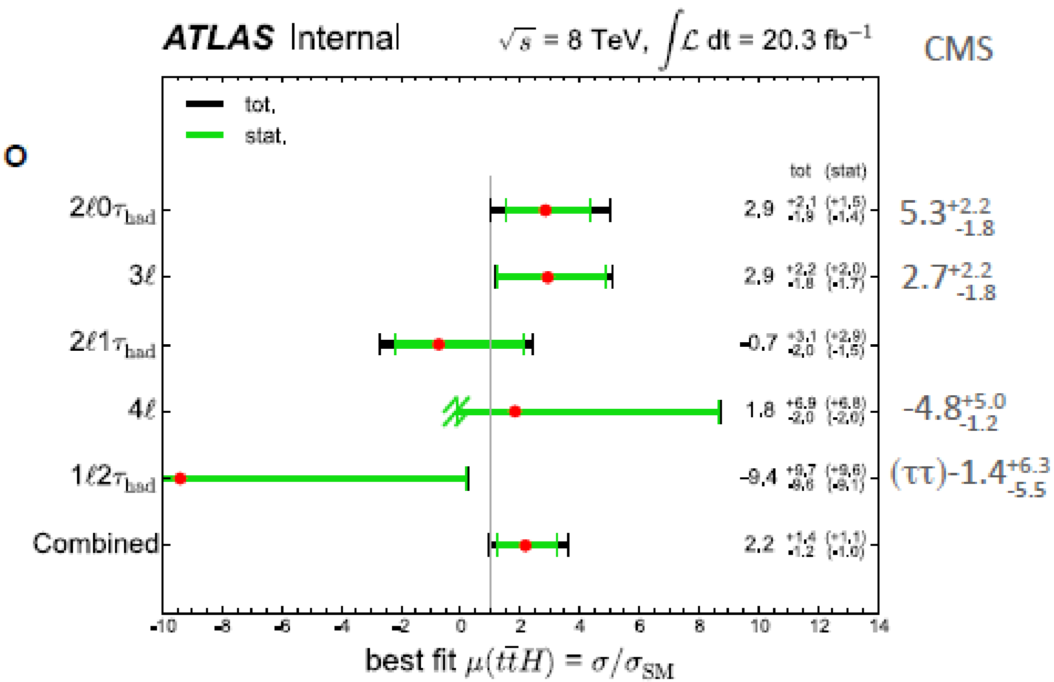


ttH→ττ →2 leptons same sign +1hadronic tau + X

ttH→multileptons (3)

For Moriond !

- Limits @95% CL on $\mu_{ttH}=\sigma/\sigma_{SM}$:
  - Observed (exp) is 4.7 (2.4)
  - Sensitivity comparable to that o ttH→bb 3.4 (2.2)
- Combined p-value of excess with respect to SM hypothesis (μ=1) is ~1σ
- Combined measured μ:
  - Excesses for leptonic only channels
  - Deficits for channels with hadronic taus
  - @8 TeV
    - ✓ ttH→bb: μ = 1.5 ± 1.1
    - ✓ ttH→multilep μ = 2.2 ± 1.4
    - ✓ ttH→$\gamma\gamma$ μ = 1.5 ± 2.2



Overall ttH combination @ 8TeV:
μ = 1.56 ± 0.78

→ ttH combination included in coupling combination results

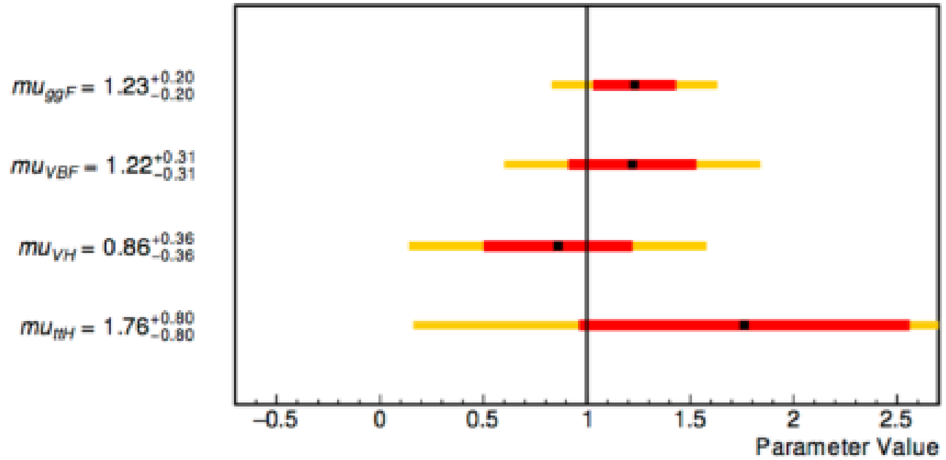
Paper to be circulated soon

Higgs Coupling combination (1)

For Moriond !

- Previously: 5-channel combination WW,ZZ,γγ,bb,ττ [Moriond 2014]
- New **9-channel combination** in preparation [target: Moriond2015]
  - Uses updated results for WW,ZZ,γγ,bb,ττ (final run-1 numbers)
  - **Adds μμ, Zγ, ttH(bb,nlep) and VH(WW)**
- Global signal strength $\mu = 1.18^{+0.10}_{-0.10}(\text{stat.})^{+0.11}_{-0.10}(\text{syst.}) = 1.18^{+0.10}_{-0.10}(\text{stat.})^{+0.07}_{-0.06}(\text{expt.})^{+0.08}_{-0.08}(\text{theo.}),$
- Signal strength per production process (assuming SM Higgs boson)

Production process	Signal strength 7 TeV	Signal strength 8 TeV	Signal strength combined	Cross section (pb) 7 TeV	Cross section (pb) 8 TeV
ggF	1.42 ± 0.48	1.24 ± 0.21	1.23 ± 0.20	21.4 ± 7.2	23.8 ± 4.0
VBF	-0.61 ± 0.59	1.53 ± 0.36	1.22 ± 0.31	–	2.41 ± 0.57
VH	–	0.93 ± 0.39	0.80 ± 0.36	–	1.03 ± 0.43
ttH	–	1.56 ± 0.78	1.76 ± 0.80	–	0.20 ± 0.10



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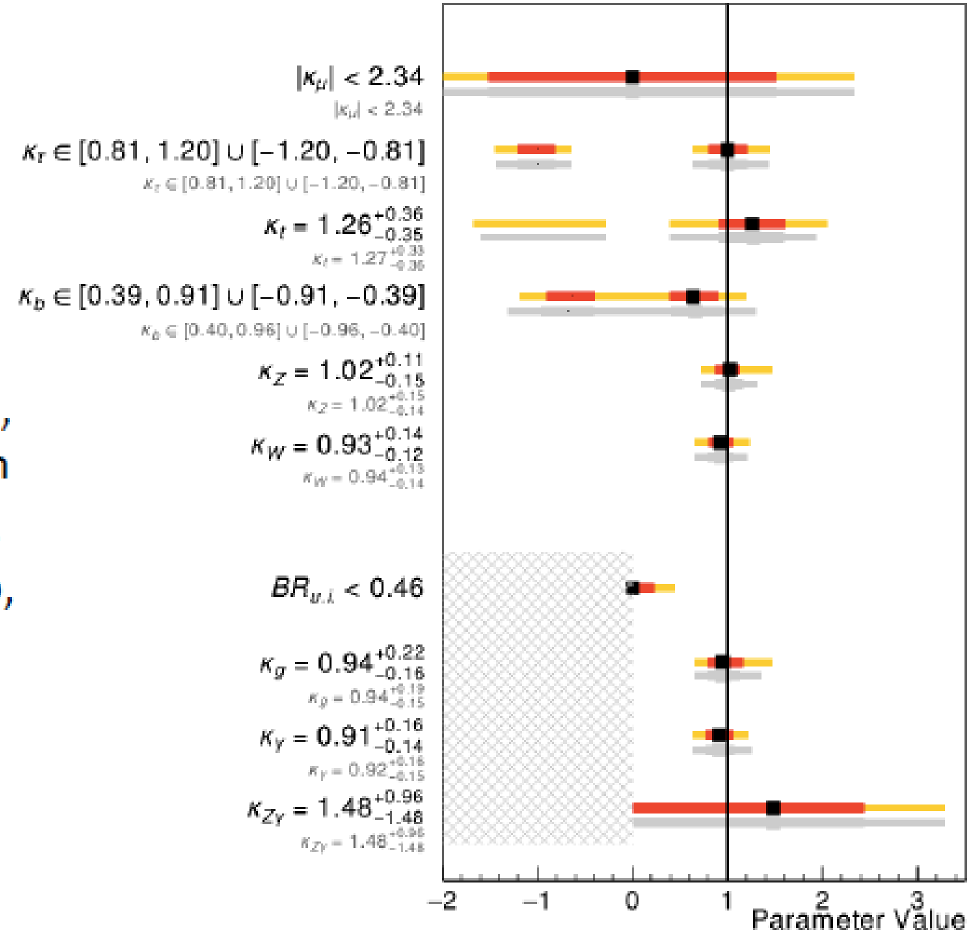
Conclusions

- Very successful Run 1 !
  - Discovery and first property measurements
  - New results for Moriond:
    - ✓ In this talk: ttH→bb/ multileptons, A→Zh, spin/CP WW, differential cross section, couplings & mass combination
    - ✓ Many more not tackled in this presentation: high mass comb, H+ → τν, H+ → WZ, H→aa (ττμμ), ...
- For the moment Higgs boson very compatible with Standard Model.
  - A few finishing analyses on Run 1, but searches about to begin on Run 2



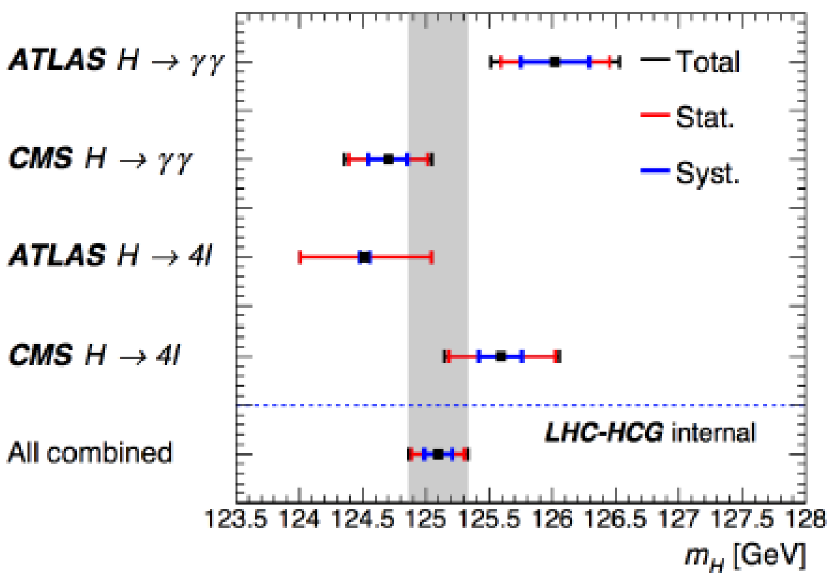
Combined fit of 6 t,b,W,Z,μ,τ Higgs couplings + effective loops k_g, k_γ, $k_{Z\gamma}$ (and invisible-undetected BRui with kV<1) for BSM

Time to pass the baton to run 2 !

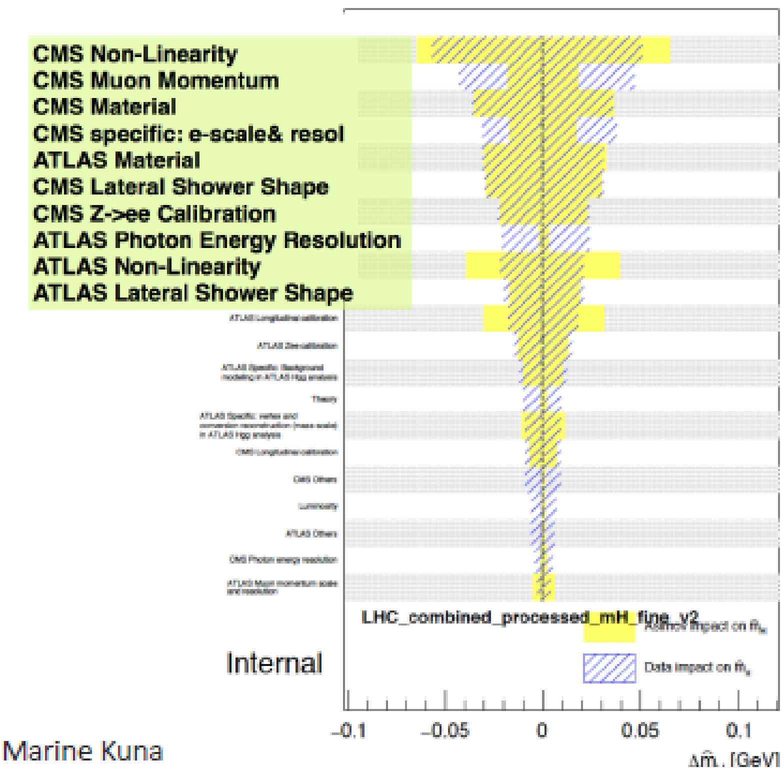
ATLAS-CMS Mass Combination

For Moriond !

- Compatibility of measurements tested in several ways: 7% - 10% [depending if free μs, $\mu s_{CMS}=\mu s_{ATLAS}$]
- Overall Compatibility with SM ($m_{H(\gamma\gamma)} = m_{H(ZZ)}$, $\mu s = 1$) : 85%
  - Examples: $m_{H(\gamma\gamma)} - m_{H(ZZ)} = -0.1 \pm 0.5$ GeV; $m_{H,\ ATLAS} - m_{H,\ CMS} = 0.4 \pm 0.5$ GeV

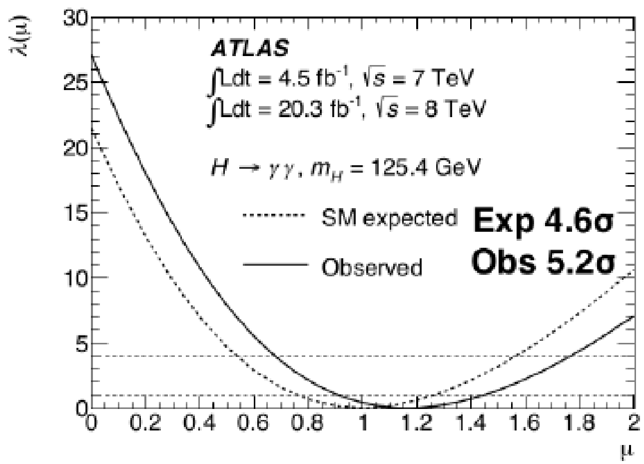


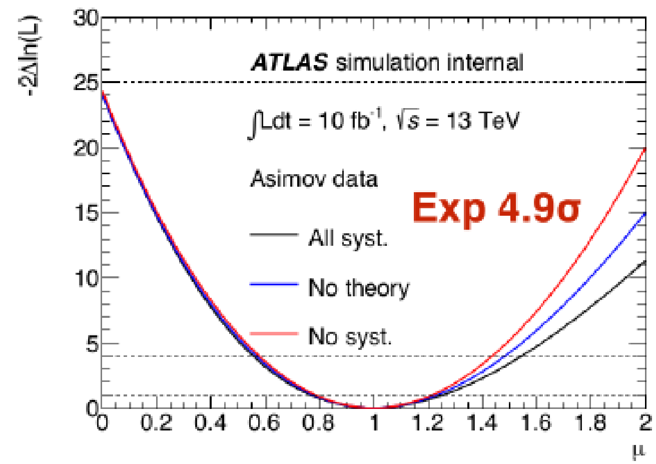
m_H=125.09±0.21(stat)±0.11(syst) GeV



Предсказания для бозона Хиггса СМ

HGamma combined signal strength





- 2015 expected μ:

  1.00+0.22-0.21(stat)+0.09-0.06(syst)+0.10-0.07(theory)

- Run I, 25 fb-1 expected:

  μ=1.00+0.23-0.23(stat)+0.09-0.06(syst)+0.11-0.06(theory)

Stat uncertainty ~2.5 times larger than syst.
With 100 fb-1 @ 13 TeV, stat. uncert. reduced by sqrt(100/10) = 3.3

Xsec (pb)	ggF	VBF	WH	ZH	ttH	bbH
8 TeV	19.27	1.578	0.7046	0.4153	0.1293	0.2106
13 TeV	43.92	3.748	1.380	0.8696	0.5085	0.5116
Ratio	2.28	2.38	1.96	2.09	3.93	2.43

More on H → bosons prospects from Dag:

https://indico.cern.ch/event/301300/session/10/contribution/62/material/slides/0.pdf

HBSM early searches (2-5 fb-1)

- **Heavy Neutral Higgs (decaying to fermions)**
  - H/A→$\tau\tau$ →μμ, bb, tt ...
- **Charged Higgs**
  - H^+→$\tau\nu$+jets
  - H^+→tb (+boosted) (→cs, cb, Wh, Wγ, μν ..)
- **Heavy Neutral Higgs (decaying to bosons)**
  - H→VV(Z/W)→4l, llqq (llbb,$\nu\nu$bb), ll$\nu\nu$, lνlν, lνqq H→$\gamma\gamma$
  - X→hh→$\gamma\gamma$bb, 4b; bb$\tau\tau$, WW$\gamma\gamma$... X→hZ→ll$\tau\tau$...
- Light Higgs NMSSM
- Dark sector, H->inv., mono-H
- Combinations and interpretations
- Exotics, rare decays

➡ **Details :** Higgs BSM related searches in RUN-II (https://indico.cern.ch/event/350320/)

➡ **For more 1st year analyses see German's talk!**

ATLAS Physics workshop Nov 2014 Higgs potential early discoveries Erez Etzion,Tel Aviv U. 11

… and more HBSM

Neutral Heavy Higgs to Fermions
- H/A→(b)ττ (LL,LH,HH)
- H/A→(b)μμ
- H/A→(b)bb
- H/A→tt

Neutral Heavy Higgs to Bosons
- H→γγ
- H→ZZ→4l
- H→ZZ→llνν
- H→ZZ→llqq
- H→ZZ→ννqq
- H→WW→lνlν
- H→WW→lνqq

Neutral Heavy Higgs to Bosons, including light Higgs
- (H→)hh→γγbb
- (H→)hh→4b
- (H→)hh→bbττ
- (H→)hh→VVγγ→4jγγ,
- (H→)hh→WWγγ→lνqqγγ
- A→Zh→llττ (LL,LH,HH)
- A→Zh→(ll/νν)bb

Heavy and light Charged Higgs
- H+→τν+jets
- H+→tb (resolved)
- H+→tb s-chan (had, L+j)
- H+→τν+lep(s)
- H+→μν
- H+→cs
- H+→cb
- - AW
- H+→Wh (WH, WA)
- H+→Wγ
- H+→tb (boosted)
- H+→WZ→tb (lνqq, qqll)
- H++

LFV / FCNC / rare decays
- H→τμ, τe
- H→eμ
- H→J/ψγ, Υγ
- H→ZJ/ψ, ZΥ
- H→ϕγ
- t→cH (various

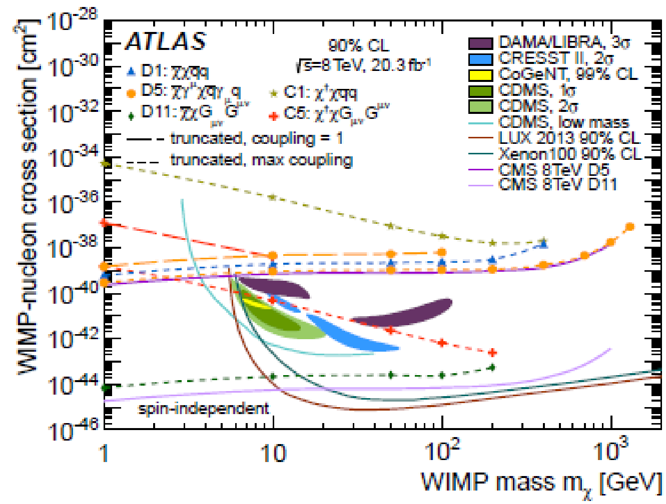
Exotics decays with MET, Dark-sector Inspired
- mono H (→γγ+MET)
- mono H (→bb+MET)
- mono H (→4l+MET)
- H→γγdark
- ZH→(ll)INV
- VBF H→INV
- VH→(jj)INV
- ttH→INV (various
- ggF H→INV (monojet).

Exotics decays with no MET, Dark-sector / NMSSM Inspired
- H→ZdarkZ(dark)→4l
- h→2a→μμμμ
- h→Za→llμμ
- a→μμ
- h→2a→4γ(multiphoton)
- h→2a→bbμμ
- h→2a→bbττ
- (bb)a→(bb)ττ→(bb)eμ
- h→2a→4τ
- H+→aW

Поиски новой физики

Jets and Dark Matter searches

- **Newly public**
  - Mono-jet search: submitted to EPJC [1502.01518]
    - ADD Graviton, Gravitino, DM, H→inv
    - ISR-jet, sensitive for low-mass DM
    - EFT+Simplified DM models
- **Newly published/accepted**
  - Mono-photon search: [PRD91(2015)012008]
    - ISR-γ or pair-produced DM interacts with γ



metry. Specifically within the concrete framework of supergravity grand unification one finds that the Higgs boson mass is predicted to lie below $\sim$ 130 GeV. The fact that the observed HIggs boson mass respects this bound is a significant support for SUGRA GUT. Further, the Higgs boson mass of $\sim$ 126 GeV requires the average SUSY scale to be high, i.e., in the TeV region. This high scale explains why we have seen no significant deviation from the Standard Model prediction in FCNC processes such as $b \to s\gamma$ and $B_s \to \mu^+\mu^-$. Further, the same high SUSY scale explains the non-observation of sparticles in $\sqrt{s} = 7$ TeV and $\sqrt{s} = 8$ TeV data at RUN I of the LHC.

conditions. Here it is possible to have light electroweak gauginos and light sleptons while the squarks are heavy. In this case one can explain the Brookhaven $g_\mu - 2$ result as well as achieve a Higgs boson mass consistent with experiment. The discovery of the Higgs boson mass is important not only because one has found the last missing piece of the Standard Model but also because it is likely the first piece of a new class of models such as supersymmetric models which require the existence of a whole new set of particles. It is hoped that LHC RUN II will reveal some of these.

P.Nath, arXiv: 1501.01679

Conclusion

Итоги поиска новой физики в Ран 1

- The Run-1 physics program for SUSY and EXOTICS is mostly completed. Still some new results to come for both groups, including the SUSY summary papers.
- No evidence for new physics has been observed, but stringent limits have been derived on a various set of theoretical models
- Nevertheless, excesses of data have been seen in a few channels
  → to be further investigated in Run-2
- The priority is now clearly to focus on the already very active Run-2 preparation
- For more information about last published results:
  - Exotics: https://twiki.cern.ch/twiki/bin/view/AtlasPublic/ExoticsPublicResults
  - Susy: https://twiki.cern.ch/twiki/bin/view/AtlasPublic/SupersymmetryPublicResults

Включенность МГУ в работы

- Активное участие **Л.К.Гладилина** в подготовке публикаций коллаборации как члена PubCom ATLAS
- Проведение под его руководством нескольких анализов в группе B-физики
- Представление им результатов ATLAS и CMS по исследованиям физики тяжелых кварков в Морион КХД (25-27 марта)
- Тестирование газовых смесей и исследование старения детекторов TRT (В.Крамаренко)

Включенность МГУ в работы

- В 2014г. участники от МГУ сделали   докладов от ATLAS на международных конференциях :

Quarkonium 2014, The International Workshop on Heavy Quarkonium, 10-14 November, CERN, Geneva, Switzerland, С.Турчихин.

ICHEP 2014. 37th International Conference on High Energy Physics, 2-7 July 2014, Valencia, Spain. Л.Гладилин.

PANIC 2014, 20th Particles and Nuclei Interaction Conference, 20 -29 August 2014, Hamburg, Germany. Л.Смирнова.

HSQCD 2014, Hadron Structure and QCD: from low to high energies, 30 June – 4 July 2014, Gatchina, Russia. С.Сивоклоков.

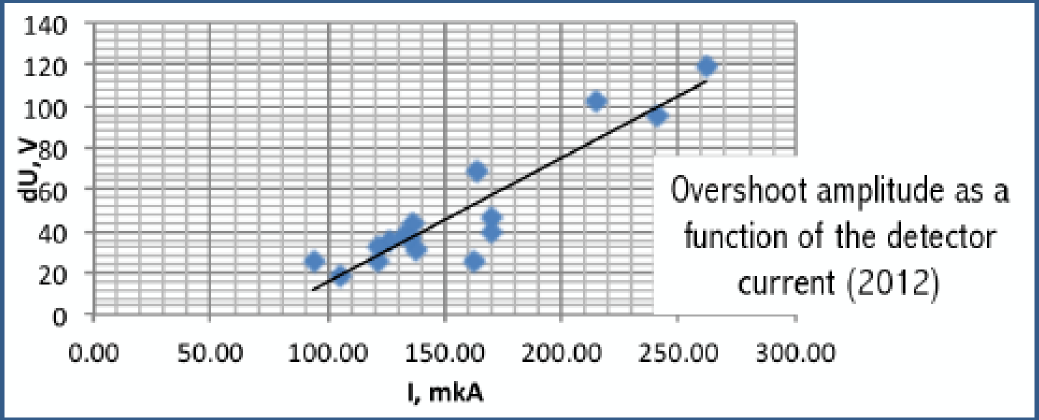
Capri 2014, Fifth Workshop on Theory, Phenomenology and Experiments in Flavour Physics, 23-25 May 2014, Villa Orlandi, Anacapri, Capri Island, Italy. А.Болдырев.

- Выиграли проект Минобрнауки через ИФВЭ по апгрейду ATLAS на 7.5 млн.руб. (2014-2016)
- Ведут работы по обеспечению работы детектора в подсистемах ТДПИ (TRT) и триггере B-физики, где существенен вклад молодых сотрудников (А.Болдырев, А.Маевский – TRT, С.Турчихин – B-триггер)

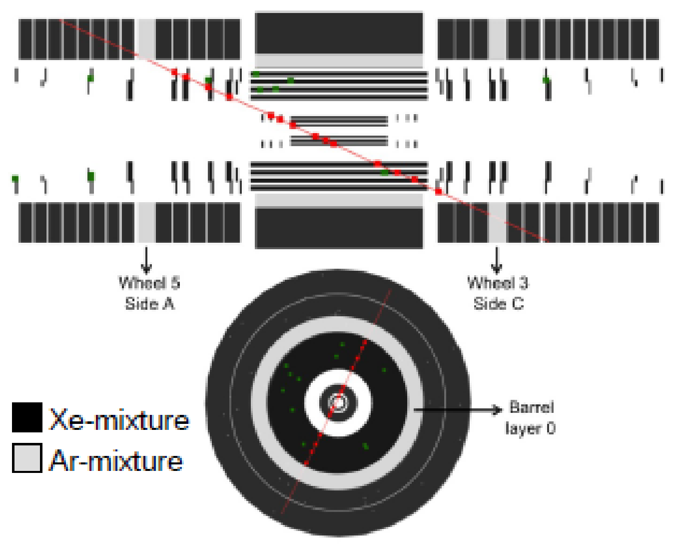
Transition Radiation Tracker

- High voltage ON in the entire detector
  - Successfully tested operation at 100 kHz with up to 50% occupancy
  - FastOR trigger in stable use during cosmic ray runs
- New active gas system
  - Leaks can lead to contamination into active gas volume
  - New system allows to remove accumulated nitrogen
  - Baseline for 2015: operating part of the detector with Argon mixture instead of Xenon
  - Impact on e/γ-identification small after algorithm updates
- HV overshoot at beam dump in run-1
  - Amplitude depends linearly on detector current
  - Solution found: under preparation (for summer 2015)

А. Болдырев, А. Маевский



Baseline scenario for 2015 operation



Physics&Performance Week 2015

Trigger status and commissioning plans for Run-2

James Walder[1], Semen Turchikhin[2]
on behalf of the B-trigger community

[1]Lancaster University

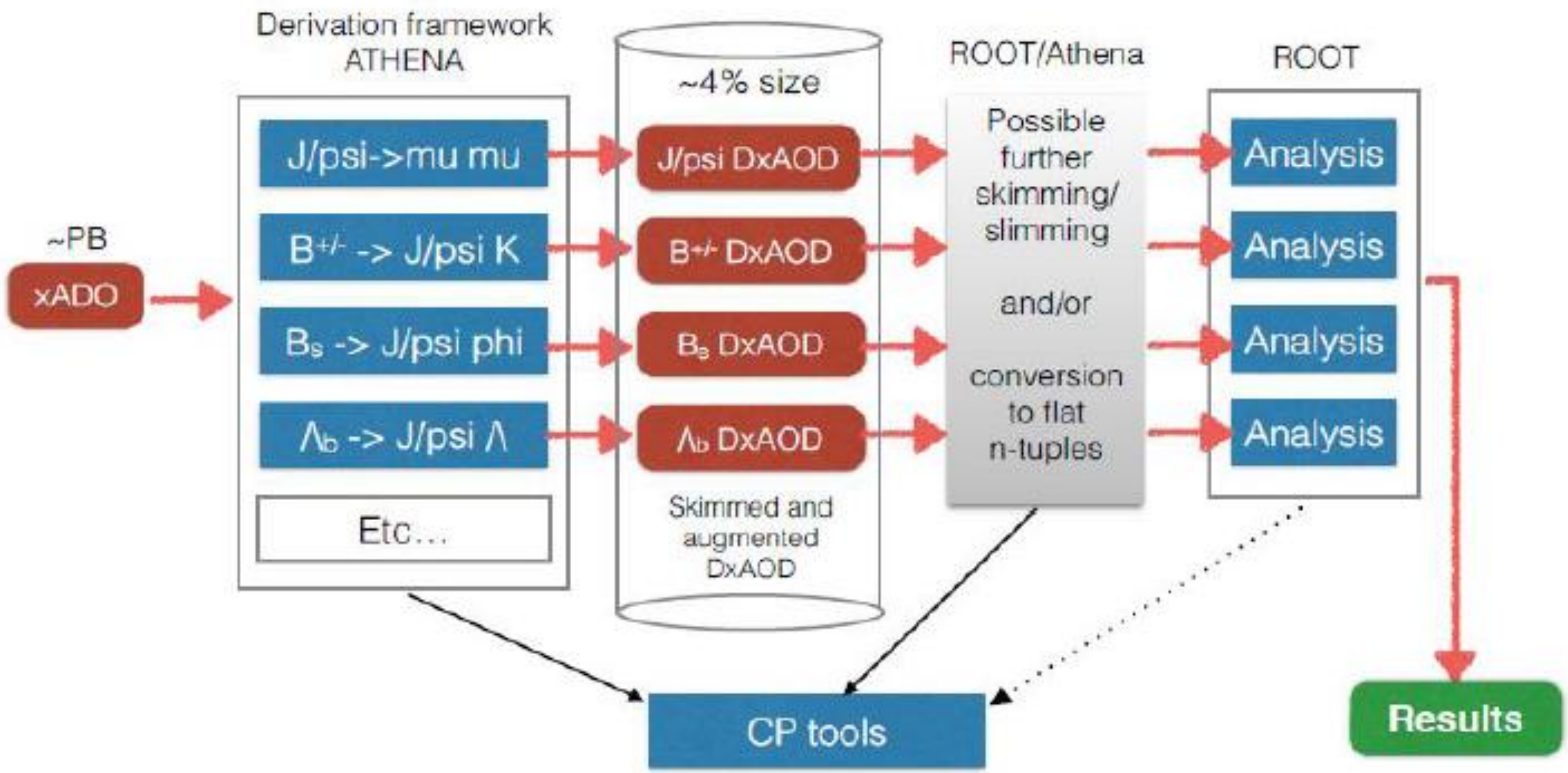
[2]Skobeltsyn Institute of Nuclear Physics
Moscow State University

B Physics Group meeting

28 January 2015

From D.Scheirich

B-physics model



Заключение презентации
С. Турчихина: задачи МГУ

Conclusion

- Moving towards the data-taking start
  - **Trigger code**: all migration etc. finished, a couple of issues in progress, validation on-going
  - **Monitoring**: minimum for the offline part mostly done, just need to add more histograms; some more work needed for online; the Express stream composition to be iterated
  - **Menu**: everything is principally ready, more validation needed
- SampleT is crucial for all validation – hope to have it soon

Operational man-power

- B-physics&Muon Signature On-call shifts
  - Class-2 OTP, booked for 1 week, duties are documented in TWiki (to be updated)
  - Many people from muon side will contribute, but our contribution is much desirable
  - Special training to be organized
- B-trigger software validation shifts
  - Class-3 OTP – check RTT tests, manage JIRA issues etc. (TWiki)
  - 1 or 2 week rotation of the shifters
  - More people are welcome in order to reduce the average workload
- If you want to contribute to any of these – please contact myself and James!

Trigger Menu Status

- **All items are now in the main menu MC_pp_v5**
  - Counts on tt and J/ΨΦ samples now available (except for L1Topo items where L1 seeds are defined but the chain definitions are not working yet)
  - *Barrel* and *BarrelOnly* options available
  - Optimised thresholds for mass and ΔR almost finalised

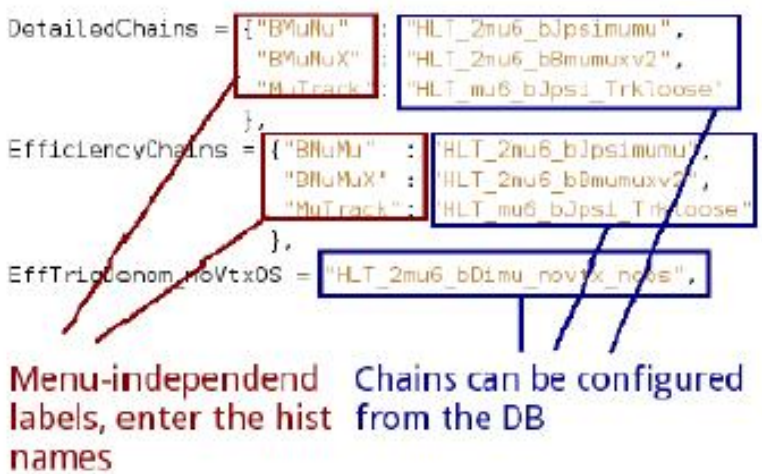
- HLT code should not be changed for L1Topo seeds
  - Only fixes in menu side are needed
  - Missing only the python implementation in Trigger menu to enable the chains in MC_pp_v5

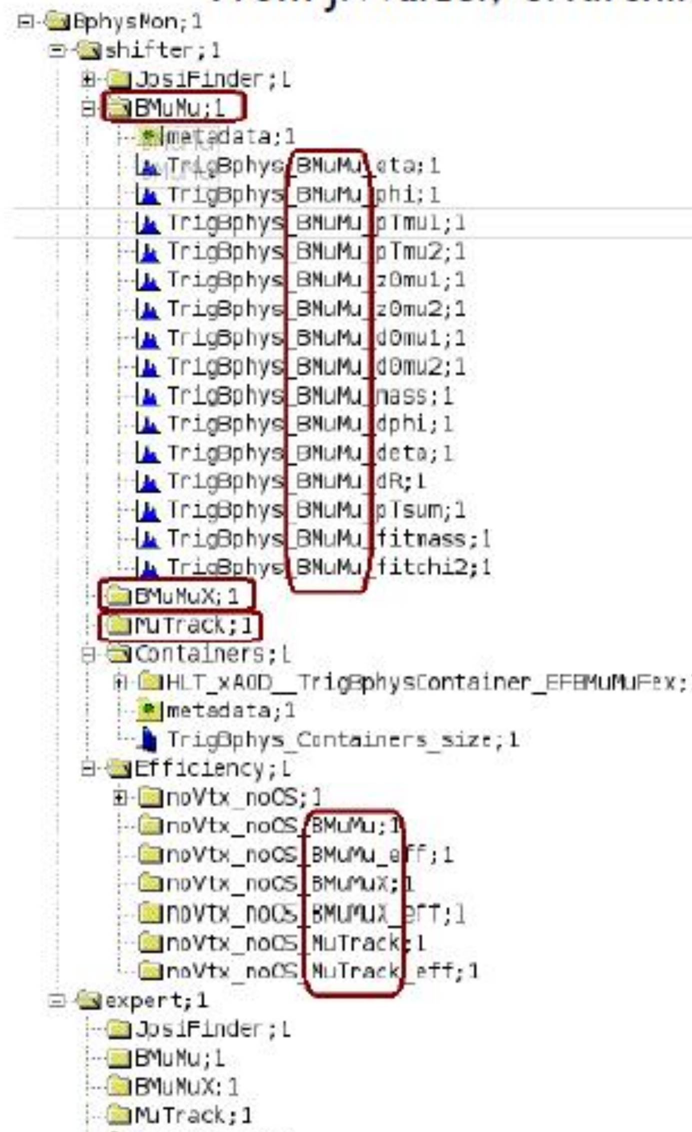
- **Tracking for *Bmumuxv2, mu+track* chains is now in the menu** (to be used in B+ monitoring)
  - Fast algorithm to identify the muons, then look to additional tracks (in full resolution) in a wider RoI (±0.75)
  - Appropriate validation still to be completed

Offline monitoring

From J.Walder, S.Turchikin

- `TrigBphysMonitoring` is now completely menu-aware
  - Tag added to 20.1.0.Y
- Need to add more chains to monitor (L1Topo)
- Web display configuration (han) to be finalized by M8
- Little progress on B^+ lifetime monitoring yet
  - Require offline development





University of Sussex

Направления физического анализа

- $B \to \mu\mu$ (Сивоклоков, Турчихин, Смоленков)
- $B \to \mu\mu\varphi$ (Комина, Мухамадеев, Турчихин)
- $pp \to B_c^* + X$ (Турчихин, Гладилин)
- $B \to J/\Psi\varphi$ (Маевский, Сенов) + ИФВЭ
- $pp \to J/\Psi\eta_c + X$ (Маевский, Гладилин, Сенов)
- AA, pA (Болдырев, Короткова)+МИФИ
- Адронные распады. Резонансы (Гладилин+ОИЯИ)

В том числе, с участием студентов кафедры общей ядерной физики (4-6 курсы)

Заключение

- Первый сеанс LHC принес множество результатов и поставил на новый уровень понимание природы фундаментальных взаимодействий
- Новый сеанс работы при 13 ТэВ может позволить не только провести поиск новых явлений, но и сделать открытия
- Будем надеяться на открытия!!!

Back-up

Heavy Ions physics in ALICE

/ *Nuclear Physics B Proceedings Supplement 00 (2015) 1–8*

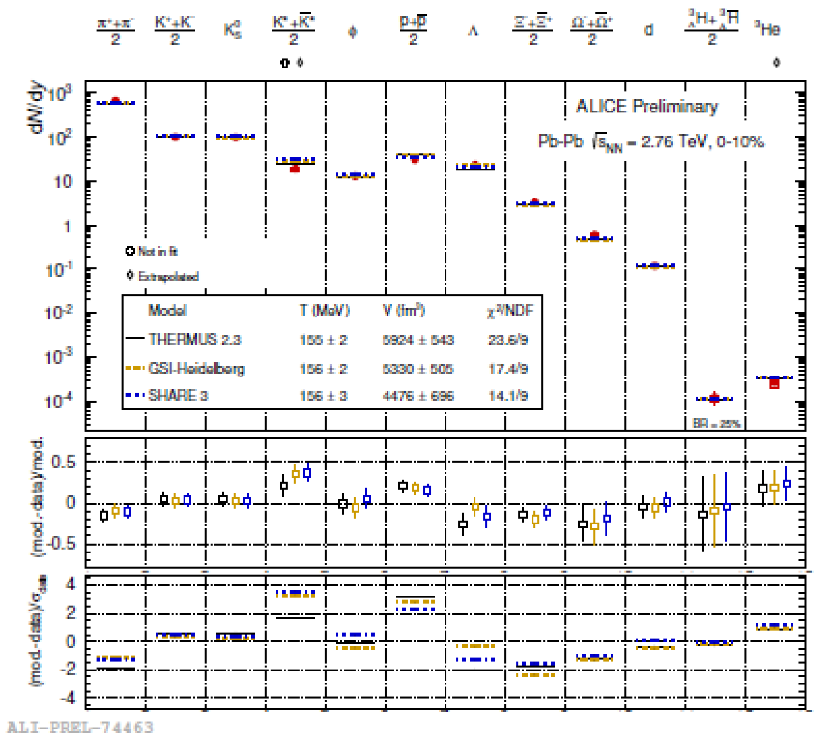


Figure 1: Thermal fits of particle yields in 0-10% Pb–Pb collisions.

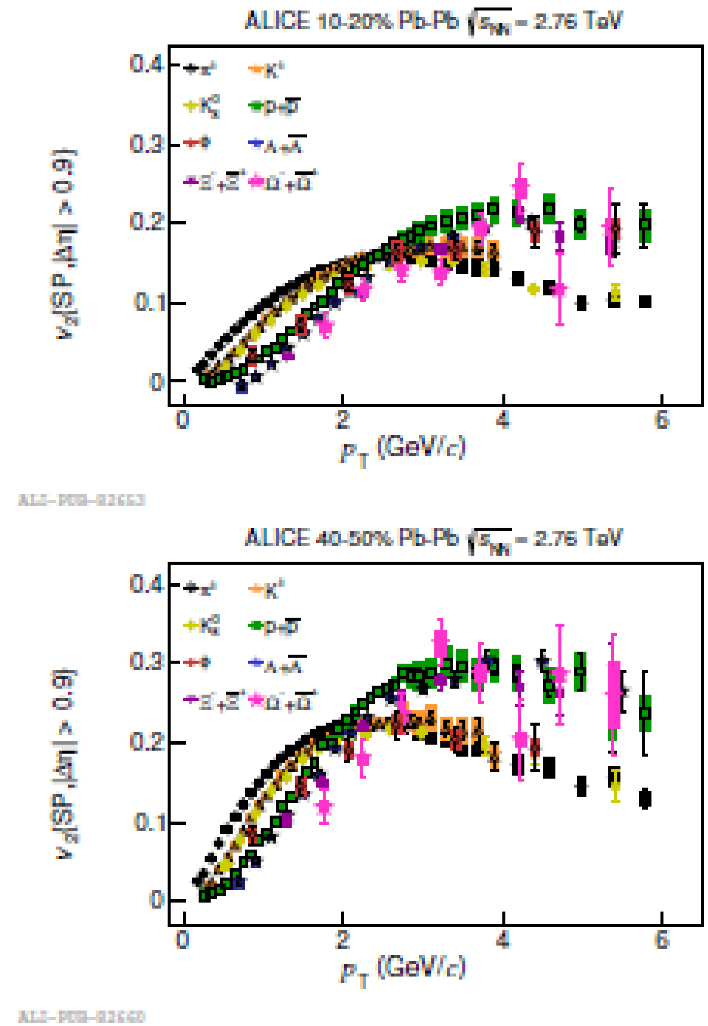


Figure 5: Elliptic flow coefficient (v_2) of identified hadrons as a function of p_T measured for central (top) and peripheral (bottom) Pb–Pb collisions.

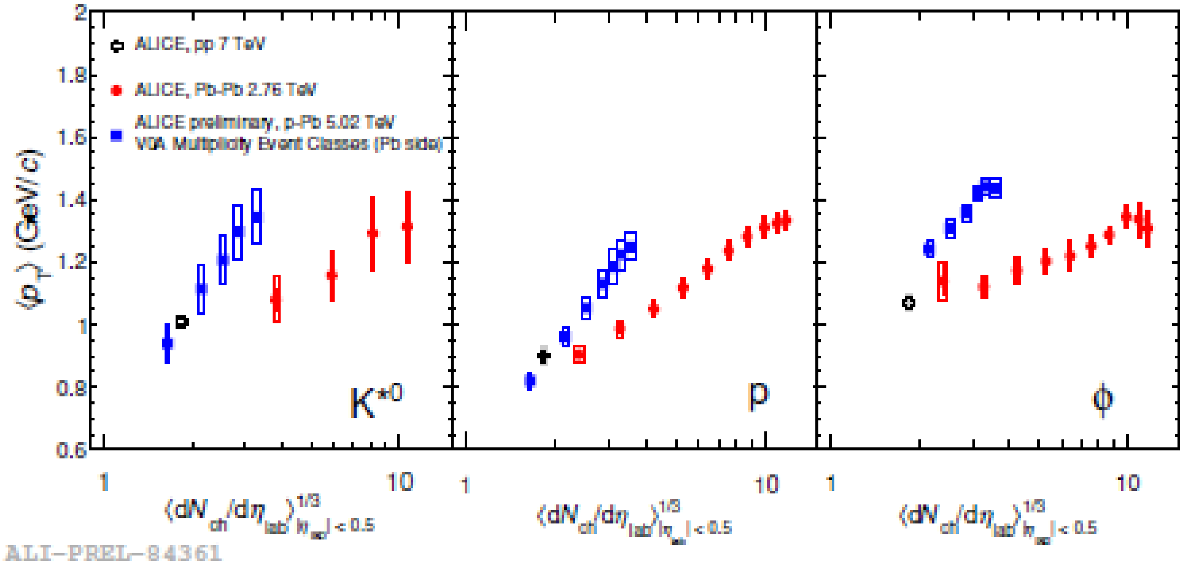
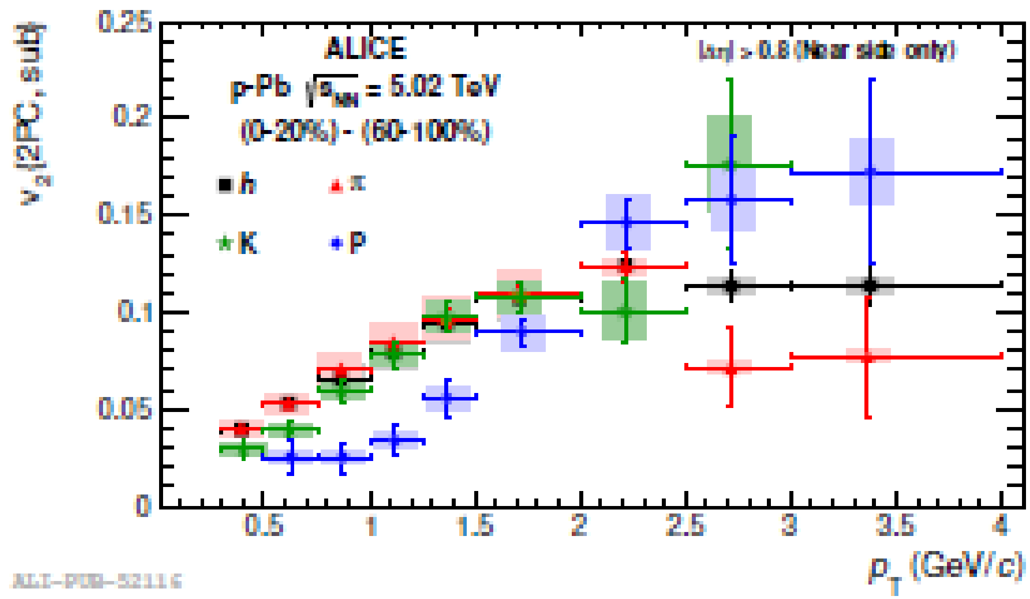


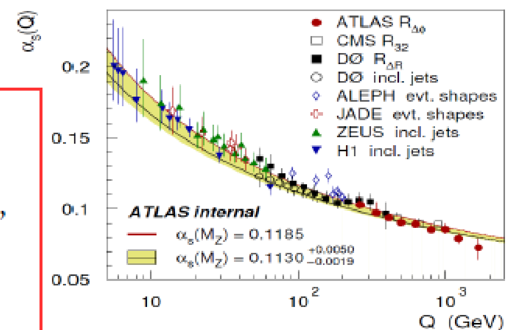
Figure 7: Mean transverse momentum of resonances compared to that of proton in the three different collision systems, as a function of the system size.



CM

α_S measurements

- Multiple analyses extracting α_S using different techniques



<u>STDM-2012-19</u>

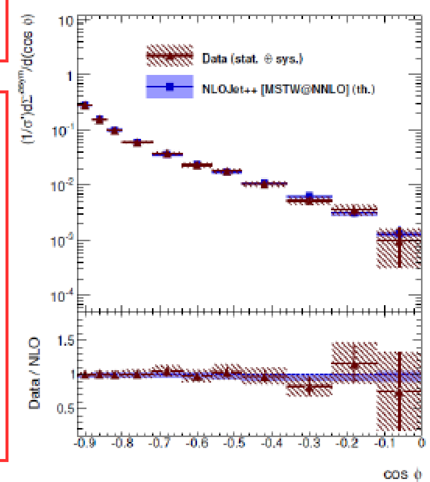
- Azimuthal decorrelations in 8 TeV dijet events, as function of rapidity.
- Measure $\alpha_S(Q)$ up to Q=1.675 TeV
- ***In SM approval***

<u>STDM-2014-03</u>

- Energy-energy correlations in multijet events at 7 TeV
- Little dependence on JES, μ_F, μ_R

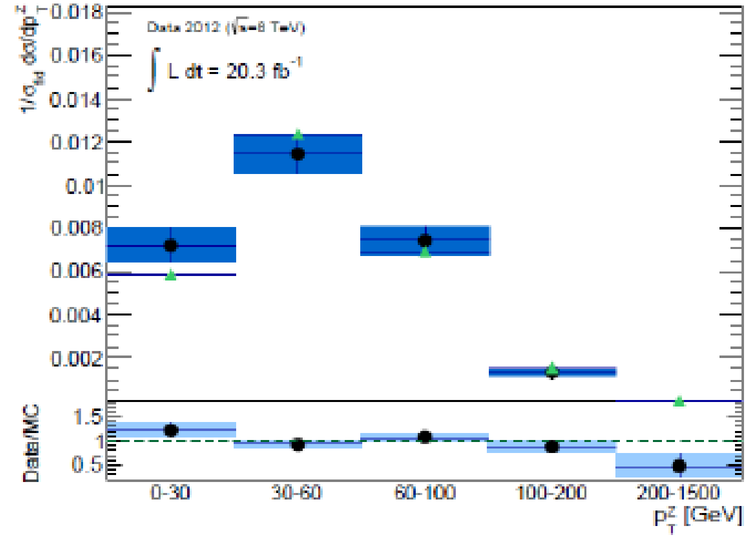
$$\alpha_s(m_Z) = 0.1181 \pm 0.0025\ (\text{exp.})\ {}^{+0.0053}_{-0.0015}\ (\text{scale})\ {}^{+0.0005}_{-0.0005}\ (\text{PDF})\ {}^{+0.0000}_{-0.0000}\ (\text{NPC})$$

- ***In SM approval***

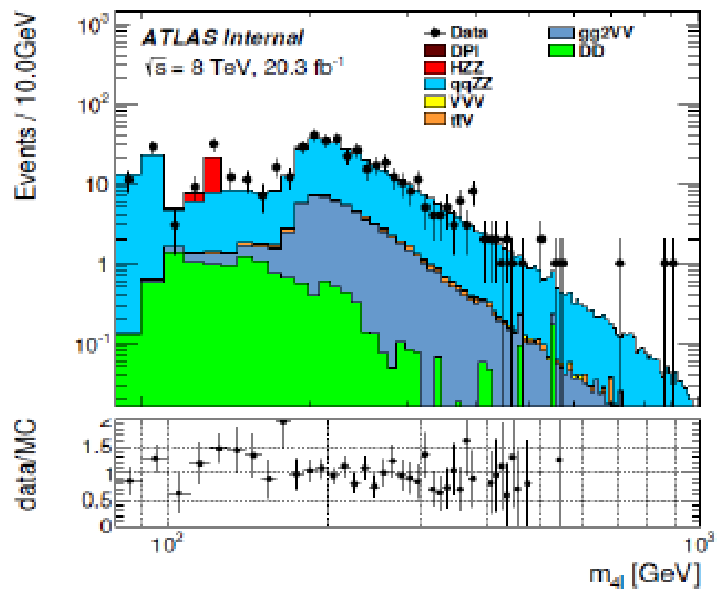


ZZ: 4l inclusive and on-shell

<u>STDM-2014-16</u>
ZZ measurement at 8 TeV
Both 4l and llvv
Measure fid x-sec, unfolded distributions, limits on neutral aTGCs.
In EB stage



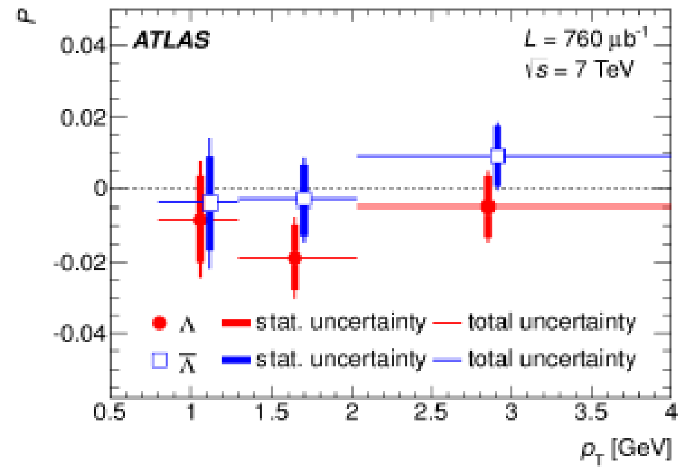
<u>STDM-2014-15</u>
Measure full 4-lepton inclusive mass spectrum at 8 TeV.
Includes ZZ, H->ZZ, qq->Z with additional Z radiated off of lepton.
In EB stage



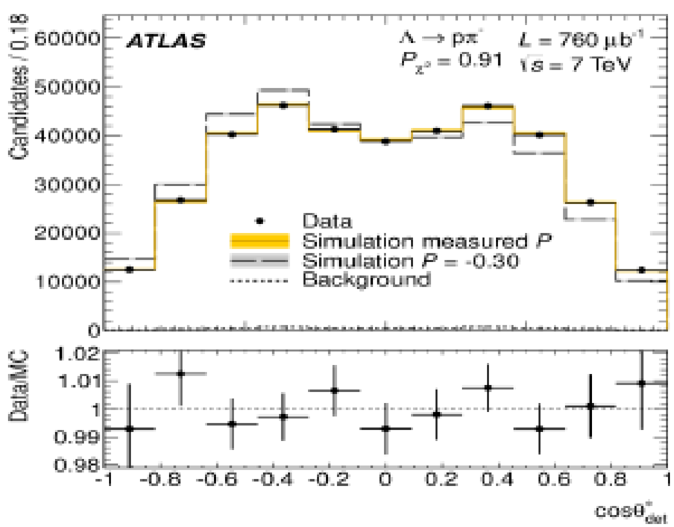
PRD 91, 032004

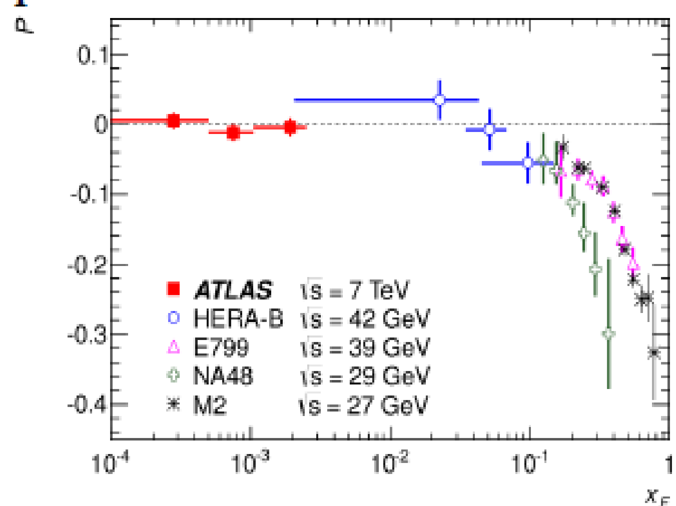
Λ polarization

- 7 TeV measurement
- Previous experiments showed large Λ polarization, but no anti-Λ polarization. No successful model.
- ATLAS probes lower xF than other experiments.
- Polarization measured from fit to angular moments of decay products



Polarization consistent with zero – in agreement with extrapolation from previous experiments





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