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IHEPI TSU in ATLAS Experiment

Tamar Djobava (IHEPI TSU)

Outline:

1. ATLAS Detector
2. ATLAS Physics Program
3. Georgian Joint Team “Tbilisi” in ATLAS
4. Hadronic Tile Calorimeter of ATLAS and Test Beam Data Analysis
5. Sensitivity of ATLAS to Top Quark FCNC Decays
6. Study of SUSY-like Signal fromTwo Gluinos at ATLAS
7. Summary

"A Toroidal LHC ApparatuS"

General-purpose PP Experiment at the Large Hadron Collider at CERN.

ATLAS Experiment

- The ATLAS experiment is one from 5 main (basic) projects planned at Large Hadron Collider (LHC) at CERN (Geneva, Switzerland).

- ATLAS is the one of the largest collaborative effort ever attempted in physical sciences. There are 1800 physicists participating from more than 150 universities and laboratories in 34 country

ATLAS Experiment

The Large Hadron Collider

- The LHC is a proton-proton collider with 14 TeV centre of mass energy and design luminosity of 10^{34} $cm^{-2}s^{-1}$, designed and constructing to explore the electroweak symmetry breaking mechanisms up to TeV energies.
- The bunch crossing time will be 25 ns and at design luminosity there will be approximetely 23 proton-proton collisions per bunch crossing.
- The design centre-of-mass energy of 14 TeV will be reached at the machine start-up. During the first three years of operation the luminosity (L) is expected to increase from 10^{32} - 10^{33} cm^{-2} s^{-1} (low L) to the design value of 10^{34} cm^{-2} s^{-1} (high L).
- Data taking at the LHC should start in the year 2007. The LHC opens a new frontier in particle physics due to its higher collisions energy and luminosity compared to the existing accelerators.

The ATLAS Detector

- The ATLAS experiment has now entered the construction phase for many of its detector components, with a strict schedule to meet the first collisions at LHC in 2007.
- The ATLAS detector consists of the following major components:

The Inner Tracker which measures the momentum of each charged particle (Pixel detector, Semiconducter tracker, Transition radiation tracker)

The calorimeter which measures the energies carried by the particles

1. Electromagnetic calorimeter (barrel part and two end-caps),

2. Hadronic calorimeters (Tile calorimeter-one barrel, two extended barrels, Liquid-Argon hadronic end-cap calorimeters, Liquid-argon forward calorimeter).

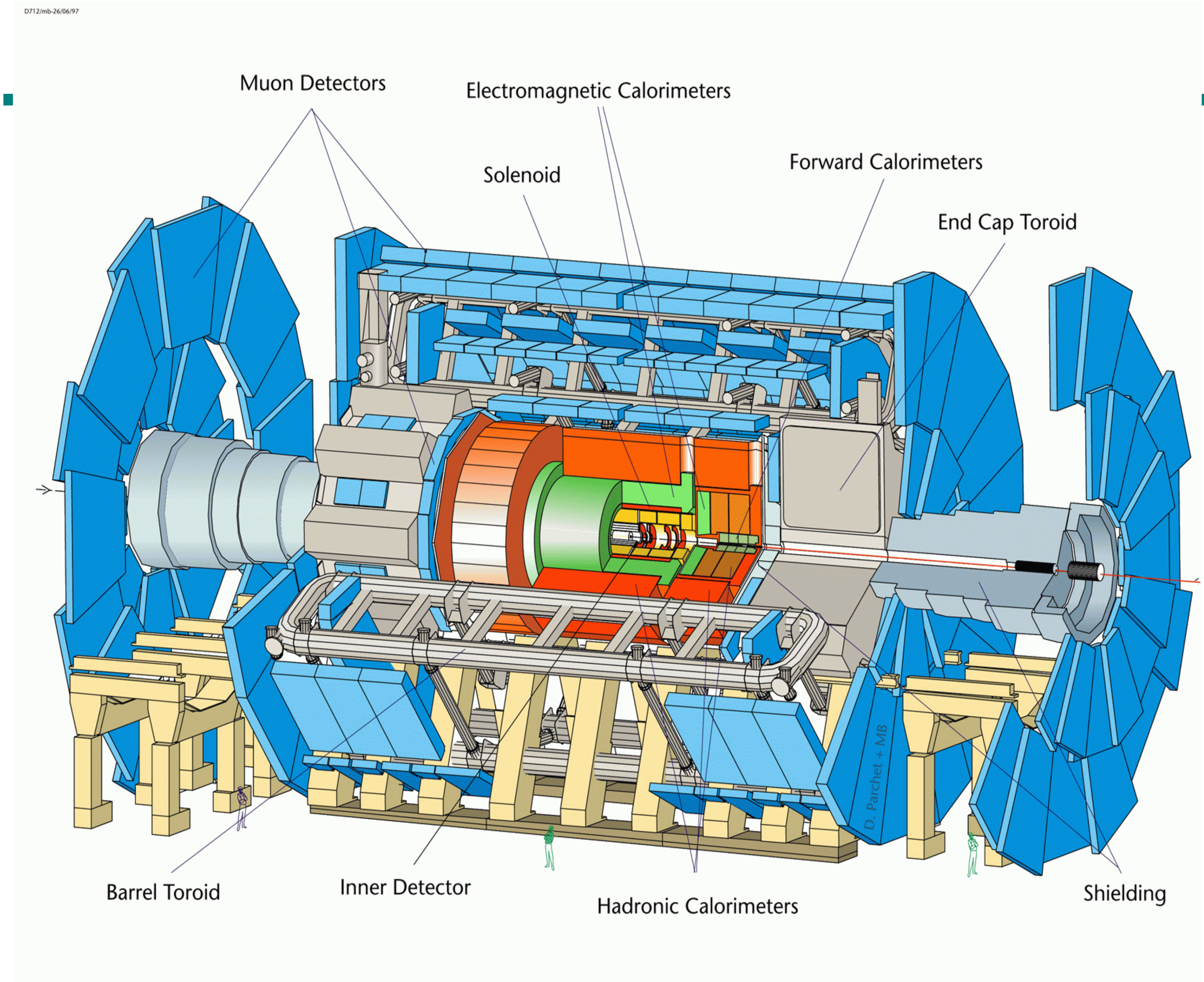
Muon Specrometer which identifies and measures muons (Monitored drift tube chambers, Cathode strip chambers, Resistive plate chambers, Thin gap chambers)

The Magnet system that bends charged particles for momentum meausrement (the central ATLAS colenoid and Air-core toroid system)

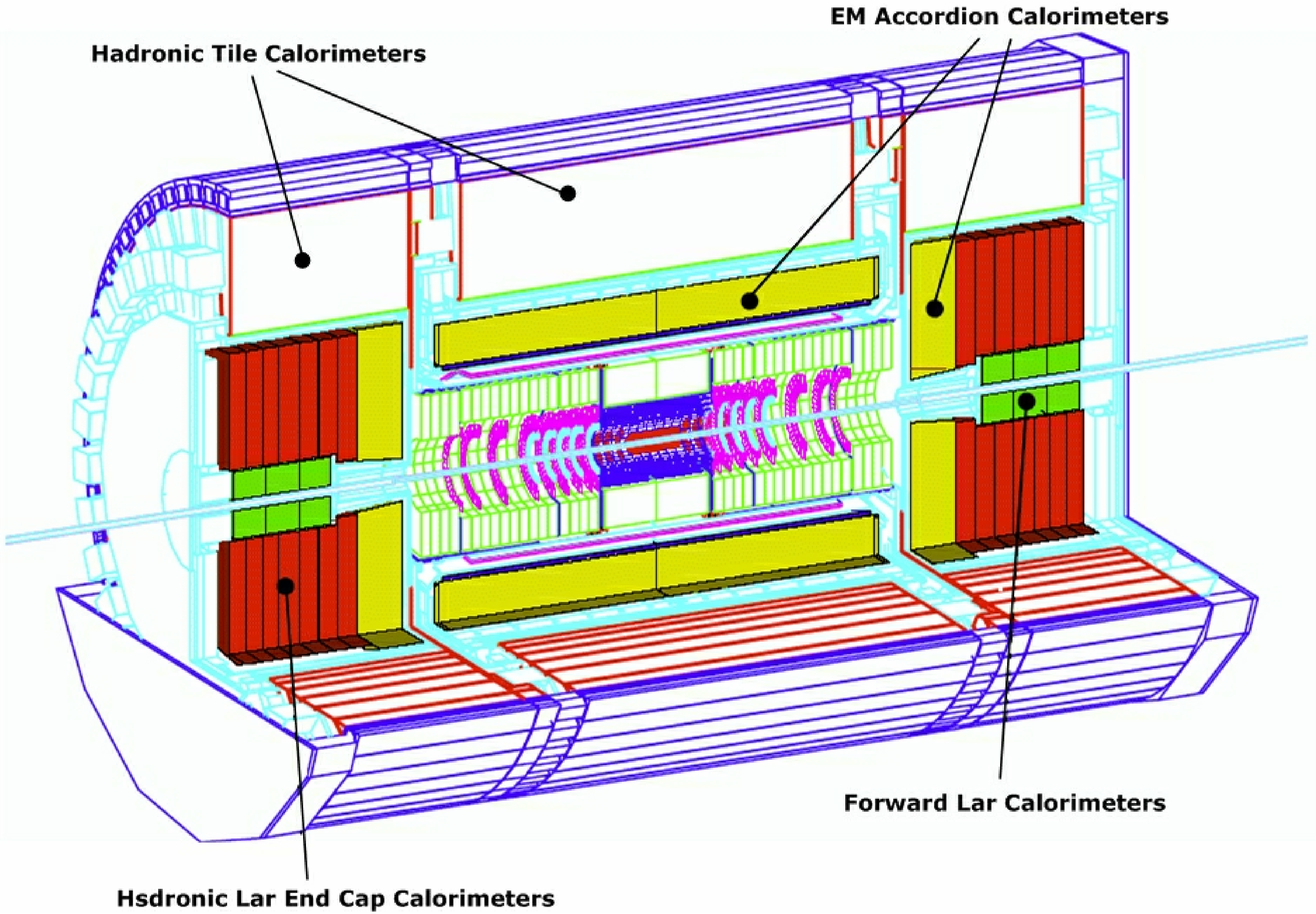
The ATLAS Detector

- Trigger
- Data-Acquisition system (DAQ).

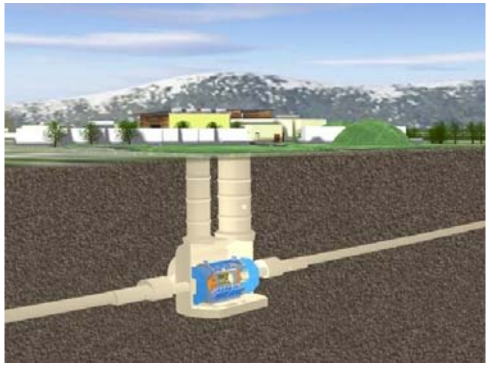
The detector is a cylinder with a total length of 42 m and a radius of 11m and weights apptoximately 7000 tonnes.

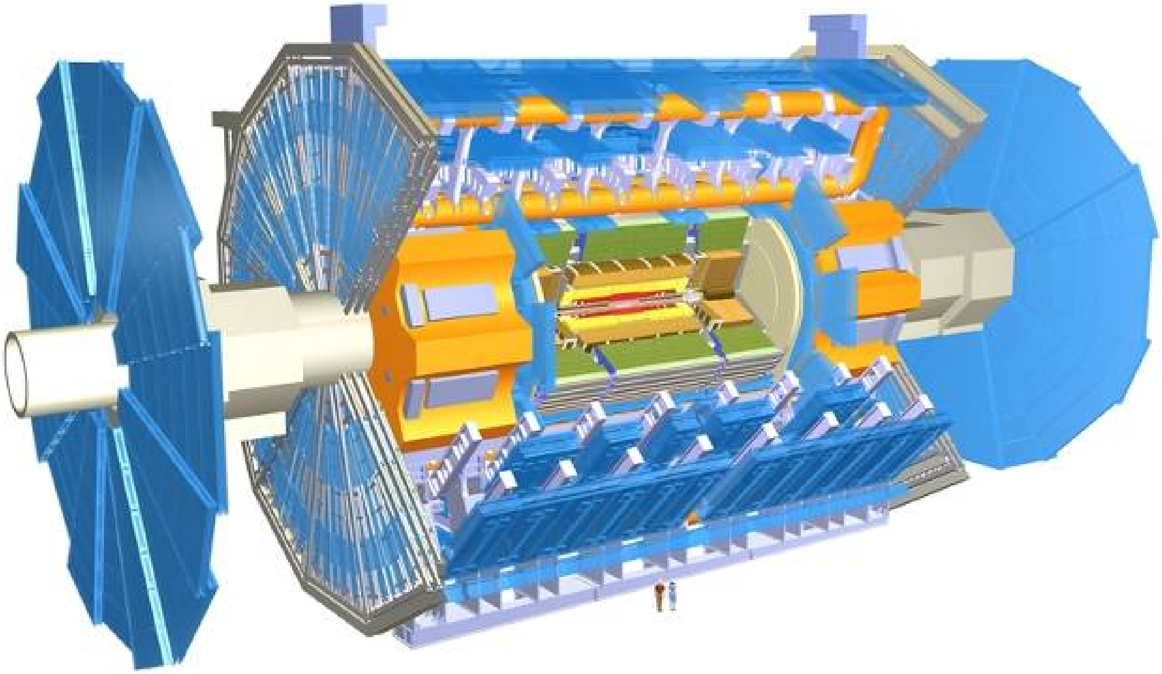

D712/mb-26/06/97
Muon Detectors
Electromagnetic Calorimeters
Solenoid
Forward Calorimeters
End Cap Toroid
Barrel Toroid
Inner Detector
Hadronic Calorimeters
Shielding
D. Parchet + MB

The ATLAS Detector



The ATLAS Detector





- Inner Detector (ID)
  - Semiconductor pixel and strip detector
  - Transition radiation tracker: straw-tubes interspersed with a radiator (e/π separation)
  - Inside solenoid of 2T magnetic field
- Calorimeter
  - Highly granular LAr EM calorimeter: $|\eta| < 3.2$
  - Hadron calorimeter: $|\eta| < 4.9$ (scintilator-tile in barrel and LAr in end-caps and forward)
- Muon spectrometer
  - Air-core toroid system on average ~ 0.5 T
  - MDTs & CSCs; RPCs & TGCs

ATLAS Physics Program

The origin of mass at the electro-weak scale is a major focus of interest for ATLAS.

Other important goals are the searches for:

- **Higgs Bosons**
- **Supersymmetric particles**
- **Compositeness of the fermions**
- **The investigations of CP-violation in B-decays, and**
- **Detailed studies of the top quark**

The most prominent issue for the LHC is the quest for the origin of the spontaneous symmetry-breaking mechanism in the electroweak sector of the SM. New direct experimental insight is required to advance in one of the most fundamental questions of physics which is closely connected to this, namely: What is the origin of the different particle masses?

One of the possible manifestations of the spontaneous symmetry-breaking mechanism could be the existence of a SM Higgs bozon (H), or a family of Higgs particles ($H^{\pm}$, h, H and A) when considering the Minimal Supersymmetric extension of the Standard Model (MSSM).

The basic design considerations for ATLAS can be summarized as

- Very good electromagnetic calorimetry for electron and photon identification and measurements, complemented by hermetic jet and missing E_T calorimetry
- Efficient tracking at high luminosity for lepton momentum measurements, for b-quark tagging and for enhanced e and γ identification, as well as, τ and heavy- flavor vertexing and reconstruction capability of some B decay final states at lower luminosity
- Stand-alone, precision, muon-momentum measurements up to highest luminosity, and very low-P_T trigger capability at lower luminosity

In order to maximize the physics reach and to optimize the exploitation of the LHC it is also important to achieve

- Large acceptance in η coverage
- Triggering and measurements of particles at low P_T thresholds

Georgian Joint Team "Tbilisi" in ATLAS

IHEPI, TSU	IOP, GAS
G.Arabidze	L.Chikovani
T.Djobava	A.Gongadze
G.Glonti	I.Manjavidze
N.Grigalashvili	N.Shubitidze
G.Kekelidze	E.Tskhadadze
G.Khoriauli	V.Tsulaia
J.Khubua	
I.Minashvili	
M.Mosidze	
Z.Salukvadze	

IOP GAS

IHEPI TSU

Muon Detector Dubna – Tbilisi

-Drift tubes production and tests for BOS chambers
-BMS station preparation for installation in the Barrel
-Muon chamber test in the Barrel

-Test beam and offline analysis
-Transition-Radiation Tracker (TRT)

Tile Calorimeter Dubna – Tbilisi

-ATLAS CALORIMETER Hadronic Calibration
-Jet/E_T (missed) reconstruction
-Tile Calorimeter Cells e/π calibration
-DAQ software
-Tile Calorimeter simulation in GEANT 4
-Data Control System of TileCal (DCS)

Simulation of Physics processes

-Rare top-quark decays ($t \to Zc$, $t \to Hq$)
-Anomalous many particle production
-SUSY-like signal from two gluinos $gg \to \tilde{g}\tilde{g}$

Dubna - Tbilisi

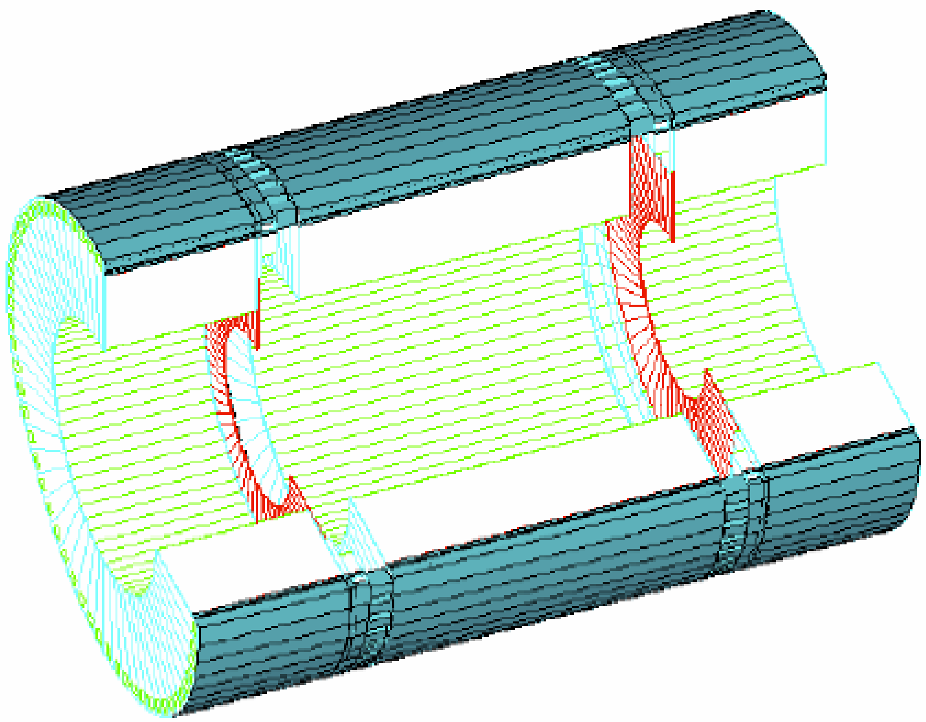
Georgian Physicists Activities in ATLAS

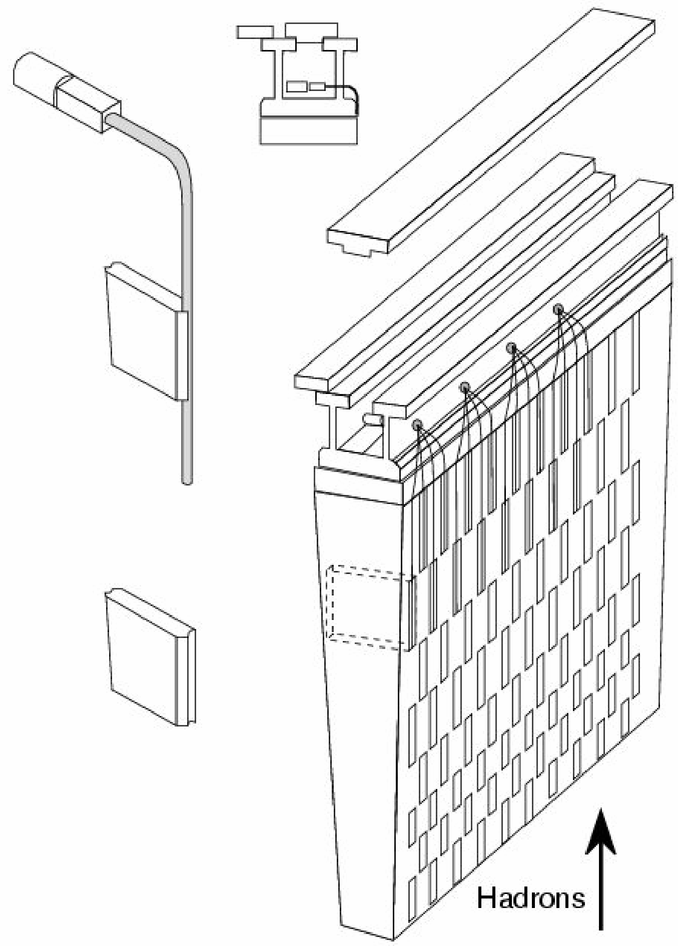
The physicists of Institute of High Energy Physics and Informatization of Tbilisi State University are participating in:

- Design, construction and assembly of Hadronic Tile calorimeter (central barrel) of ATLAS detector (J.Khubua, I.Minashvili, Z.Salukvadze, G.Glonti, G.Arabidze, G.Khoriauli)
- Calorimeter Test Beam Analysis (J.Khubua, I.Minashvili, M.Mosidze, G.Khoriauli, G.Arabidze, T.Djobava)
- Construction and design of Transition Radiation Tracker (TRT) (N.Grigalashvili)
- TRT Test Beam Analysis (N.Grigalashvili)
- Study of Top Quark Rare Decays via Flavor Changing Neutral Currents within the ATLAS Physics simulations (L.Chikovani (IOP GAS), T.Djobava)
- Study of the prospects for ATLAS observation of a SUSY-like signal from two gluinos via gluon-gluon fusion gg→ğğ . The solution of dark matter problem (G.Khoriauli, J.Khubua)

Hadronic Tile Calorimeter of ATLAS Detector

- The Hadronic barrel Tile Calorimeter is a sampling calorimeter using iron as the absorber and scintillating tiles as the active material. The tiles are placed radially and staggered in depth. The structure is periodic along *z* . The tiles are 3 mm thick and the total thickness of the iron plates in one period is 14 mm. Two sides of the scintillating tiles are read out by wavelength shifting (WLS) fibres into two separate photomultipliers (PMT's).
- The Tile Calorimeter is composed of one central barrel (6 m long, weighting 1350 t) and two extended barrels (each being 3 m long and weighting 700 t). Radially the tile calorimeter extends from an inner radius of 2.28 m to an outer radius of 4.25 m. It is longitudinally segmented in three layers, approximately 1.4, 4.0 and 1.8 interaction lengths thick at $\eta=0$. Azimuthally, the barrel and extended barrels are divided into 64 modules. The calorimeter is placed behind the Electromagnetic calorimeter ($\approx 1.2\ \lambda$) and the solenoid coil. The barrels cylinder covers the region $|\eta| < 1.0$.
- The 64 modules of the central barrel have been designed and constructed at Laboratory of Nuclear Problmes of JINR and then transported to CERN




Hadrons

Hadronic Tile Calorimeter of ATLAS Detector

- The assembly the central barrel from these 64 modules have been carried out at CERN .

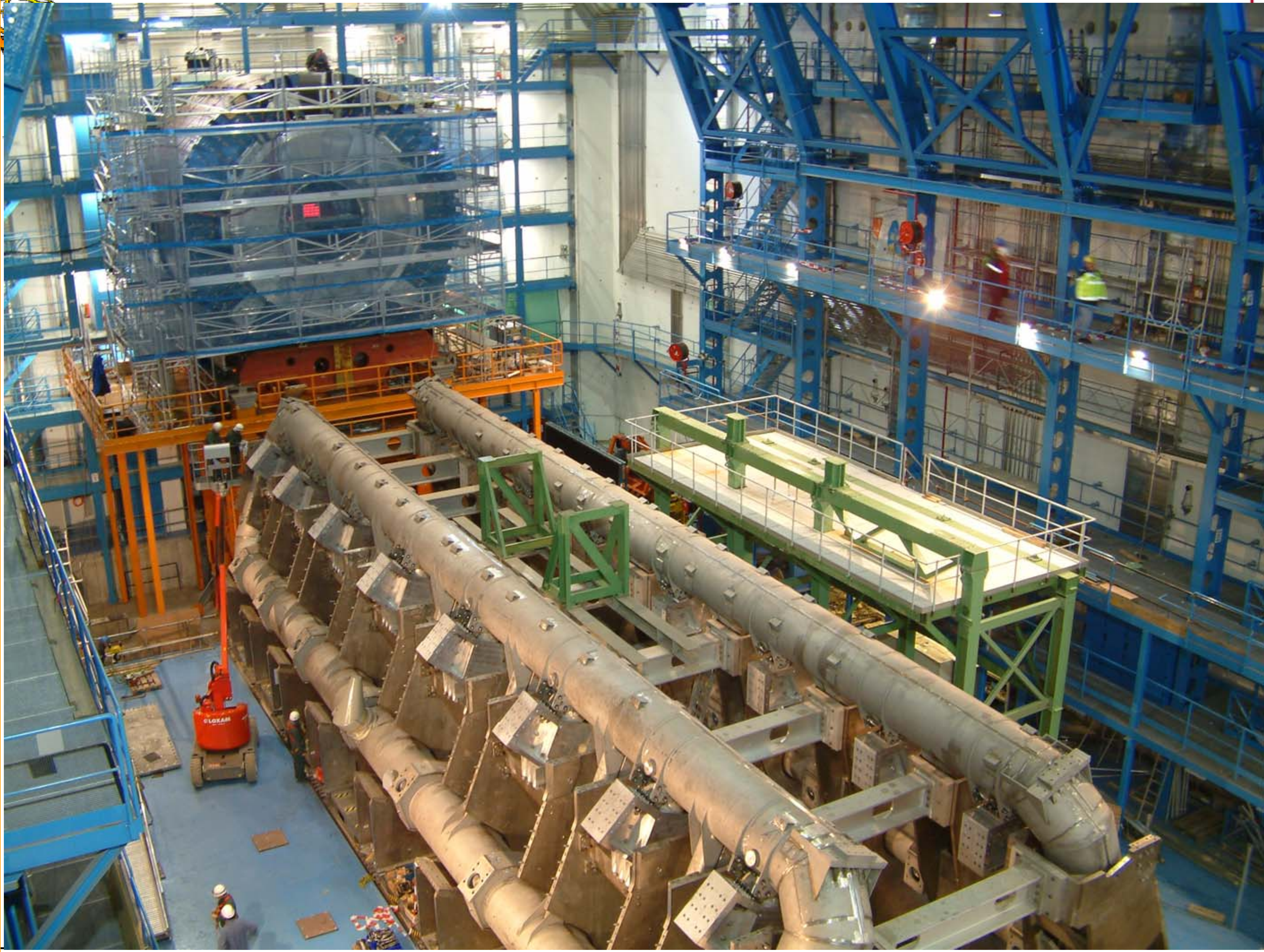
Assembly of barrel is a complex, large-scale technological process. It is quite unique in the HEP practice:

1. relative precision of ≈ 1.2×10^{-3} for the diameter of the assembled barrel;

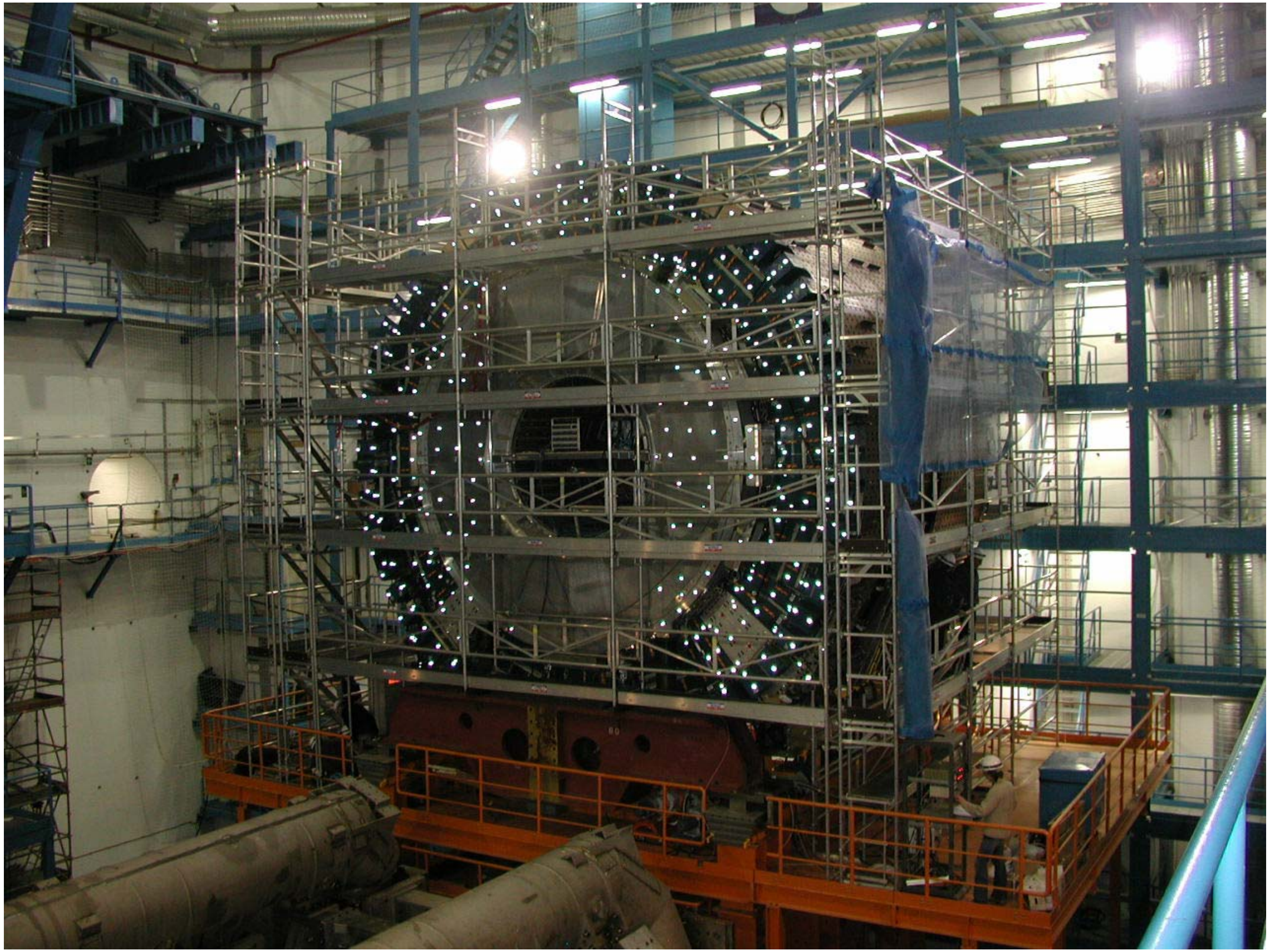
2. 10^{-4} rad precision of controlled angular dimensions

are to be achieved with the above-mentioned weight/dimensions of the full-scale calorimeter after connecting 64 modules per one barrel. A complex of metrology methods (laser, photogrammetry, theodolite, mechanic, PREDICTION programme) developed at the principal stages and resulted in successful high-precision erection of the barrel.

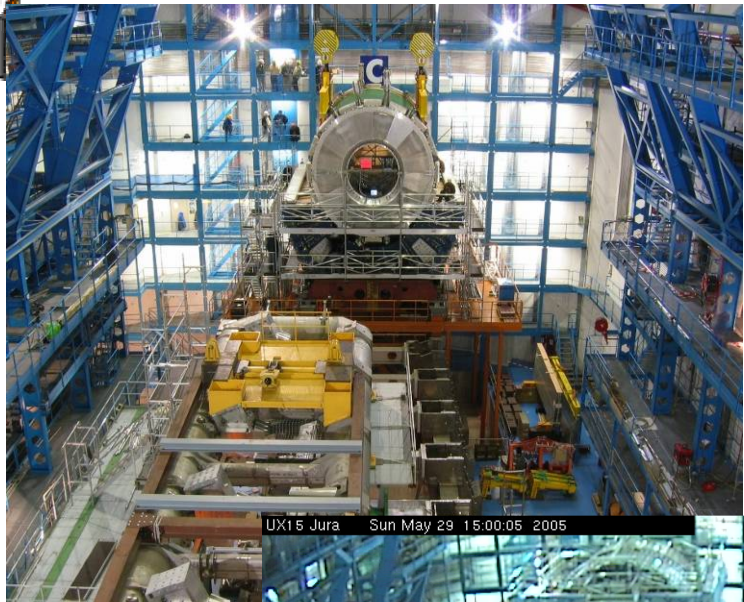
J. Khubua, I. Minashvili, Z. Salukvadze participated in all steps of these works.

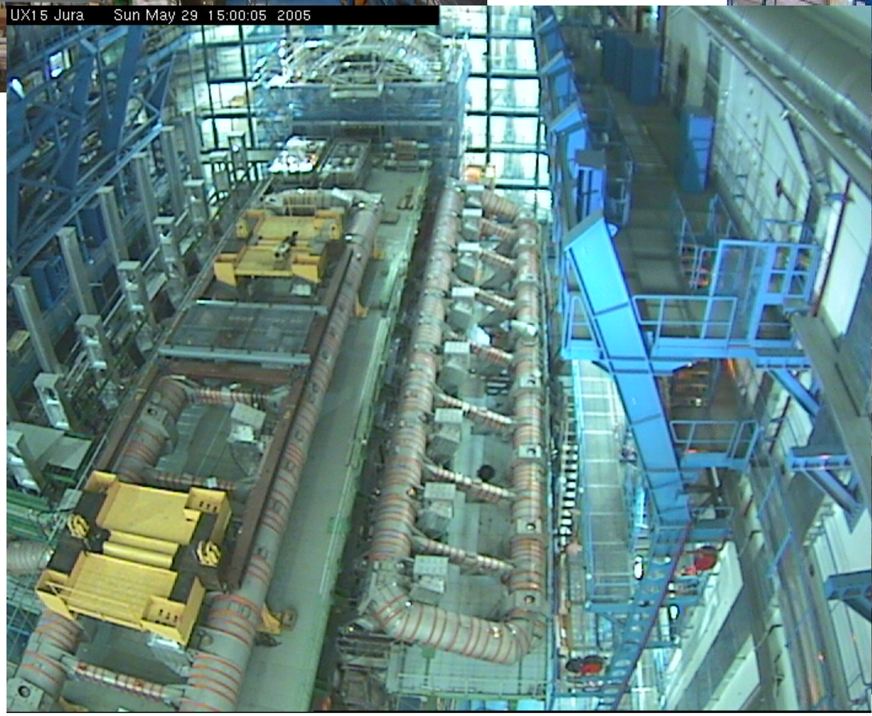


ATLAS is Getting Ready



ATLAS is Getting Ready





Hadronic Tile Calorimeter of ATLAS Detector

Commissioning of the Tile Calorimeter is going on now:

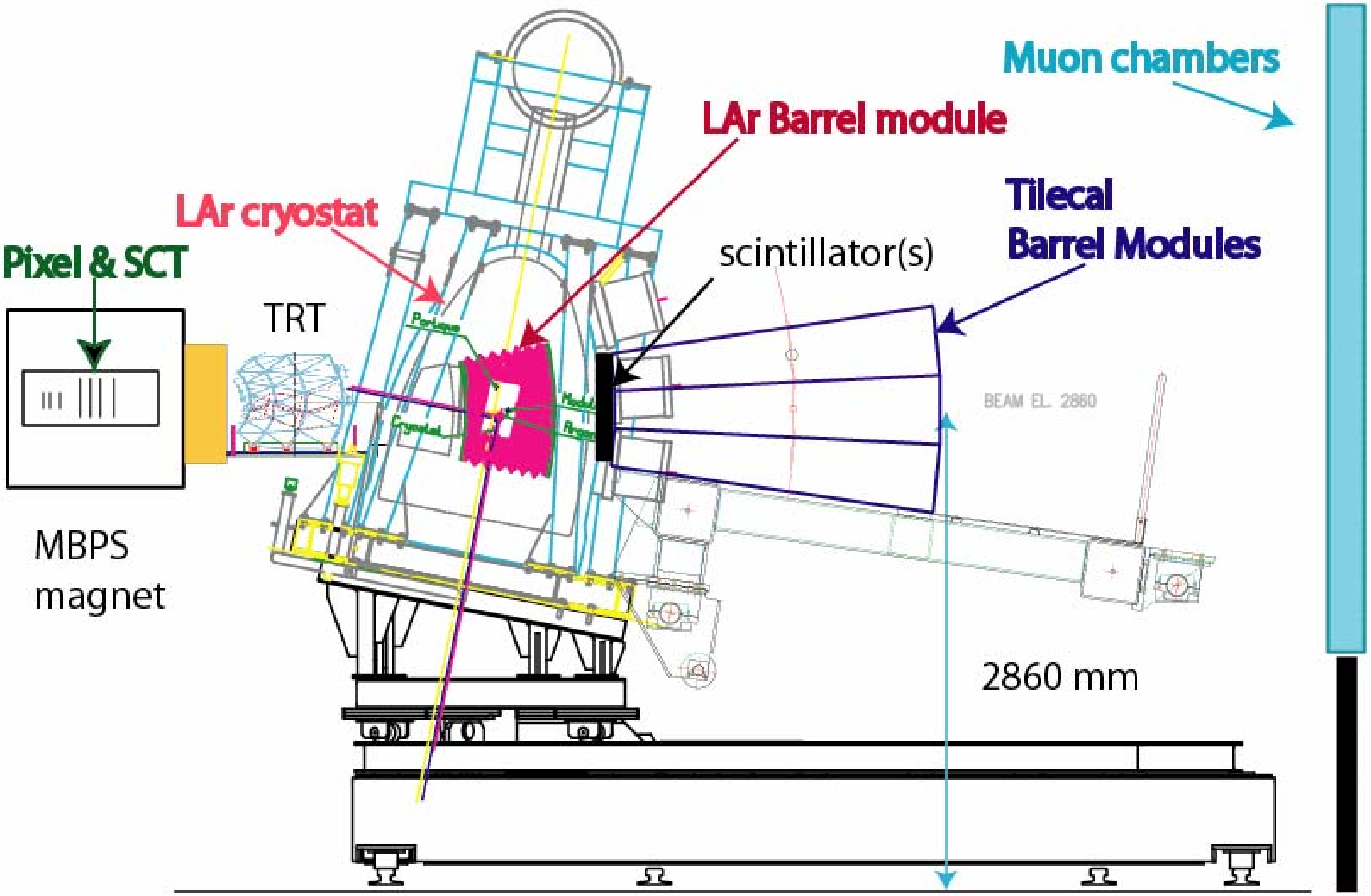
- **Cabling** (installation of the final cables and fibers) **, implementation with electronics**(**performance stability tests to identify electronics associated problems and participation in fixing of them**). (**I.Minashvili, G.Arabidze**)

- **Development and implementation of the Tile Calorimeter Detector Control System (DCS) and further preparation for phase II and III commisioning (I.Minashvili, G.Arabidze)**

TileCal Test Beam Data Analysis

- An optimization and a final determination of electro-magnetic energy scale and a study of different characteristics (energy resolution and linearity) of Tile Calorimeter and its calibration before the running of the ATLAS detector and obtaining the real experimental data are very important tasks.
- Hadronic calibration of the calorimeter is very crucial aspect in studying of physical processes with hadronic jets production. The goal of the hadronic calibration is to provide improved methods and estimations of their parameters for an impact hadron energy reconstruction in the calorimeter. The way to solve this problem is a detailed Monte-Carlo (MC) study of the calorimeter response dependence on the impact hadron energy and pseudo-rapidity and comparing MC results with experimental test data.
- Tests of the combined electromagnetic liquid argon (LAr) and the hadronic Tile calorimeter prototypes of the future ATLAS experiment were carried out, using pion beams of energy 10÷350 GeV from CERN SPS accelerator.

Combined Electromagnetic LAr Calorimeter and The Hadronic TileCal set-up



TileCal Test Beam Data Analysis

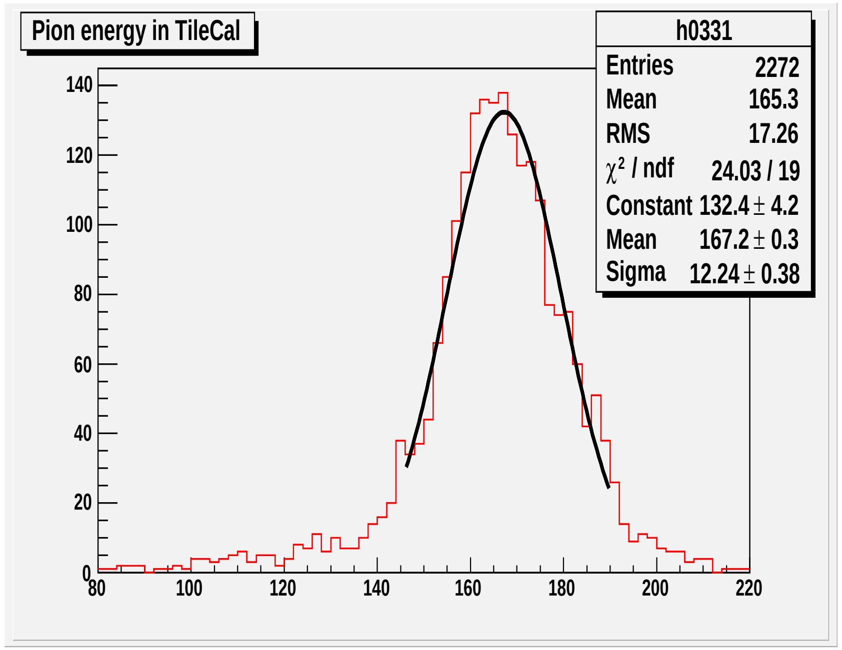
- The main purpose of the combined setup was to demonstrate that the choice of a hybrid calorimeter (Liquid Argon electromagnetic Calorimeter and Tile Hadronic Calorimeter) will allows one to reconstruct the energy of incident hadrons with resolution and linearity within the goals of ATLAS.
- A performance of the combined setup to electrons, pions and muons responses has been studied. J. Khubua, I. Minashvili, M. Mosidze, G. Arabidze, G.Khoriauli with the colleagues from JINR carried out these researches.
- Offline analysis have been performed and showed that the ATLAS hadronic Calorimeter will allow one to reconstruct the incident hadron energy with resolution and linearity within the goals of ATLAS, i.e. with the energy resolution

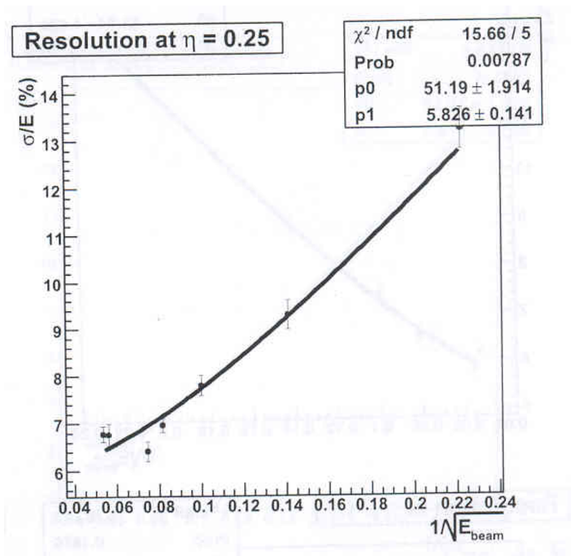
$$\Delta E/E = 50\%/\sqrt{E} + 3\%$$

and better than 2% linearity.

.The angular resolution in the φ direction for hadron showers was studied (M.Mosidze). The resolution can be described by the function $\sigma = (68.17 \pm 0.75)\ \%/\sqrt{E} + (0.9 \pm 0.11)$ mrad.

TileCal Test Beam Data Analysis





TileCal Test Beam Data Analysis

- In the year 2004, ATLAS has been involved in a huge combined test beam effort. As a result a full slice of the ATLAS detector has been tested with beams of different particles (pions, electrons, protons, muons and photons) at different incident angles and energies, ranging from 1 GeV up to 350 GeV. This test provided a unique opportunity to evaluate the individual sub-detector performances, and also to exploit the full power of the ATLAS detector for detailed particle identification and measurement and to understand better the detector performance in a realistic combined data taking. The huge information (~4.6 TB of data, ~90 million events) has been collected.
- The features to be studied for pions and electrons at 1 ÷ 350 GeV and $|\eta| < 1.3$ are :

a. The hadronic energy linearity (cell weighting H1 and e/h methods);

b. The hadronic energy resolution (cell weighting H1 and e/h methods);

c. The LAr and Tile calorimeters non-compensations;

d. The Monte-Carlo GEANT 4 detailed validations and tuning with Combined 2004 data;

e. The transition effect for improvement of an electromagnetic energy scale

f. The detailed study of the hadronic shower energy losses in the dead material before and between the calorimeter parts to improve the hadronic calibration precision.

TOP Quark FCNC Decays

L. Chikovani (IOP GAS), T.Djobava (IHEPI TSU)

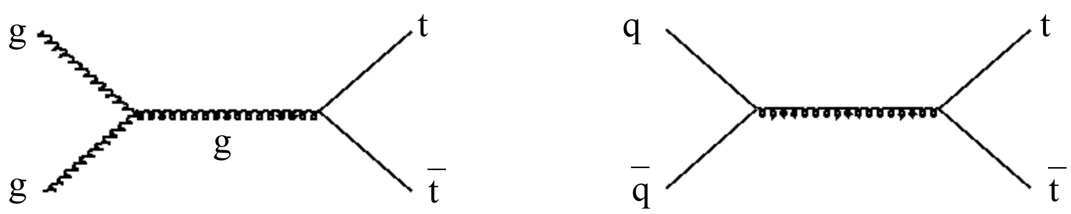
- The ATLAS Experiment Sensitivity to FCNC top quark decays $t \to Zc(u)$, $t \to \gamma c(u)$, $t \to gc(u)$, $t \to Hc(u)$ at the LHC has been studied.
- In SM, FCNC top quark rare decays are strongly suppressed (loop suppression, heaviness of gauge bosons) $Br(t \to Zq) \sim 1.3 \times 10^{-13}$; for $m_H = 100$ (160) GeV one gets $Br(t \to Hq) \sim 0.9 \times 10^{-13}$ (4×10^{-15}) respectively
- The Minimal Supersymmetric Standard Model, Two Higgs Model (2HDM II) and Technicolor (TC2) Models predict the following values of Branching ratios for $t \to Zq$ and $t \to Hq$ processes: $Br(t \to Zq) \sim 10^{-5} \div 10^{-4}$ and $Br(t \to Hq) = 5 \times 10^{-4}$
- Observation of significantly larger Br's will be a clear signal of new physics (new dynamical interactions of top quark, multi-Higgs doublets, exotic fermions or other possibilities)
- Although FCNC processes associated with the decay of top quarks ($t \to \gamma c/u$, $t \to Zc/u$) have been studied at CDF (FNAL), the amount of data collected up to now is not comparable with the statistics expected at LHC

LHC will be a" top factory"

- **NLO prediction that $\sigma(t\bar{t})$ = 833 pb (which is ≈ 100X larger than at FNAL) in pp collisions at $\sqrt{s}$ = 14 TeV implies that more than 80 thousands $t\bar{t}$ pairs per day will be produced in low luminosity (10^{-33}cm $^{-2}$ s^{-1}) running of LHC**
- **Production processes at LHC:**

  Top Quark Pair Production through gluon fusion and quark-antiquark annihilation

90% gg + 10% q-qbar



TOP Quark FCNC Decays

The results obtained by the different analyses is presented within two approaches :

- **Branching ratio sensitivities**

$$Br=5(\sqrt{B}\times\varepsilon_l)/\,(2\times L\times\sigma(t\bar{t}_{SM})\times\varepsilon_t\times\varepsilon_l)$$

$\varepsilon_l=0.9^n$

(assuming a 5σ signal significance for discovery)

- **95% confidence level limits**

(in the hypothesis of signal absence)

TOP Quark FCNC Decays

Monte Carlo Event Generation

- The MC generation of the background processes :
  b-bar, Z/γ^{*}+jets, WW, ZZ, ZW with PYTHIA ; W+jets with HERWIG
  Single top quark production, SM t-tbar & Signal - ONETOP & TopReX
- Initial and final state QED and QCD radiation (ISR+FSR), multiple interactions, fragmentations and decays of unstable particles were enabled.
- The generated background and signal events were passed through the ATLAS fast simulation ATLFAST 2.0, 2.14 or 2.53 and ATLFAST-B packages.
- ATLFAST was used with its default parameters for low and high luminosity running.
- The b-jet tagging efficiency was set to 60% for low luminosity (L= 10 fb^{-1}) and 50% for high luminosity (L = 100 fb^{-1})
- The rejection factor of c - jets is 10 and of light quarks jets 100.
- The CTEQ2L and CTEQ5L Parton Distribution Functions were used.

TOP Quark FCNC Decays

$t \rightarrow Zq$ ($q = u, c$)

- CDF Br < 33% @ 95%CL

- The enormous QCD backgrounds at hadron colliders make the search for the signal via hadronic decays $t\bar{t} \rightarrow WbZq \rightarrow$ 6-jets very difficult

- $Z \rightarrow l^+ l^-$ ($l = e,m$) significantly reduces the backgrounds provides a relatively clean experimental signature. The final state is determined by the decay of W:
  - $t\bar{t} \rightarrow Zq,Wb \rightarrow llj, l\nu b$ leptonic mode
  - $t\bar{t} \rightarrow Zq,Wb \rightarrow llj, jjb$ hadronic mode

- The hadronic decay mode of W has a much larger Branching ratio, but suffers from larger backgrounds.

TOP Quark FCNC Decays

$t\bar{t} \rightarrow Zq, Wb \rightarrow llj, l\nu b$

Sequential Analysis (leptonic mode)

- Experimental Signature:
  - 3 isolated charged leptons (with $m_{ll} \approx m_Z$)
  - missing transverse momentum p_T
  - two jets : light _jet + b_{jet}
- Backgrounds :
  - * Z+jets dominated by
    - $qg \rightarrow Zq$
    - $q\bar{q} \rightarrow Zq$

    thresholds were imposed at the generator level on the invariant mass, $\hat{m}=\sqrt{s}=130$ GeV and transverse momentum ($p_T > 50$ GeV)hard parton interaction.

    $\sigma =$ 3186pb 2.1x 10^7 events
  - * ZW (26.58pb) ;
  - * Wjj (18000pb)
  - * Wbb (300pb)
  - * Single top: W-gluon Fusion (244pb), Wt (60pb), s-channel (10 pb)
  - * $t\bar{t}_{SM}$ (833pb) : dileptonic decay, semileptonic decay, hadronic decay

TOP Quark FCNC Decays

- The final topologies of most dangerous backgrounds:
  - $WZ \to l^+ l^- l^\pm \nu$ 38 000 events
  - $t\bar{t} \to W^+ bW^- b \to l^+ \nu b l^- \nu b$ 3.9×10^6 events
- selection cuts:
  - three isolated carged leptons with $p_T^l > 30$ GeV (e) , $|\eta| < 2.5$;
    Z+jets, $t\bar{t}$, Wjj, $Wb\bar{b}$, Wt
  - at least two jets with $p_T^{jet} > 50$ GeV, $|\eta| < 2.5$, $\Delta R_{jj} > 0.4$, $\Delta R_{lj} > 0.4$; ZW
  - $p_T^{miss} > 30$ GeV Z+jets
  - A like sign, same-flavor pair of isolated leptons was required to reconstruct to the Z mass within a window of $m_{ll} = m_Z \pm 6$ GeV , Z mass resolution ~ 2.9 GeV.
    t-tbar
  - A peak at the top quark mass in the Zj invariant mass distribution within mass window

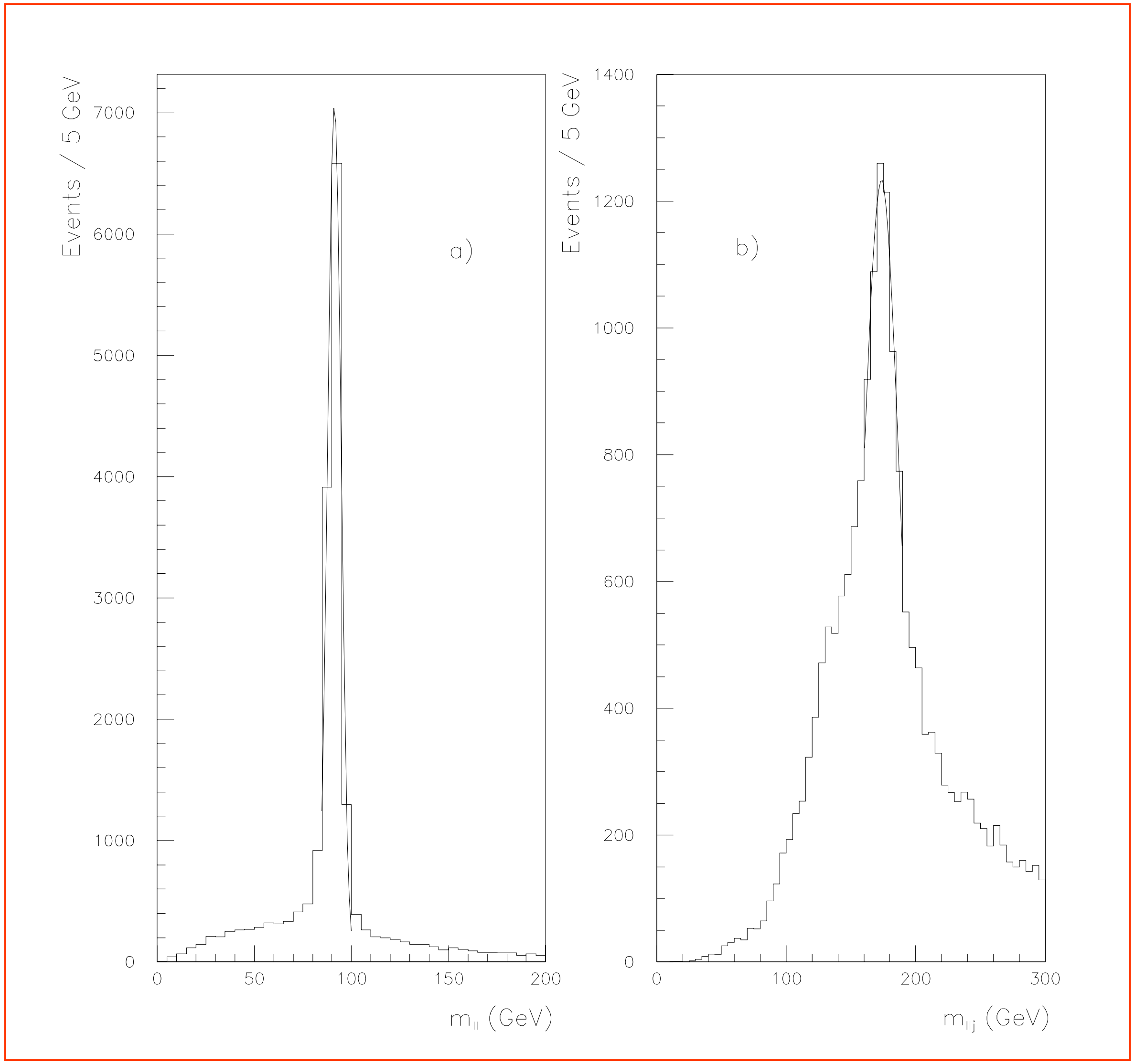
  $m_{llj} = m_t \pm 12$ GeV, $m_{llj} = m_t \pm 24$ GeV

  The top quark mass resolution $\sigma(m_{llj}) = 14$ GeV

  After all cuts, we have (for L=100 fb-1)

  - signal efficiency = 6.1 %
  - number of surviving background events : 2 WZ , 4 t-tbar

TOP Quark FCNC Decays



TOP Quark FCNC Decays

$t\bar{t} \rightarrow Zq,Wb \rightarrow llj, jjb$

Sequential Analysis (hadronic mode)

- Experimental Signature:
  - two isolated charged leptons (with $m_{ll} \approx m_Z$)
  - four jets : three light _jet + b_{jet}
- Backgrounds :
  - * Z+jets dominated by
    - $qg \rightarrow Zq$
    - $q\bar{q} \rightarrow Zq$

    thresholds were imposed at the generator level on the invariant mass, $\hat{m}=\sqrt{s}=130$ GeV and transverse momentum ($p_T > 50$ GeV) hard parton interaction. σ(Z+jets) = 3186pb

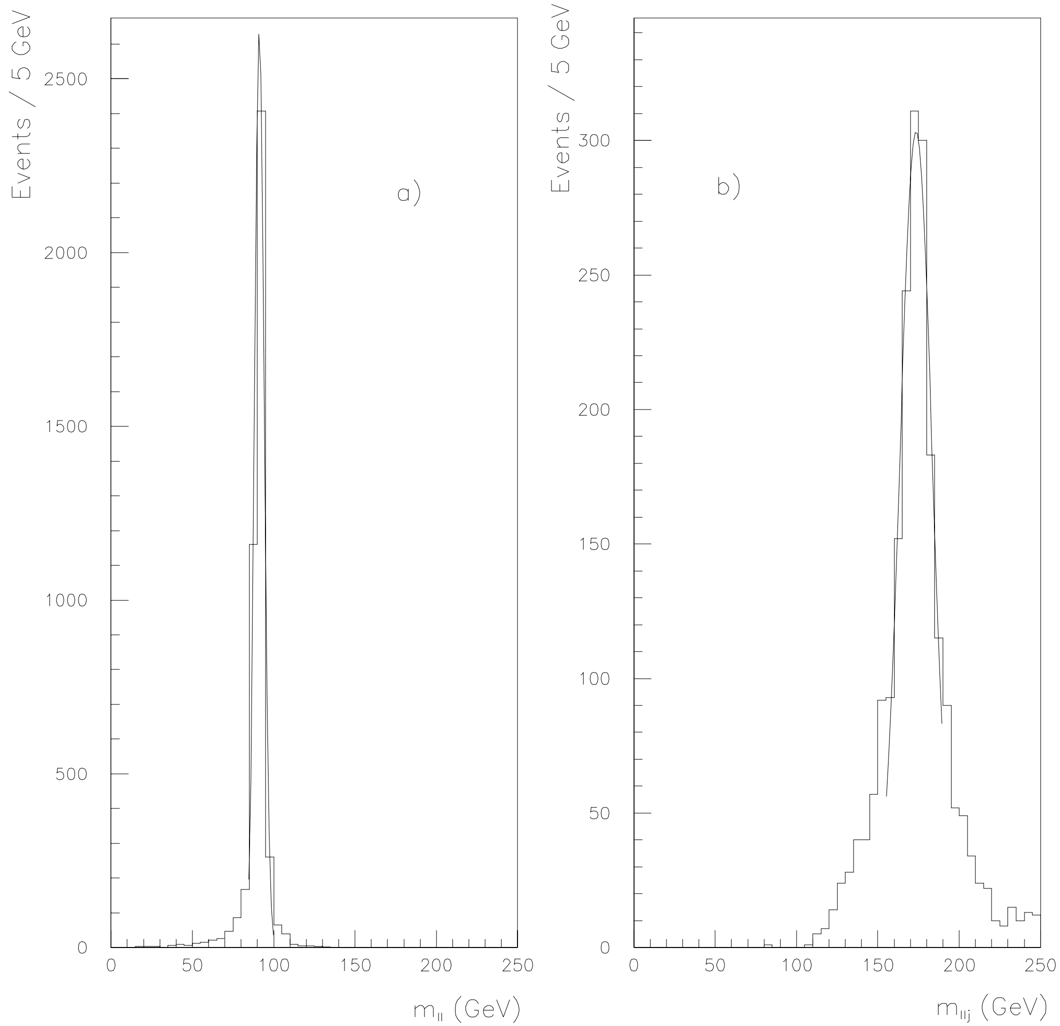
    2.1×10^7 events
  - * ZW (26.58pb) ;
  - * Wjj (18000pb)
  - * Wbb (300pb)
  - * Single top: W-gluon Fusion (244pb), Wt (60pb), s-channel (10 pb)
  - * $t\bar{t}_{SM}$ (833pb) : dileptonic decay, semileptonic decay, hadronic decay

TOP Quark FCNC Decays

- The final topologies of most dangerous backgrounds:
  - Z +jets→ $l^+ l^-$ + jets 2.1x10^6 events
  - $t\bar{t}$→$W^+ bW^- b$→$l^+ \nu b l^- \nu b$ + $l^\pm \nu bjj$ 28.x10^6 events
- selection cuts:
  - two isolated charged leptons with p_T^l > 30 GeV (e) , $|\eta|$ < 2.5;
    $t\bar{t}$ (semileptonic decay mode)
  - at least four jets with p_T^{jet} > 50 GeV, $|\eta|$ <2.5, ΔR_{jj} > 0.4, ΔR_{lj} > 0.4; WZ
  - A like sign, same-flavor pair of isolated leptons was required to reconstruct to the Z mass within a window of $m_Z \pm 6$ GeV , Z mass resolution ~ 2.9 GeV.
  - invariant mass $m_{jj} = m_W \pm 16$ GeV , W mass resolution ~ 8 GeV.
    Z+jets
  - one jet tagged as b-jet Z+jets ,WZ
  - invariant mass $m_{jjb} = m_t \pm 8$ GeV , m_{jjb} mass resolution ~ 18.5 GeV. WZ & Z+jets
  - A peak at the top quark mass in the Zj invariant mass distribution within mass window $m_{llj} = m_t \pm 12$ GeV, $m_{llj} = m_t \pm 24$ GeV, Z mass resolution $\sigma(m_{llj})$ =14 GeV

  after all cuts we have (for L=100 fb-1)
  - signal efficiency = 0.4 %
  - Number of surviving background events : two Z+jets, four $t\bar{t}$

TOP Quark FCNC Decays



TOP Quark FCNC Decays

$t\bar{t} \to Zq, Wb \to llj, l\nu b$

Probabilistic Analysis (leptonic mode)

- selection cuts:
  - three isolated charged leptons with $p_T^l > 25GeV$ (e) , $|\eta| < 2.5$;
    Z+jets, $t\bar{t}$, Wjj, $Wb\bar{b}$, Wt
  - at least two jets with $p_T^{jet} > 20$ GeV, $|\eta| < 2.5$, ZW
  - $p_T^{miss} > 20$ GeV Z+jets
  - A like sign, same-flavor pair of isolated leptons was required to reconstruct to the Z mass by calculating m_{ll} invariant mass.
    $t\bar{t}$
  - the top quark mass (m_{llj}) reconstruction was done by associating the non-b- jet with lepton pair.

Last cut :

- $L_R > 5.62$

TOP Quark FCNC Decays

$t\bar{t} \rightarrow Zq, Wb \rightarrow llj, l\nu b$

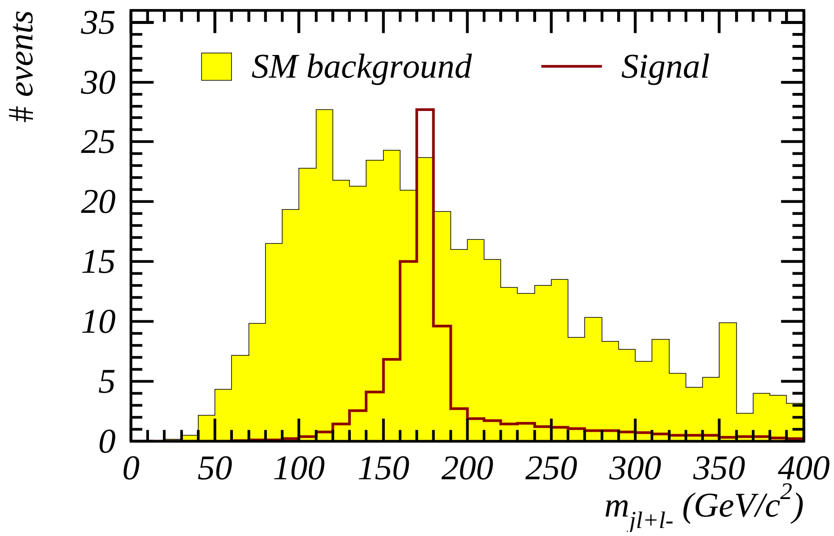
Probabilistic Analysis (leptonic mode)

- Following the final selection, a probabilistic type of analysis was applied. Signal ($P_i^{\,signal}$) and background-like ($P_i^{\,back.}$) probabilities were computed using Probability Density Functions (p.d.f.) constructed from relevant physical variables. The signal $L_S = \prod_{i=1}^{n} P_i^{\,signal}$ and background $L_B = \prod_{i=1}^{n} P_i^{\,back}$ likelihoods (n is the number of p.d.f.) were used to built the discriminant variable, defined as $L_R = L_S / L_B$.

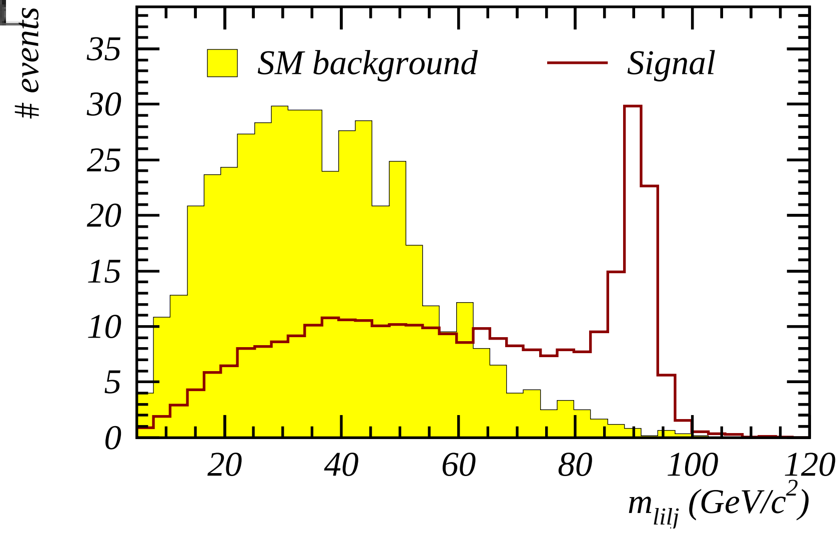
  For the $t \rightarrow Zq$ channel the p.d.f. were based on the following physical distributions :

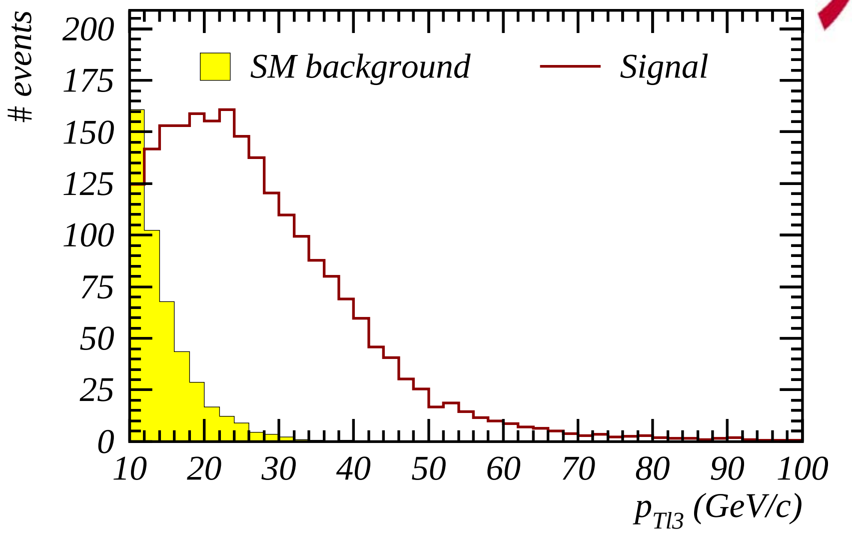
- minimum invariant mass m_{ll} of the three possible combinations of two leptons (only the three leading leptons were considered);
- transverse momentum of the third lepton p^{l3}_T
- the jll invariant mass and
- transverse momentum of the most energetic non-b jet p^{jet}_T

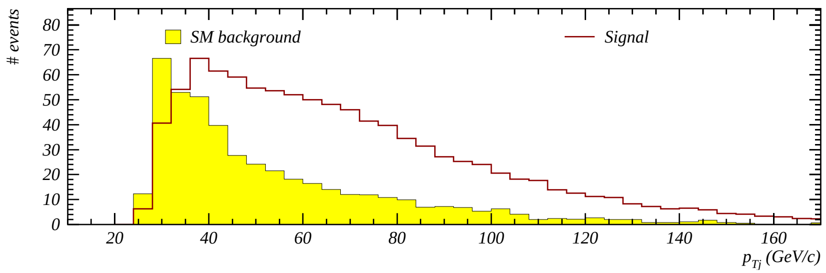
TOP Quark FCNC Decays

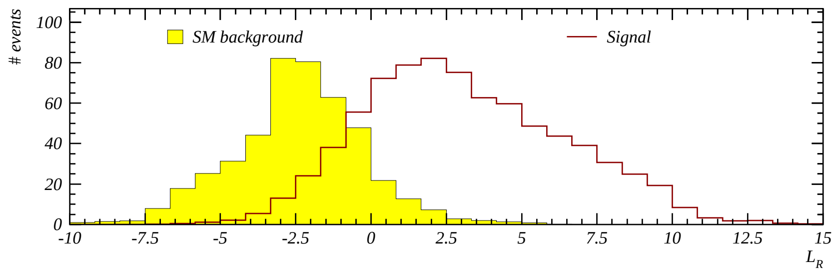


TOP Quark FCNC Decays









TOP Quark FCNC Decays

The branching ratio sensitivity in the 5sigma discovery hypothesis

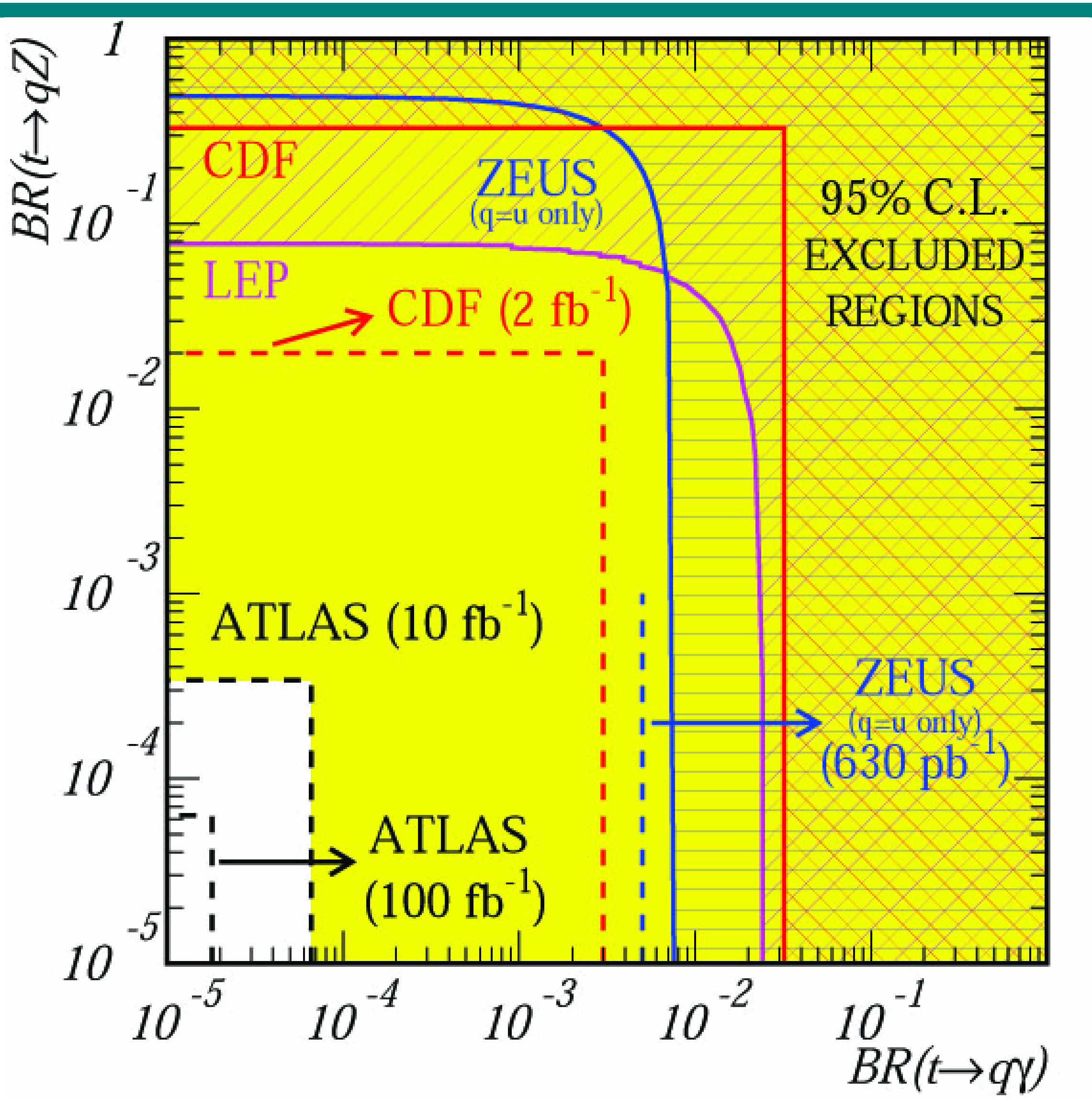
channel	type		BR(L=10 fb^{-1})	BR(L=100 fb^{-1})
$t \to Zu(c)$	sequental	hadr.	1.7×10^{-3}	5.0×10^{-4}
		lept.	4.7×10^{-4}	1.1×10^{-4}
	probabilistic	lept.	4.4×10^{-4}	1.4×10^{-4}
$t \to \gamma u(c)$	sequental		–	1.0×10^{-4}
	probabilistic		1.2×10^{-4}	3.6×10^{-5}
$t \to gu(c)$	probabilistic	"3jets"	4.3×10^{-3}	1.4×10^{-3}
		"4jets"	6.9×10^{-3}	2.2×10^{-3}

TOP Quark FCNC Decays

The expected 95% confidence level limits on the FCNC top decays branching ratio in the absence of signal hypothesis

channel	type		BR(L=10 fb^{-1})	BR(L=100 fb^{-1})
$t \to Zu(c)$	Sequental	hadr.	–	2.7×10^{-4}
		lept.	–	6.3×10^{-5}
		comb.	–	5.5×10^{-5}
	probabilistic	lept.	3.1×10^{-4}	6.1×10^{-5}
$t \to \gamma u(c)$	probabilistic		6.3×10^{-5}	1.8×10^{-5}
$t \to gu(c)$	probabilistic	"3jets"	1.6×10^{-3}	4.8×10^{-4}
		"4jets"	2.4×10^{-3}	7.5×10^{-4}
		comb.	1.3×10^{-3}	4.2×10^{-4}

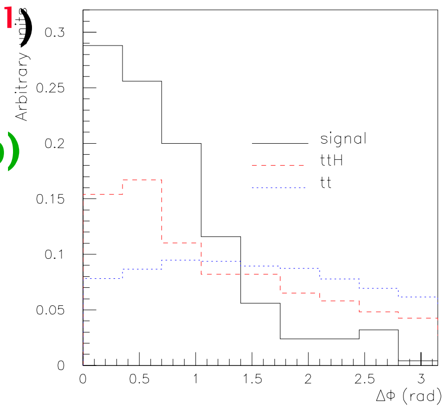
TOP Quark FCNC Decays



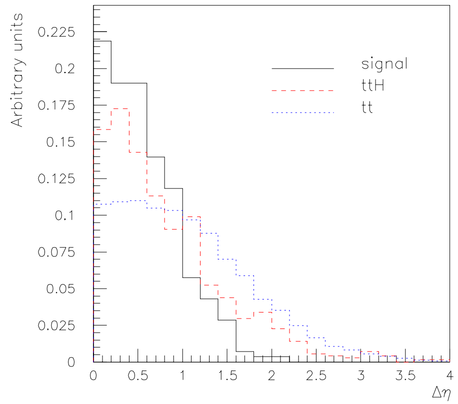
TOP Quark FCNC Decays

$t \to Hq$

- The various approaches to $t \to Hq$ has been studied
- Earlier results for $t\bar{t} \to Hq\ Wb \to b\bar{b}j,\ l\nu b$ for m_H = 115 GeV
  - Sensitive to $Br(t \to Hq) = 4.5 \times 10^{-3}$ ($100\ fb^{-1}$)

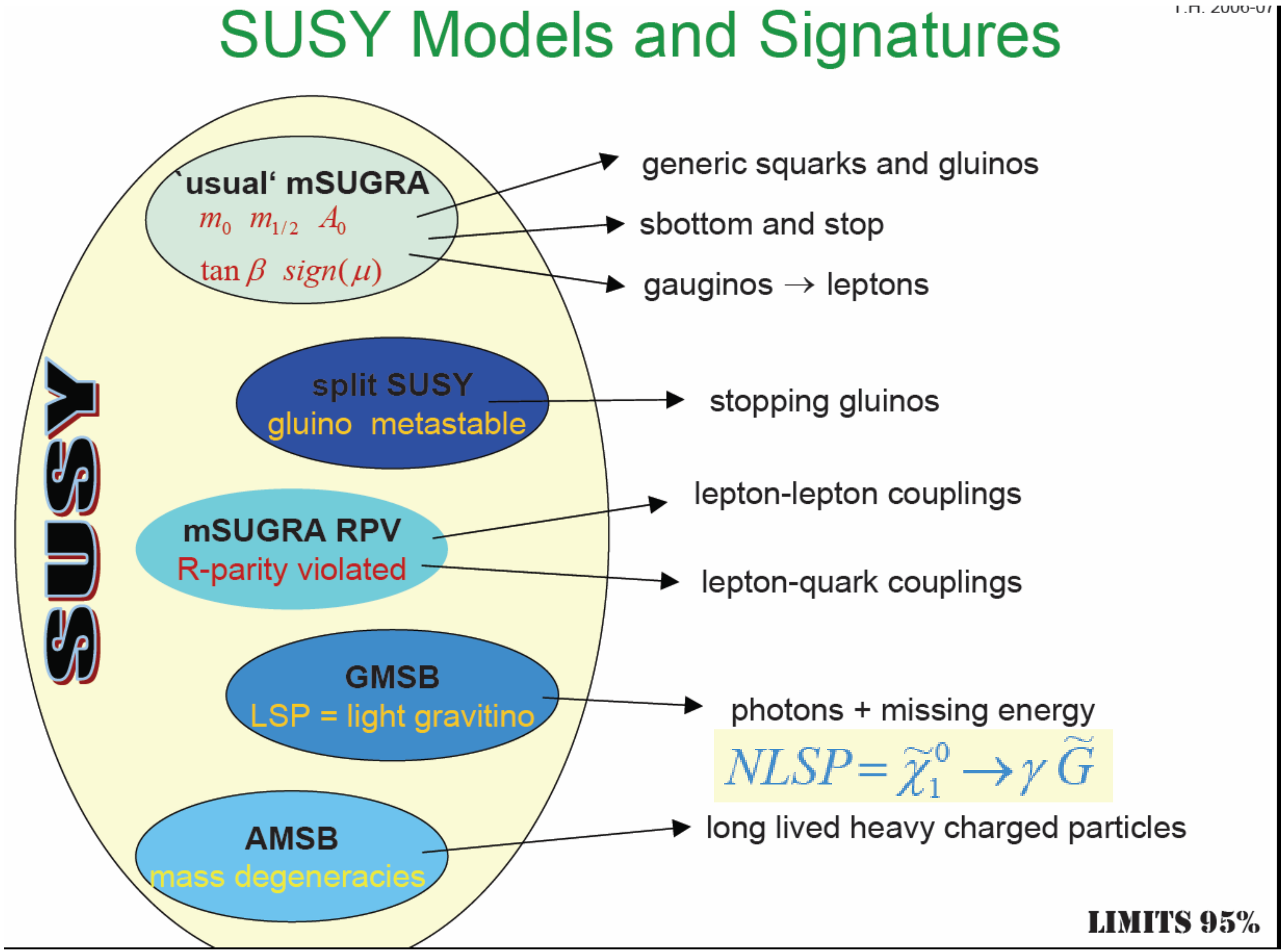


- New results for $t\bar{t} \to Hq\ Wb \to WW^*q\ Wb \to (l\nu\ l\nu j)\ (l\nu b)$
  - $\geq$ 3 isolated leptons with $p^{lep}_T > 30$ GeV
  - $p^{miss}_T > 45$ GeV
  - $\geq$ 2 jets with $p^{jet}_T > 30$ GeV, incl. $\geq$ 1 jet with b-tag
  - kinematic cuts to take advantage of angular and other correlations

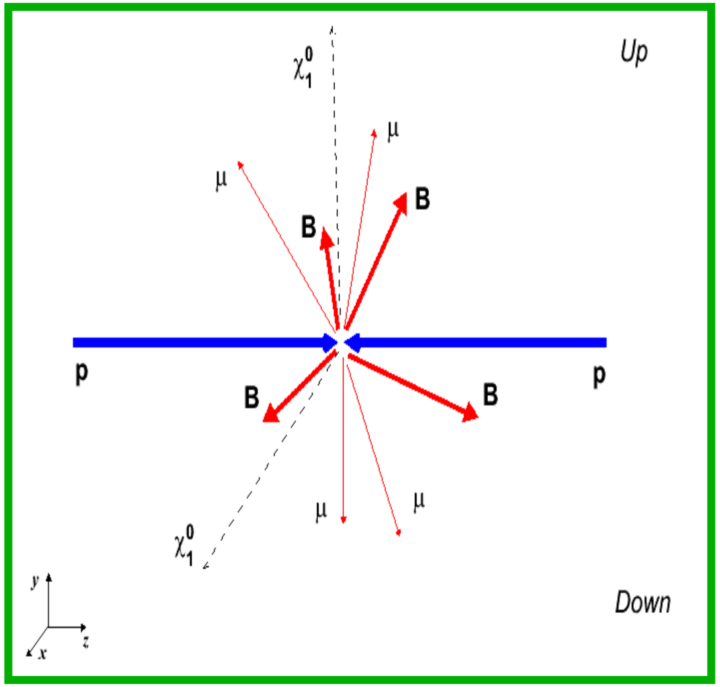


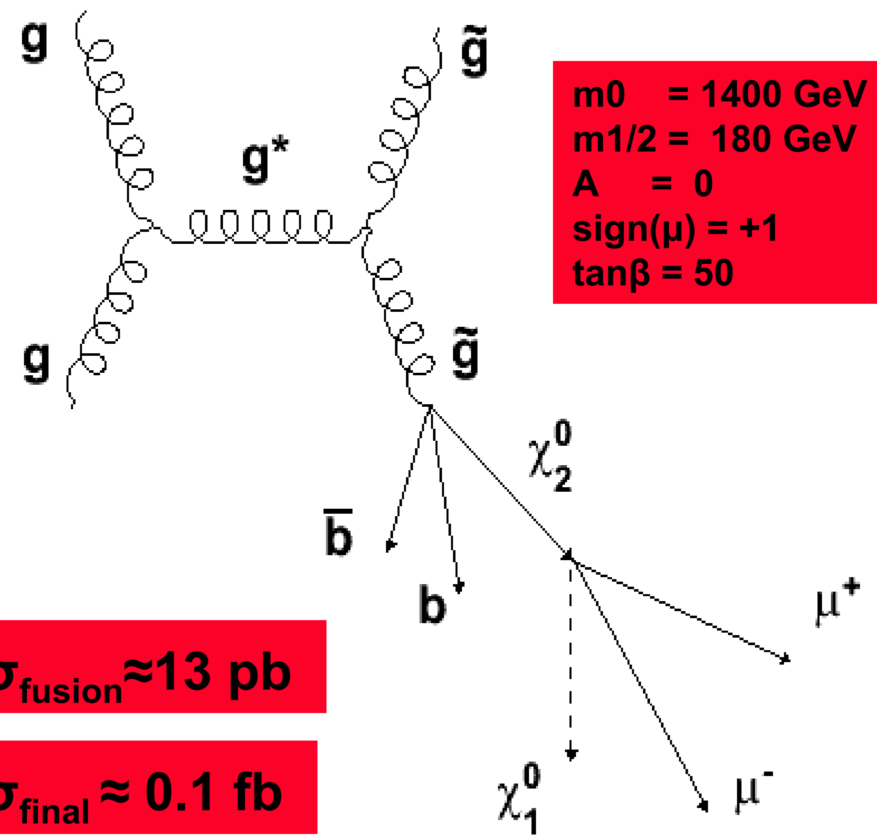
- Sensitive to $Br(t \to Hq) = 2.4 \times 10^{-3}$
  for m_H = 160 GeV ($100\ fb^{-1}$)

Study of the Possibility for ATLAS Observation of SUSY-like Signal from Two Gluinos



Study of the Possibility for ATLAS Observation of SUSY-like Signal from Two Gluinos





m0 = 1400 GeV
m1/2 = 180 GeV
A = 0
sign(μ) = +1
tanβ = 50

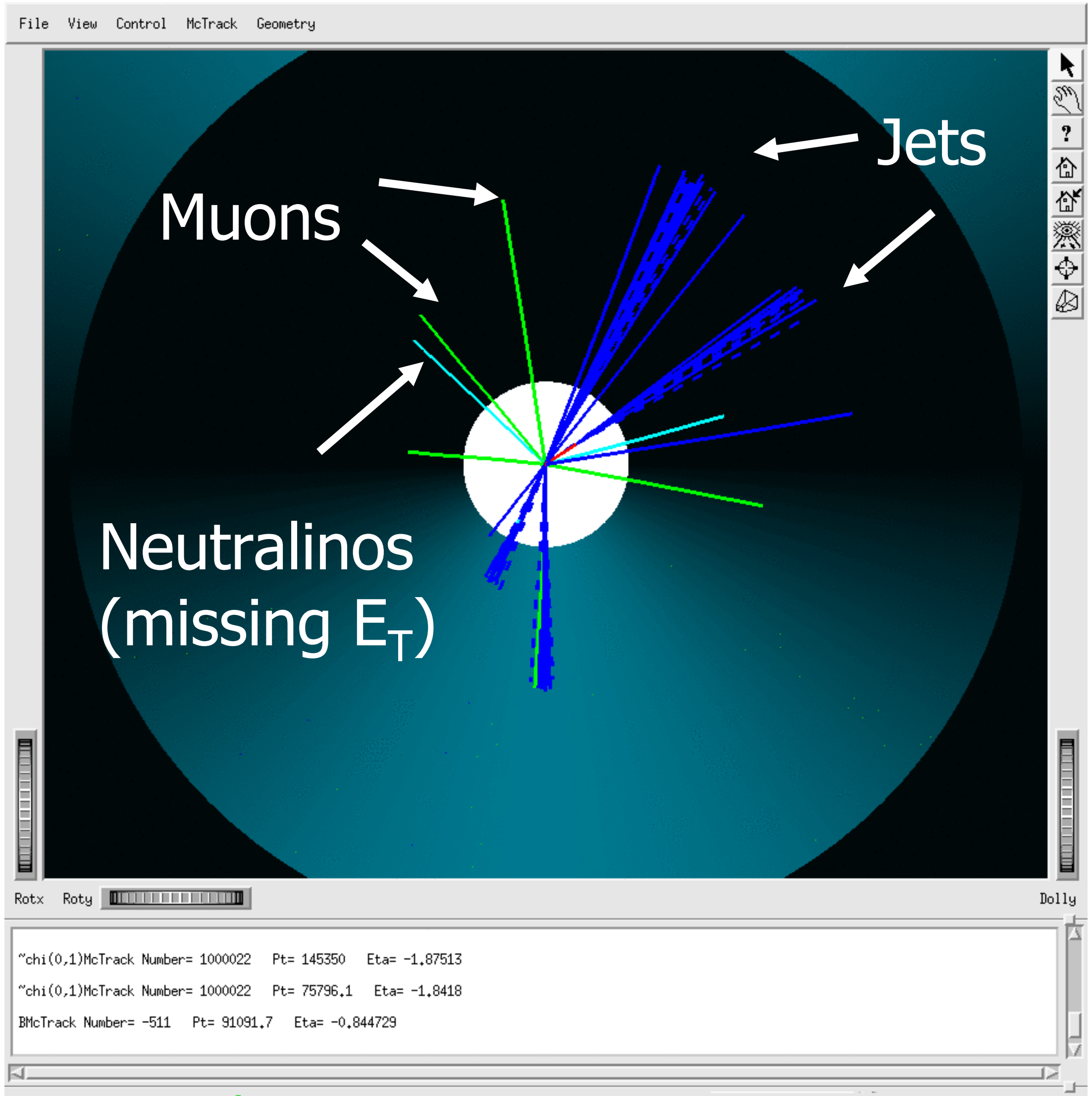
$\sigma_{fusion} \approx 13$ pb

$\sigma_{final} \approx 0.1$ fb

SIGNATURE:
4 b-jets + 4 muons + E_T^{miss}

LARGE!

Study of the Possibility for ATLAS Observation of SUSY-like Signal from Two Gluinos

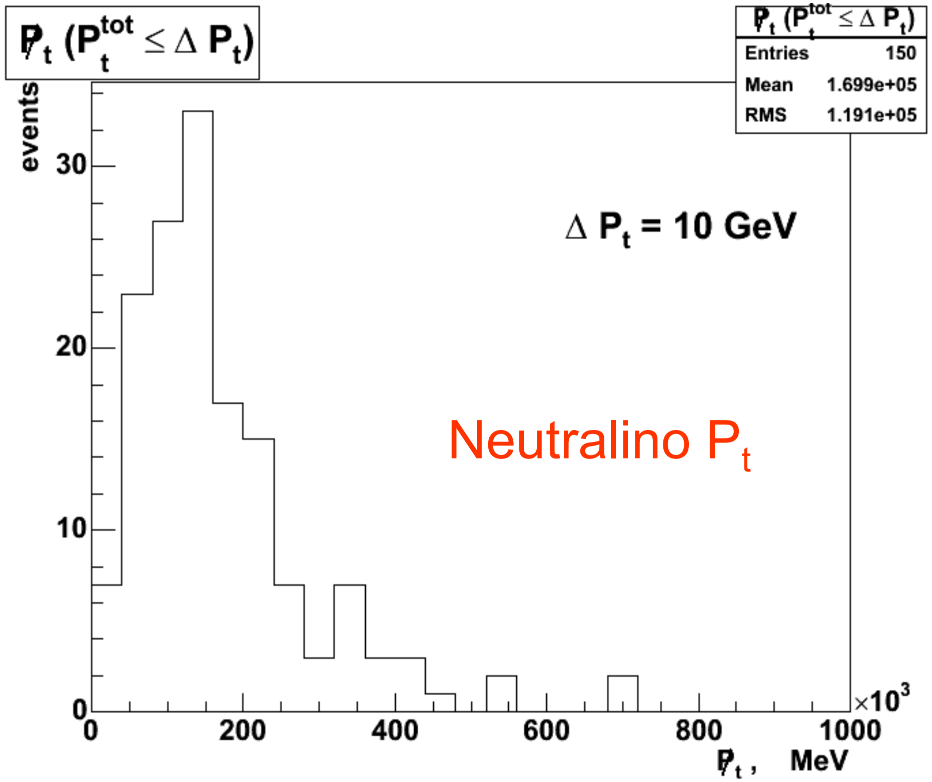


Study of the Possibility for ATLAS Observation of SUSY-like Signal from Two Gluinos

$gg \rightarrow \tilde{g}\tilde{g}$

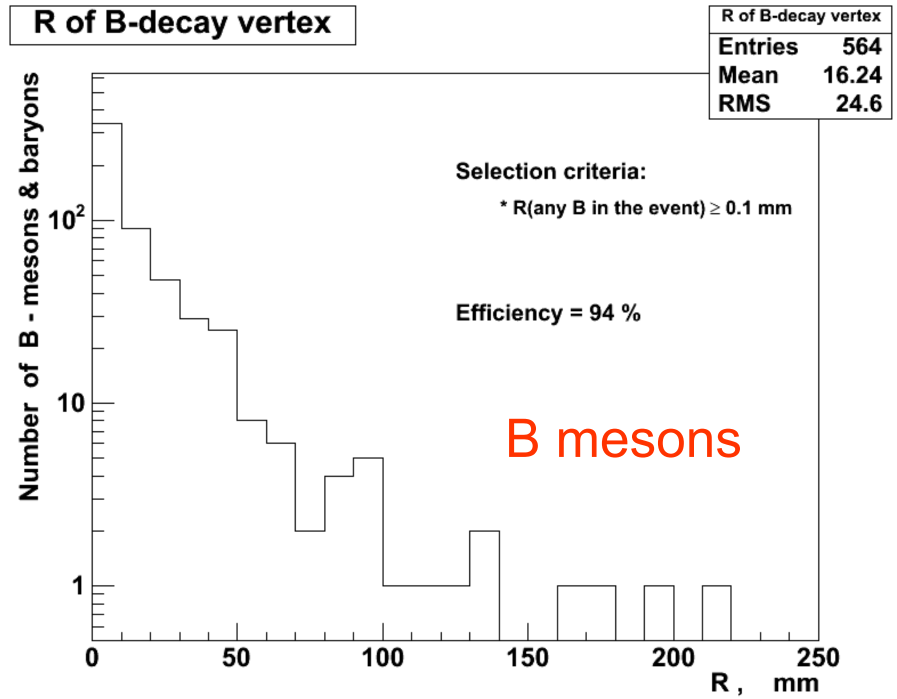
JINR(Dubna) ATLAS Group

V. Bednyakov, Y.Budagov, G. Khoriauli, J.Khubua



Pythia within ATHENA,

B-vertex taging



$$\Sigma P_t^{B,B,\mu,\mu}\,(\text{down}) - \Sigma P_t^{B,B,\mu,\mu}\,(\text{up}) = \not{P}_t \equiv \not{E}_t$$

Summary

- The ATLAS detector is being installed and getting ready for the first physics run in 2007

- Tests of the combined electromagnetic liquid argon (LAr) and the hadronic Tile calorimeter prototypes of the future ATLAS experiment were carried out, using pion beams of energy 10÷350 GeV from CERN SPS accelerator. The analysis showed that the ATLAS hadronic Calorimeter will allow one to reconstruct the incident hadron energy with resolution and linearity within the goals of ATLAS, i.e. with the energy resolution

$$\Delta E/E = 50\%/\sqrt{E} + 3\,\%$$

within ± 1% over the full energy range of the data. The angular resolution in the φ direction for hadron showers was studied

Summary

- **Top Quark Physics (both theoretical and experimental) is and will be very active in the next years. The sensitivity of the ATLAS experiment to FCNC $t \rightarrow qX(X=Z, \gamma,g)$ and $t \rightarrow qH$ decays of top quark was performed. Different types of analysis(sequental and probabilistic) were used to obtain the FCNC branching ratio sensitivities (assuming a 5σ signal significance for discovery) or 95% CL limits on the FCNC branching ratios (in the absence of signal). The expected branching ratio sensitivities obtained be the different analysis are compatible, being in the range from 10^{-3} to 10^{-5} (for $L=100\ fb^{-1}$).**

- **Prospects for ATLAS observation of a SUSY-like signal from two gluinos $pp \rightarrow \tilde{g}\tilde{g}$ are investigated within a certain region of the mSUGRA parameter space, where the cross section of the two gluinos production via gluon-gluon fusion $gg \rightarrow \tilde{g}\tilde{g}$ is estimated at a rather high level of 13 pb.**