JINR contribution to LHC data analysis

ATLAS

I. Yeletskikh on behalf of JINR group

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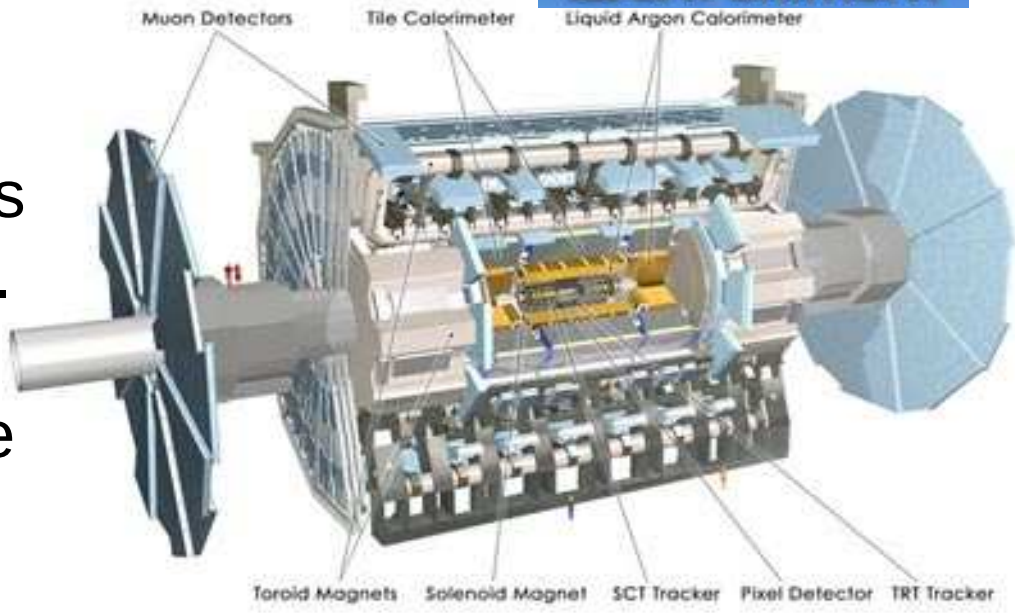
Institute of Electrophysics and Radiatioon Technologies, Kharkov, Ukraine

The ATLAS experiment



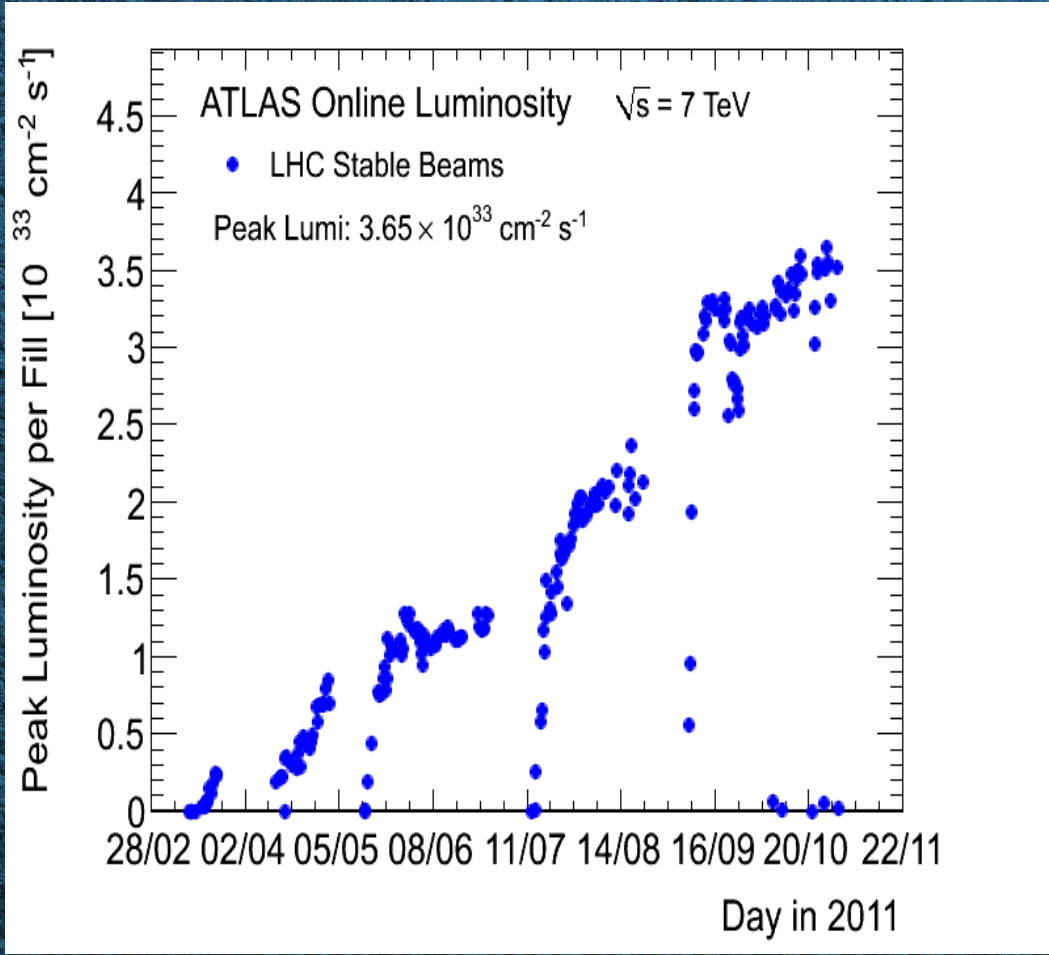
ATLAS collaboration involve 38 countries and more than 174 universities and labs.

ATLAS is one of the largest collaborative efforts ever attempted in the physical sciences.

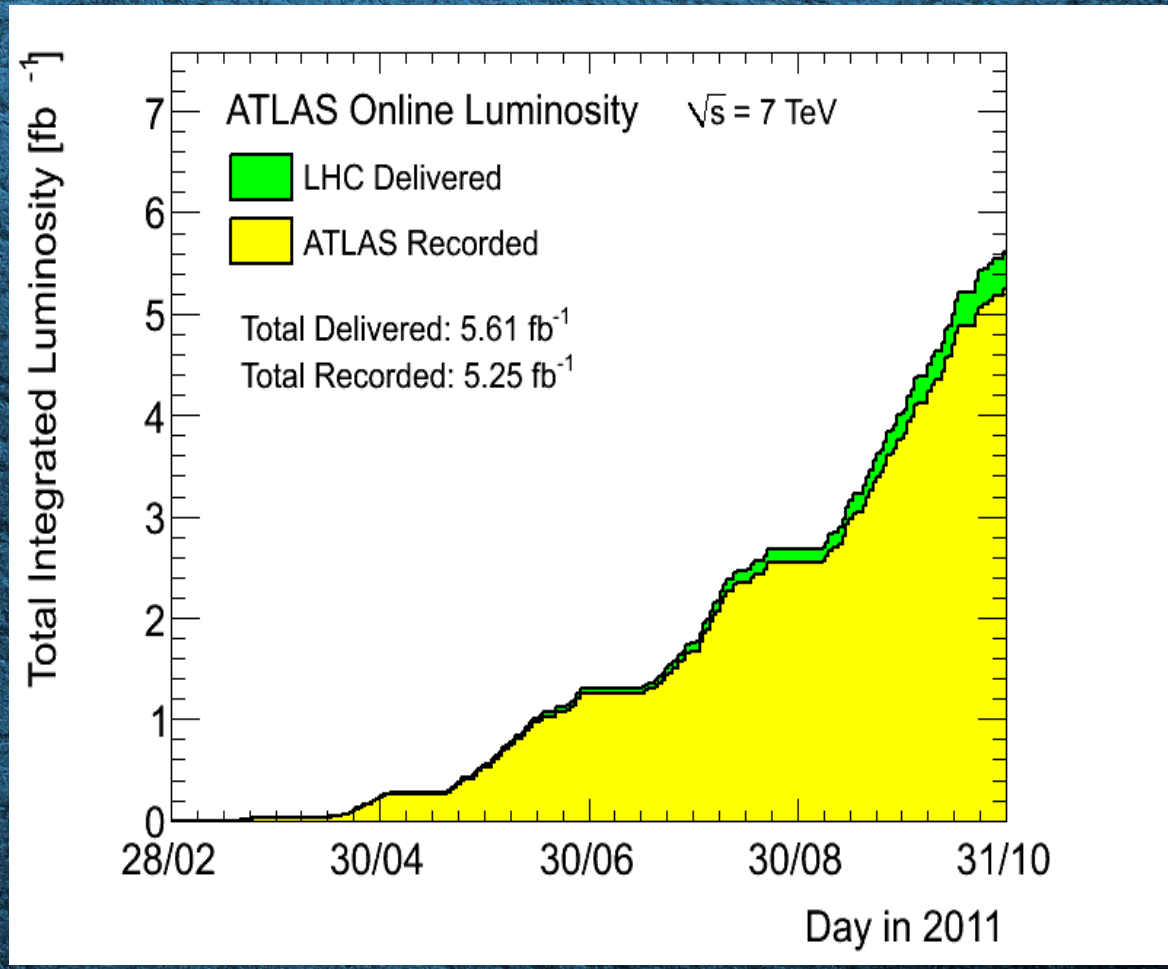
Physics program of ATLAS experiment includes searches for SuperSymmetry, Extra Dimentions, broad spectrum of exotic physics, studying quark-gluon plasma, further development of Standard Model physics, etc., and, of cause, search for the Higgs boson.

100 ATLAS Collaboration publications in 2011 based on experimental data

2011 ATLAS data taking

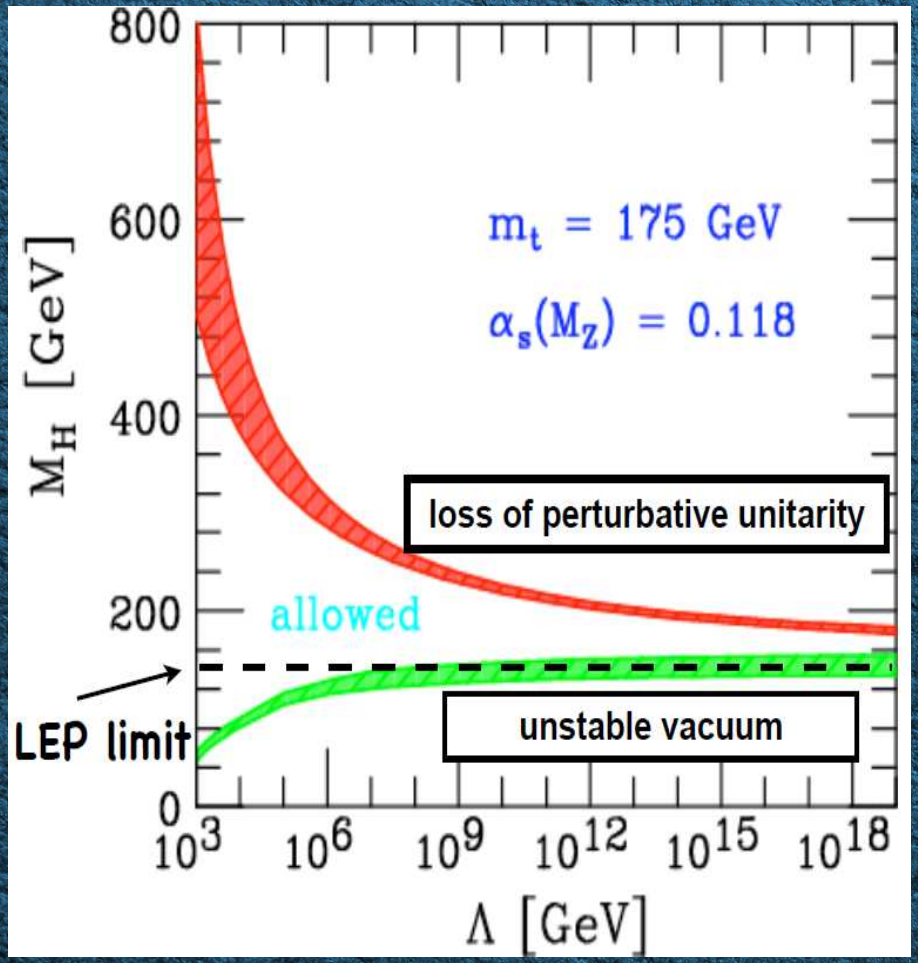


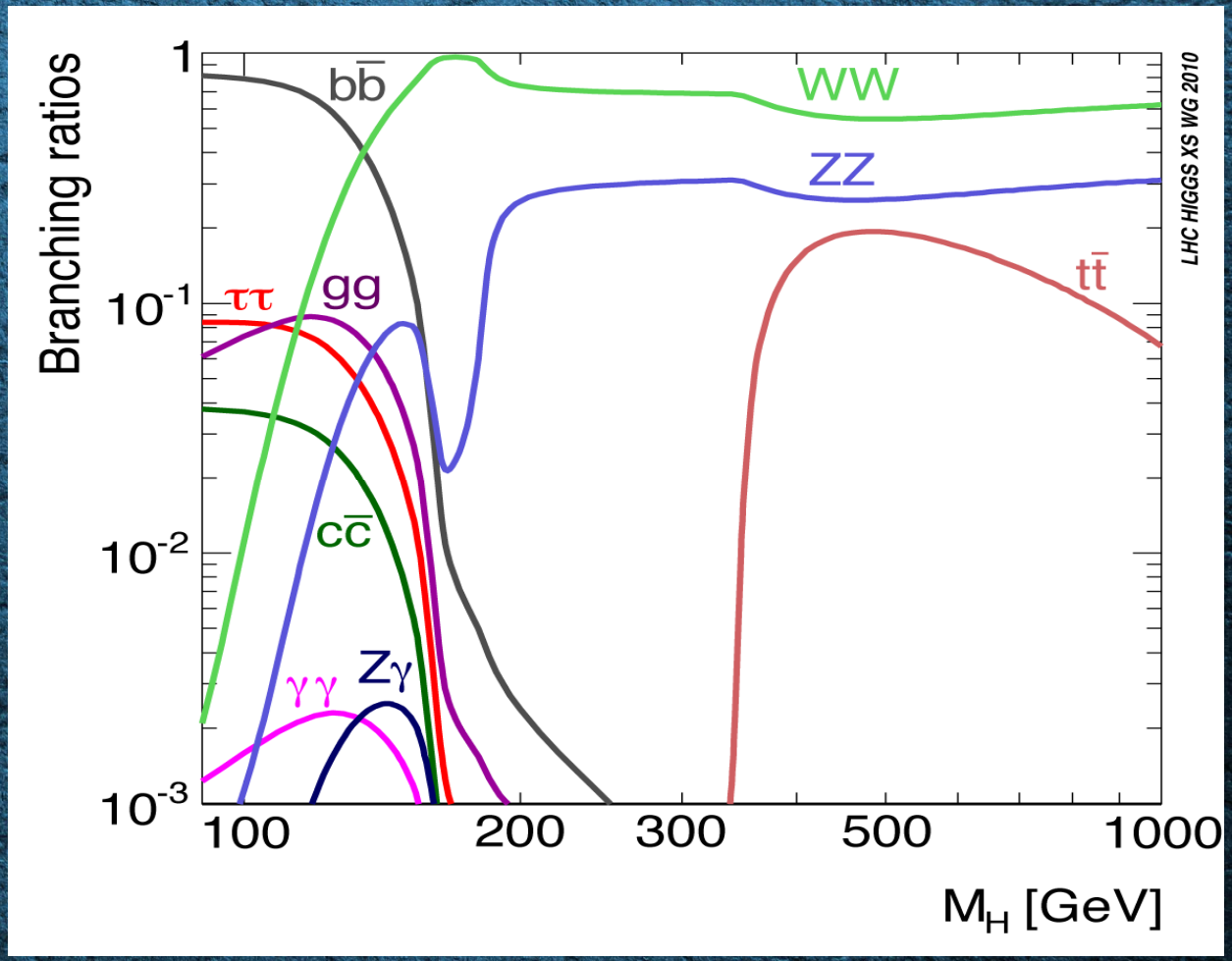
LHC instant luminosity



Integral Luminosity recorded

Higgs theoretical expectations

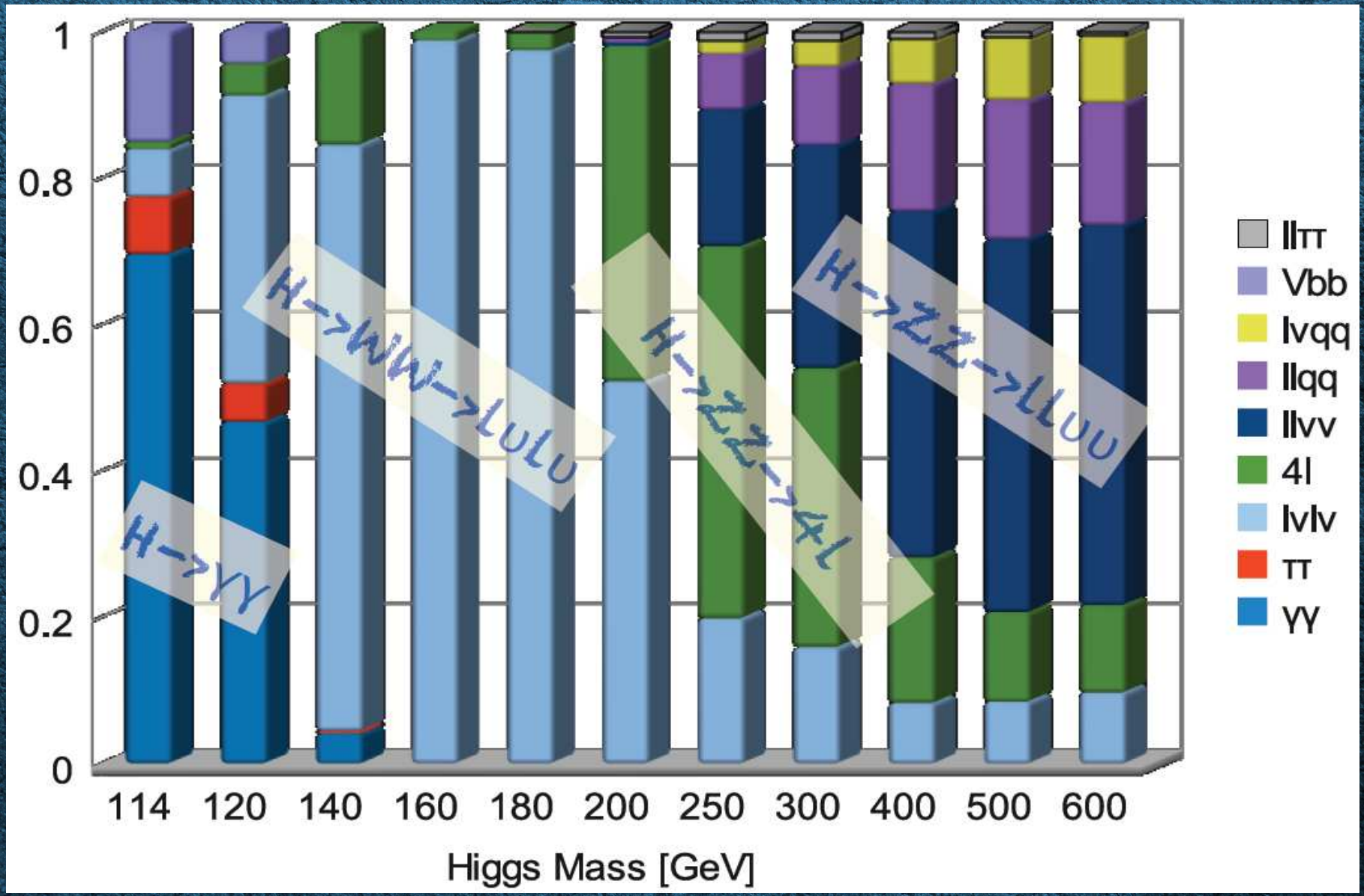




If SM is valid up to 10^{16} GeV, then $130<M_H<170$ ГэВ

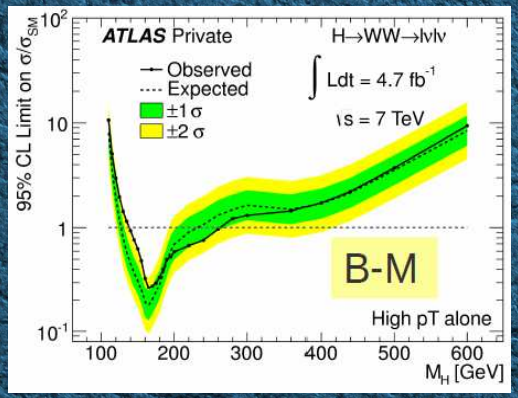
Higgs branching ratios depending on it's mass

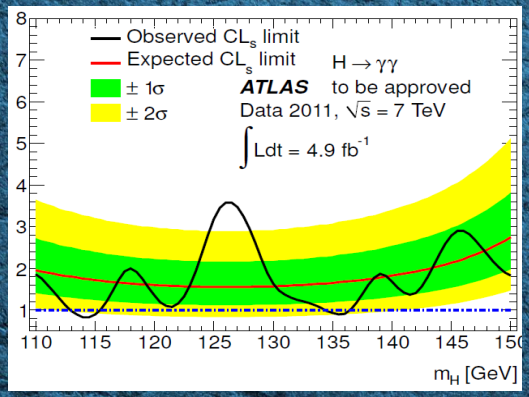
Weights of different Higgs search channels accounting for detector performance

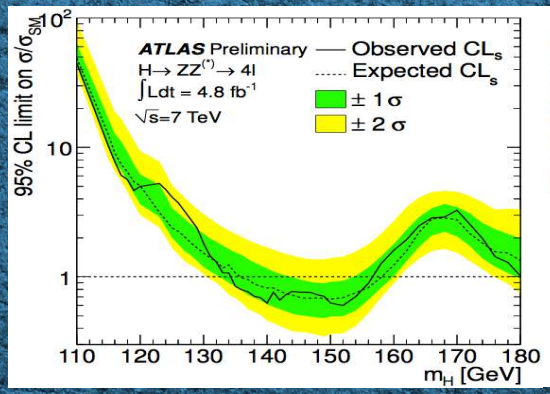


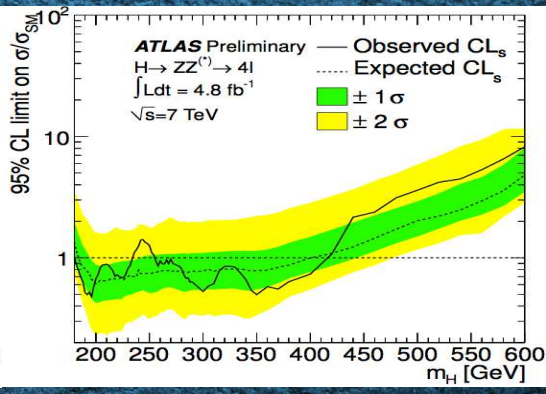
Higgs limit plots

$H \to WW \to l\nu l\nu$ $H \to \gamma\gamma$ $H \to ZZ \to 4l$





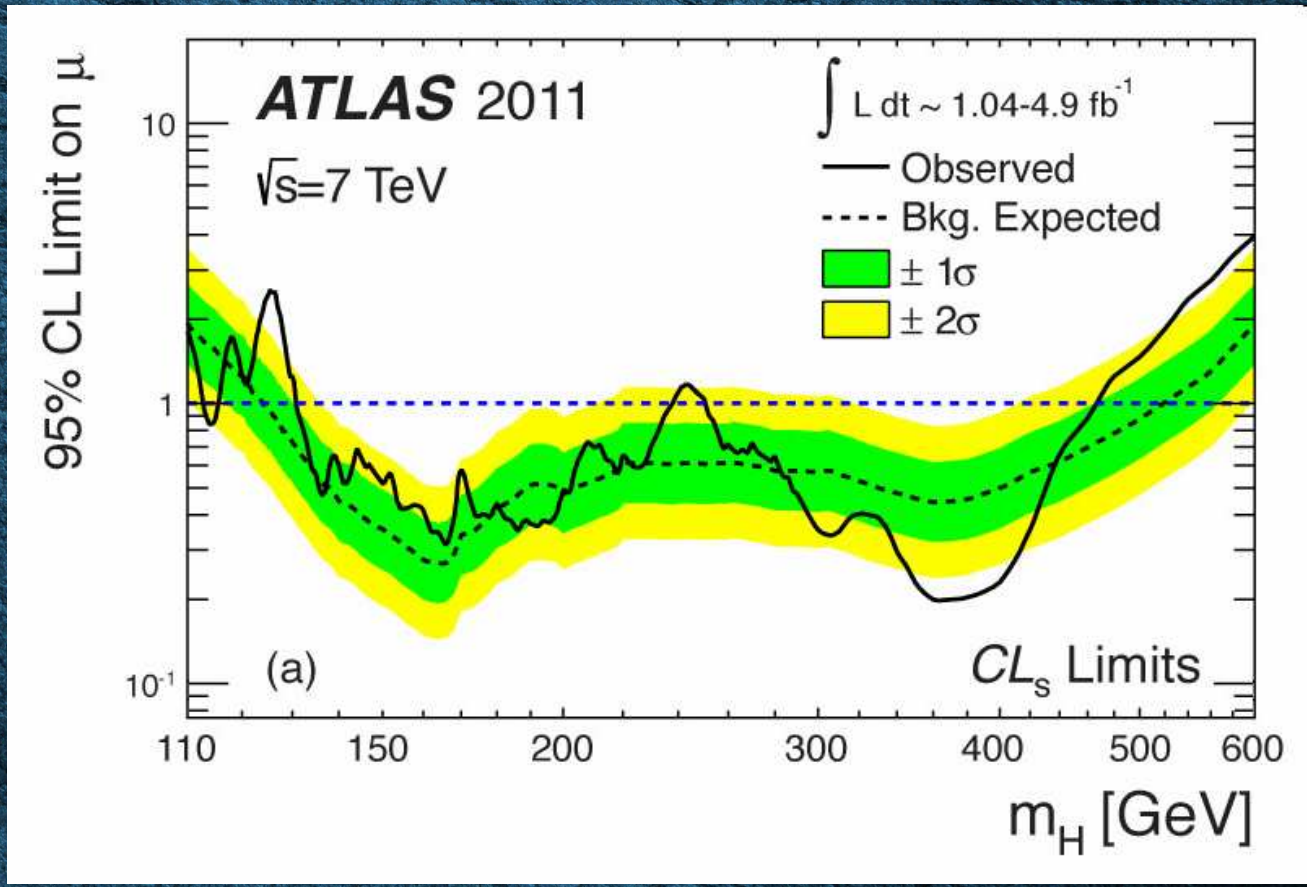




Higgs limits, expressed in terms of the ratio of the observed cross-section to the cross-section predicted by the SM

Excluded Higgs masses
112.7-115.5 ГэВ,
131-468 ГэВ

Excess 2.5σ
for Higgs mass 126.5 ГэВ
coming mainly
from H→γγ



Higgs search in 2012

1. Transition to the energy of **8TeV** in the center of mass frame – 125GeV Higgs production cross section rises by ~25%

2. Total integrated liminosity to be delivered by LHC in 2012 – **$15fb^{-1}$**

3. Discovery or exclusion of the Standard Model Higgs al least on the level of **5σ**

Most advanced JINR activities in ATLAS data analysis

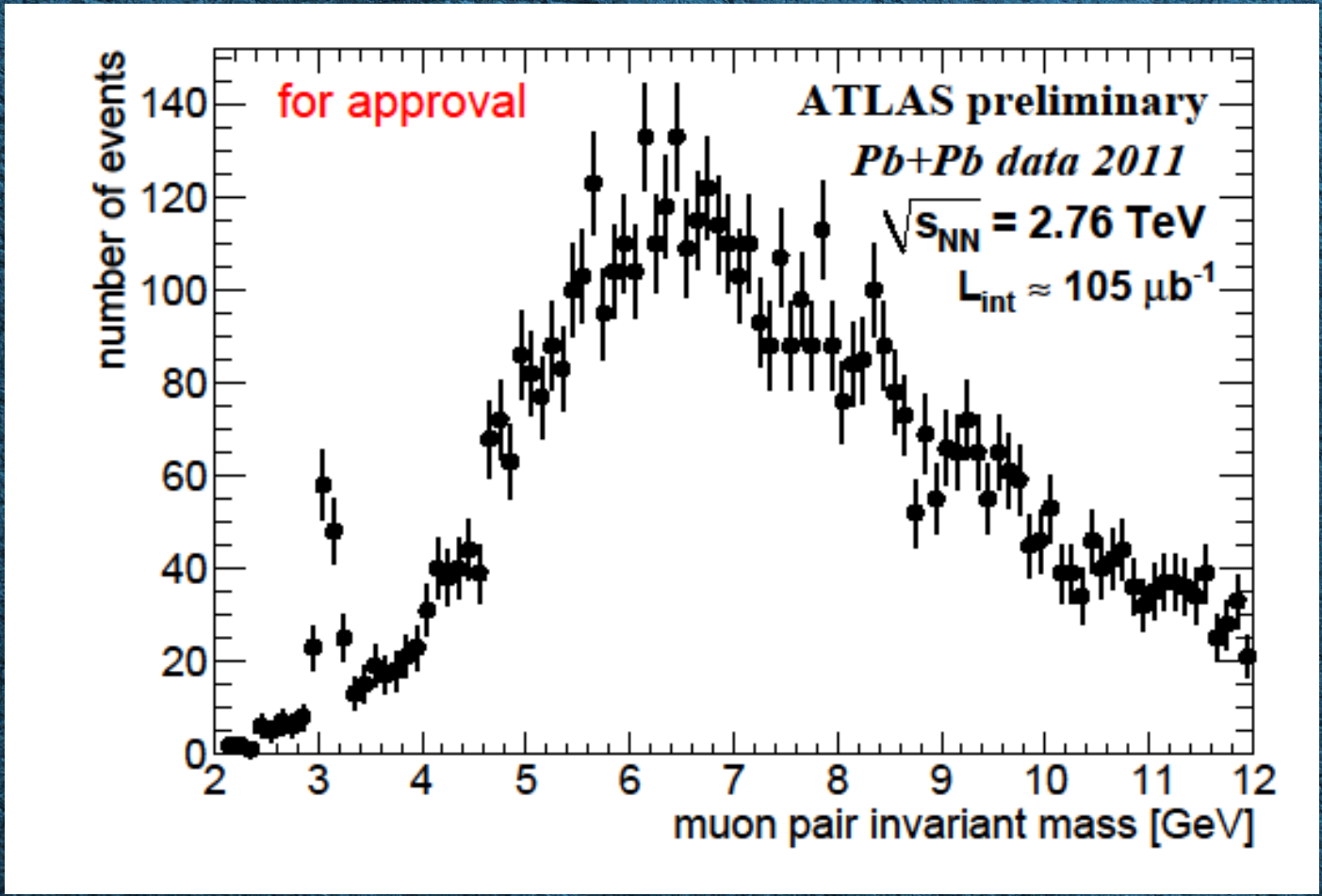
Search for SUSY with 1-lepton+multi-jets+ETmiss final state	V. Bednyakov, S.Karpov, E. Khramov, A. Soloshenko
Heavy Ions physics: Ultra peripheral collisions, Z+jets	V. Pozdnyakov et al.
Z* search in dilepton channel	M. Chizhov, V. Bednyakov, I. Yeletskikh, I. Boyko
Measurement of charmed mesons properties.	L. Gladilin, V. Lyubushkin
Search for Z' decaying into ttbar via muon + 2 b-jets final state	Z. Karpova, V. Bednyakov, E. Khramov
Gluon PDF in hard and soft collisions at LHC	G. Lykasov et al.
Search for SM Higgs produced in association with W and decaying into bb-pairs	A. Cheplakov, F. Ahmadov, N. Javadov

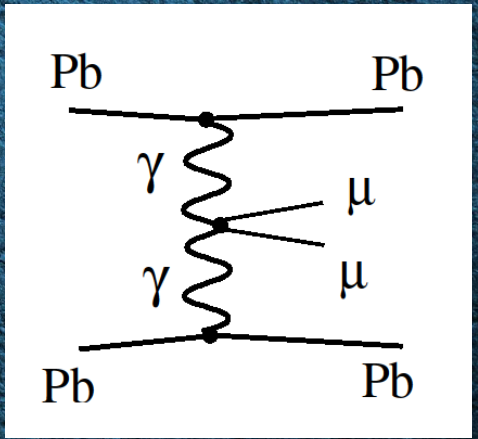
and others…

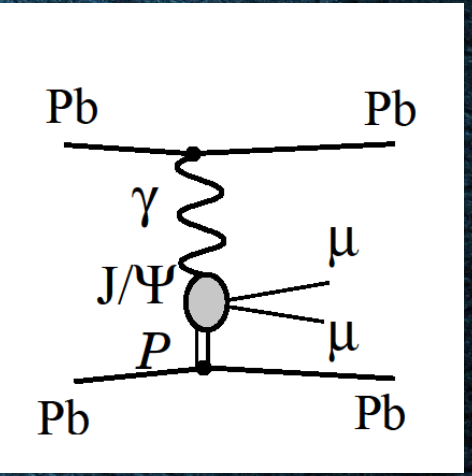
ATLAS Heavy Ion physics. Ultra peripheral collisions.

JINR team was focused on the analysis of ultra-peripheral HI collisions:

- **on-line analysis during the November'2011 run**
- **special trigger was proposed and implemented**







Aimed at σ(γγ→μμ), σ(γγ→J/Ψ →μμ) measurement.
To be completed soon in 2012…

Search for SUSY in lepton+multijet channel

The JINR team proposal accepted by the ATLAS SUSY WG - to look at the final states with one charged lepton, neutrino and 6 or 8 hadronic jets:

$$pp \to \tilde{g}\tilde{g} \to 2\chi_1^0 + 1\ell + 1\nu + 6(8)\, j + X\,.$$

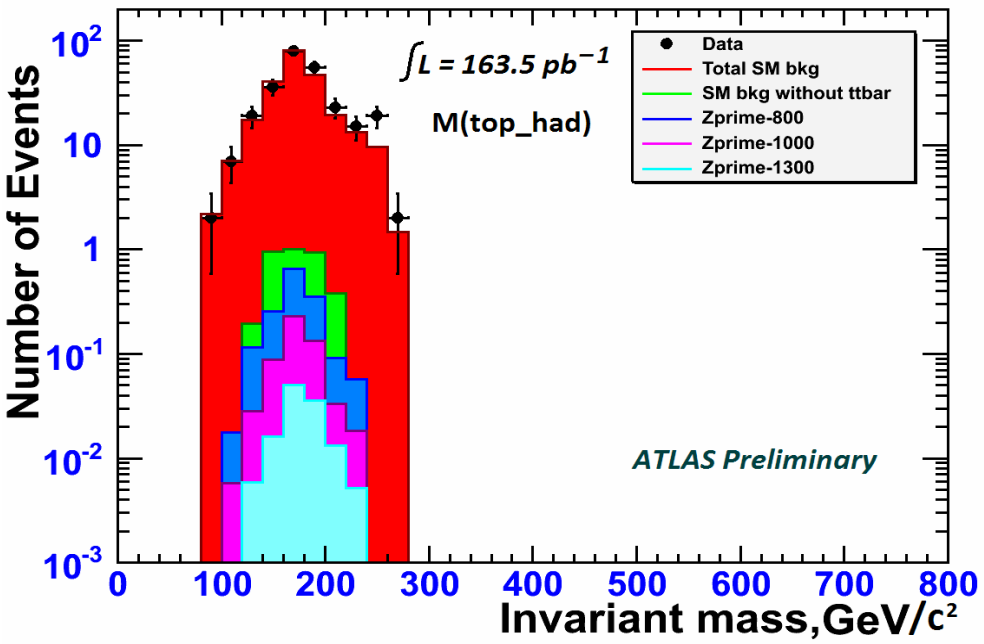
It was demonstrated that SUSY search in the EGRET-domain of the mSUGRA model could be preferable especially for heavy masses and increased LHC luminosity.
JINR leads the analysis of 2011 data (~5 fb^{-1}). To be presented on Moriond 2012.

Search for heavy resonance decaying to *tt*-pair via *μ+2b-jets* final state

The channel proposed by JINR physicists:

$Z' \to t\,t \to$ *2b-jets +2jets +* ℓ *+*ν*.*

No excess in the reconstructed invariant mass distribution of Z'-candidate was observed at Lint=163 pb-1. Analysis is continuing for 5 fb-1 dataset.



Search for Z* boson in dilepton channel in 2011 ATLAS data

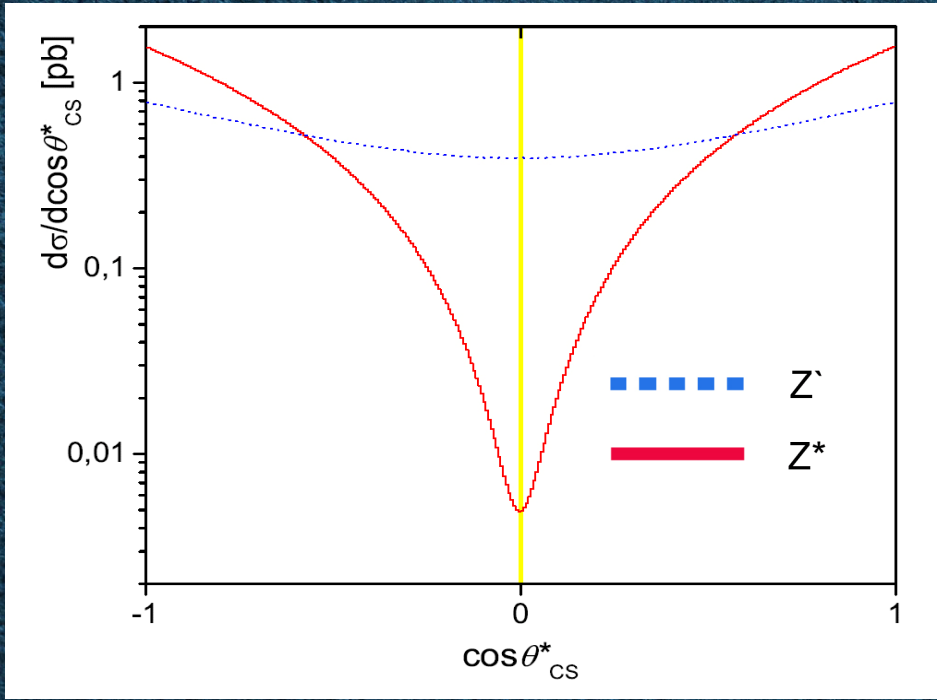
Z* is an excited spin 1 neutral boson

$$\mathcal{L}_{Z^*} = \frac{g}{2\sqrt{2}\Lambda}\,\bar{\psi}\,\sigma^{\mu\nu}\psi \cdot \left(\partial_\mu Z^*_\nu - \partial_\nu Z^*_\mu\right)$$

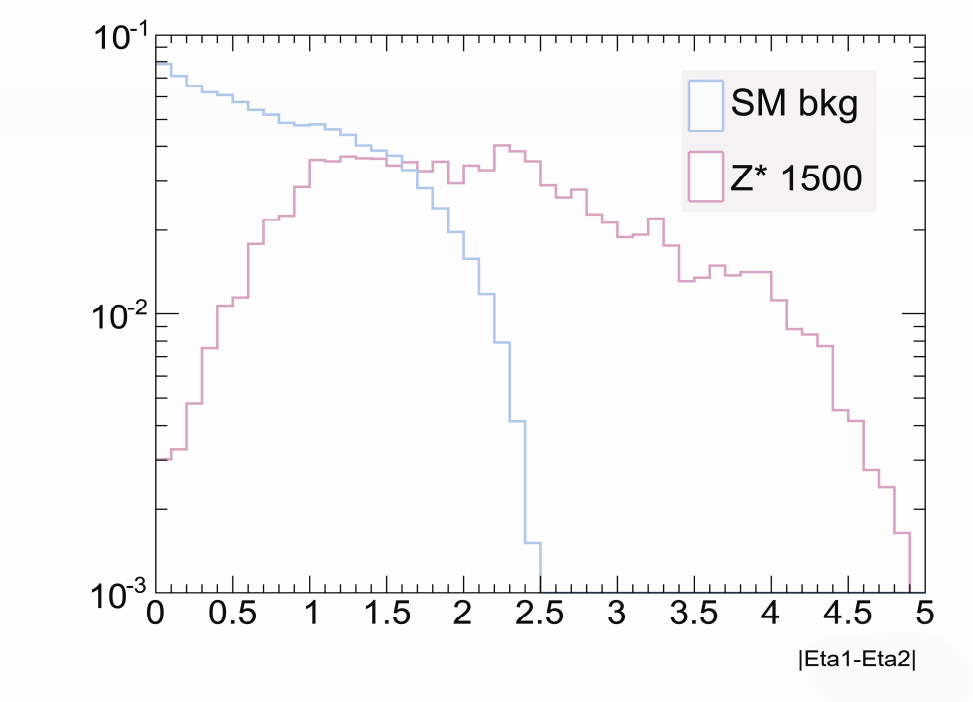
Proposed by Chizhov, Bednyakov, Budagov.

Z* can appear in theories:

1. Aimed at solving the hierarchy problem
2. Including extra spatial dimentions
3. Assuming non-elementary nature of standard model EW bosons

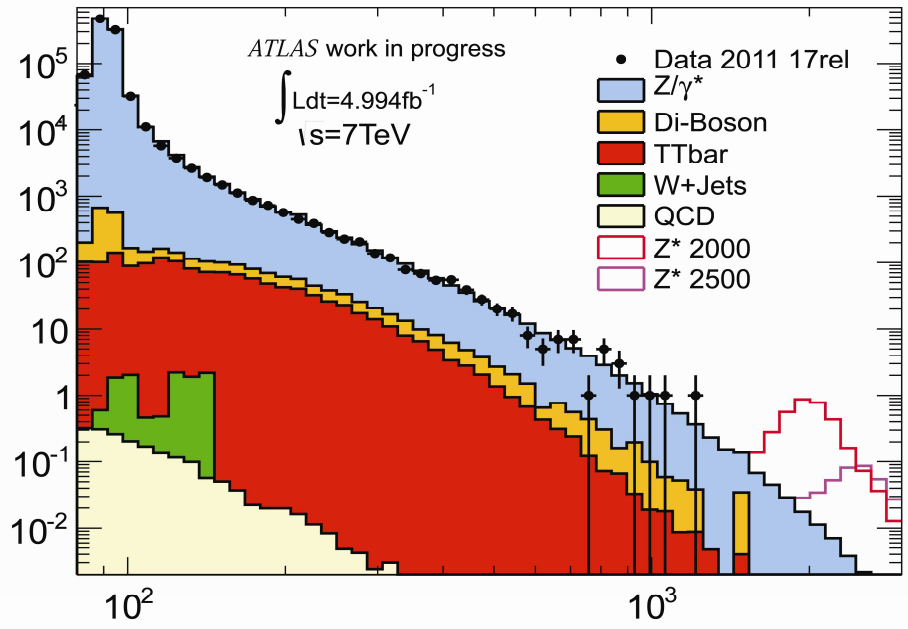


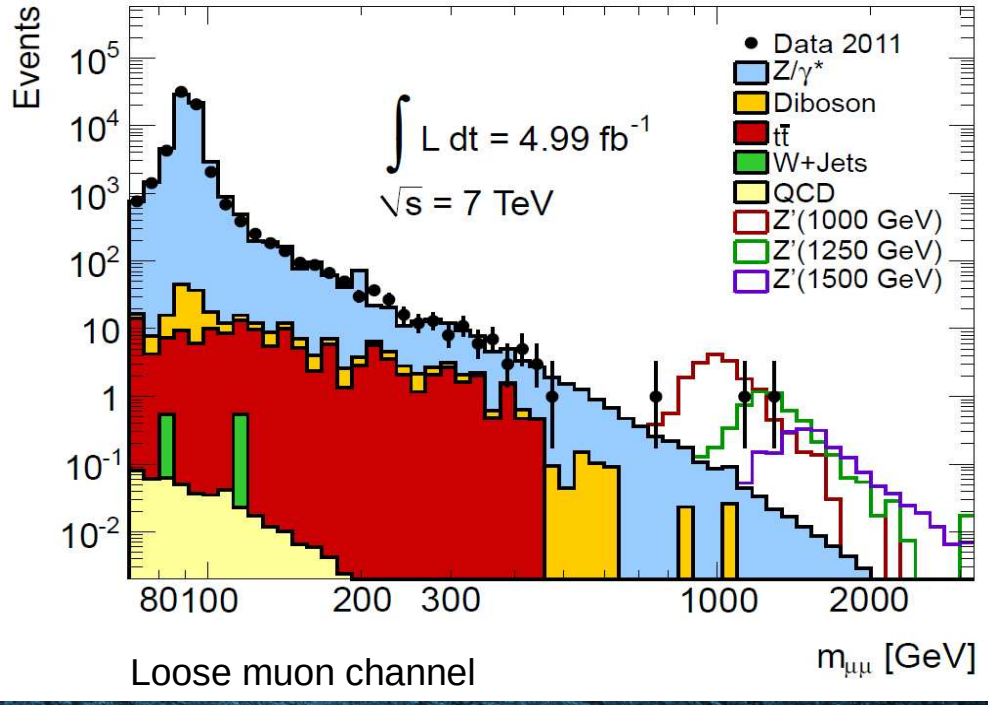
Angular distribution of decay products of Z' и Z*

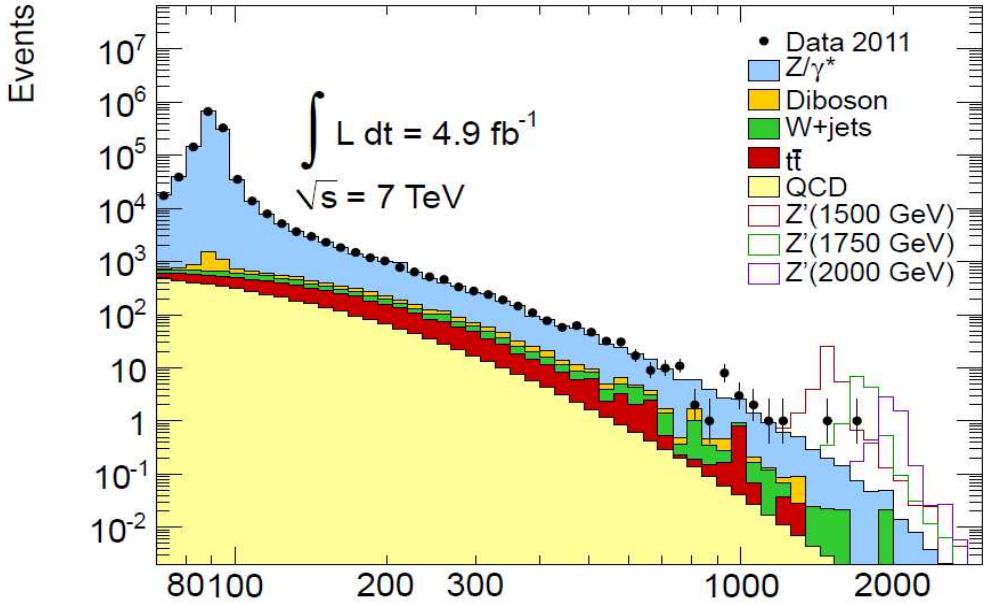


Pseudorapidity difference between two muons coming from Z* and from the standard model background.

Invariant mass distributions in dilepton channel. ATLAS 2011 data



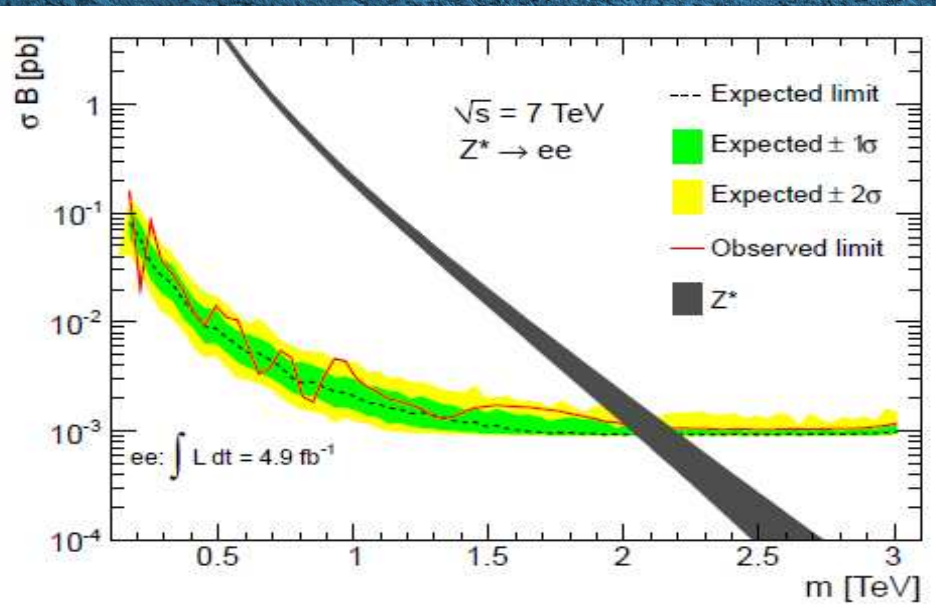




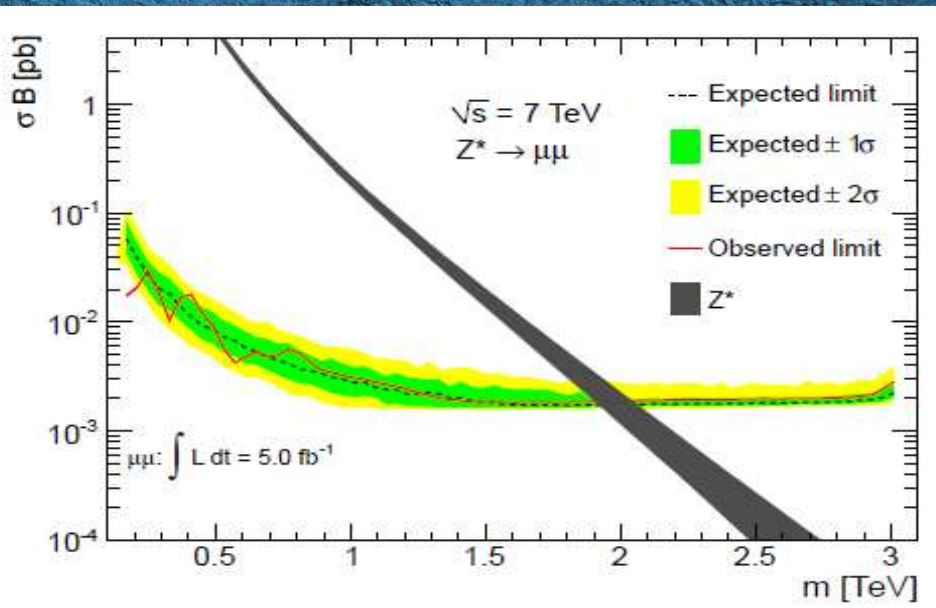
Good agreement between data and MC so far

2011 Z* mass limit

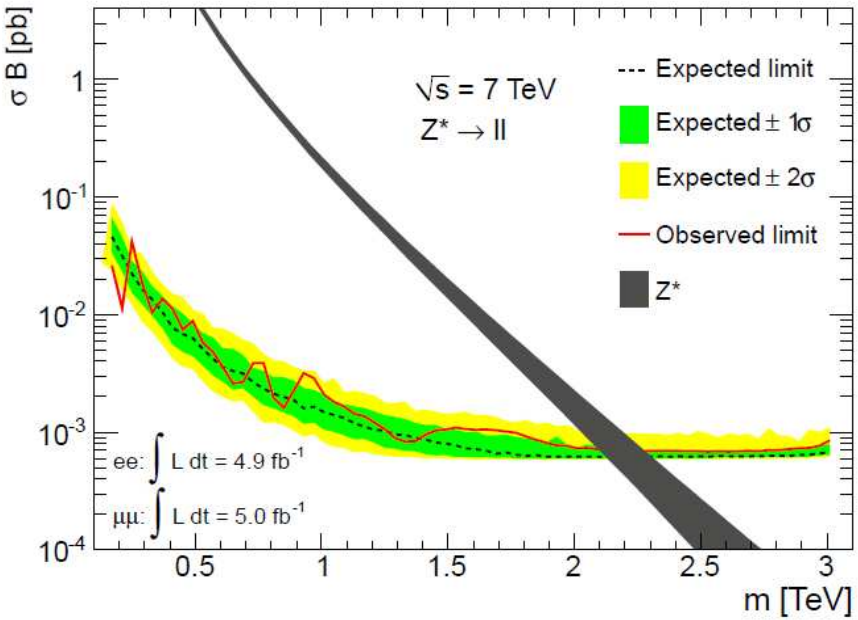
Electron channel



Muon channel



Combined

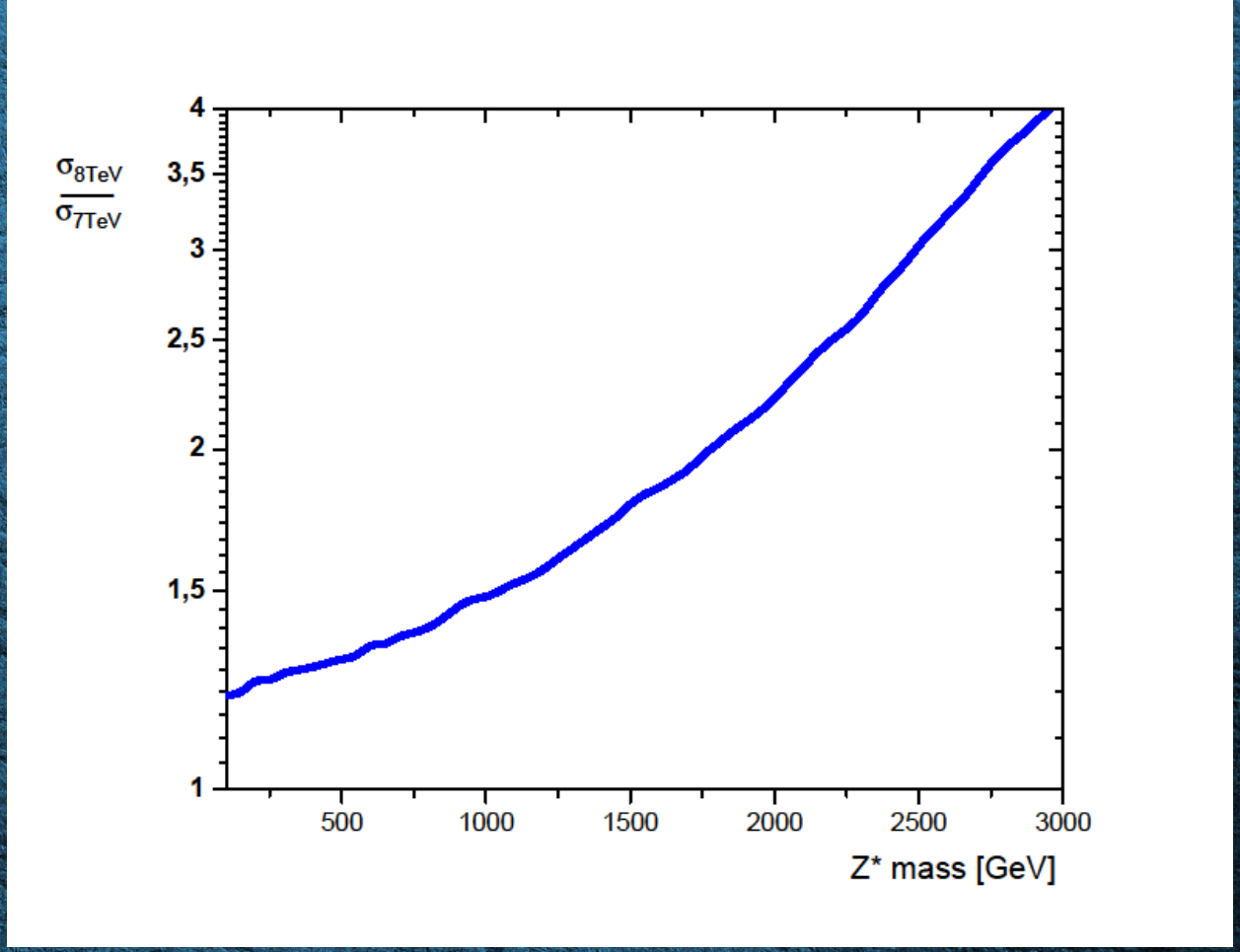


	Observed limit mass [TeV]
$Z^* \to e^+e^-$	2.10
$Z^* \to \mu^+\mu^-$ (tight dimuon selection)	1.98
$Z^* \to \ell^+\ell^-$ (tight dimuon selection)	2.20

Z* search in 2012…

Moving to 8TeV pp collisions

Addition of dijet channel



Ratio between Z* cross sections at 8TeV (2012) and 7TeV (2011) proton proton collisions

Expected mass region up to ~2.6TeV in dilepton channel to be investigated in case 10fb^{-1} recorded in 8TeV collisions.

To sum up…

ATLAS detector demonstrated excellent performance in 2011,
a lot of really exiting results were obtained by
ATLAS collaboration

JINR physicists made a significant contributions
to ~20 collaboration notes/pares… and our participation is growing up

ATLAS group in JINR includes 10 PhD students

JINR actively participates in detector maintenance and upgrade…

More information available from JINR ATLAS program advisory committee:
http://indico.jinr.ru/getFile.py/access?contribId=9&resId=0&materialId=0&confId=279

More to come in 2012!

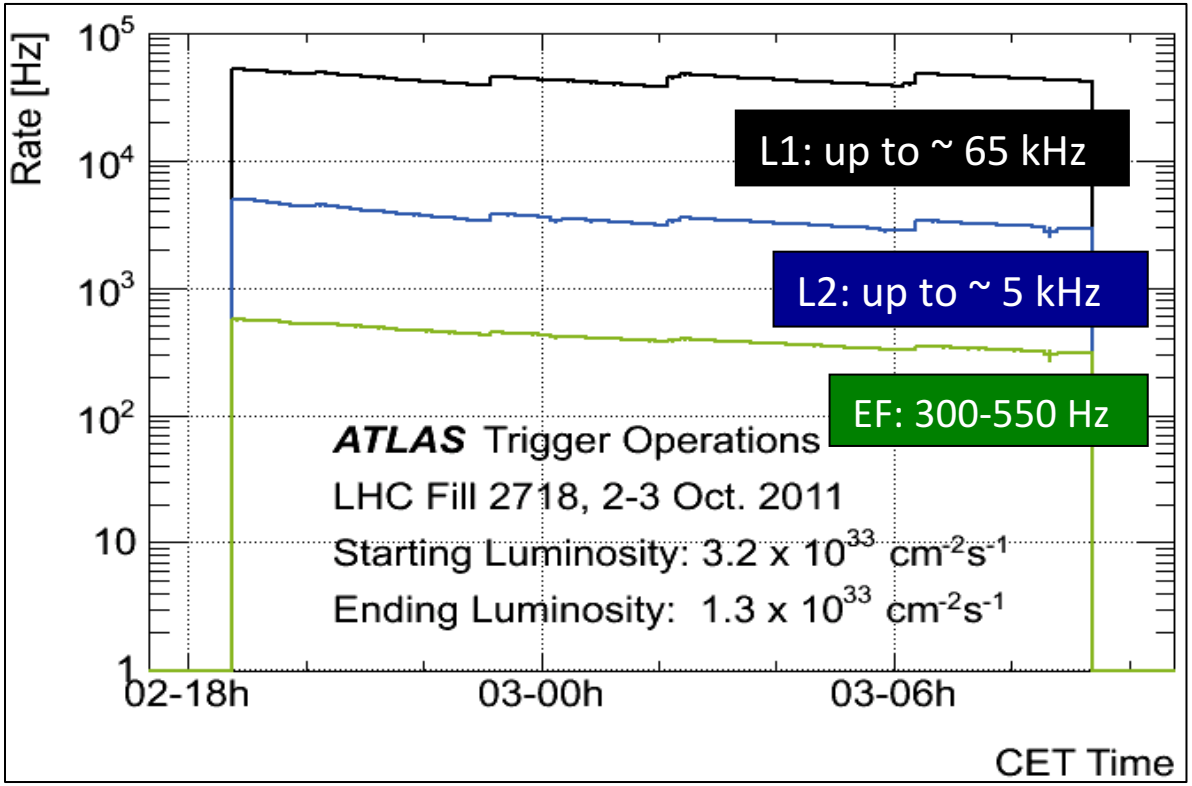
Lots of thanks to colleagues from ATLAS collaboration, PNPI and JINR!

BACKUP

(from the 2012 JINR ATLAS Program Advisory Committee)

ATLAS detector status

Sub-detector	Number of channels	Approx. Operational
Pixels	80 M	96.4%
SCT Silicon Strips	6.3 M	99.2%
TRT Transition Radiation Tracker	350 k	97.5%
LAr EM Calorimeter	170 k	99.8%
Tile calorimeter	9800	96.2%
Hadronic endcap LAr calorimeter	5600	99.6%
Forward LAr calorimeter	3500	99.8%
LVL1 Calo trigger	7160	99.9%
LVL1 Muon RPC trigger	370 k	99.0%
LVL1 Muon TGC trigger	320 k	100%
MDT Muon Drift Tubes	350 k	99.7%
CSC Cathode Strip Chambers	31 k	97.7%
RPC Barrel Muon Chambers	370 k	97.0%
TGC Endcap Muon Chambers	320 k	97.9%



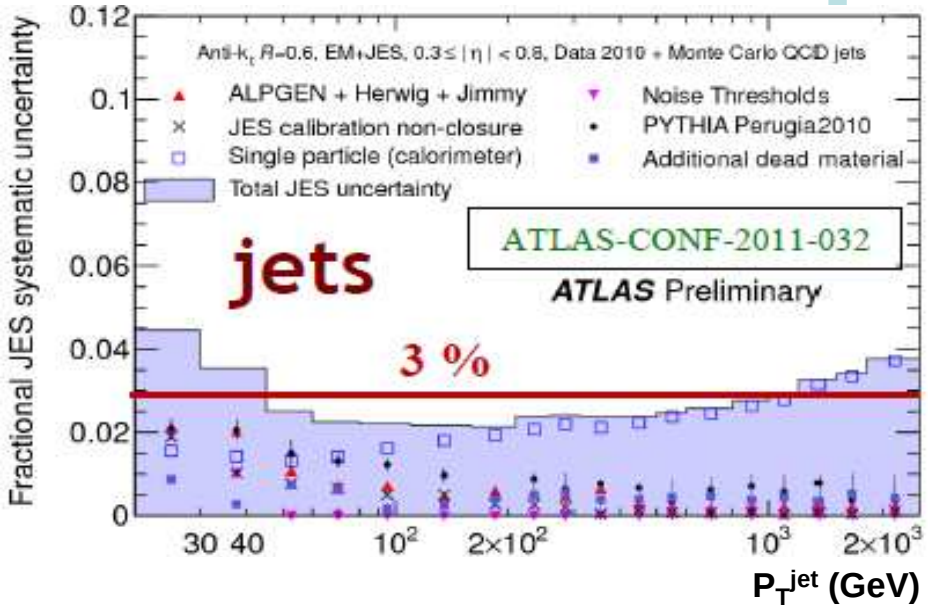
Running smoothly:

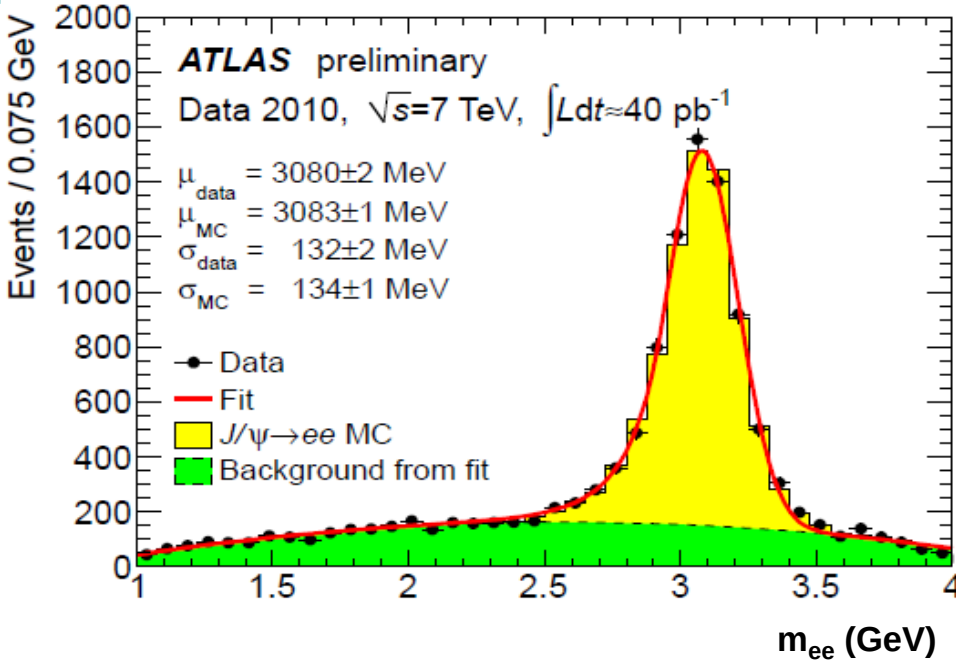
- **95% data taking efficiency,**
- **high & stable recorded physics rate**

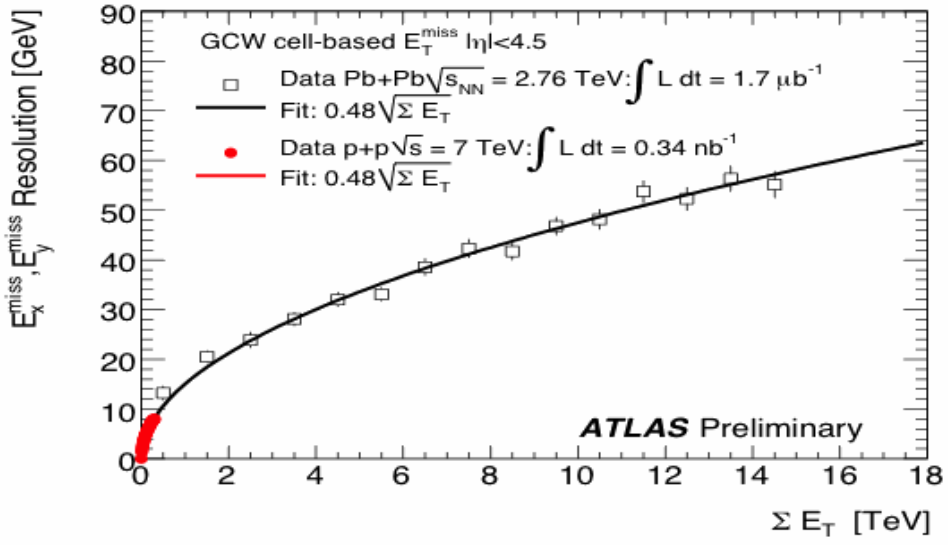
GRID resources are in intensive use

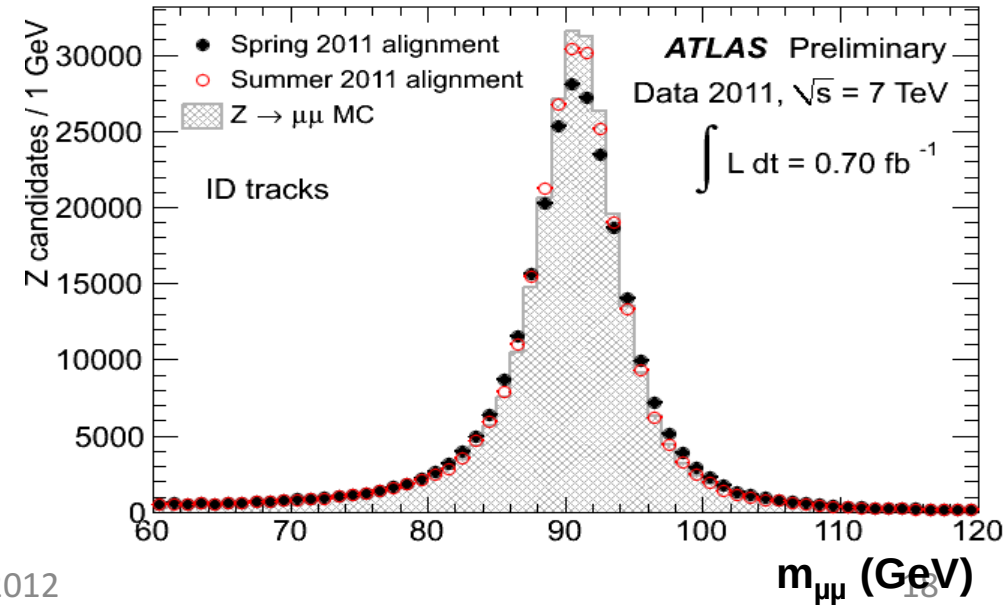
- **reconstruction in ~2 days,**
- **available for the analysis on GRID in ~ 1 week**

ATLAS performance for physics







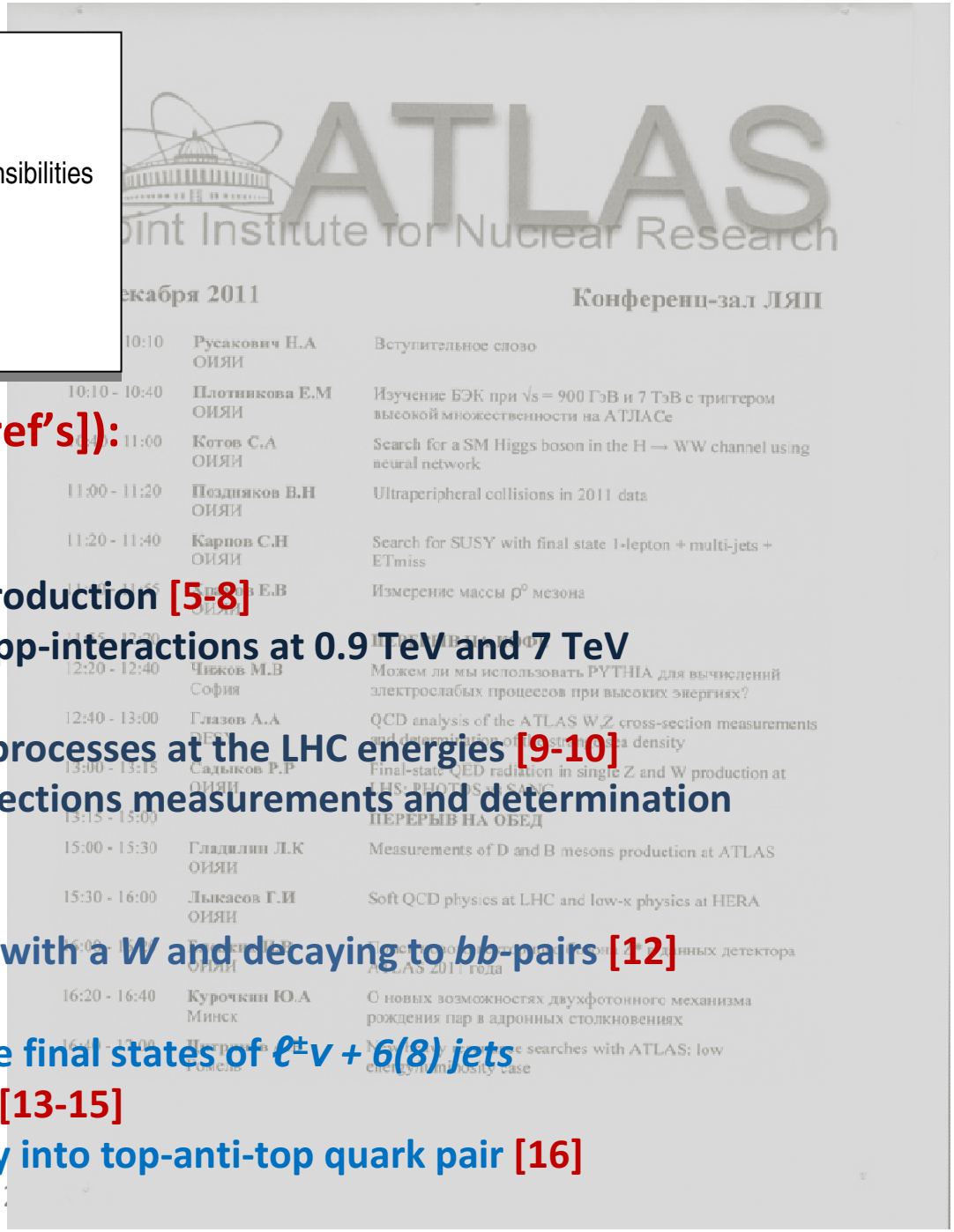


ATLAS physics analyses in Dubna

R E C O M M E N D A T I O N S

from 35th meeting, PAC for Particle Physics

The PAC requests that future reports should focus on specific contributions and responsibilities of the JINR groups participating in these experiments and include in particular:
– a list of **talks** given at international conferences;
– a list of **analysis notes** submitted to the collaboration;
– a list of **PhD students**;
– a list of **management duties and conveners** of data calibration and analysis groups.



Incomplete list of the Dubna analyses (with [ref's]):

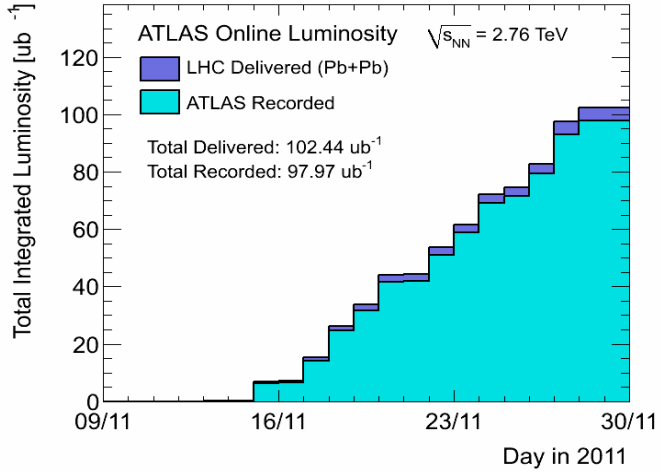
- **study of ultra-peripheral HI collisions (UPC) [1-4]**
- **measurement of charmed D^{*+}, D^{+} and D^{+}_{s} meson production [5-8]**
- **study of Bose-Einstein correlations of pion pairs in pp-interactions at 0.9 TeV and 7 TeV**

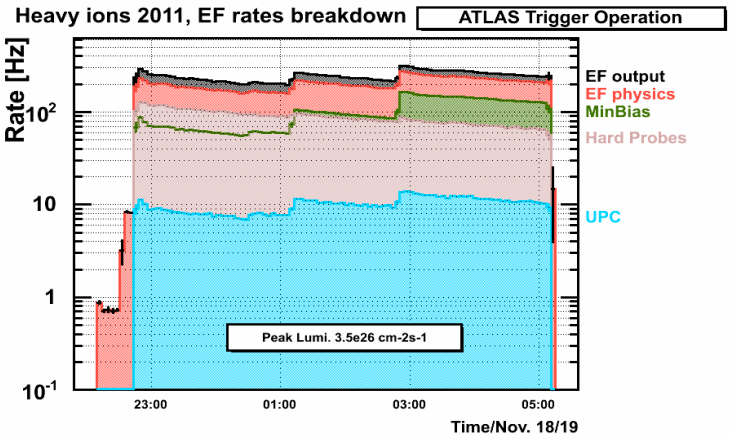
- **modified gluon PDF for semi-hard ans soft hadron processes at the LHC energies [9-10]**
- **QCD analysis of the ATLAS W-> *l* ν and Z-> *ll* cross-sections measurements and determination of the strange sea density [11]**

- **search for SM Higgs boson produced in association with a *W* and decaying to *bb*-pairs [12]**

- **search for SUSY in EGRET-domain of mSUGRA in the final states of $\ell^{\pm}\nu$ + 6(8) jets**
- **search for neutral chiral vector W*- and Z*-bosons [13-15]**
- **search for narrow neutral Z'-resonance via its decay into top-anti-top quark pair [16]**
- **etc…**

2.76 TeV Pb+Pb collisions at LHC

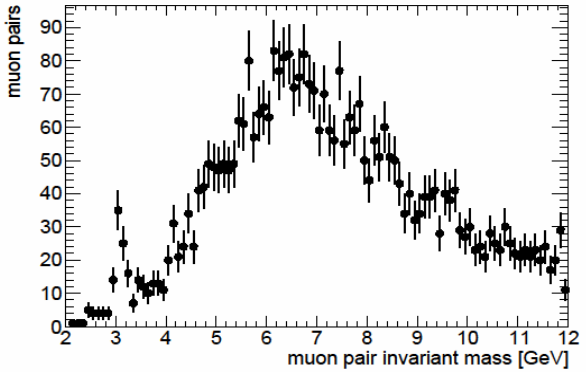




JINR team was focused on the analysis of ultra-peripheral HI collisions (UPC):
- a special trigger was proposed and implemented
- on-line analysis during the November'2011 run

Direct production of the dimuons and dimuon pairs from J/ψ-decays was observed and studied in HI data from 2010.

$$A\,A \rightarrow A\,A + \mu^+\,\mu^-$$



The analysis of the 2011 HI run (with very much higher statistics) is under way and will be completed soon in 2012.

[1] V.N. Pozdniakov and Y.L. Vertogradova "Direct photon and photon-jet measurement capability of the ATLAS experiment at the LHC", Nucl. Phys. A855, 343-346, 2011;

[2] V. Pozdnyakov, A. Ereditato, A. Olszewski, Yu. Vertogradova, L. Rosselet, H.P. Beck, B. Budick, V. Bednyakov, S. White, "Measurement of the muon pair production cross sections in ultra-peripheral Pb-Pb collisions". ATL-COM-PHYS-2011-1361, ATLAS-COM-CONF-2011-182;

[3] "Study of ultra-peripheral interactions in heavy ion collisions", ATL-COM-PHYS-2011-461;

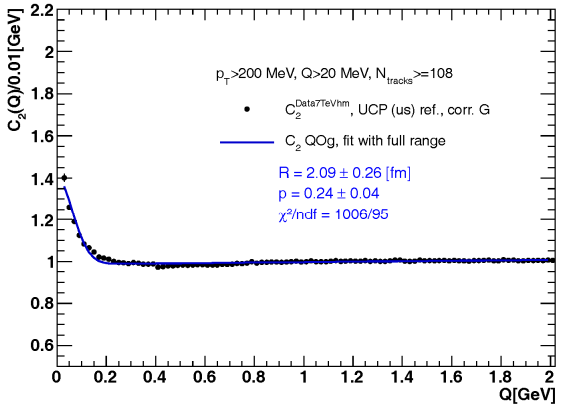
[4] "A first look at Ultra-Peripheral Collisions in ATLAS from the 2011 heavy ion data", ATL-COM-PHYS-2011-1668

Pion interferometry

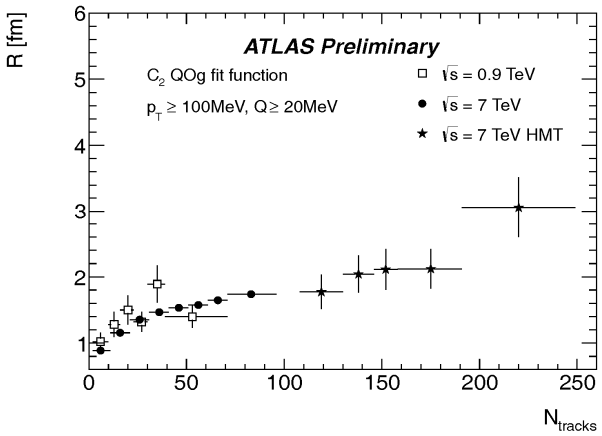
Systematic study of the Bose-Einstein correlations of pion pairs at 0.9 and 7 TeV is ongoing

$C_2(Q) = C_0\,[1 + 2p(1-p)\exp(-R^2Q^2) + p^2\exp(-2R^2Q^2)]\,(1+Q\,\varepsilon)$

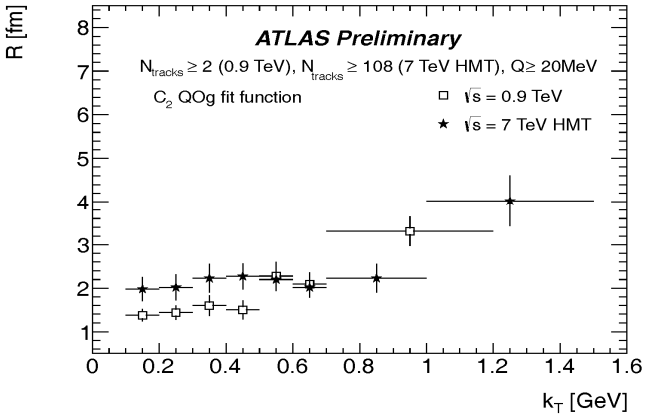
Correlation functions C_2 were obtained for the first time in the high multiplicity region up to 250 (a special trigger, HMT, was implemented)



- a tendency of "saturation" of the correlation radius



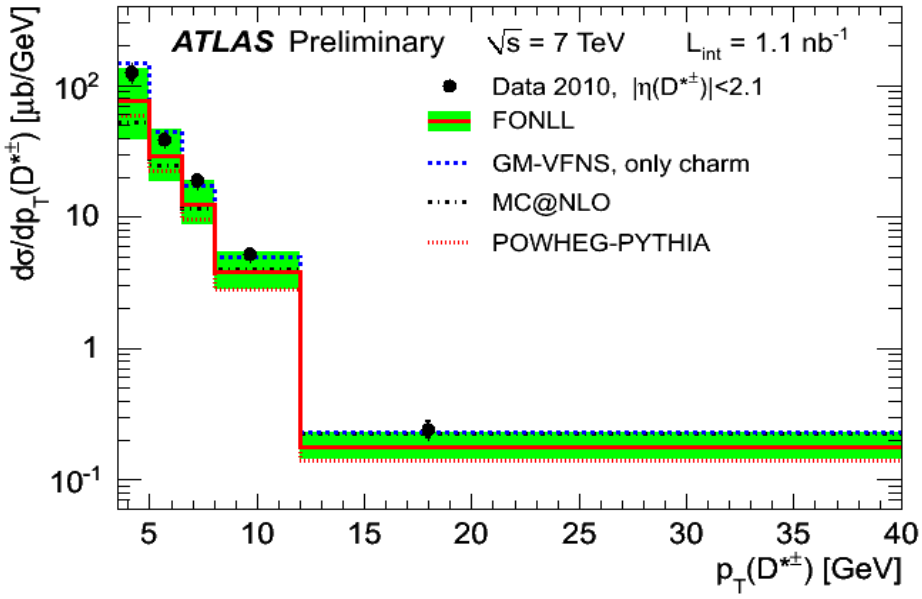
R as function of initial energy, hadron multiplicity and transverse momentum is under study.



The paper and ATLAS Notes are in preparation.

Charmed D^{*+}, D^{+} and D_s meson production

Total and differential production cross sections were compared to NLO QCD calculations and found to be in agreement within a rather large theoretical uncertainties



[5] ATLAS Collaboration, “Measurement of D(*) meson production cross sections in pp collisions at_sqrt(s) = 7 TeV with the ATLAS detector”, ATLAS-CONF-2011-017, 2011.

[6] “Comparison of D(*) meson production cross sections with FONLL and GM-VFNS predictions”, ATL-PHYS-PUB-2011-012, 2011.

[7] ATLAS Collaboration. “QCD analysis of the ATLAS W⟶ *lν* and Z⟶ *ll* cross-sections measurements and determination of the strange sea density”; ATL-PHYS-INT-2011-081, to be published in PRL:

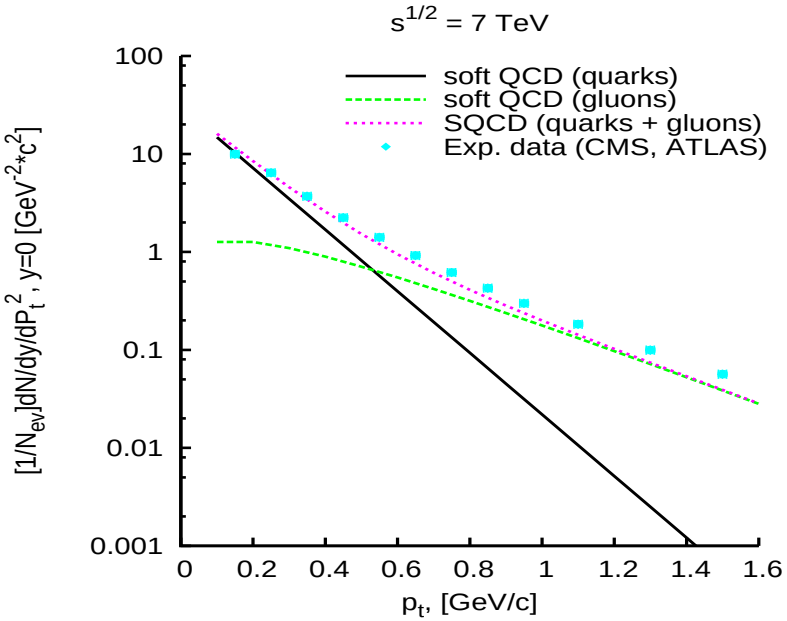
[8] A. Cooper-Sarkar, S. Glazov, M. Klein, U. Klein, J. Kretzschmar, V. Radescu, A. Sapronov, S. Whitehead, ATL-COM-PHYS-2011-1430.

Contributions from the JINR theorists

A new, modified gluon distribution density was proposed taking into account the dependence on the proton transverse momentum.

The usefulness was demonstrated for description of semi-hard and soft hadronic processes at the LHC energies.

A similarity was observed with low-x physics at HERA.

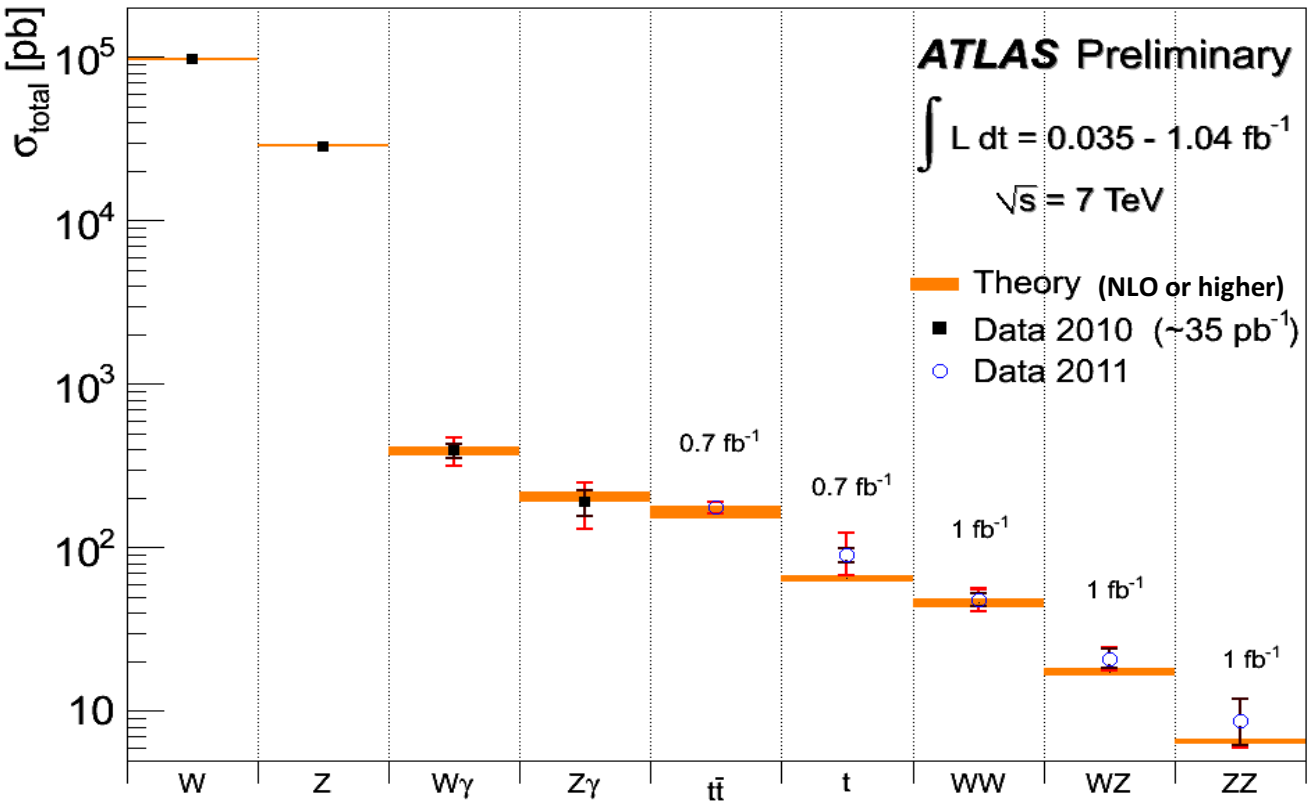


[9] G.Lykasov. V.Bednyakov, A.Grinyuk, M.Poghosyan and A.Dolbilov, arXiv:1109.1469 [hep-ph]
'Physics at LHC -2011', Perugia, Italy, June 2011 and 'Hadron Structure-2011', Strba, Slovakia, June 2011
[10] G.Lykasov, V.Bednyakov, A.Grinyuk, H.Jung, A.Lipatov and N.Zotov, MPI@LHC-2011, DESY, November 2011

QCD analysis of the ATLAS W $\rightarrow$ *l* ν and Z $\rightarrow$ *ll* cross-sections measurements and determination of the strange sea density was performed in the Prof. D.Bardin group.
The analysis was carried out in very fruitful collaboration with our colleagues from DESY, Hamburg.

[11] ATLAS Collaboration "QCD analysis of the ATLAS W$\rightarrow$ *l*ν and Z$\rightarrow$ *ll* cross-sections measurements and determination of the strange sea density"; ATL-PHYS-INT-2011-081, to be published in PRL.
A. Cooper-Sarkar, S. Glazov, M. Klein, U. Klein, J. Kretzschmar, V. Radescu, A. Sapronov, S. Whitehead, ATL-COM-PHYS-2011-1430.

Summary of SM total production cross-section measurements



In our present dataset (5 fb^{-1}) we have (after selection cuts):
~ 30 M W→ μν, eν
~ 3 M Z → μμ, ee
~ 60000 top-pairs
→factor ~ 2 (W, Z) to 10 (top) more than total CDF and D0 datasets
→will allow more and more precise studies of a larger number of (exclusive) processes

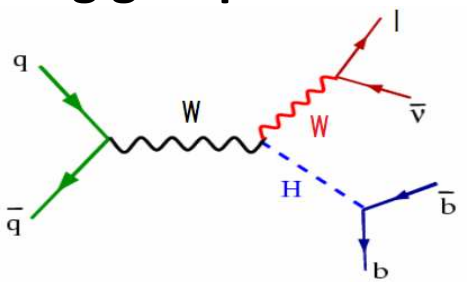
- ✓ **Experimental precision starts to challenge theory for e.g. tt (backgr to most H searches)**
- ✓ **Measuring cross-sections down to few pb (~40 fb including leptonic branching ratios)**

Good agreement with SM expectations (within present uncertainties)

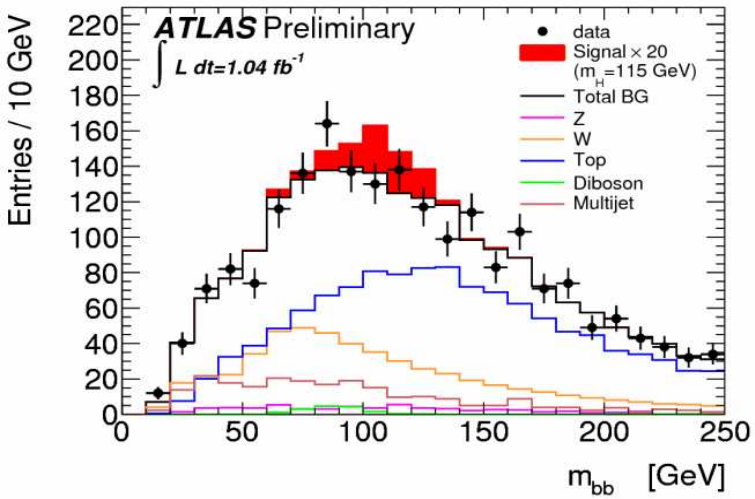
Search for SM Higgs boson produced in association with W

Two ATLAS meetings were organized in Dubna in 2011:

- **GRID related**
- **Higgs working group** **- both very useful!**

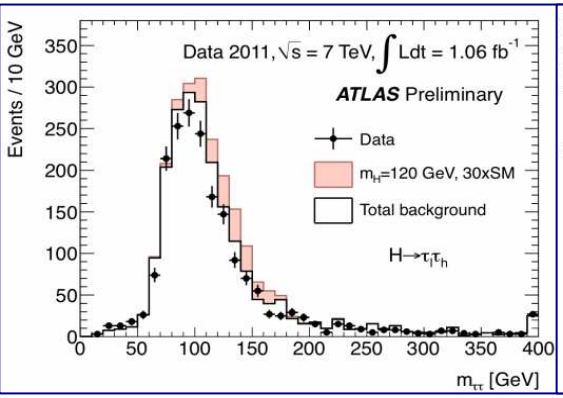


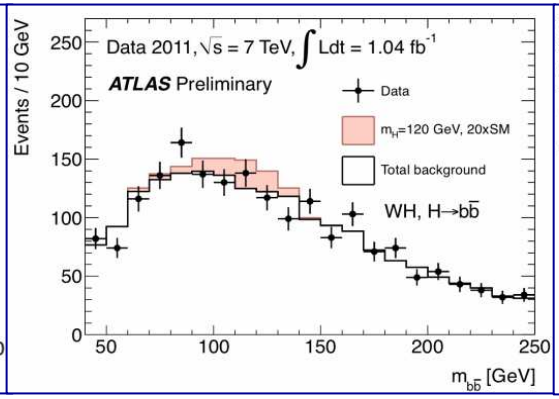
Cuts	Bham/Li	LMU	Glasgo	Dubna	Yao
Initial:	641361	641361	641361	641361	641361
HFor Rejection	554555	554555	554555	554555	554555
N_good leptons>0	194163	197121	197118	197121	179118
Trigger:	191143	194118	194117	194118	194117
Vertex:	191133	194108	194107	194108	194107
MET cleaning:	191133	194108	194107	194108	194107
Jet FEB:	189869	-	-	-	-
1 selected e or mu:	189866	-	194104	194104	194103
Lepton Veto:	189865	194102	194102	194102	194103
MT:	169629	173284	173282	173284	173278
MET:	139642	142583	142580	142583	142584
NJET=2 (abs(η)< 2.5):	2966	3040	3039	3040	3040
NBJET>=1	210	221	221	221	224
NBJET=2	11	11	11	11	11

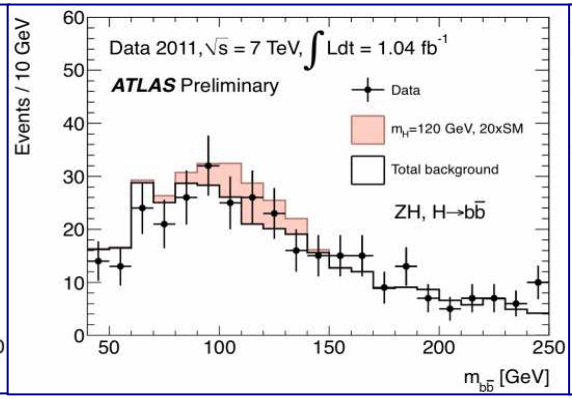


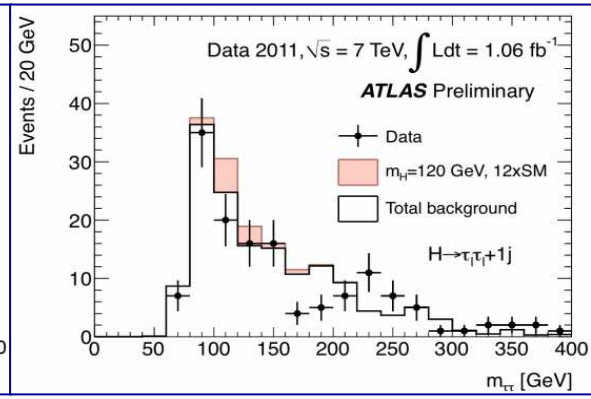
[12] F.Ahmadov et al, "Searches for a Standard Model Higgs boson decaying to a b-quark pair with the ATLAS detector at the LHC", ATL-COM-PHYS-2011-929,
also presented at School of Physics in Gomel, Belorussia, August, 2011.

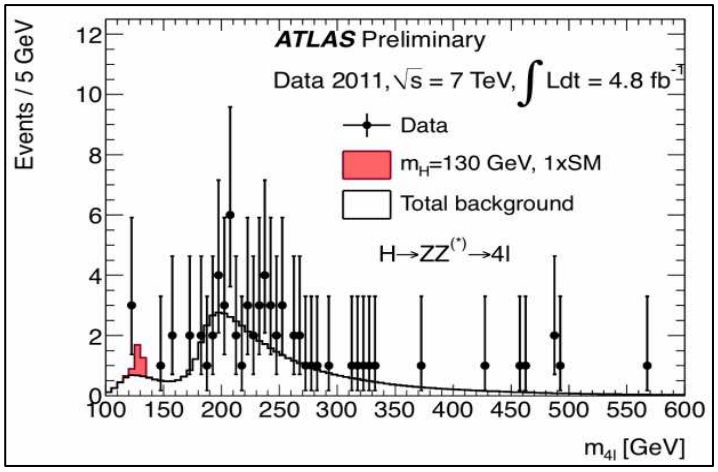
ATLAS Higgs searches:
11 distinctive channels in mass range 100-600 GeV

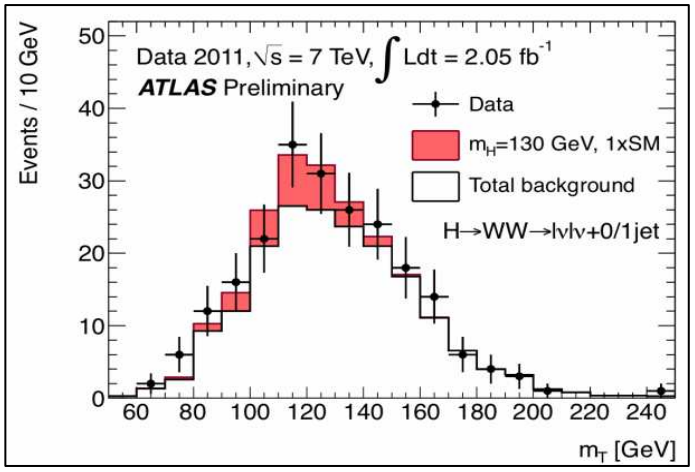


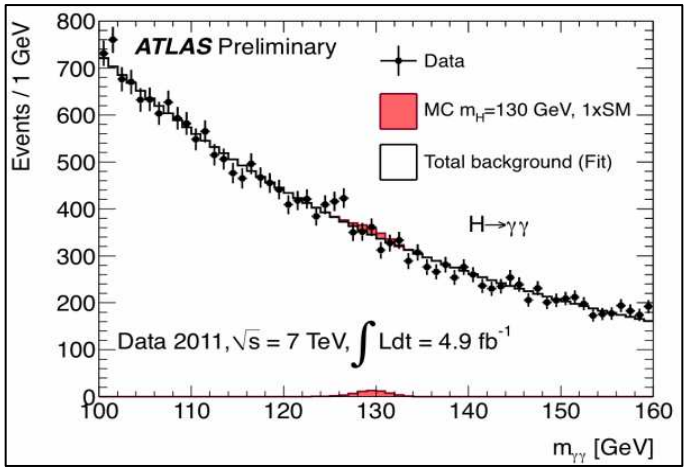


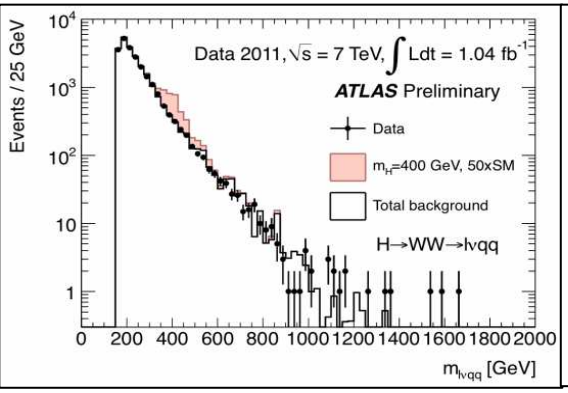


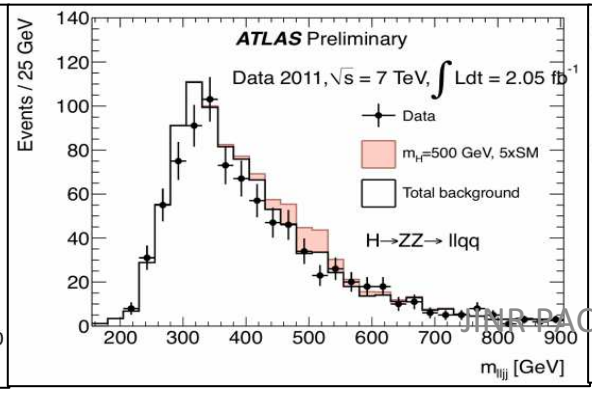


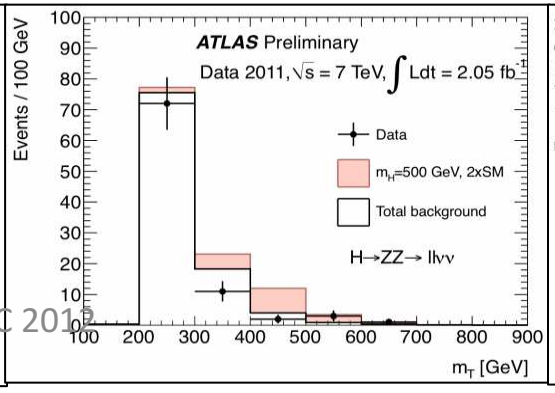


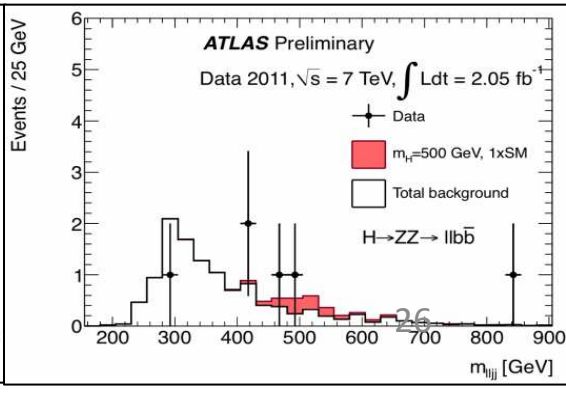








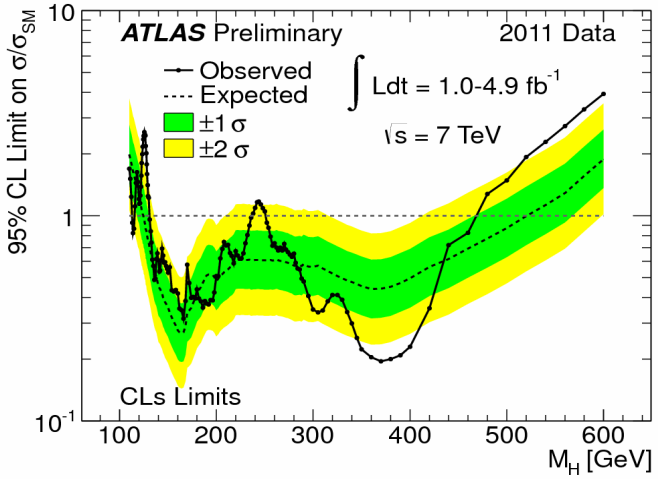




Micro-summary of present Higgs searches in ATLAS

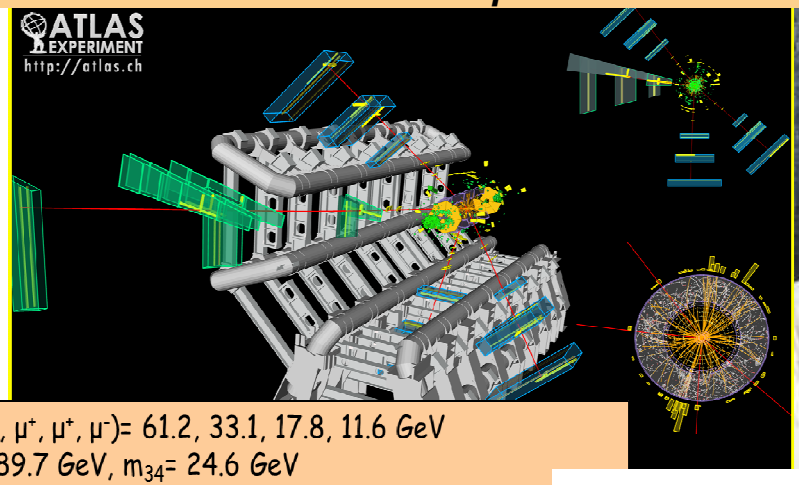
Channel	m_H range (GeV)	Int. lumi fb^{-1}	Main backgrounds	Number of signal events after cuts	S/B after cuts	Expected σ/σ_{SM} sensitivity
H→ γγ	110-150	4.9	γγ, γj, jj	~70	~0.02	1.6-2
H → ττ → ll+ν	110-140	1.1	Z→ ττ, top	~0.8	~0.02	30-60
H → ττ → lτ_{had}	100-150	1.1	Z→ ττ	~10	~5 10^{-3}	10-25
W/ZH → bbl(l)	110-130	1.1	W/Z+jets, top	~6	~5 10^{-3}	15-25
H →WW(*)→ lνlν	110-300	2.1	WW, top, Z+jet	~20 (130 GeV)	~0.3	0.3-8
H → ZZ(*) → 4l	110-600	4.8	ZZ*, top, Zbb	~2.5 (130 GeV)	~1.5	0.7-10
H→ ZZ → ll νν	200-600	2.1	ZZ, top, Z+jets	~20 (400 GeV)	~0.3	0.8-4
H→ ZZ → ll qq	200-600	2.1	Z+jets, top	2-20 (400 GeV)	0.05-0.5	2-6
H→ WW → lνqq	240-600	1.1	W+jets,top,jets	~45 (400 GeV)	10^{-3}	5-10

The combined upper limit on the SM Higgs boson production cross section divided by the SM expectation

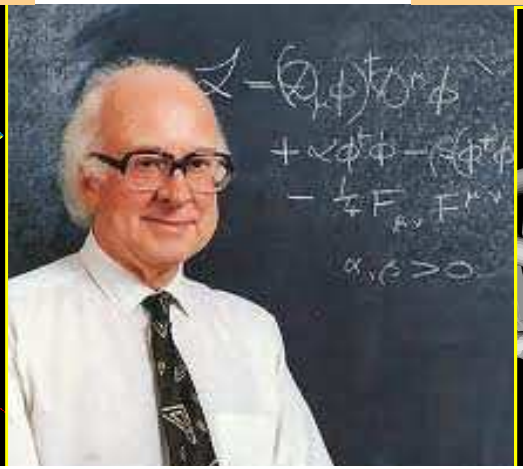


An excess of events is observed in the H → γγ and H → ZZ(*)→ $\ell^+\ell^-\ell^+\ell^-$ channels, at m_H close to 126 GeV, which is also supported by a broad excess in the H → WW(*)→ $\ell^+\nu\,\ell^-\nu$ channel. The combined local significance of these excesses is **3.6σ.** The expected local significance in the presence of a signal is **2.5σ**.

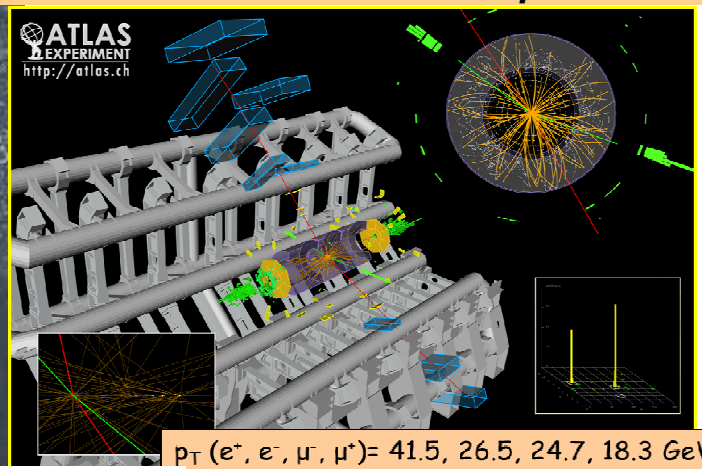
4μ candidate with $m_{4\mu}$= 124.6 GeV



p_T (μ^-, μ^+, μ^+, μ^-)= 61.2, 33.1, 17.8, 11.6 GeV
m_{12}= 89.7 GeV, m_{34}= 24.6 GeV



$2e2\mu$ candidate with $m_{2e2\mu}$= 124.3 GeV



p_T (e^+, e^-, μ^-, μ^+)= 41.5, 26.5, 24.7, 18.3 GeV
m(e^+e^-)= 76.8 GeV, m($\mu^+\mu^-$) = 45.7 GeV

At least one of three is Higgs for sure!

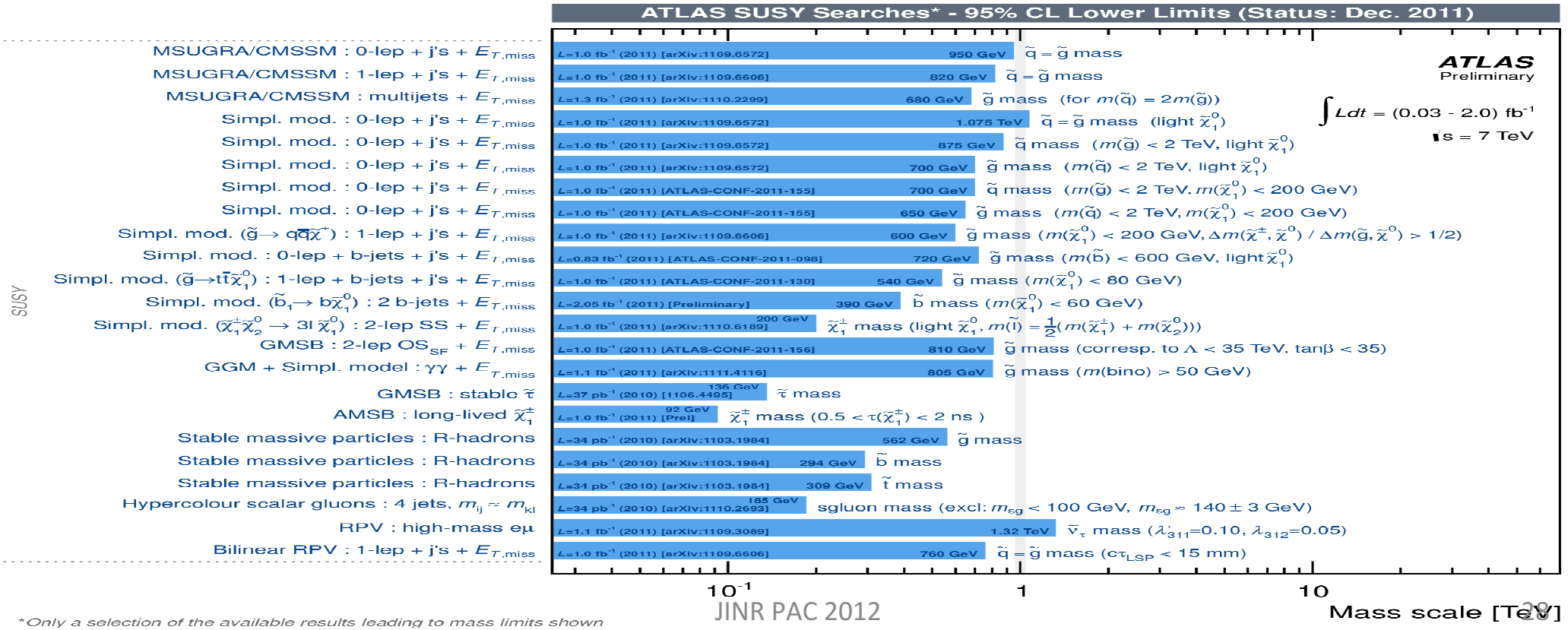
Mass reach of ATLAS searches for new phenomena (SUSY)

The JINR team proposal accepted by the ATLAS SUSY WG - to look at the final states with one charged lepton, neutrino and 6 or 8 hadronic jets:

$$pp \to \tilde{g}\tilde{g} \to 2\chi_1^0 + 1\ell + 1\nu + 6(8)\, j + X\,.$$

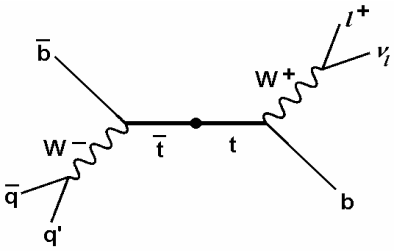
It was demonstrated that SUSY search in the EGRET-domain of the mSUGRA model could be preferable especially for heavy masses and increased LHC luminosity.

JINR leads the analysis of 2011 data (~5 fb^{-1}). The publication is expected in 2012.



*Only a selection of the available results leading to mass limits shown

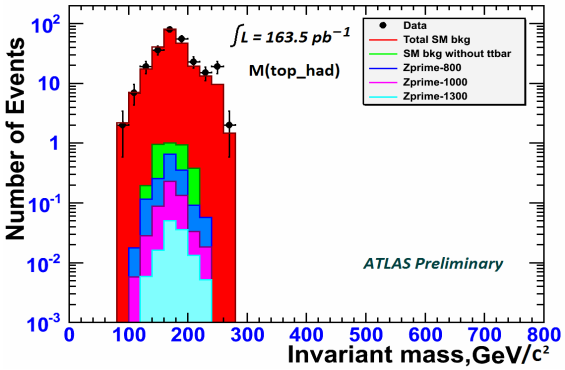
Search for heavy resonance decaying to *tt*-pair via *μ+2b-jets* final state



Signature of the lepton-jet decay mode

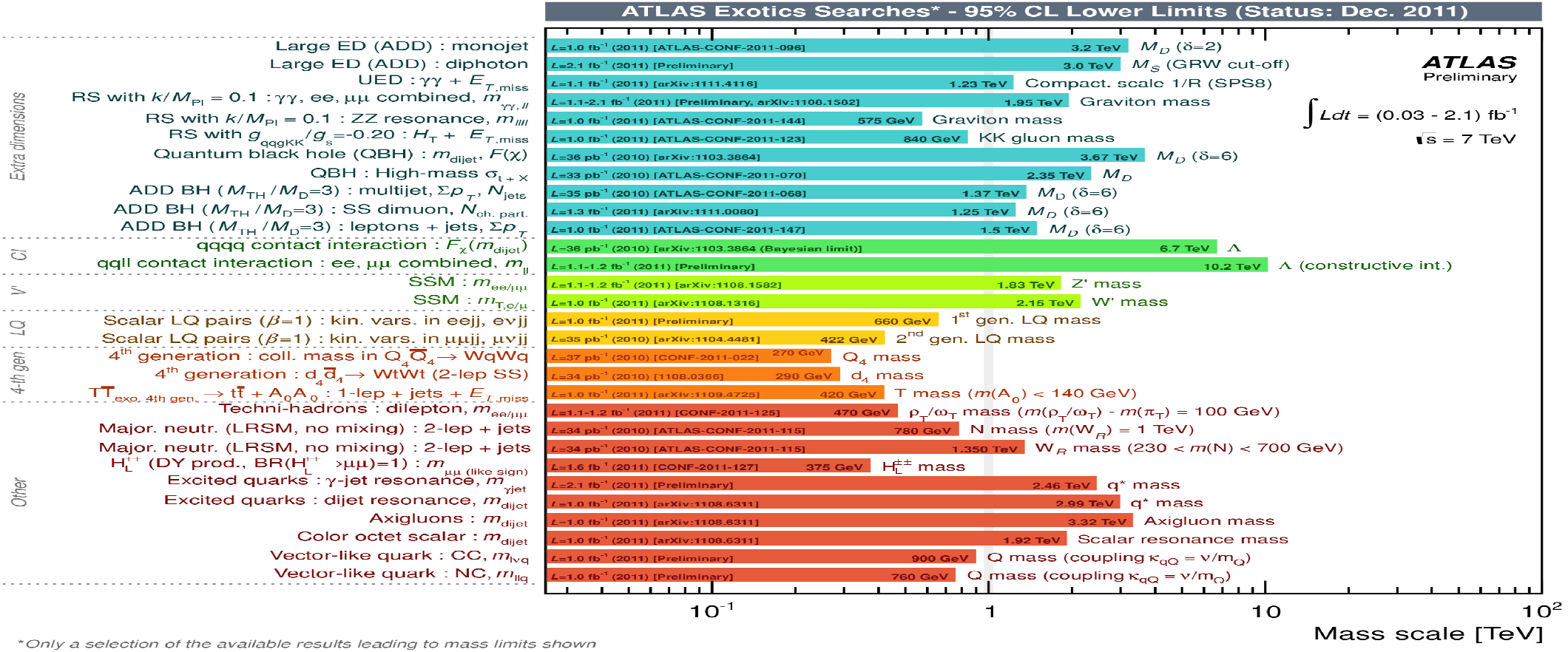
Z' →t t → 2b-jets +2jets + ℓ +ν.

No excess in the reconstructed invariant mass distribution of Z'-candidate was observed at L_{int}=163 pb^{-1}. Analysis is continuing for 5 fb^{-1} dataset.



[16] Z.M. Karpova, S.N. Karpov, E.V. Khramov, V.A. Bednyakov and N.A. Russakovich, Search for heavy resonance decaying into tt-pair via μ+2b-jets final state signature at the LHC energy of 7 TeV, December 7, 2011. ATLAS-COM-PHYS-2011-1688.

Mass reach of ATLAS searches for new phenomena (exotics)



*Only a selection of the available results leading to mass limits shown

ATLAS Upgrade Schedule

(we follow the LHC Upgrade schedule)

Possible upgrade timetable

$\int Ldt$

7 & 8 TeV

$2x10^{33}$ cm^{-2} s^{-1}

~ 3000 fb^{-1}

14 TeV

$1x10^{34}$ cm^{-2} s^{-1}

$2x10^{34}$ cm^{-2} s^{-1}

Phase-2

~ 300 fb^{-1}

- Inner tracker: Full replacement
- Trigger/DAQ: Major upgrades
- Muons: new forward chambers
- LAr calorimeters:
  - Electronics in barrel
  - New Forward Elements
- Tile calorimeters: Electronics

- Muons: new small wheel
- Trigger/DAQ: Moderate upgrades
- LAr: new readout electronics
- Other minor upgrades, e.g. TRT HV PS

Phase-1

~ 50 fb^{-1}

- Detector consolidation
- IBL
- LAr and Tile readout demonstrators

Phase-0

~ 10 fb^{-1}

(T.Kawamoto at TIPP-2011)

2013-2014 2018 ~2022 **Year**

ATLAS Upgrade (Phase 1)

… not too much has been changed since PAC meeting in June'2011 (more details of JINR participation in ATLAS Upgrade are in the backup slides)

LoI should be ready for the Collaboration approval by 03/02/2012

Table 11.1. CORE Cost table (2012-2018)

Project	Core cost (MCHF	Possible additio
New muon Small Wheels	9.20	0.14
New LAr Calorimeter	7.98	-
New Tile Calorimeter upgrade	0.38	-
Fast Tracker	3.59	-
Trigger and DAQ Upgrade	8.78	3.21
Forward Physics	2.70	-
Total (MCHF)	32.62	3.35

JINR involvements	Cost estimate (kUSD)
Muon system: - MM chambers	210
Tile calorimeter: - LVPS - FE-electronics	800
LAr calorimeter: - Cold electronics - Rad.tests at	440
Magnet system	400

JINR presence in ATLAS management

N. Rusakovich – member, ATLAS Executive Board
L. Gladilin – convener, hadronic decays WG for B-physics
A. Cheplakov – member, Advisory group for LAr calorimeter system Upgrade
I. Minashvili – coordinator, Tile calorimeter maintenance group
N. Zimin – member, ATLAS Magnet group

ATLAS Notes, publications, talks

- **100 ATLAS Collaboration publications based on experimental data**
- **JINR made a major contribution to ~20 Notes/papers**
- **6 talks were presented at the International Conferences**

G.Lykasov (PLHC-2011, Italy; MPI@LHC), V.Bednyakov, A.Cheplakov (Lomonosov-15), V.Kukhtin (Como'12, Italy), F.Ahmadov (Gomel, Belorussia)

A lot more presentations at the regular ATLAS WG meetings (weekly)

ATLAS group in JINR includes **10 PhD students**

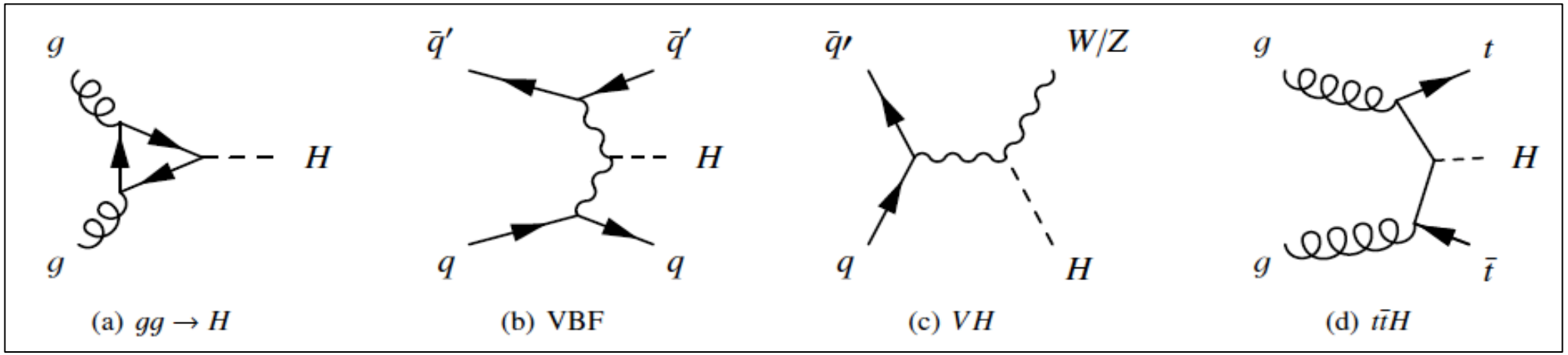
Conclusions

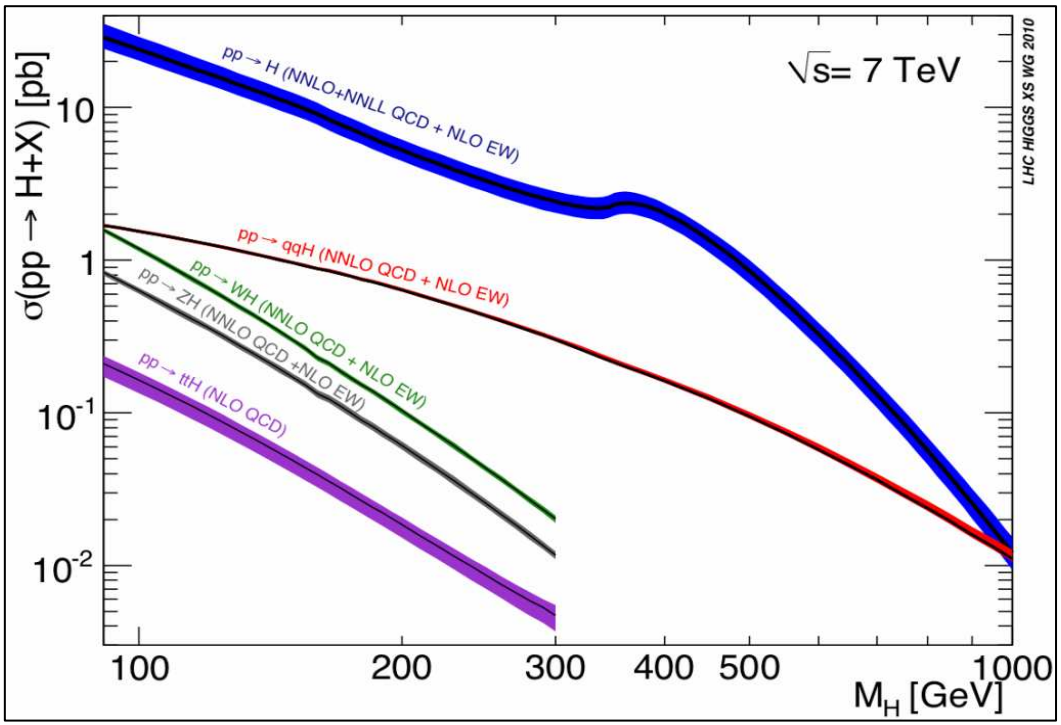
- **ATLAS detector is demonstrating an excellent and stable performance since 2009**
- **Many results were published and presented at the conferences**
- **Dubna participation in physics analysis is growing up**
- **ATLAS Upgrade project for HI-LHC is shaping up and is due to start later in 2012**

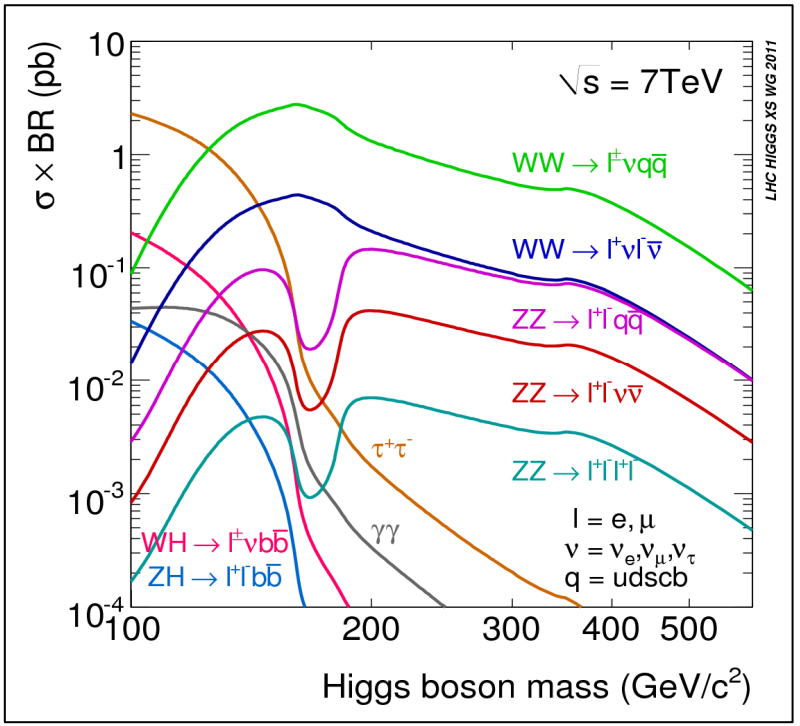
… more great news to come in 2012

Thank you!

Higgs boson searches in ATLAS





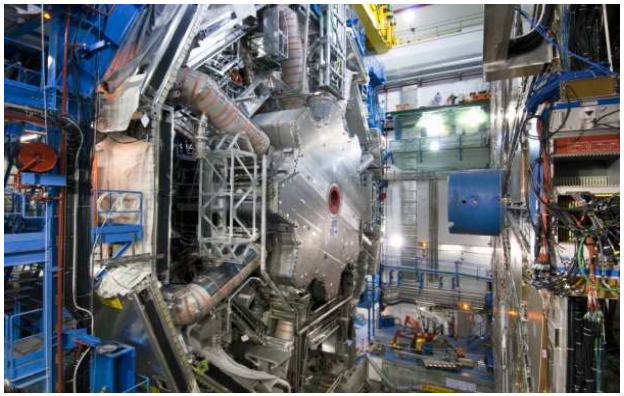


Magnet System Upgrade

"Since the start of ATLAS construction JINR has made a major contribution to realization and commissioning of this unique and world record size device, providing skilled manpower to the on-surface cold mass integration and underground installation of the toroidal magnets, as well as guidance of other important hardware produced in Russian Federation. Based on the success of the ATLAS-JINR collaboration we support other projects like the installation of safety valves on the LHC dipoles." (H.H.G. ten Kate - PL)

For the ATLAS Magnet System the repair and upgrade works up to the 2020 Technical Stop presently concern (list not exhaustive and may grow with the years):

- Improvement and modification of the 8 and 21 kA magnet bus bars system
- Modifications on the vacuum systems
- Installation of new forward muon chambers requiring rearrangements of the vacuum system pipe work
- Installation of a new buffer dewar for the Solenoid Proximity cryogenics to allow independent operation of solenoid and toroid
- Installation of second Helium storage dewar for the Toroid cryogenics
- A new Helium return line to the surface to shorten quench recovery time
- Modifications to the Toroids Axial Transfer Force system
- Modifications to cabling for upgrading the controls
- Installation of seismic brackets on the End Cap Toroids.



The works related to the LHC Splice Consolidation planned for 2013-2014 concern:

- Installation of new safety valves on dipole cryostats
- Opening and closing of the so-called magnet interconnects
- Modifications to various stand alone cryostats and structures.

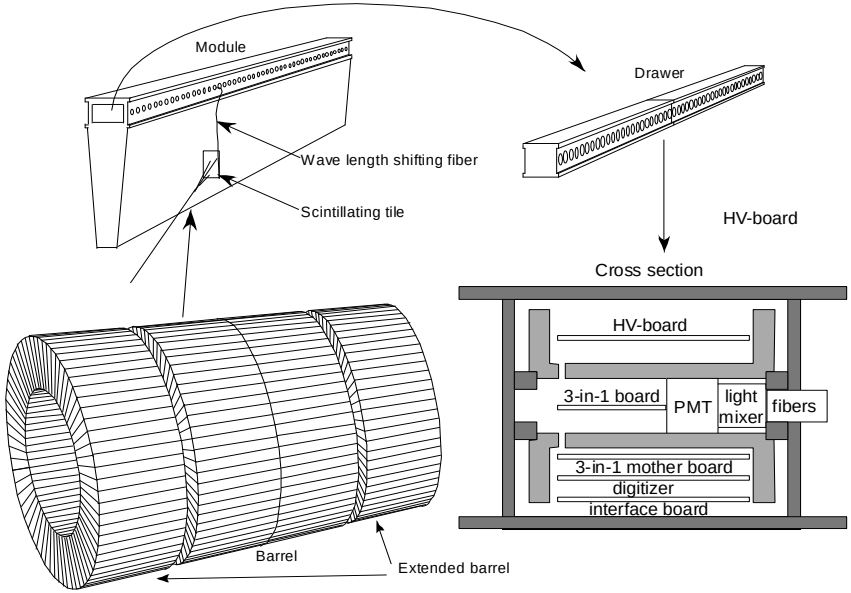
Requested resources:

- 1 man year per year
- associated costs for traveling and living in the CERN area
- cost is estimated at 75 kCHF per year
- a commitment for the next 4 years including full coverage of the 2013-2014 technical stop
- a reconsideration in 2015 to estimate the works for the period 2016-2020.

TileCal Upgrade Program

- **Drawer mechanics** – smaller size
- **PMT dividers** - better linearity
- **New Front-End electronics** -

  3-in-1 / ASIC / QIE designs
- **Main and Link boards**
- **High Voltage Power Supply for PMTs**
- **New LVPS**
- **Off-detector electronics**
- **System test slice using existing hardware and emulators (Stockholm)**



- **Demonstrator project**

Item	Time period	Manpower	Resources
Development, construction, testing of LVPS	**2011-2013**	**2-3man/year**	**150 k$**
Test-benches construction for new LVPS and electronics	**2011-2014**	**2-3man/year**	**400 k$**
Radiation tolerance tests of new electronics	**2012-2017**	**2-3man/year**	**300 k$**
Production/test of 4-5 drawers (new FE&ROD)	**2014-2018**	**2-3man/year**	**250 k$**
Final tuning/testing (in labs, test-beam) and installation	**2019-2023**	**3-4man/year**	**350 k$**

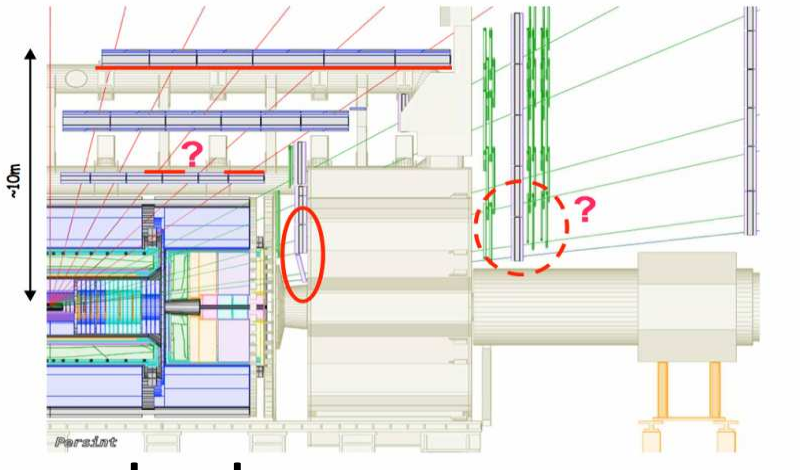
ATLAS Muon spectrometer Upgrade

- increase of background rate to ~10-20 kHz/cm^2

  at high η-regions

- all CSC chambers, some MDTs and some

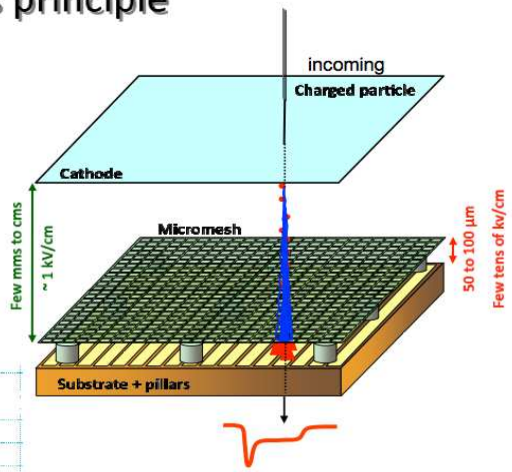
  TGCs (~ 150 m^2) should be replaced

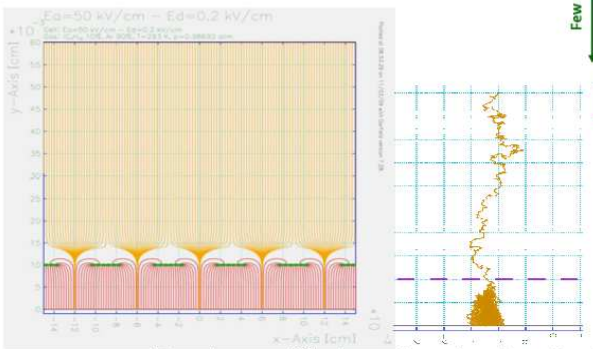


Since 2009 JINR Muon group is the member of MAMMA collaboration which has proposed Micromegas chambers

Micromegas principle

- Micro-Mesh Gaseous Structure
  G.Charpak, I. Giomataris et al., NIM-A 376 (1996) 29
- Micro-pattern readout
- Metallic mesh
- Conversion gap (~1kV/cm; from mm to cm -TPC !-)
- Amplification gap (~50 kV/cm; 50-100 μm)





Garfield simulation of field lines and avalanche in a Micromegas detector

Due to gas diffusion, almost no ions back in drift region.

Many advantages:

- ✓Easy to manufacture, robustness
- ✓Good ageing properties
- ✓Small size gap (50-100μm)
- ✓Fast signal (~10ns)
- ✓High rate capability (>MHz)
- ✓High gain (up to 10^5 or more)
- ✓Good time resolution (a few ns)
- ✓Good energy resolution (~18%)

- ✓Radiation hardness (25 mC/mm^2)
  - to be tested (Dubna has voluteered)

Muon Group Upgrade Plans

Short term (2011-2012) - **define which resistive Micromegas technology should be used for the upgrade.**

Mid term (2013-2014) - **installation of MM chamber during shutdown in 2013;**

- **radiation tests of resistive MM technology (to neutrons);**
- **ageing tests.**

Long term (2014-2018) - **production of MM chambers for 2 small wheels (100 m^2) to be replaced during the shutdown in 2017-2018**

Total cost estimation for 2012-2017 – 210 k$.

MM test set-up construction at JINR (2012-2013)	35 k$/year	70 k$
MM aging tests and assembling at JINR (2013-	10 k$/year	50 k$
Scientific contacts (2012-2017)	15 k$/year	90k$

HiLum ATLAS Endcap Project

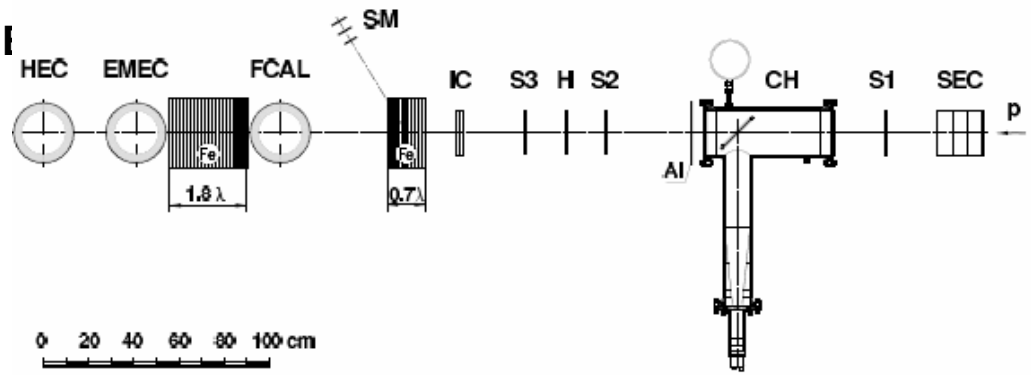
Collaboration of Arizona, Dresden, JINR Dubna, Kosice, Mainz, LPI Moscow, MPI Munich, BINP Novosibirsk, IHEP Protvino, TRIUMF, Wuppertal.

Goal: establish limitations on the operation of the endcap calorimeters at highest LHC luminosities

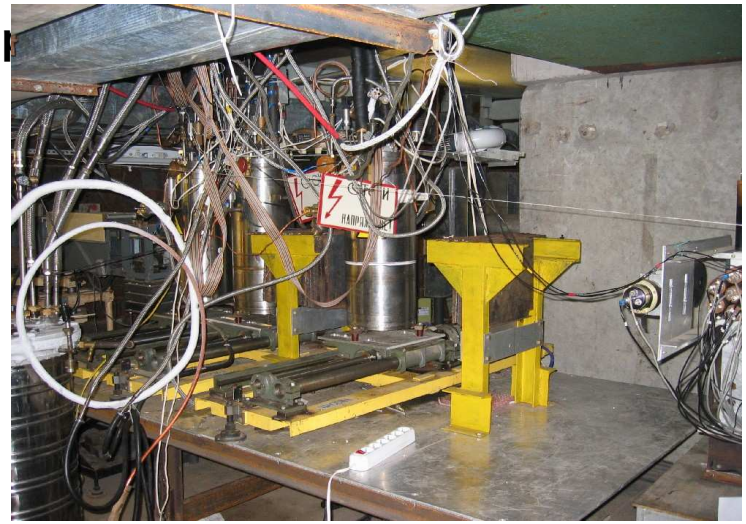
Critical issues:

- ion build in LAr gap;
- decreasing electric field, increasing recombination rate, distorting signal shape;
- heat impact (FCAL) at high |η|;
- increase of temperature up to 5° K ,
- bubbling of LAr → HV sparks;
- radiation hardness: fluence increase by factor 10 (→ IBR-2m in Dubna).

IHI



up to 10^{12} p



- ✓ each calorimeter module in a separate cryostat;
- ✓ absorbers: energy deposition as close as possible to η/longitudinal dependence in ATLAS (MC tuning!)!

IBR-2m for HI-LHC

- Widely used in 90s for irradiation tests of ALL components (including cold electronics immersed into the LAr cryostat) of ATLAS calorimeters.
- Successful collaboration work with MPI (Munich), Canadian Institutes, Arizona, Grenoble...
- Several NIM publications, JINR award...

No other place to go for future tests of ATLAS components:

- **$3 \cdot 10^{17}$ n cm^{-2} in two weeks time;**
- **20cm x 40cm direct beam aperture.**

List-to-do: shielding, Ge-detector (from Collaboration?), frame extention, remote manipulator, cryogenics

Cost estimate : 4-5 man/year & 200k$ in 2011-12 for infrastructure