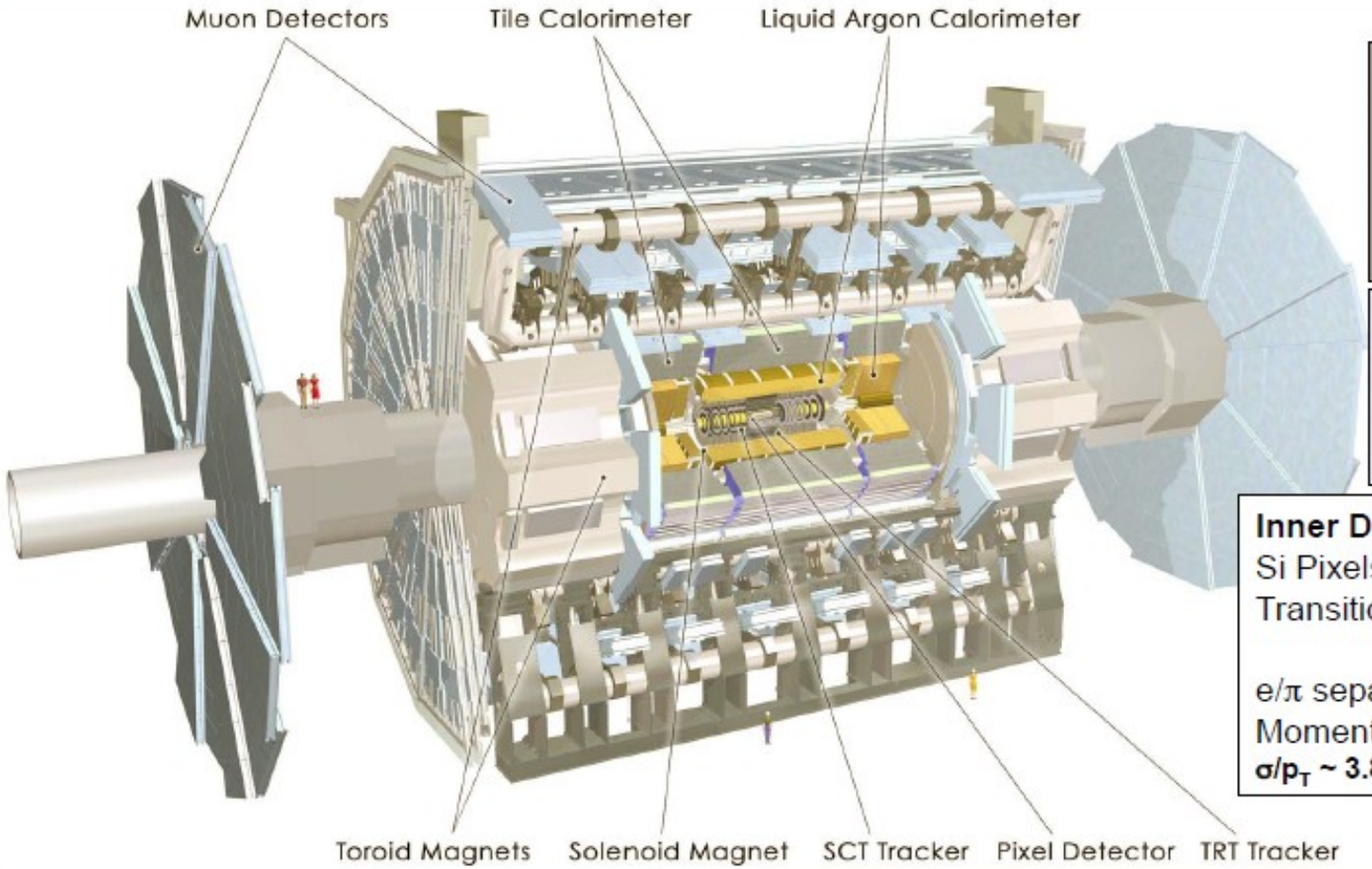
JINR participation in the ATLAS experiment at the LHC

V.A.Bednyakov
(on behalf of JINR ATLAS group)

JINR SC-110, 15.09.2011

The ATLAS detector is the big one

Muon Spectrometer ($|\eta|<2.7$) : air-core toroids with gas-based muon chambers
Muon trigger and measurement with $\Delta p/p < 10\%$ up to $E_\mu \sim 1$ TeV



Length : ~ 46 m
Radius : ~ 12 m
Weight : ~ 7000 tons
~10^8 elec. channels
3000 km of cables

3-level trigger reducing the rate from 40 MHz to ~200 Hz

Inner Detector ($|\eta|<2.5$, B=2T):
Si Pixels, Si strips,
Transition Rad. Tracker

e/π separation
Momentum resolution:
$\sigma/p_T \sim 3.8\times10^{-4}\ p_T\,(\text{GeV}) \oplus 0.015$

EM calorimeter: Pb-LAr Accordion
e/γ trigger, identification and measurement
E-resolution: $\sigma/E \sim 10\%/\sqrt{E}$

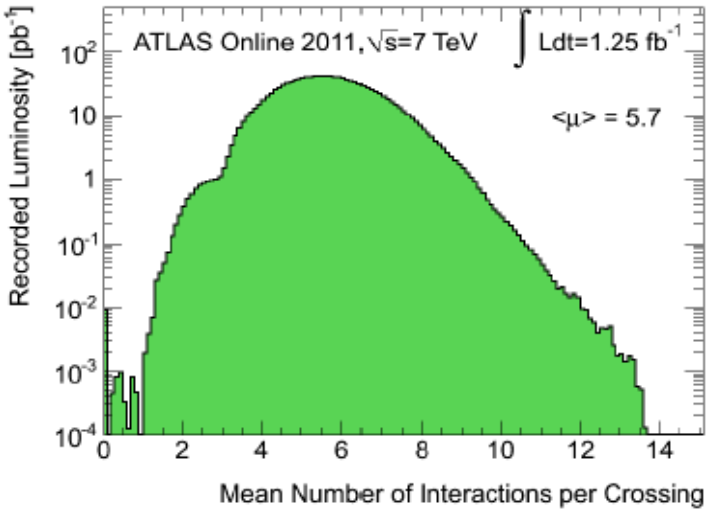
HAD calorimetry ($|\eta|<5$): segmentation, hermeticity
Fe/scintillator Tiles (central), Cu/W-LAr (fwd)
Trigger and measurement of jets and missing E_T
E-resolution: $\sigma/E \sim 50\%/\sqrt{E} \oplus 0.03$

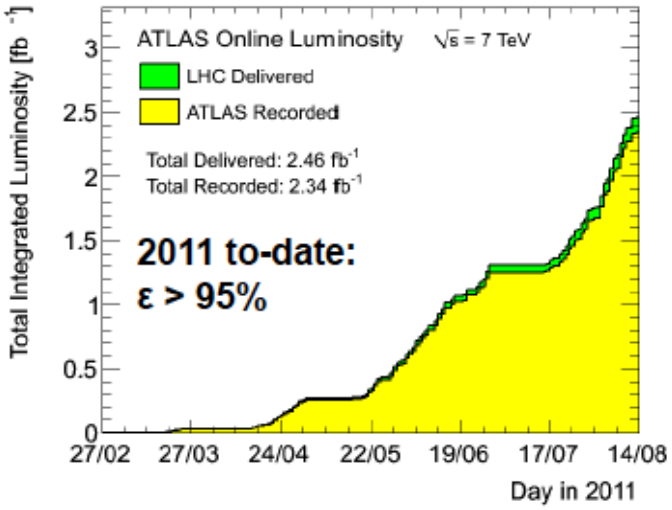
The ATLAS detector works very good !

Subdetector	#Channels	Approx. Operational Fraction
Pixels	80 M	96.9%
SCT Silicon Strips	6.3 M	99.1%
TRT Transition Radiation Tracker	350 k	97.5%
LAr EM Calorimeter	170 k	99.5%
Tile calorimeter	9800	97.9%
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	99.5%
LVL1 Muon TGC trigger	320 k	100%
MDT Muon Drift Tubes	350 k	99.8%
CSC Cathode Strip Chambers	31 k	98.5%
RPC Barrel Muon Chambers	370 k	97.0%
TGC Endcap Muon Chambers	320 k	98.4%

ATLAS is running smoothly with > 95% data taking efficiency. Recorded physics rate is 300Hz. The first 1/fb of data was recorded by June 17th. Already it has 2/fb.
It will be 3/fb very soon!

Good data taking efficiency (96.6%)





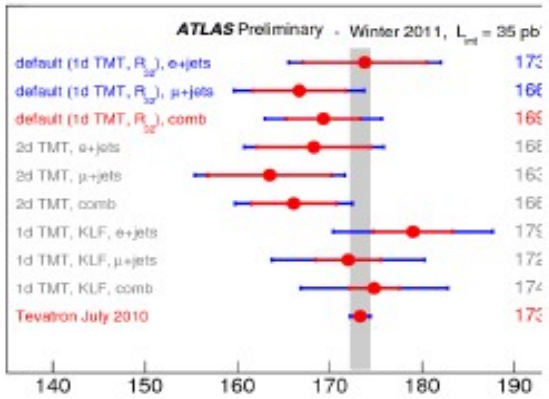
Just example of ATLAS physics topics

ATLAS physicists have presented 25 reports at "Physics at LHC 2011", Perugia, 6-11 June 2011

- EWK-diboson production in ATLAS
- Results from lead-lead collisions at sqrt(s_NN)=2.76 TeV with ATLAS at the LHC
- Vector Boson production in ATLAS
- ATLAS measurement of particle multiplicities and correlations
- Multijet and the internal structure of jets measurement in ATLAS
- Diffraction and the inelastic cross section measurement with ATLAS
- Recent EVK results from ATLAS
- Recent hard QCD results from ATLAS
- Top results from ATLAS
- Quarkonium production at ATLAS
- Jet production in association with vector bosons at ATLAS
- Top quark pair production cross section measurement in the single lepton and di-lepton channels with ATLAS
- Search for single Top-Quark production with the ATLAS detector in pp collisions at sqrt(s) = 7 TeV
- Top quark property measurements at ATLAS
- Recent Higgs results from ATLAS
- Recent results from new Physics searches in ATLAS
- ATLAS Higgs results
- Overview of the ATLAS Supersymmetry searches with 2010 LHC data
- Searches for new particles decaying into jet pairs in 2011 ATLAS data
- Search for Susy in Jets plus missing transverse momentum final states with the ATLAS detector
- Search for Susy in lepton jets and missing transverse momentum fianl states at ATLAS
- Search for new Heavy Gauge Bosons in 2011 ATLAS data
- Search for Ttbar resonances in 2011 ATLAS data
- Jet production measurement with the ATLAS detector

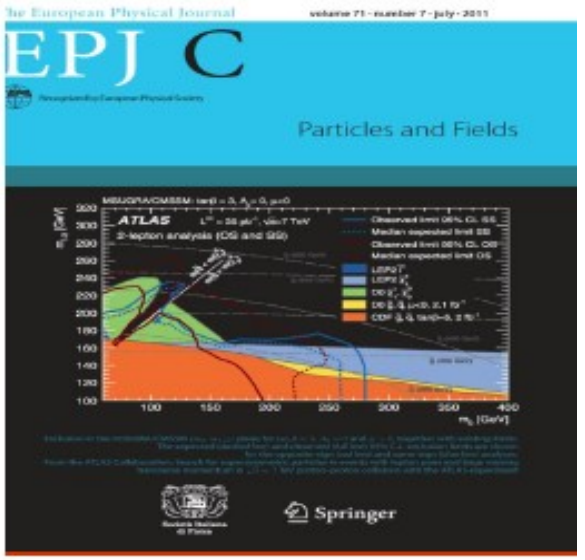
http://indico.cern.ch/conferenceOtherViews.py?view=standard&confId=100963

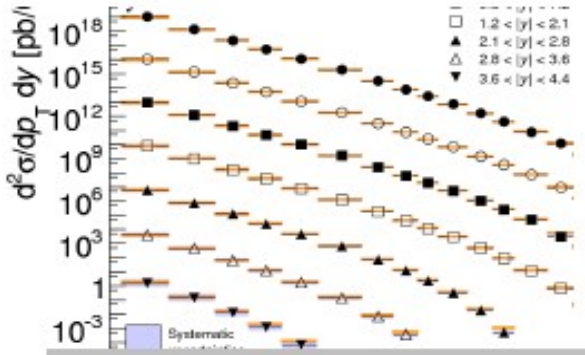
Another view on ATLAS physics topics



ATLAS Publications

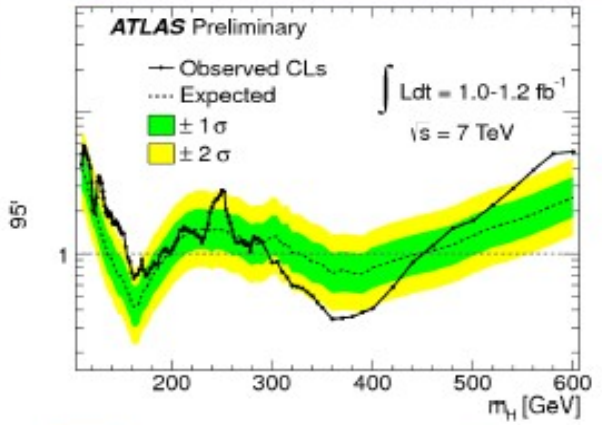
47 journal papers
> 200 conference notes

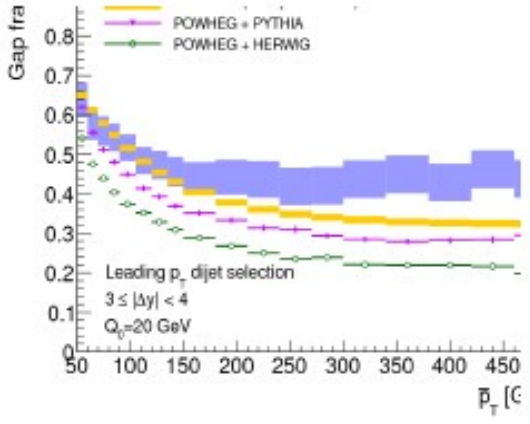


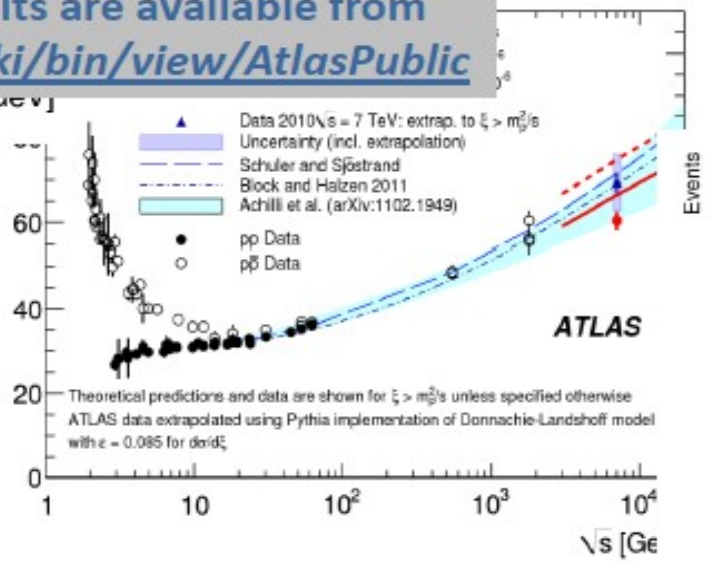


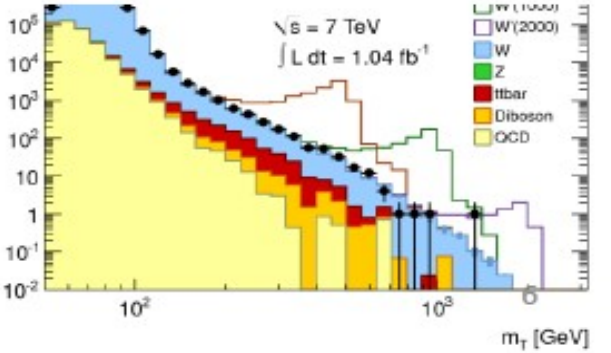
Minimum bias, Jets, W, Z, Prompt photons, Di-bosons, Top quark, B physics, Higgs, Super-symmetry, Exotics, Heavy Ions

NB: the ATLAS public results are available from
https://twiki.cern.ch/twiki/bin/view/AtlasPublic









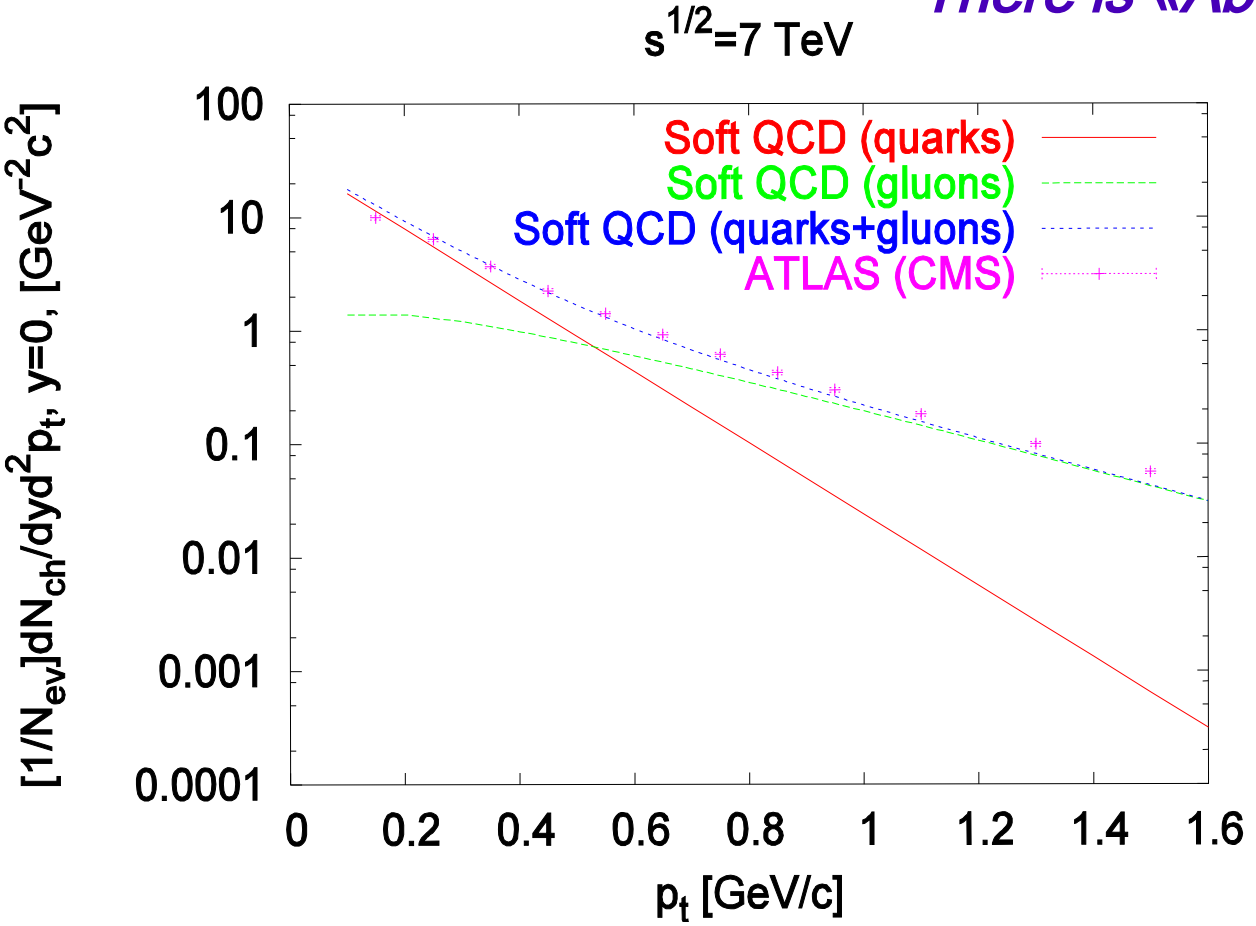
JINR in ATLAS Physics

Some examples of our recent results:

1. ***New gluon PDF for LHC energies***
2. ***Excited chiral vector boson search***
3. ***5Q-state search***
4. ***Ultra-peripheral HI collisions***
5. ***Other activities (ρ-meson, tt-resonance, heavy and charged Higgses, SUSY, heavy baryons, etc)***

Gluon PDF for the LHC physics

There is «Above ATLAS and CMS» physics



SQCD (quarks) - Dual Parton Model (DPM) without the gluon inclusion.

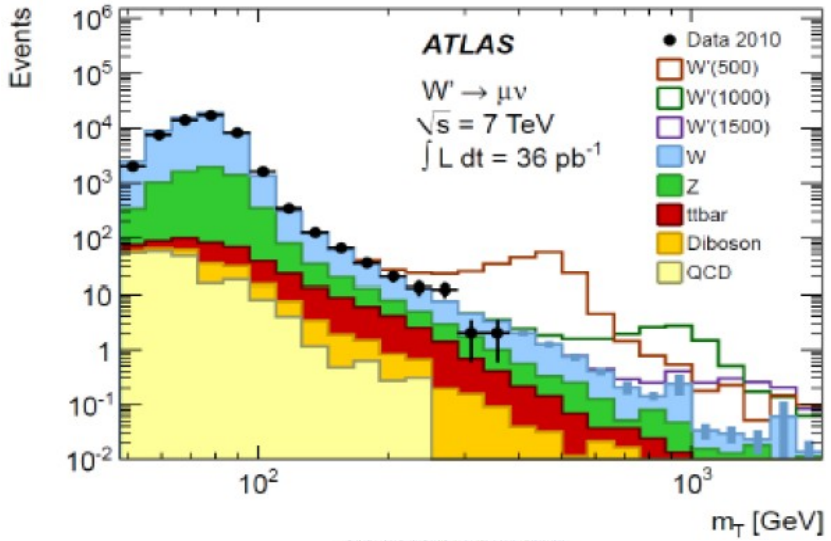
SQCD (gluons) - DPM including the emission of soft gluons and the QCD saturation effect for the gluon density.

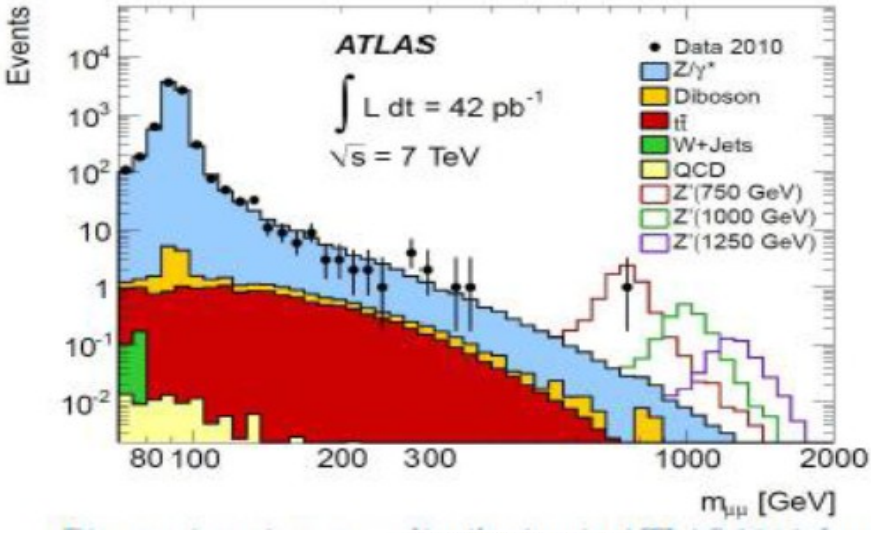
V.A.Bednyakov, A.A.Grinyuk, **G.I.Lykasov,** M.G.Poghosyan, Hep-ph/1104.0532 (2011) (talk given at the PLHC-2011)

Gluon PDF (unintegrated) **are modified at low intrinsic transverse momenta. It allows satisfactory description of the inclusive spectra of charged hadrons produced in central pp-collisions both at low p_t (SQCD) and large p_t momenta (perturbative QCD).**

Chiral extra vector bosons

For the first time a search for **chiral vector W*- and Z*-bosons** was carried out at the LHC. The inclusive high-mass lepton pairs production **(pp→W*/Z*X→ℓℓ'X)** was studied by JINR-ATLAS people (together with PINP) and unique low mass limits were obtained (and published): **1.15 TeV for W* and 1.35 TeV for Z*-boson**.





Physics Letters B 701 (2011) 50–69

Contents lists available at ScienceDirect

Physics Letters B

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Search for high-mass states with one lepton plus missing transverse momentum in proton–proton collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector ☆

ATLAS Collaboration *

Physics Letters B 700 (2011) 163–180

Contents lists available at ScienceDirect

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Search for high mass dilepton resonances in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS experiment ☆

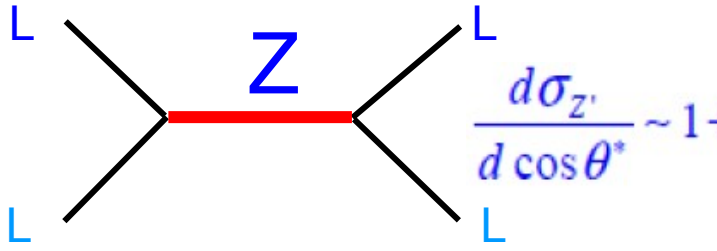
ATLAS Collaboration *

Chiral extra vector bosons

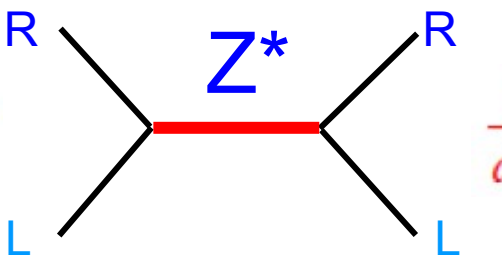
The idea of the chiral vector bosons was born in Dubna (M.Chizhov), it was proposed for ATLAS, it was accepted by the collaboration and it was realized under leadership of JINR physicists. There is no relavant investigation in other LHC experiments.

There are different classes of theories (String and GUT, alternative EW-breaking, exitation in ED and technicolor) all motivated by the hierarchy problem, which predict these new vector extra bosons (weak-doublets) with masses not far from the electroweak scale.

These bosons have new unique property — they **change chirality** during interaction with matter, and have **another angular** distributions.



$$\frac{d\sigma_{Z'}}{d\cos\theta^*} \sim 1 + ASYM \cdot \cos\theta^* + \cos^2\theta^*$$

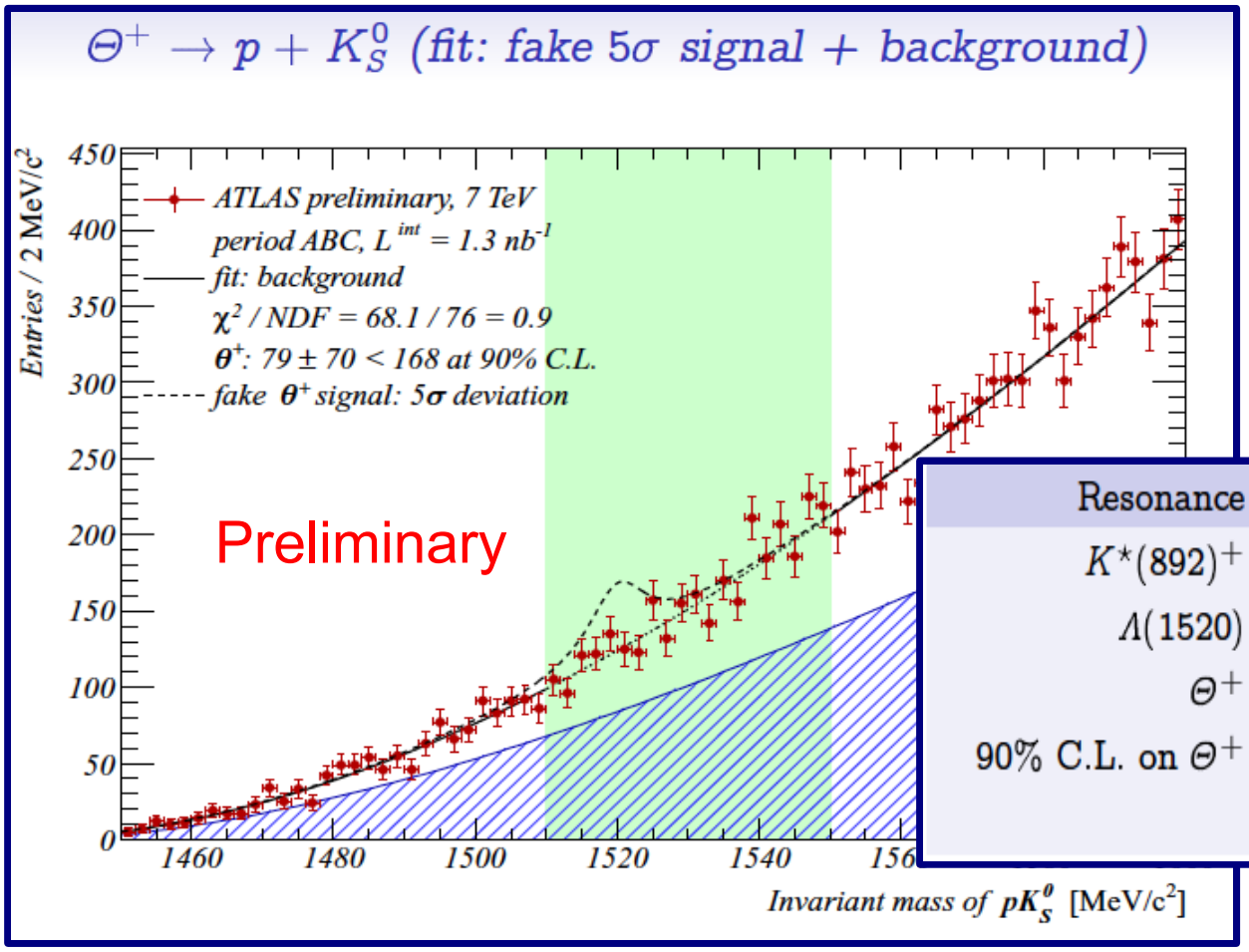


$$\frac{d\sigma_{Z^*}}{d\cos\theta^*} \sim \cos^2\theta^*$$

$$L_I^{Z^*} \sim \bar{f}\sigma^{\mu\nu} f\left(\partial_\mu Z_\nu^* - \partial_\nu Z_\mu^*\right)$$

• M. V. Chizhov, V. A. Bednyakov and J. A. Budagov, Proposal for chiral bosons search at LHC via their unique new signature, Phys. Atom. Nucl. **71** (2008) 2096

Search for exotic 5Q Θ-baryon



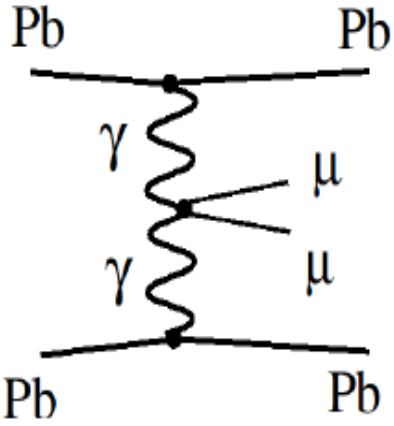
Resonance	ATLAS	CDF
$K^*(892)^+$	150012 ± 4010	15695 ± 775
$\Lambda(1520)$	45938 ± 2519	3276 ± 327
Θ^+	79 ± 70	18 ± 56
90% C.L. on Θ^+	< 168	< 89
	$< 0.4\% \times \Lambda(1520)$	$< 2.7\% \times \Lambda(1520)$

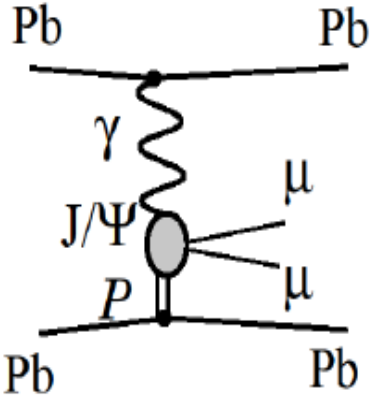
Large sample of about 90 million of minimum-bias events corresponding to 1.3/nb integral luminosity has been analyzed. Clear signals from known narrow resonances K*(892), Φ(1020), Λ and Λ (1520) were observed. No indication on 5Q state Θ+ in pK mass spectrum was found. (ATL-COM-PHYS-2011-420).

Muons in Ultra peripheral collisions

The ultraperipheral ($\gamma\gamma$ and γP) interactions with muon pairs in the final state have been observed with the data, taken by the ATLAS experiment during LHC Pb-Pb runs at beam energy of 2.75 TeV per nucleon and corresponding to an integrated luminosity of 7.9 μb^{-1}.

pure electromagnetic $\gamma\gamma$ and photonuclear reactions





Preliminary

cross sections of $AA \rightarrow AA + \mu^+\mu^-$ reactions were found to be $2.1 \pm 0.1(stat) \pm 0.3(syst)$ mb for muon pair continuum production and $1.2 \pm 0.3(stat) \pm 0.3(syst)$ mb for J/ψ photoproduction.

Conference note based on ATLAS-COM-PHYS-2011-461 is under discussion.

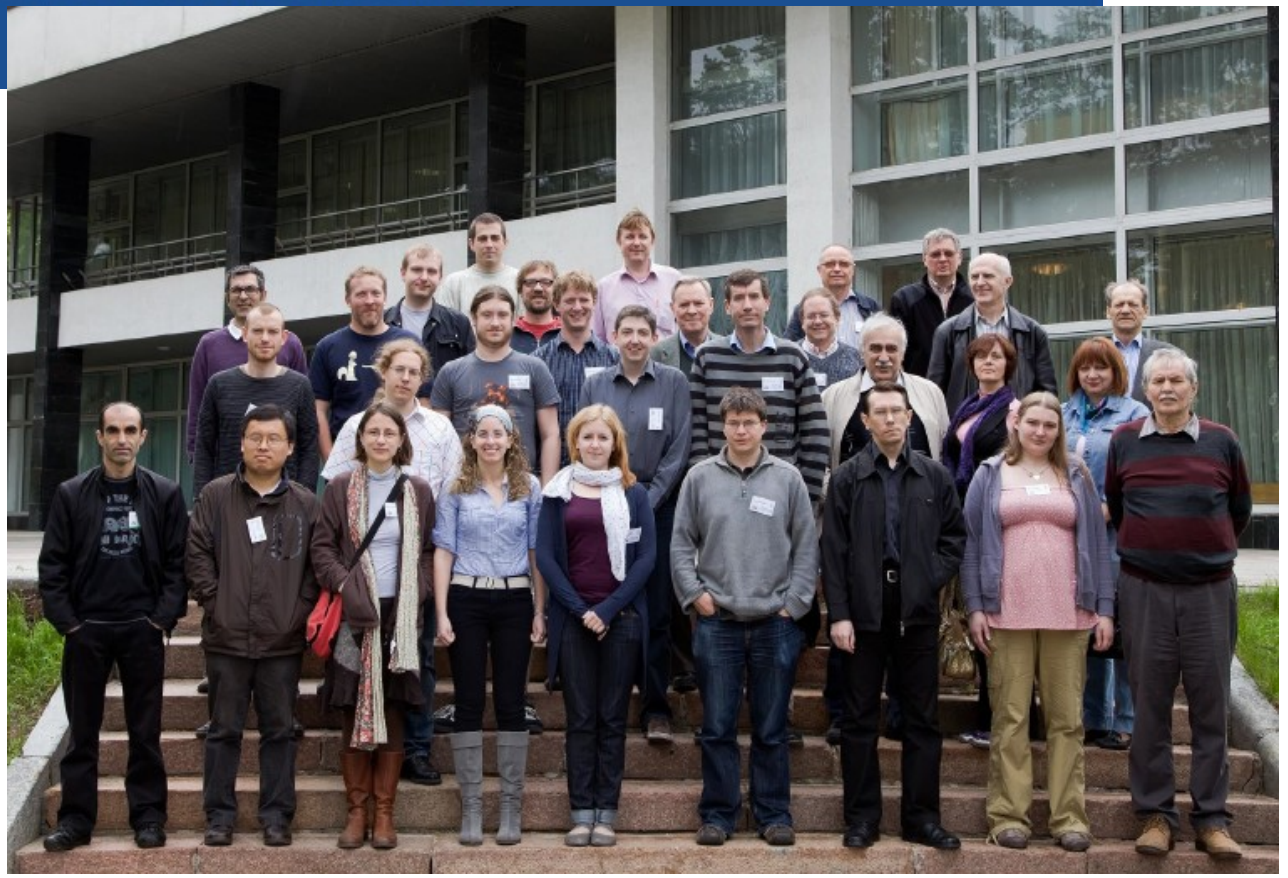
Other ATLAS activities at JINR

Two ATLAS meetings in Dubna

ATLAS HSG5 Meeting at JINR (Dubna)

from Tuesday 17 May 2011 at **09:00** to Thursday 19 May 2011 at **18:30** (Europe/Moscow)
at JINR (Dubna)

This is the SECOND meeting of HGS5 ATLAS WG in Dubna. It was very successful and useful for our team.



ATLAS Computing Technical Interchange Meeting

from Tuesday 31 May 2011 at **08:00** to Thursday 02 June 2011 at **18:00** (Europe/Moscow)
at Joint Institute For Nuclear Research (Dubna)

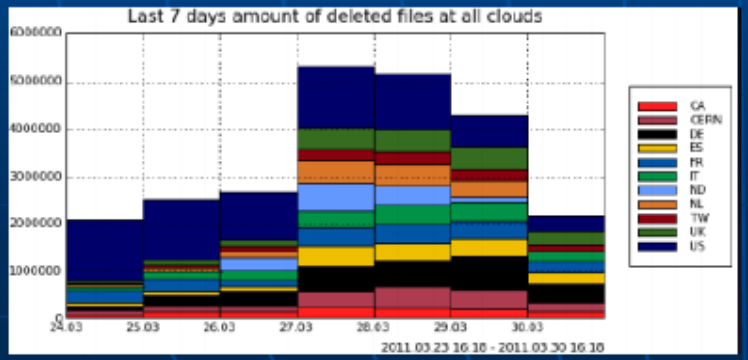
Material | Conference Fee | Original invitation | TIM_arrivalinfo | Transfer Info | Visa info

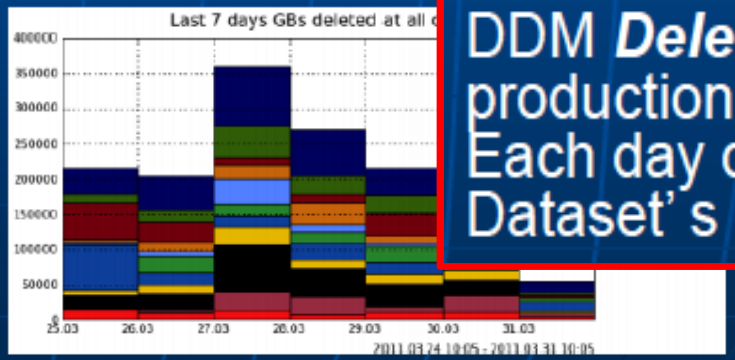
Thanks to LIT and V.V.Korenkov

JINR in Deletion service.
(ATLAS Computing TIM)

ATLAS DQ2 Deletion service

- During the 2010 year the works on development of the deletion service for ATLAS Distributed Data Management (DDM) system were performed
- Works started at the middle of April 2010. At the end August new version of Deletion Service was tested for set of sites and from November of 2010 for all sites managed by DQ2
- Development comprises the building of new interfaces between parts of deletion service (based on the web service technology), creating new database schema, rebuilding the deletion service core part, development of extended interfaces with mass storage systems and extension of the deletion monitoring system.
- Deletion service maintained by JINR specialists.





Results: new version of ATLAS DDM ***Deletion service*** is in production from November 2010. Each day deleted more 1 mln. Dataset's (300 TB).

Tier 3 JINR monitoring.
(ATLAS Computing TIM)

Tier 3 sites monitoring project

- Tier-3 sites consist of resources mostly dedicated for the data analysis by the geographically close or local scientific groups. Set of Tier 3 sites can be joined to federation.
- Many Institutes and National Communities built (or have plans to build) Tier-3 facilities. Tier-3 sites comprise a range of architectures and many do not possess Grid middleware, which would render application of Grid monitoring systems useless.
- Joined effort of ATLAS, JINR and CERN IT (ES group)
- Hopefully outcome of this work can be in future shared with other consumers
- **Objectives for Tier3 monitoring**
  - Monitoring of Tier 3 site.
  - Monitoring of Tier 3 sites federation.
- **Monitoring of Tier 3 site**
  - Detailed monitoring of the local fabric (overall cluster or clusters monitoring, monitoring each individual node in the cluster, network utilization)
  - Monitoring of the batch system.
  - Monitoring of the mass storage system (total and available space, number of connections, I/O performance)
  - Monitoring of VO computing activities at a site
- **Monitoring of Tier 3 sites federation**
  - Monitoring of the VO usage of the Tier3 resources in terms of data transfer and job processing and the quality of the provided service based on the job processing and data transfer monitoring metrics.

T.Strizh (LIT, JINR)

JINR Team monitors Infrastructure, loading, data transfer, data access, jobs ...

Remote access in JINR.
(ATLAS Computing TIM)

System of remote access in real time (SRART) for monitoring and quality assessment of data from the ATLAS at JINR

One of the most significant results of the team TDAQ ATLAS at LIT during the last few years was the participation in the development of the project TDAQ ATLAS at CERN. The system of remote access in real time (SRART) **for monitoring and quality assessment of data from the ATLAS at JINR was put in operation.**

At present the system of remote access in real time is debugged on real data of the ATLAS experiment.

T.Strizh (LIT, JINR)

Thanks to LIT

Discussions of ATLAS physics run permanently at JINR

JINR ATLAS Physics Weekly Meeting

chaired by *Vadim Bednyakov (JINR)*

Tuesday 06 September 2011 from **16:00** to **18:00** (Europe/Moscow)
at DNLP (Conf. Hall)

Participants Vadim Bednyakov; Nazim Huseynov; Tatiana Lyubushkina; Valeri Pozdnyakov

Tuesday 06 September 2011

16:00 - 16:20 Поиск Z* в димюонном канале в данных ATLAS 2011 года *20'*
Speakers: Ivan Eleckih (*JINR*)
Material: slides

16:20 - 16:50 Rho-meson studies 30' *30'*
Speakers: Eugeny Khramov
Material: slides

JINR in ATLAS Upgrade

In particular it concerns:

1. ***Magnets***
2. ***TileCal***
3. ***Muon Spectrometer***
4. ***LAr EndCap***
5. ***IBR-2M tests, etc***

Motivation of an Upgrade

- Not only ageing and radiation limits of the detector and the machine elements
- Also new physics:
  - SUSY discovery and parameters
  - extra dimensions and compositeness
  - Higgs coupling
  - Vector boson fusion at ~1 TeV …

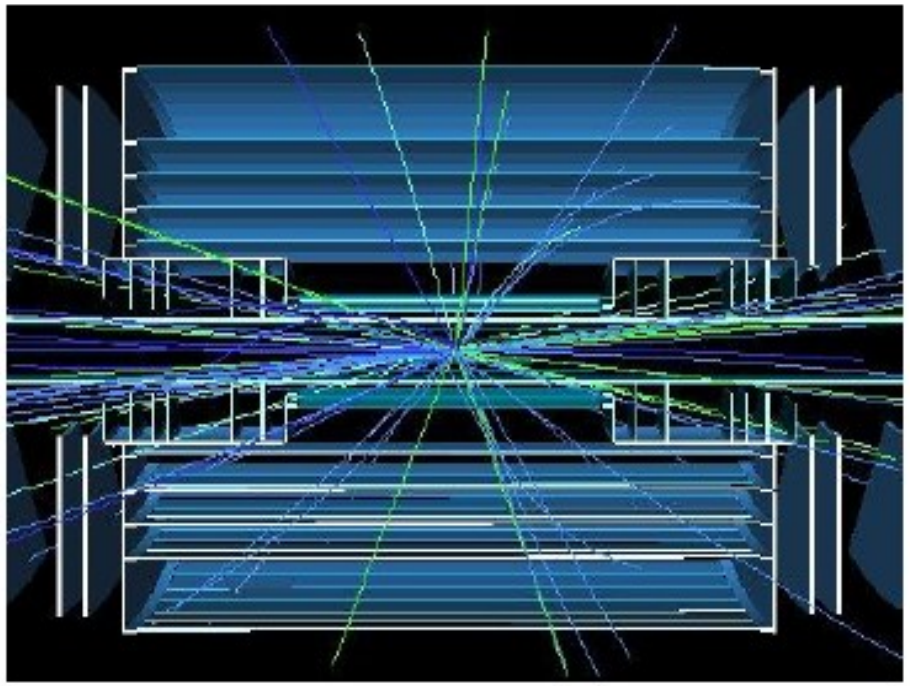
…and much more!

From the ATLAS Upgrade Steering group:

"To achieve the physics potential at HI-LHC the detector performance must be as at LHC, despite the large increase in event rate"

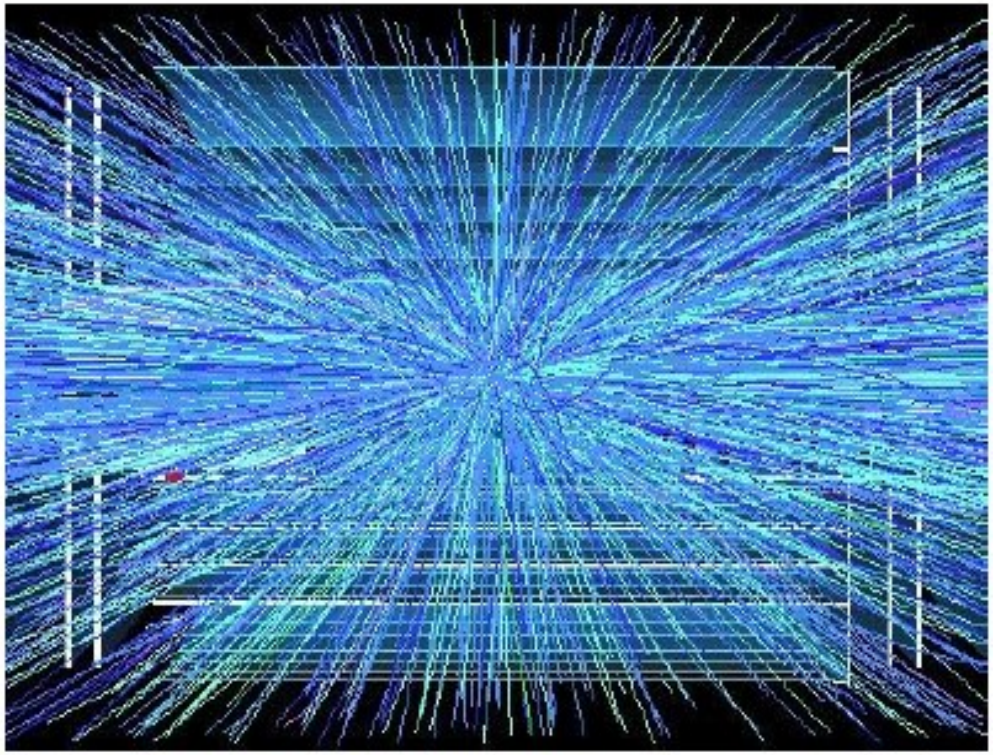
… not that easy

Pile-up Challenge



5 collisions ($L \sim 0.2 \times 10^{34}\ cm^{-2}s^{-1}$)

400 collisions ($L \sim 10 \times 10^{34} cm^{-2}s^{-1}$)



(Plots from Abdel Abdesselam, June 2010)

LHC Upgrades

The plans for increasing the integrated luminosity of the LHC beyond its nominal parameters are well under way. The first upgrade (2013) is based on improvement of the collimation system (today ~0.2 I_{norm}, allows only 40%@ 7TeV), probably the most limiting factor at present**. This will allow to reach and to pass the nominal 10^{34} cm^{-2} s^{-1}. Other improvements (2016) in the injector chain** (Linac4, PSB at 2 GeV, SPS upgrade) **and in the LHC ring** (a new cryo-plant for cooling of SC RF cavities, removal of radiation limitation in electronic equipment, etc.) **should be able to bring us around 1.7-2 10^{34} cm^{-2}s^{-1}. Then, in the longer term (beyond 2016) a major upgrade involving:**

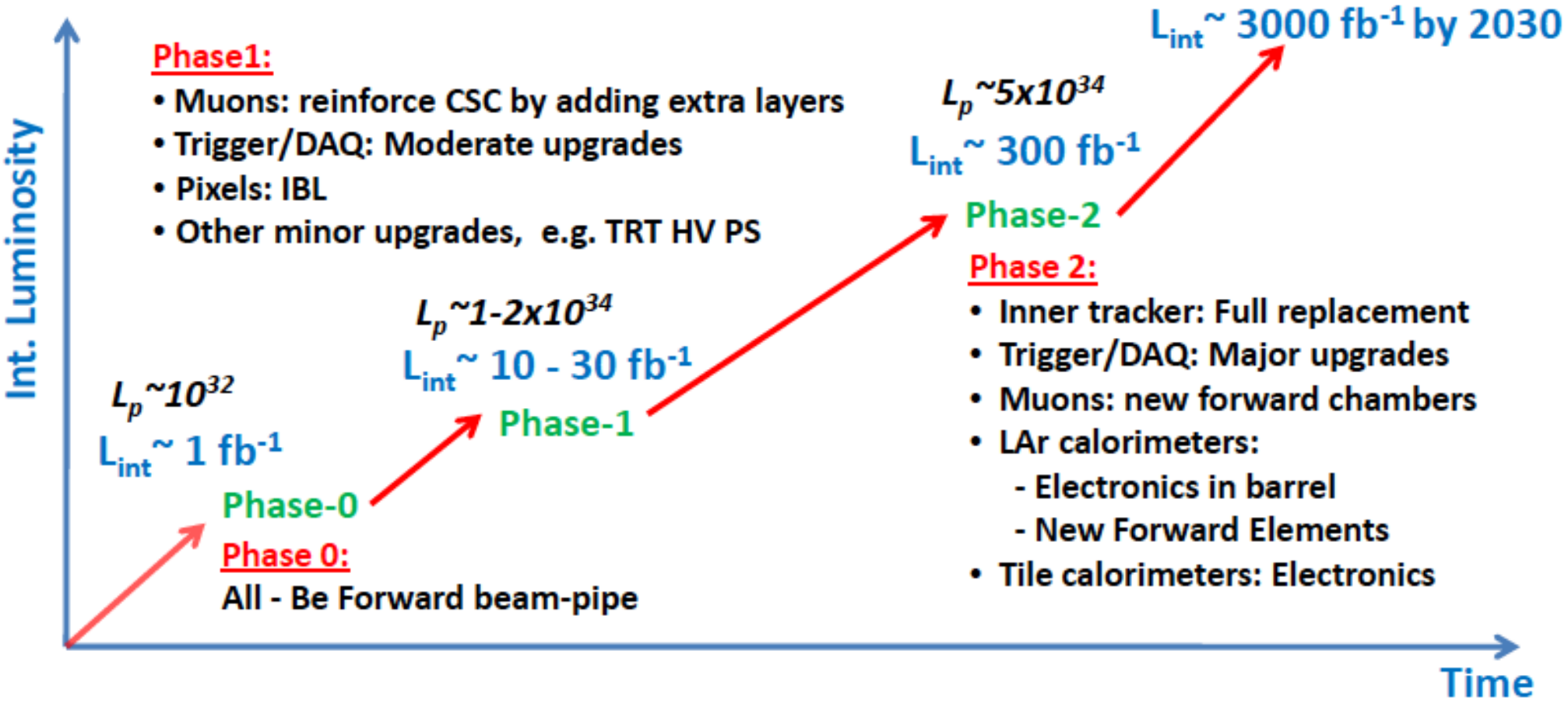
- **New Inner Triplets and insertion magnets**
- **A revision of the matching region and of the corrector system**
  Crab Cavities to allow full exploitation of the low β* of the new triplets
- **New cryo-plants dedicated to the cooling of the new magnets and cavities**

The implementation of this new scheme accompanied by other possible improvements under consideration (shorter bunches, etc.) **should allow a peak luminosity of ~ 5 10^{34} cm^{-2} s^{-1} and improved luminosity lifetime.**

Beam energy increase to 16.5 TeV (beyond 2030) is under study…

ATLAS Upgrades Schedule (1)

(we follow LHC upgrade schedule)



*Phase-0 : 15 months: **spring 2013 - 2014***

*Phase-1 : 12 months: **entire 2016***

*Phase-2 : 18 months: **end of 2019-early 2021***

ATLAS Upgrades Schedule (2)

Phase 0

Many minor changes/fixes, a major one – fwd beam-pipe replacement (all Be):

- reduces muon backgrounds by factor 2 (cheap solution);

- makes space for a new layer of pixel detectors (b-layer).

Phase 1

Inner detector: a new b-layer (IBL), stave structure inside the old one, 160 MHz readout and (CO_2) evaporative cooling, smaller beam-pipe (R=29→25 mm):

- will improve the vertexing performance because of proximity to beam;

- backup in case of problems with current b-layer;

- TDR is being prepared.

Several sensors considered: planar Si (thinned or not, n-in-n, n-in-p), 3D or diamond.

Muon detector: a new small wheel and new L1 electronics in barrel:

- requires understanding of the cavern background;

- requires understanding of the present performance and performance of the upgraded detector.

ATLAS Upgrade LoI for Phase II is in preparation.

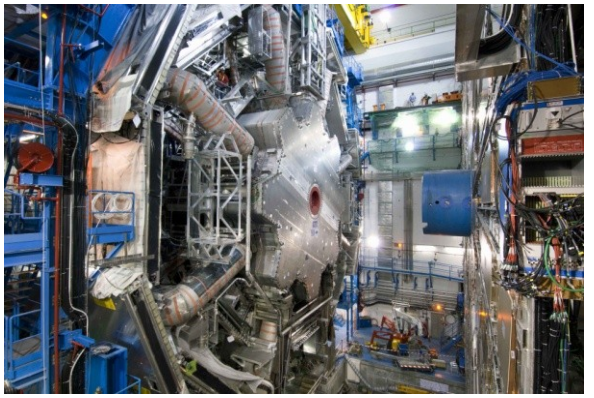
Magnet System Upgrade

"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

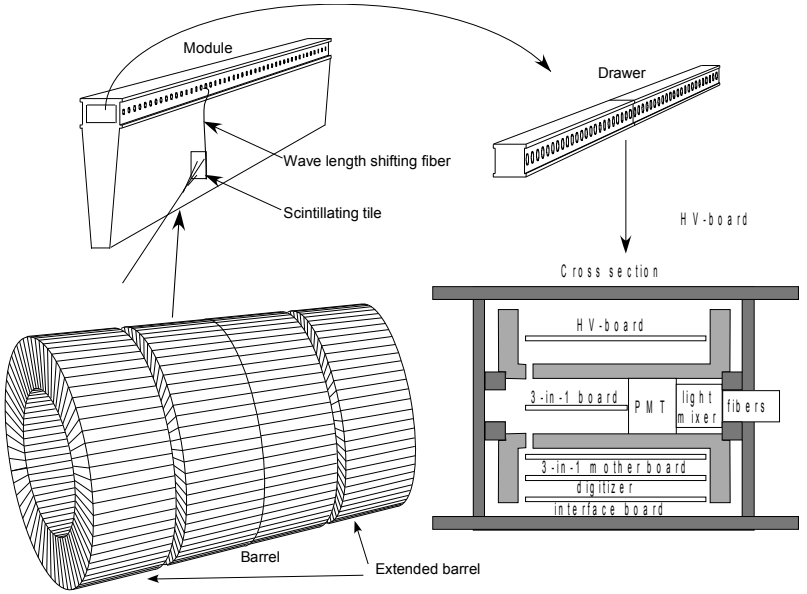
What is planned to do:

Drawer mechanics – smaller size

PMT dividers - better linearity

New Front-End electronics - 3-in-1 / ASIC / QIE designs

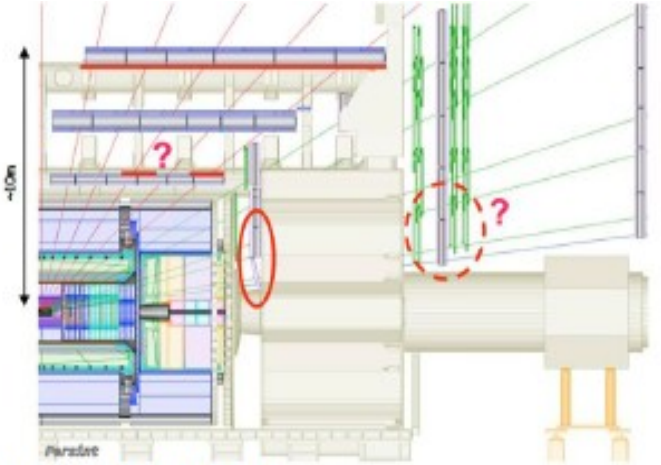
- **Main and Link boards**
- **High Voltage Power Supply for PMTs**
- **New Low Voltage Power Suply (LVPS)**
- **Off-detector electronics**
- **System test slice using existing hardware and emulators (Stockholm)**
- **Demonstrator project**



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

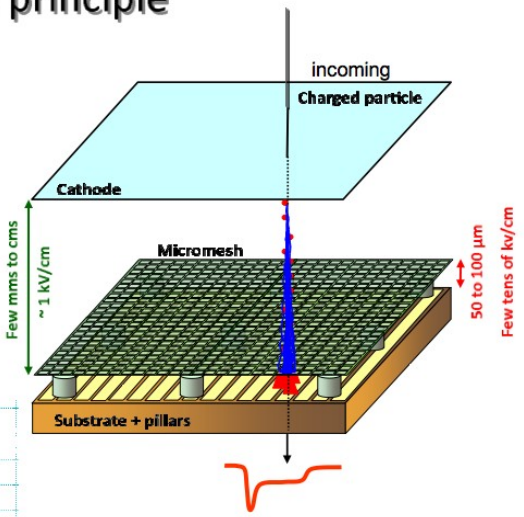
- increase of background rate to ~10-20 kHz/cm^2 at high η-regions
- all CSC chambers, some MDTs and some TGCs (~ 150 m^2) should be replaced

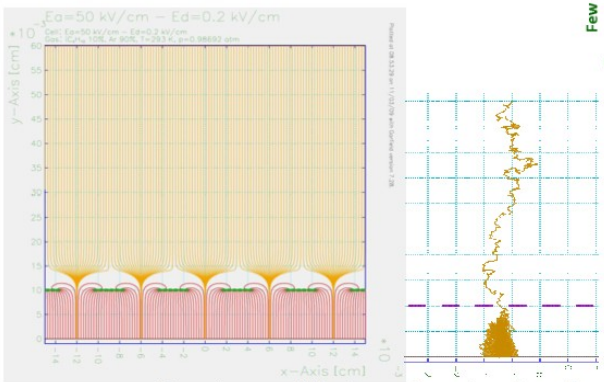


Since 2009 JINR Muon group is the member of MAMMA collaboration which has proposed Micromegas chambers

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 (2013-2017)	10 k$/year	50 k$
Scientific contacts (2012-2017)	15 k$/year	90k$

HiLumi ATLAS Endcap Project

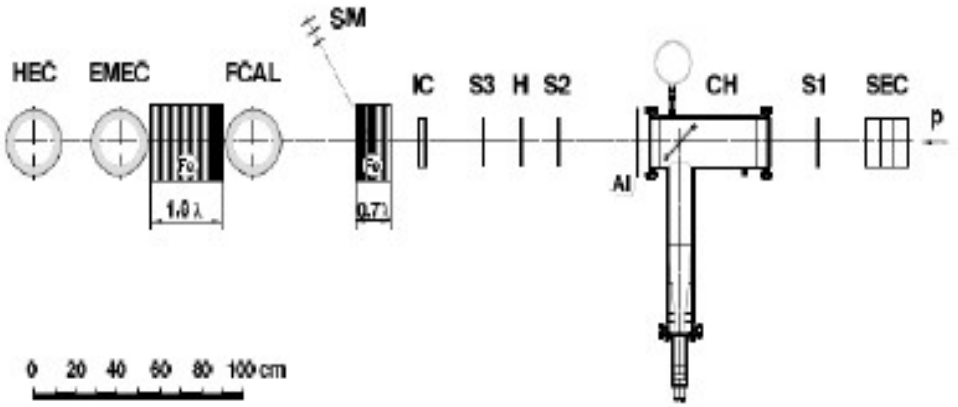
Collaboration of Arizona, Dresden, JINR Dubna, Kosice, Mainz, LPI Moscow, MPI Munich, BINP Novosibirsk, IHEP Protvino, TRIUMF, Wuppertal.

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

Critical issues:

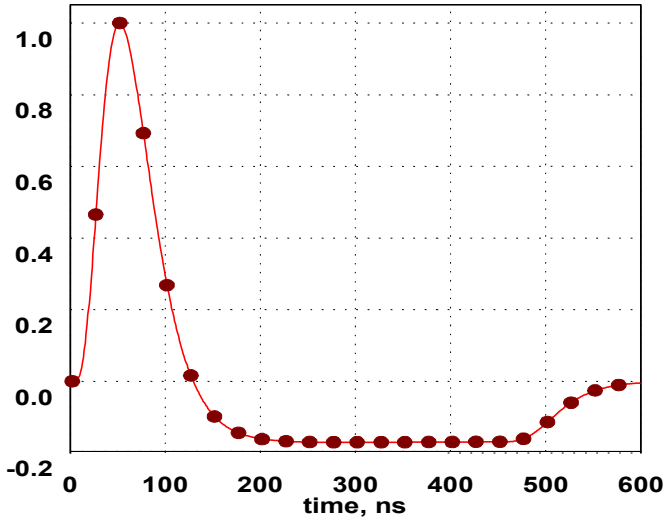
- ion build in LAr gap;
- decreasing electric field, increasing recombination rate, distorting signal shape;
- heat impact (FCAL) at high $|\eta|$;
- increase of temperature up to 5 K ,
- bubbling of LAr → HV sparks;
- radiation hardness: fluence increase by factor 10 (→ IBR-2m in Dubna).

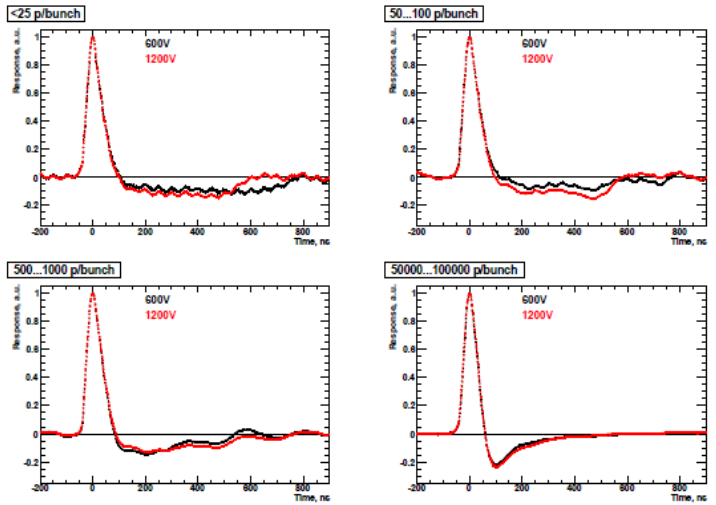
IHEP Protvino: beam line # 23: rate variation from 10^6 up to 10^{12} p/spill: E= 50-70 GeV.



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

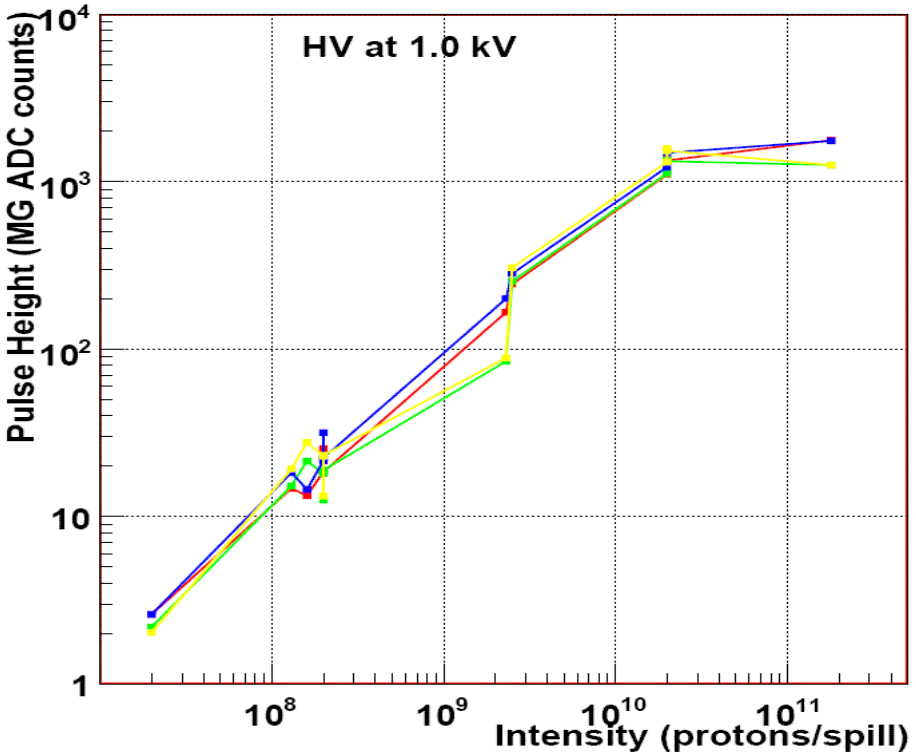
HiLumi Experiment at Protvino





Preliminary results :

- ✓ Positive ion build-up effects at high beam intensities are observed;
- ✓ EMEC and HEC will definitely meet HI-LHC radiation load;
- ✓ FCAL needs further study (**2 runs more in 2011-12**);
- ✓ Pulse shapes follow the expectations from simulation



Resources (2012-2016, 1-2 man/year):
- a new FEB: preamlifier, preshaper and trigger driver – 240k CHF

IBR-2M for HI-LHC

High flux pulsed JINR IBR-2 neutron reactor was widely used in 90s for irradiation tests of ALL components of ATLAS calorimeters (including cold electronics immersed into the LAr cryostat).

Successful collaboration work was established with MPI (Munich), Canadian Institutes, Arizona, Grenoble, etc. (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 the Collaboration), frame extension, remote manipulator, cryogenics, etc

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

ATLAS Upgrade for HI-LHC

- **ATLAS Upgrade program for HI-LHC in ATLAS is shaping up…**
- **No deficit of ideas/proposals but a lack of resources**

A search for complementary resources:

- Started by ATLAS collaboration in Dubna (October, 2010)

- 2nd Brainstorming workshop on upgrade technologies and applications using EU-funding, held in Glasgow University 27-28 May, 2011

- **Good examples of the Knowledge Transfer:**
  - **ESA, GU (Easy Access), Weizmann Institute, Institute of Cancer Research**
  - **CERN OpenLab - running project:**
    - **partnership with ORACLE, Siemens, HP, Intel**
    - **GRID, SCADA…**
- **Next steps in ATLAS:**
  - **ATLAS Technology Application Catalog (database for technology portfolio)**
  - **ATLAS Technology Lab (assistance in technology development, impact analysis, promotion)**
  - **ATLAS Project Office (assistance for EU applications)**

Conclusions

ATLAS detector is demonstrating an excellent and stable performance since 2009.

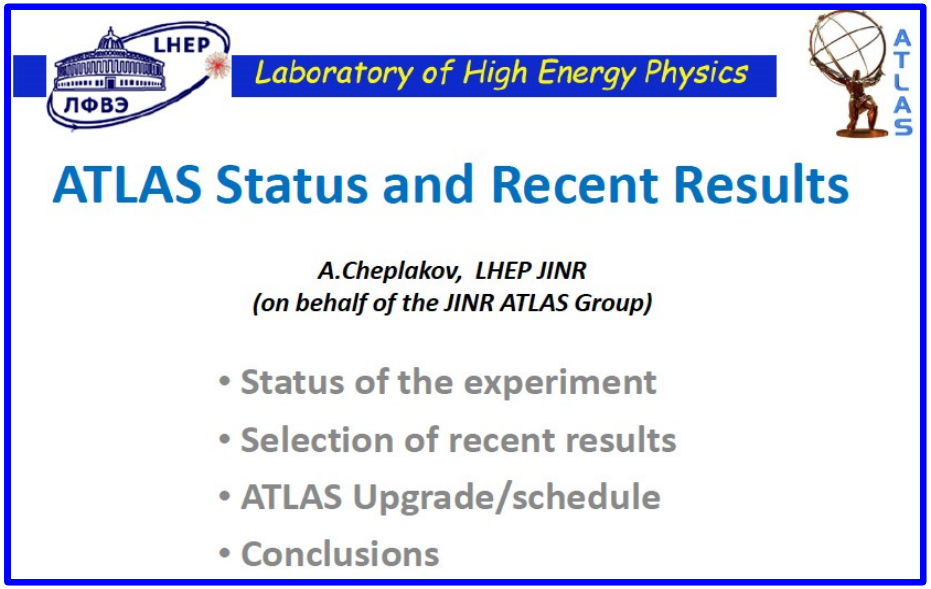
Many physical results have been already obtained and presented at summer-2011 conferences.

Dubna participation in physics analysis is growing up, we already have some important results at the collaboration level.

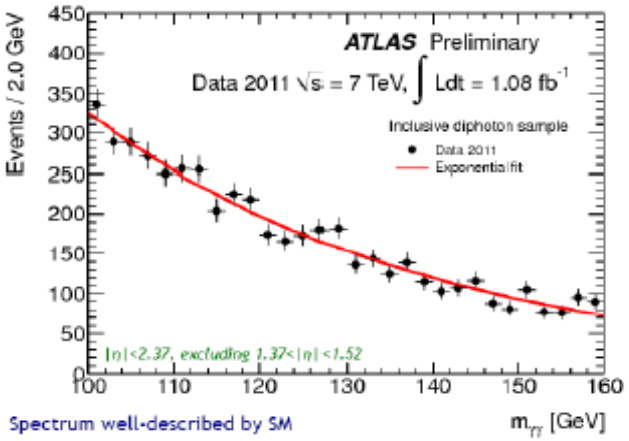
ATLAS Upgrade project becomes an important part of JINR activity.

Thanks a lot for your attention !

Many thanks for A.P.Cheplakov. His two recent talks, at JINR PAC (21.06.2011), and at 15th Lomonosov conference (18.08.2011) were used in this presentation.



Higgs search examples



Spectrum well-described by SM

H→γγ - a cleanest channel for very low Mass Higgs

A wide range of Higgs search channels cover Higgs masses from 110 to 600 GeV

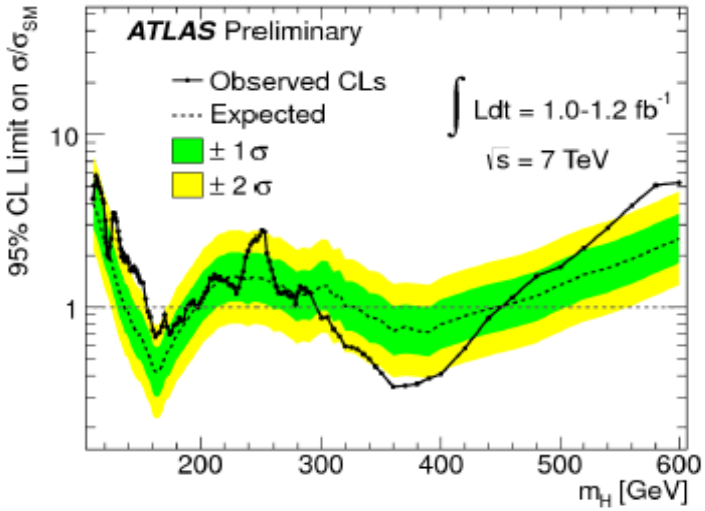
(wait for overview from Carlos Solans)

Cut based analyses are dominating, more advanced technique (NN, TMVA,..) is on the way

The standard model Higgs is excluded at 95% CL in two mass ranges (overtaking Tevatron):
155 GeV to 190 GeV and 295 GeV to 450 GeV

An excess corresponding to a 2.7 σ fluctuation of the background occurs for a Higgs mass between 130 GeV and 150 GeV.

ATLAS-CONF-2011-123



The combined upper limit of the Standard Model Higgs boson production cross section divided by the Standard Model expectation as a function of m_H

11

Chiral extra vector bosons

COMPLETENESS in the spin-1 and graviton angular distributions

Table 3.10. Angular distributions for the decay products of spin-1 and spin-2 resonances, considering only even terms in $\cos\theta^*$.

Channel	d-functions	Normalised density for $\cos\theta^*$
$q\bar{q} \to G^* \to f\bar{f}$	$\lvert d^2_{1,1}\rvert^2 + \lvert d^2_{1,-1}\rvert^2$	$P_q = \frac{5}{8}(1 - 3\cos^2\theta^* + 4\cos^4\theta^*)$
$gg \to G^* \to f\bar{f}$	$\lvert d^2_{2,1}\rvert^2 + \lvert d^2_{2,-1}\rvert^2$	$P_g = \frac{5}{8}(1 - \cos^4\theta^*)$
$q\bar{q} \to \gamma^*/Z^0/Z' \to f\bar{f}$	$\lvert d^1_{1,1}\rvert^2 + \lvert d^1_{1,-1}\rvert^2$	$P_1 = \frac{3}{8}(1 + \cos^2\theta^*)$

$$P_1^* = \frac{3}{2}\cos^2\theta^*$$

3.3.6. Discriminating between different spin hypotheses

The fractions of generated events arising from these processes are denoted by ϵ_q, ϵ_g, and ϵ_1, respectively, with $\epsilon_q + \epsilon_g + \epsilon_1 = 1$. Then the form of the probability density $P(\cos\theta^*)$ is

$$P(\cos\theta^*) = \epsilon_q P_q + \epsilon_g P_g + \epsilon_1 P_1. \quad + \varepsilon_1^* P_1^* \qquad (3.24)$$