



TeV Scale Resonances in ATLAS

LISHEP 2011, Brazil
July 8th, 2011

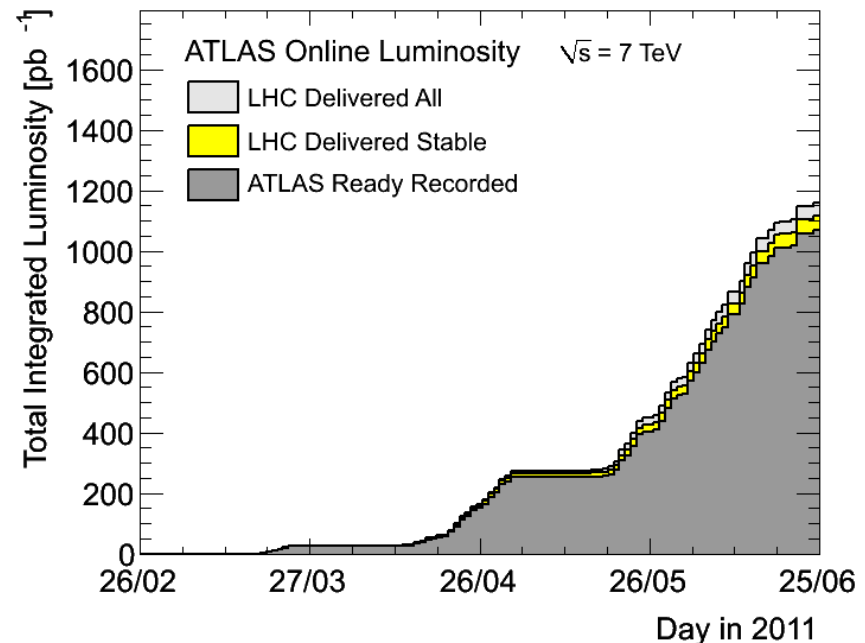


María Isabel Pedraza-Morales
University of Wisconsin-Madison
On behalf of the ATLAS Collaboration

Outline



- ❖ Brief description of the LHC and ATLAS.
- ❖ The LHC has reached a new milestone in number of particle collisions, giving $L_{\text{int}}=1 \text{ fb}^{-1}$ of data (June 17th, 2011).
- ❖ I will present you the latest ATLAS public limits on:
 - Di-jets final states
 - Di-lepton
 - Di-photons
 - Lepton and missing energy.
 - Semileptonic $t\bar{t}$.



LHC

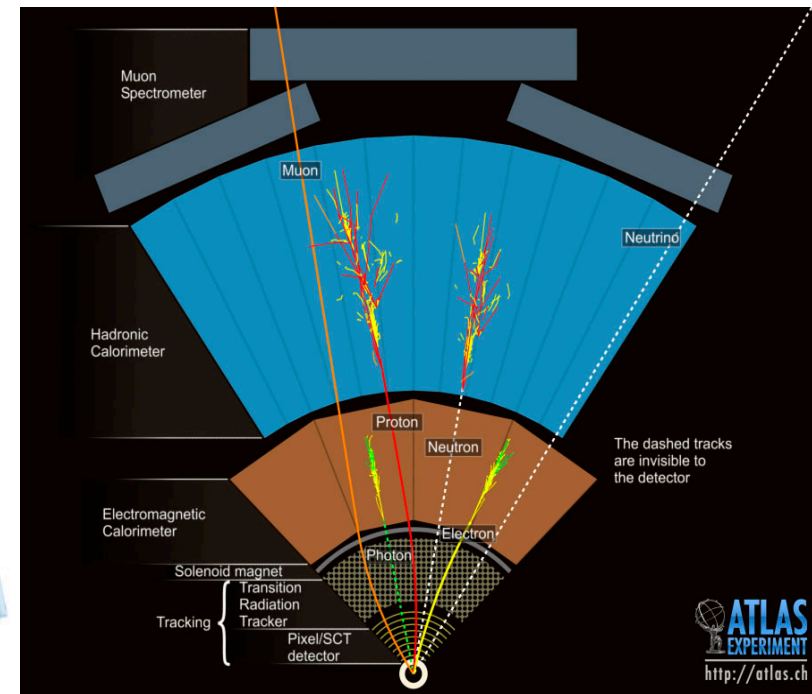
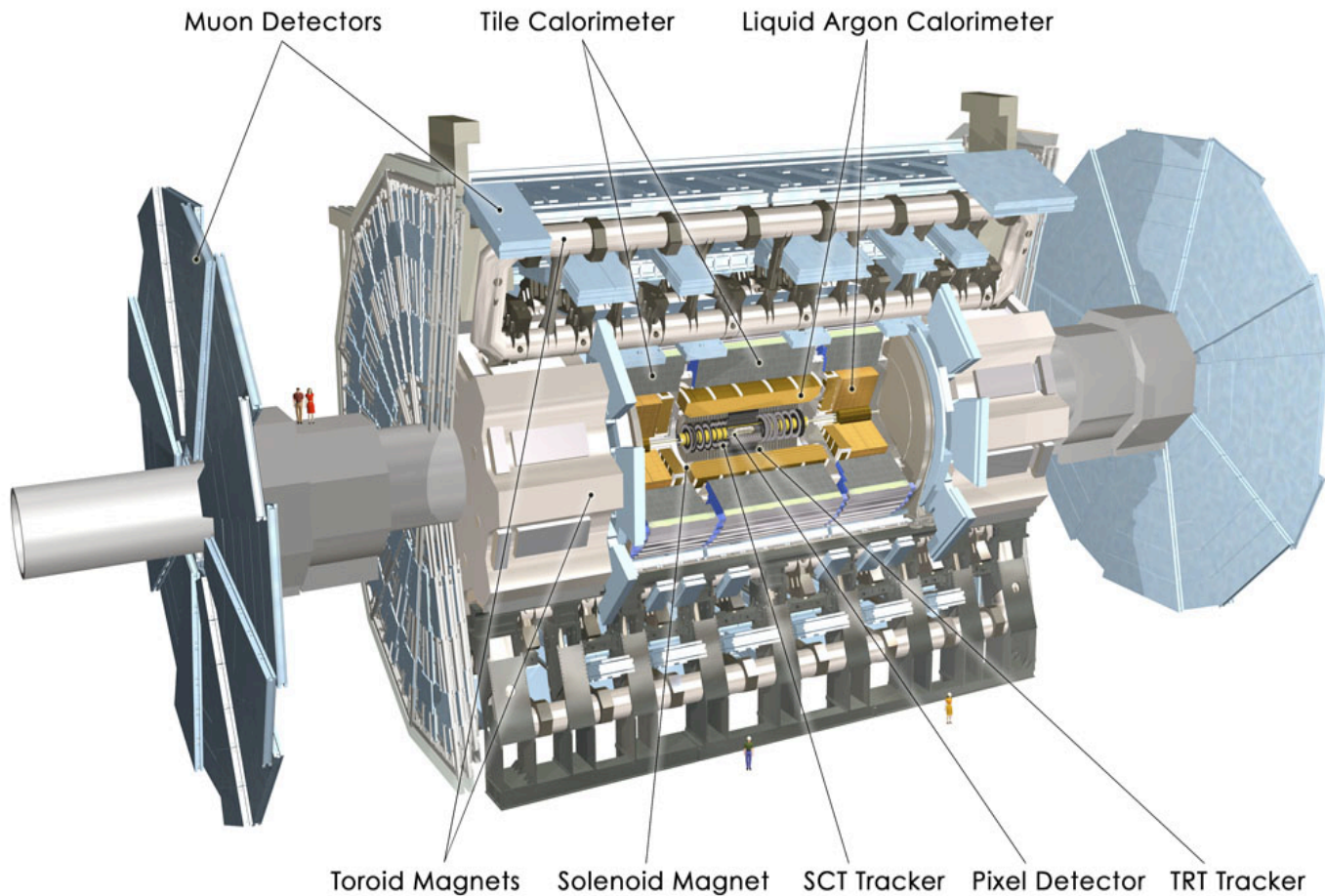
Mont Blanc

Geneva

airport



ATLAS



Tracker^[1]

Si pixels, strips + TRT (pid)

EM Calorimeter^[3]

Pb + Lar

~2% @ 50 GeV to 1% @ 200 GeV

Had. Calorimeter

Fe+scintillator / Cu + Lar

Combined Muons^[2]

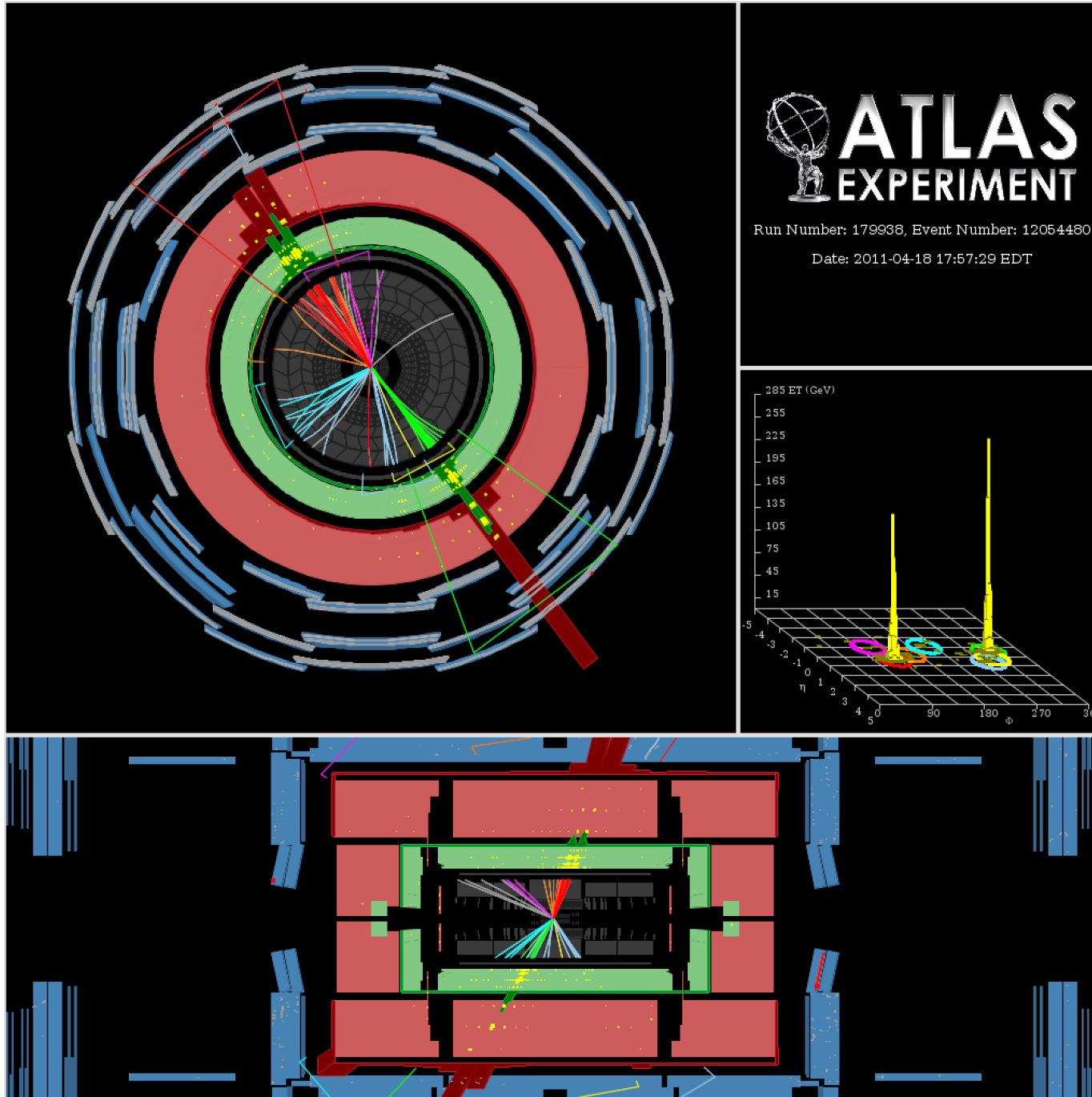
~4% @ 50 GeV to 6% @ 200 GeV

[1] ATLAS-CONF-2010-009

[2] ATLAS-CONF-2011-046

[3] CERN-PH-EP-2011-023

Di-Jet final states

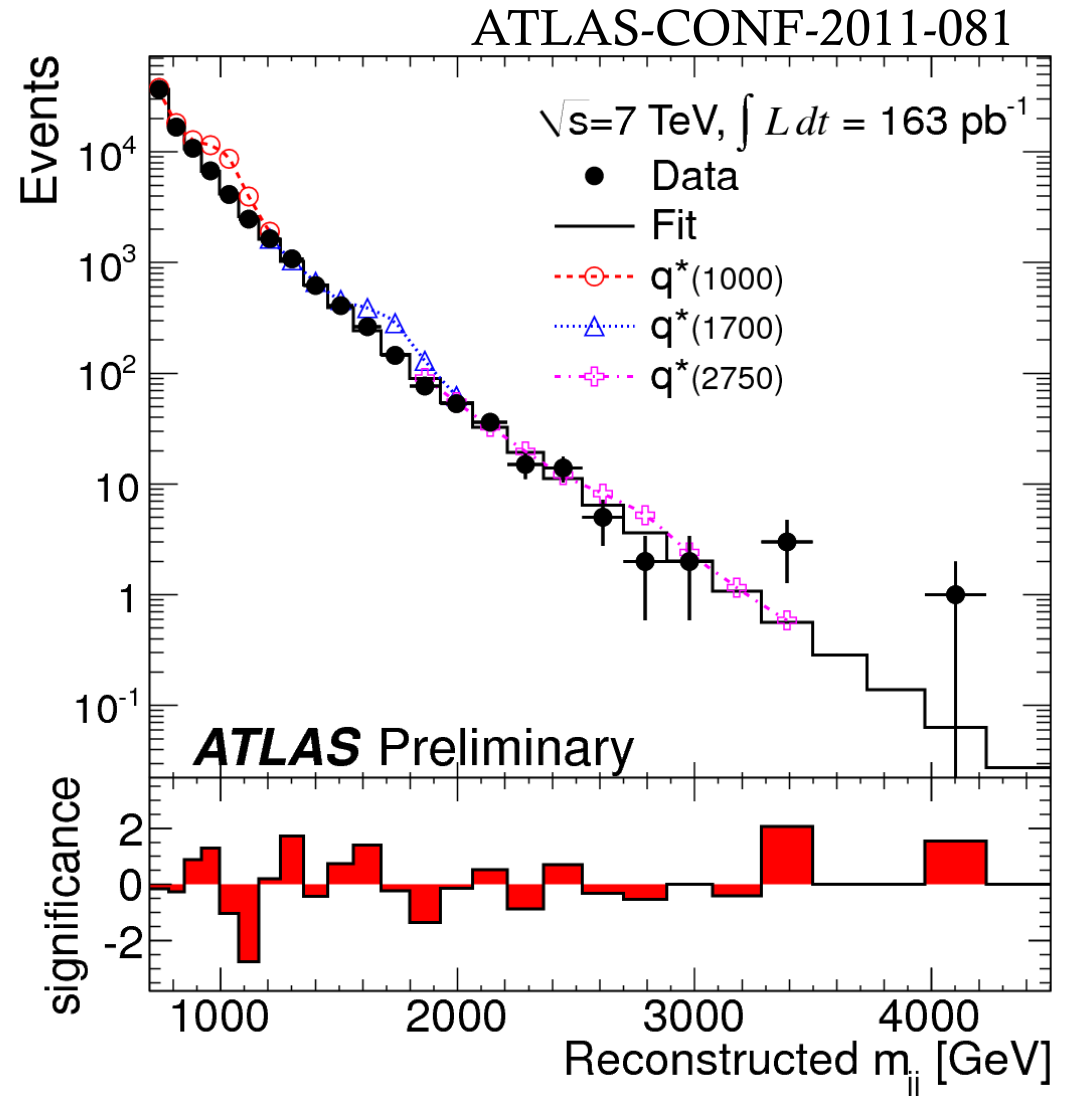


$m=4040$ GeV

Di-Jet final states

Search for:
Excited quarks.
Axigluon

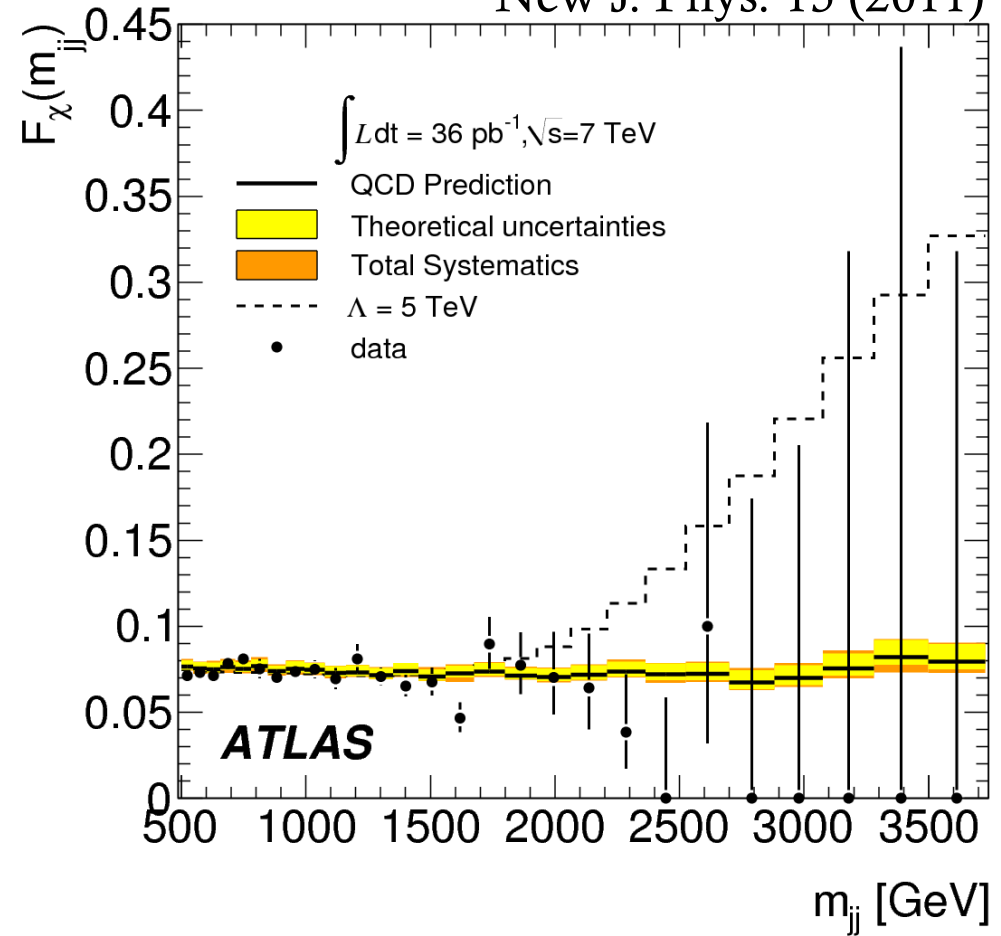
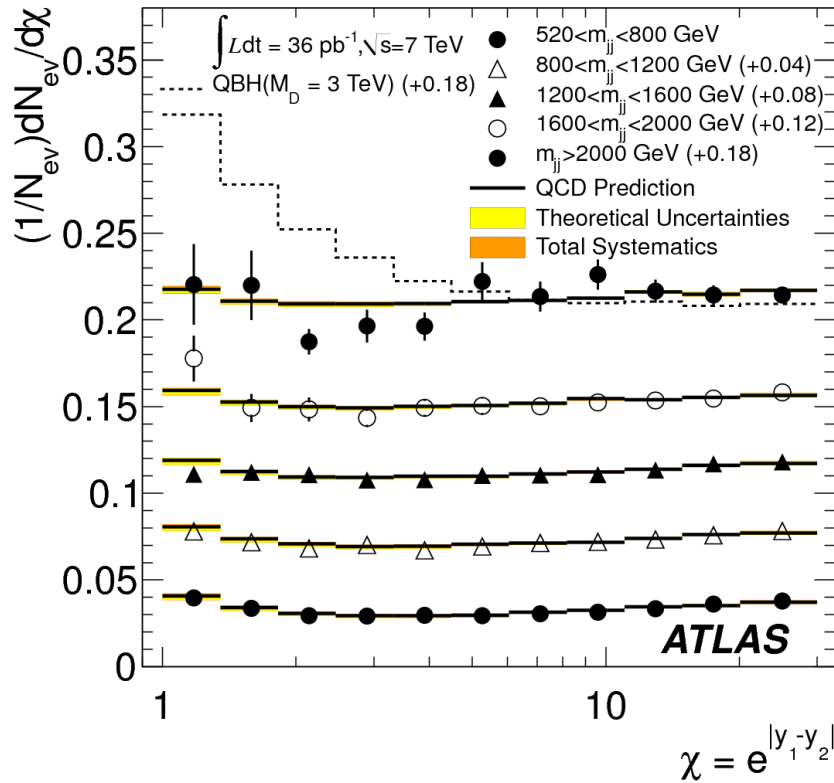
- **Observable**
 - Di-jet invariant mass.
- **Selection**
 - Two highest- p_T jets with $|\eta_j| < 2.5$ and $|\Delta \eta_{jj}| < 1.3$.
- **Background**
 - SM QCD.
- **So far no evidence of signal found.**



- Search for:
 - Quark contact interactions.

Di-Jet final states

New J. Phys. 13 (2011)



➤ Observable

- Di-jet angular distribution.

➤ Selection

- At least two jets with $p_T > 60$ GeV and $p_T > 30$ GeV.

➤ Background

- SM QCD.
- So far no evidence of signal found.

Di-Jet final states

95% C.L. Limits Observed (Expected)
(2011)

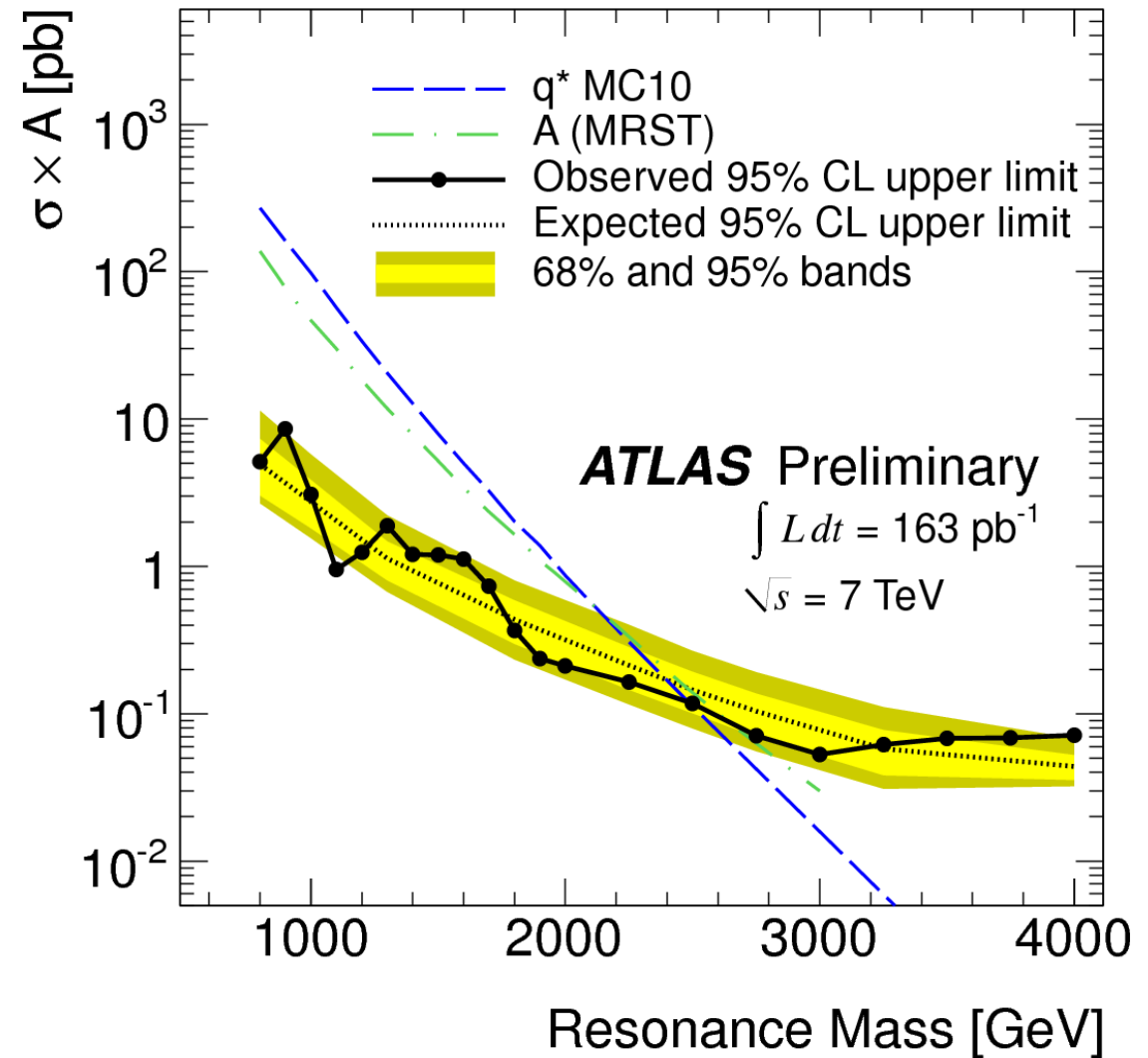
- ✓ Excited quarks (q^*)
 $M > 2.49$ (2.4) TeV
- ✓ Axiguons
 $M > 2.67$ (2.48) TeV

95% C.L. Limits Observed (Expected)
(2010)

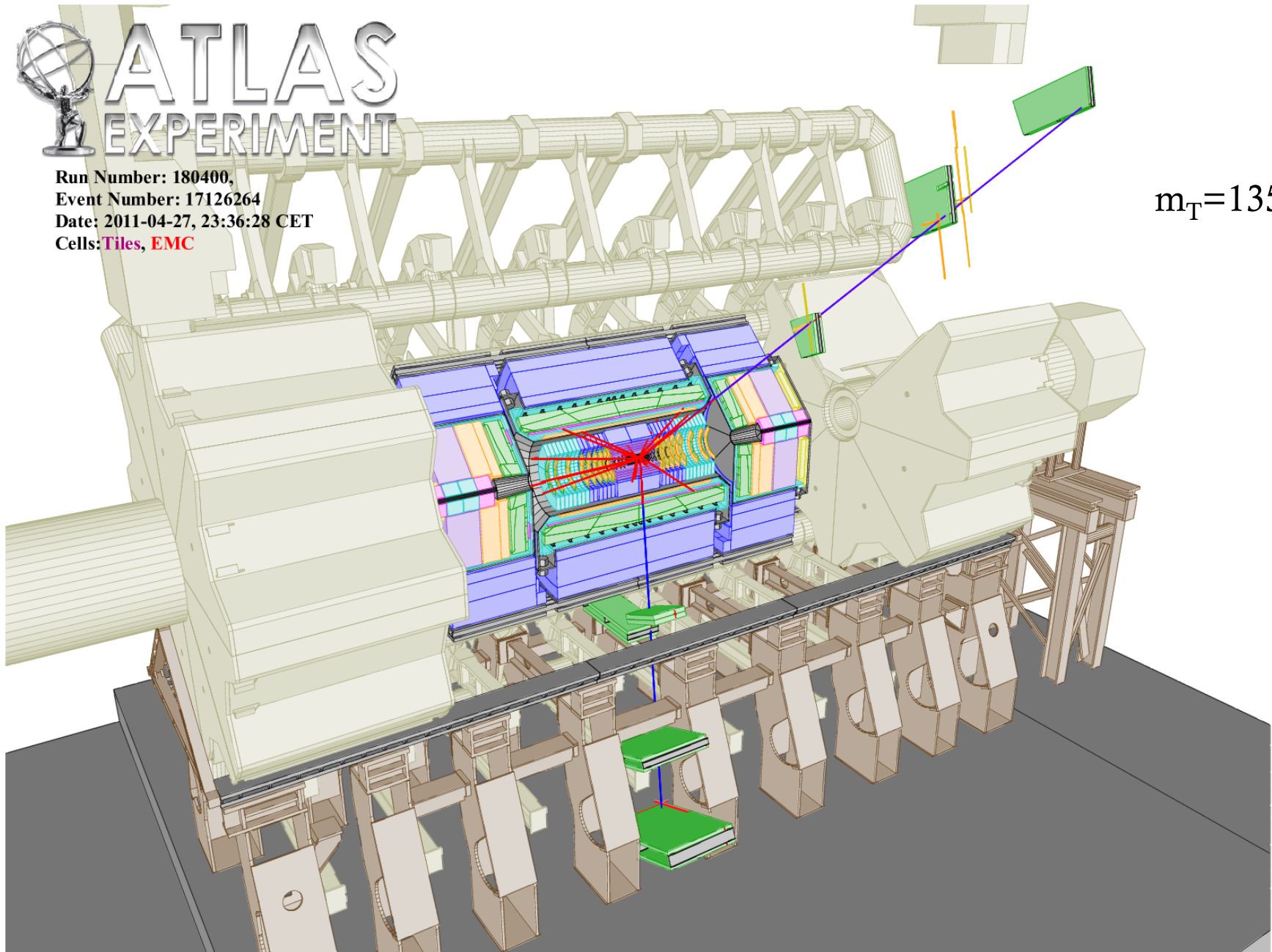
- ✓ Randall-Meade Quantum Black Hole for $n=6$
 $M > 3.67$ (3.64) TeV
- ✓ Contact Interaction
 $\Lambda > 6.7$ (5.7) TeV

Published 2010 analysis:
Phys. Lett. B694 (2011)
New J. Phys. 13 (2011) 053044 2011
update: ATL-CONF-2011-081

ATLAS-CONF-2011-081



Di-lepton final states



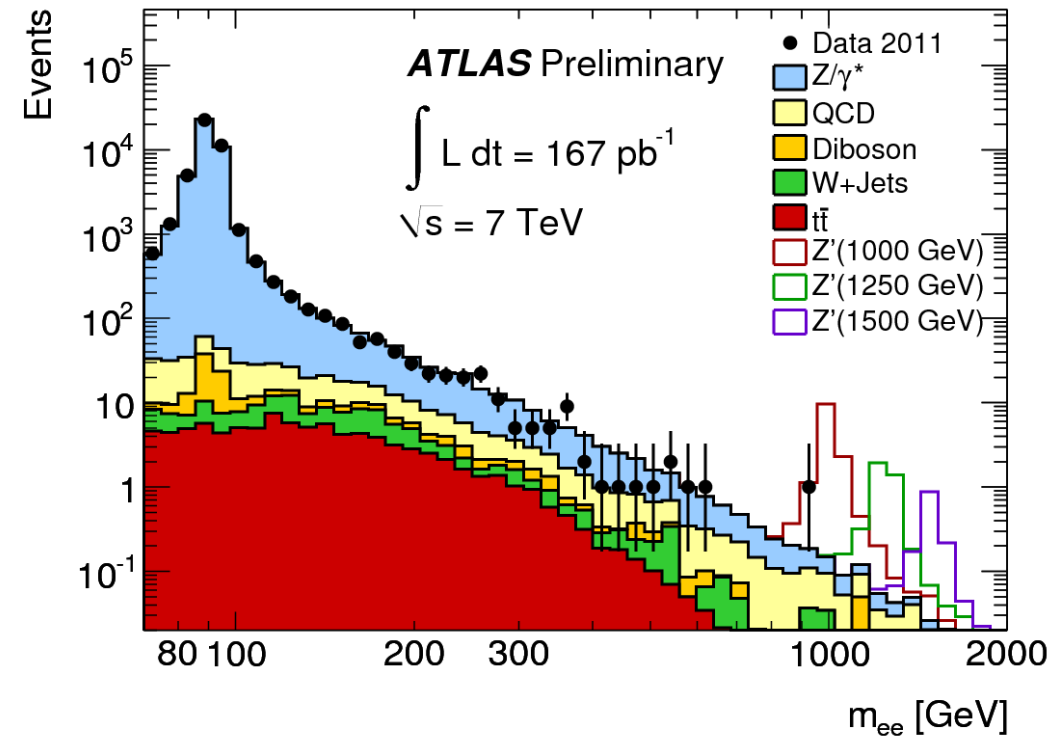
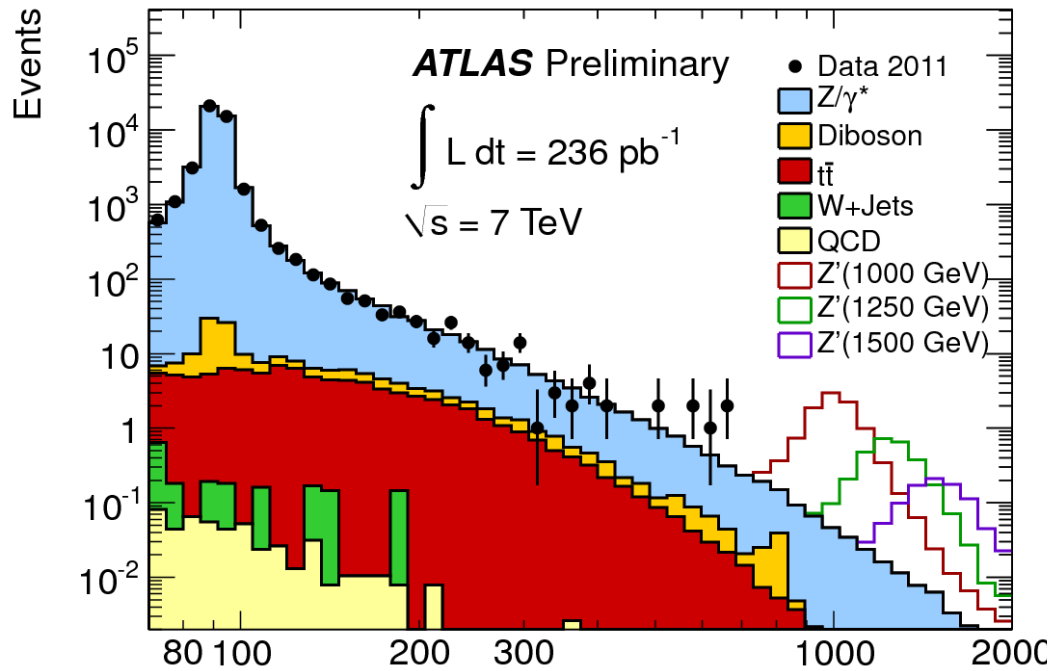
Search for:

Z'

Contact Interactions

Di-lepton final states

ATLAS-CONF-2011-083



➤ Observable

- Di-lepton invariant mass.

➤ Selection

- Select events with two leptons of same flavor (ee , $\mu\mu$).

➤ Background

- Main background SM Z.

➤ So far no evidence of signal found.

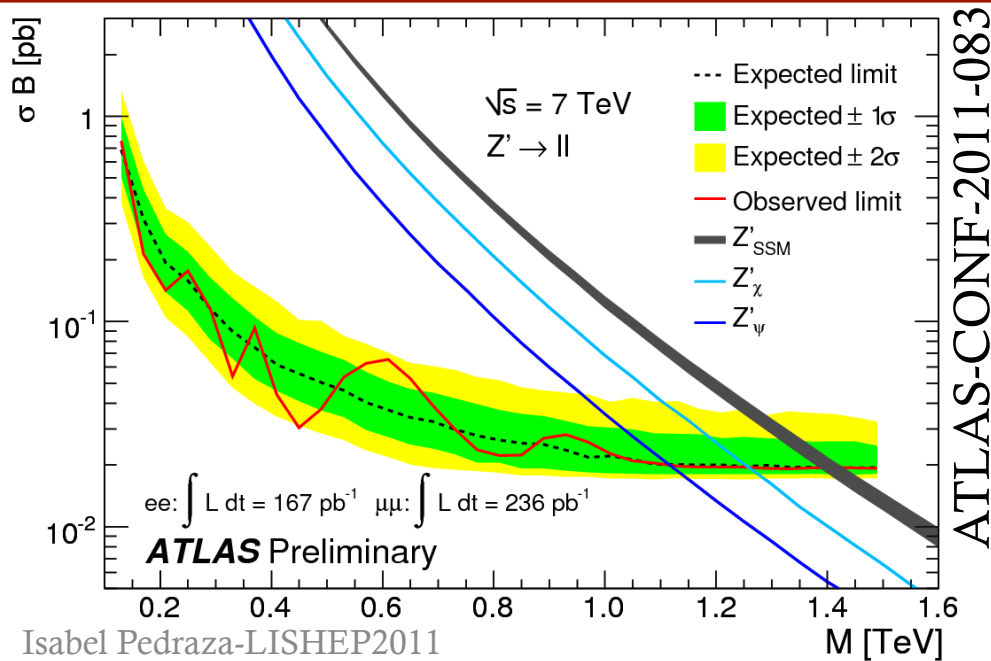
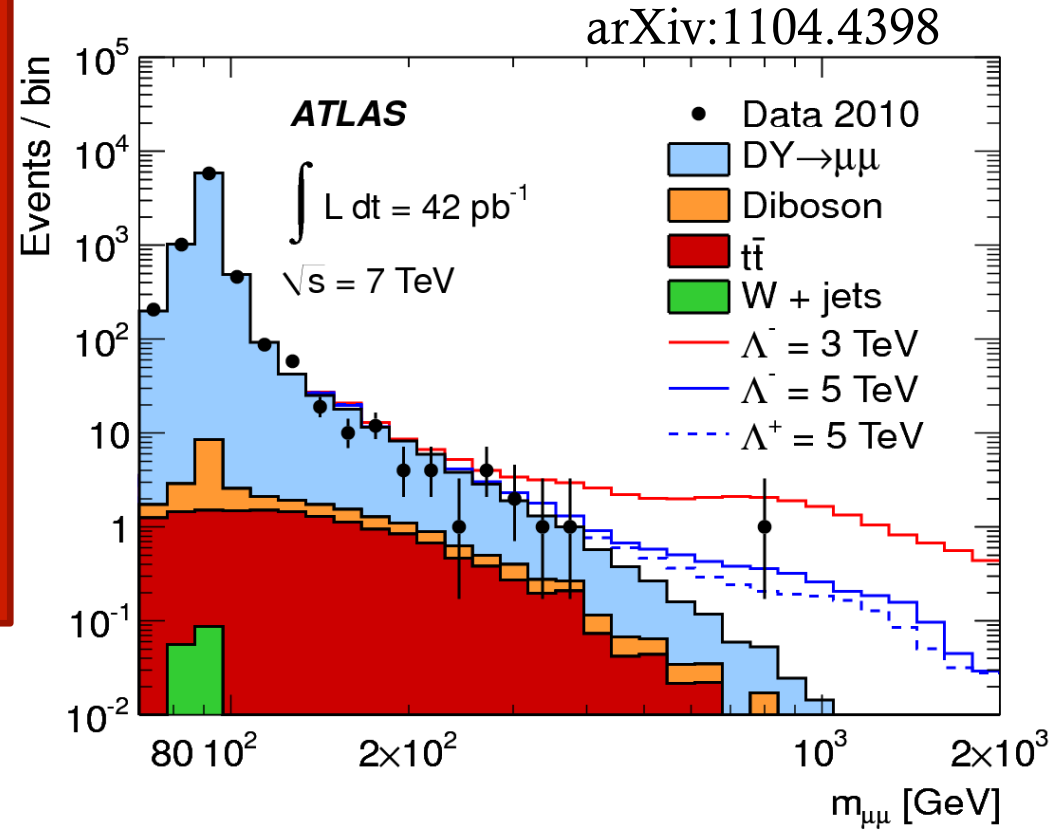
Di-lepton final states

95% C.L. Limits Observed (Expected)
(2011)

✓ Z' SSM $M > 1.407$ (1.407) TeV

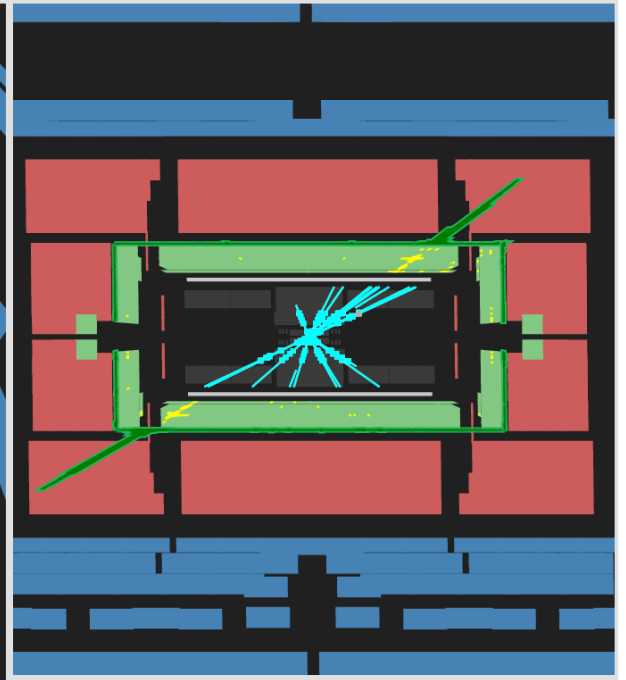
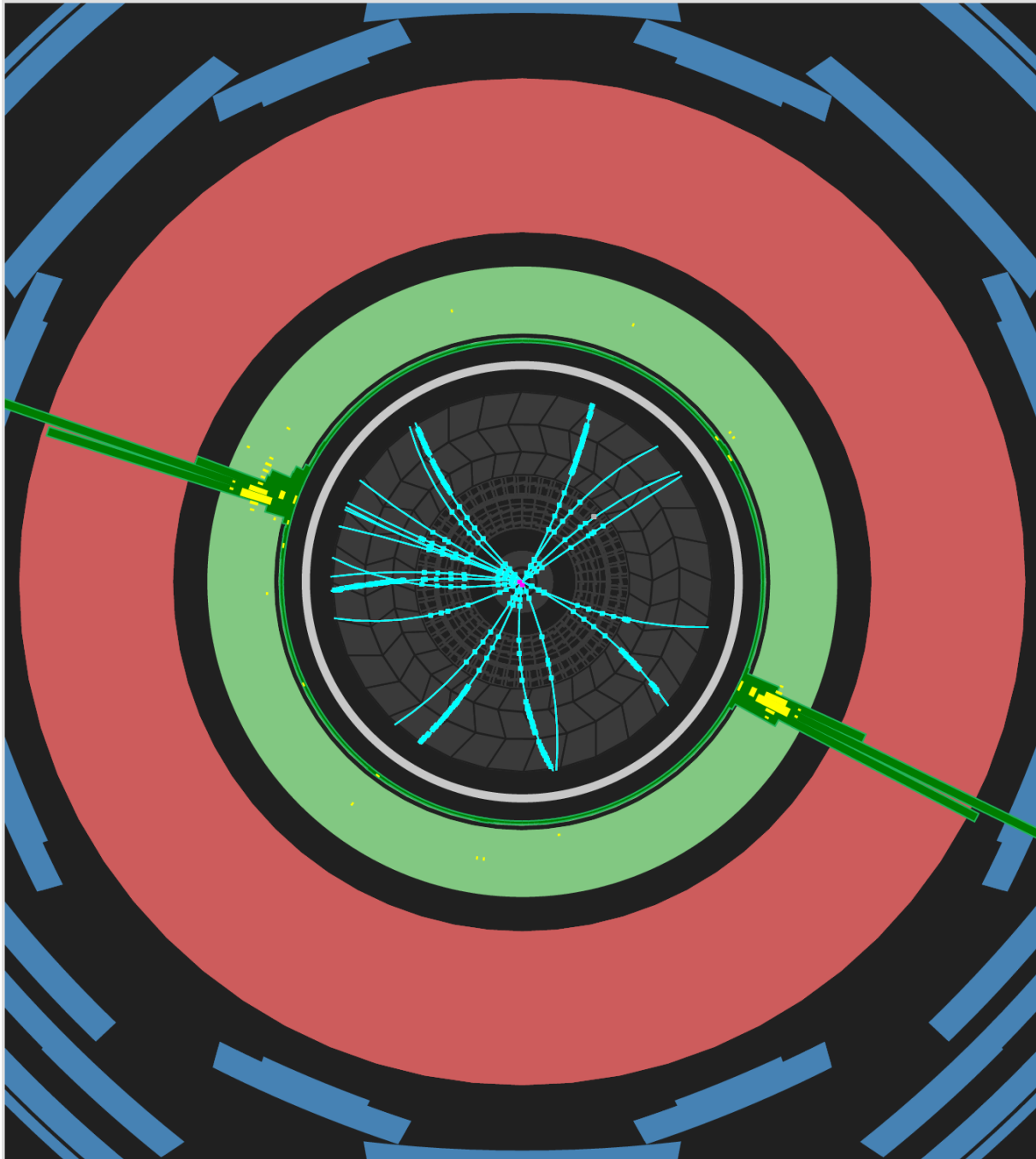
✓ E6-motivated Z' bosons M in the
range 1.116-1.259 (1.12-1.26) TeV
(2010)

✓ Contact Interaction Di-muon
 $\Lambda > 4.9$ (5.1) TeV



Published 2010 analysis:
Phys Lett B700 (2011) 163-180
arXiv:1104.4398, accepted by PRD
Update: ATL-CONF-2011-083

Di-photon final states



 **ATLAS**
EXPERIMENT

Run Number: 166786, Event Number: 77246540

Date: 2010-10-14 10:16:28 CEST

Di-photon final states

Search for:

Randall-Sundrum Graviton

Observable

- Di-photon invariant mass.

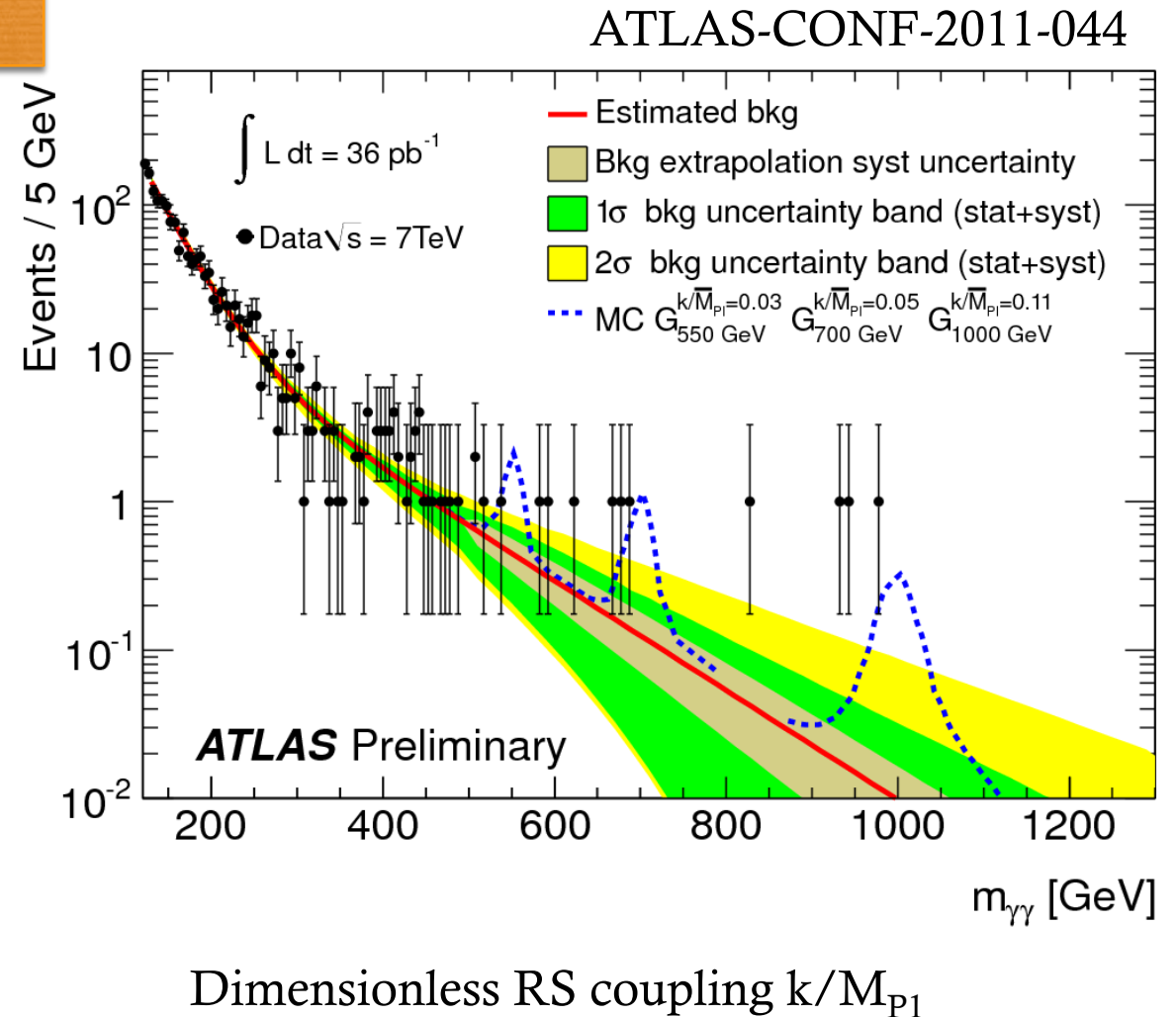
Selection

- Two photons with $p_T > 25$ GeV

Background

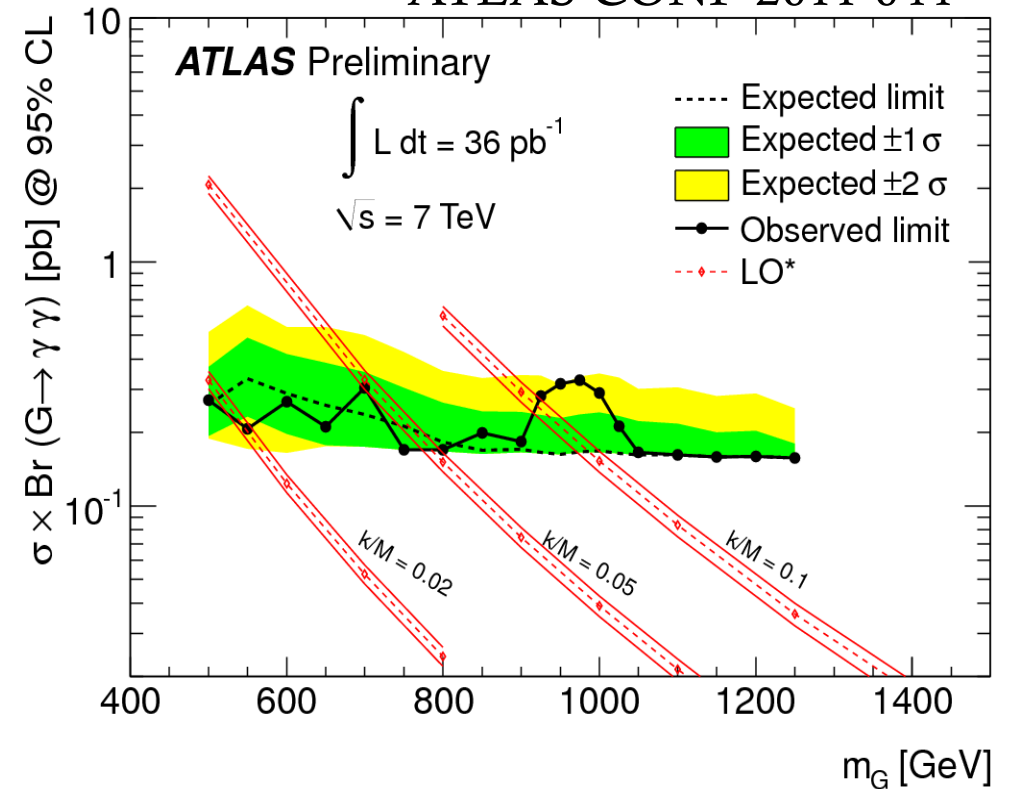
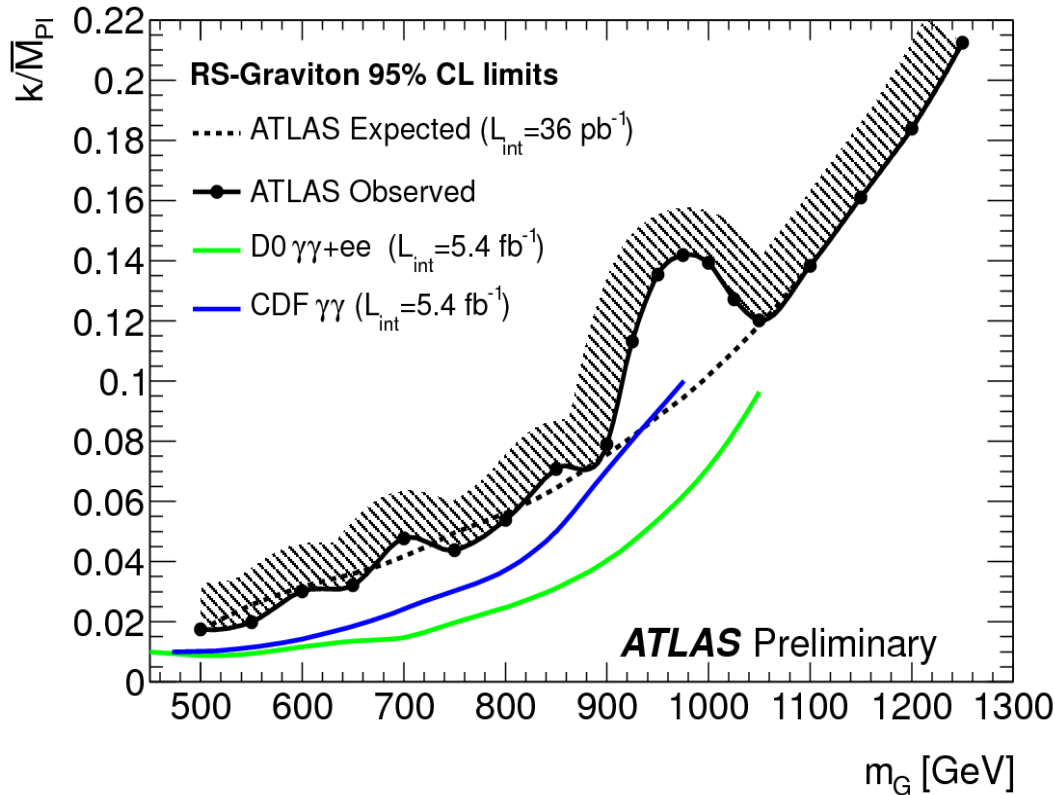
- SM di-photon production plus fakes from QCD

So far no evidence of signal found.



Di-photon final states

ATLAS-CONF-2011-044

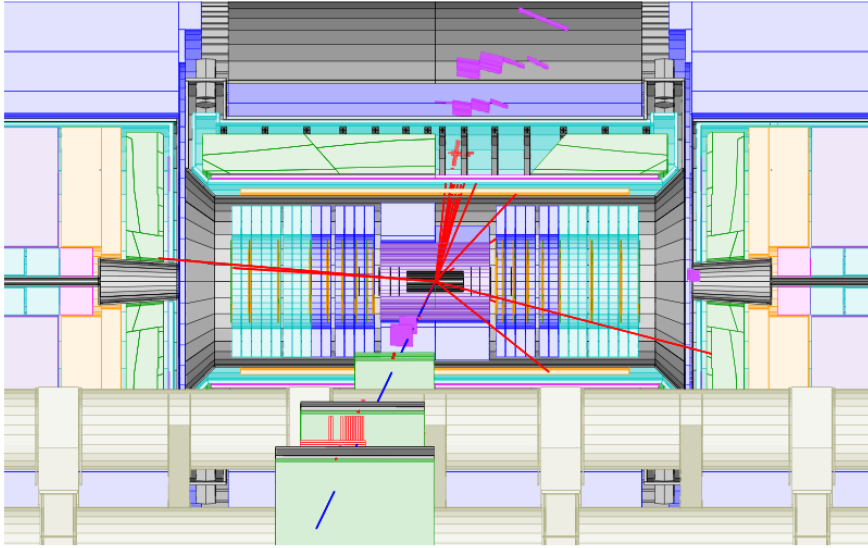


95% C.L. Limits Observed (Expected) (2010)

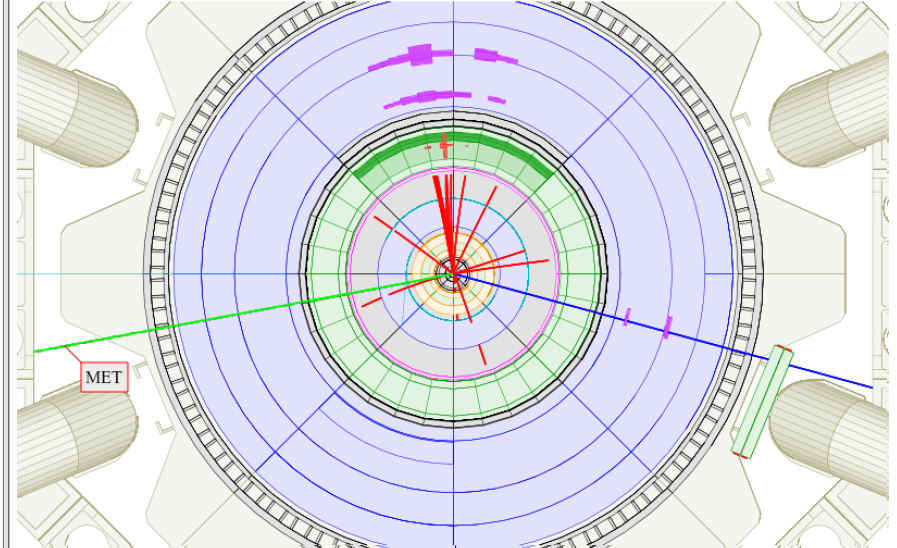
✓ $G \rightarrow \gamma\gamma$, $k/M=0.02$ $M > 545$ (503) GeV

✓ $G \rightarrow \gamma\gamma$, $k/M=0.1$ $M > 920$ (975) GeV

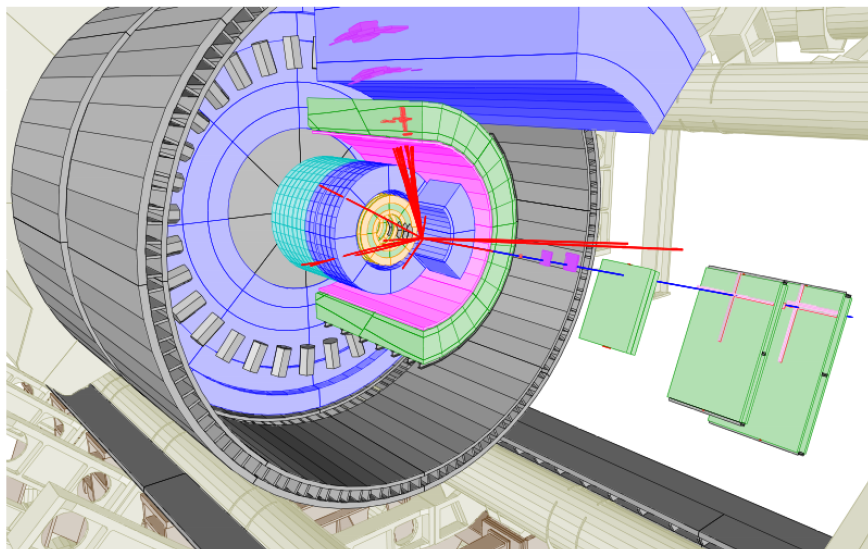
Lepton+MET final states



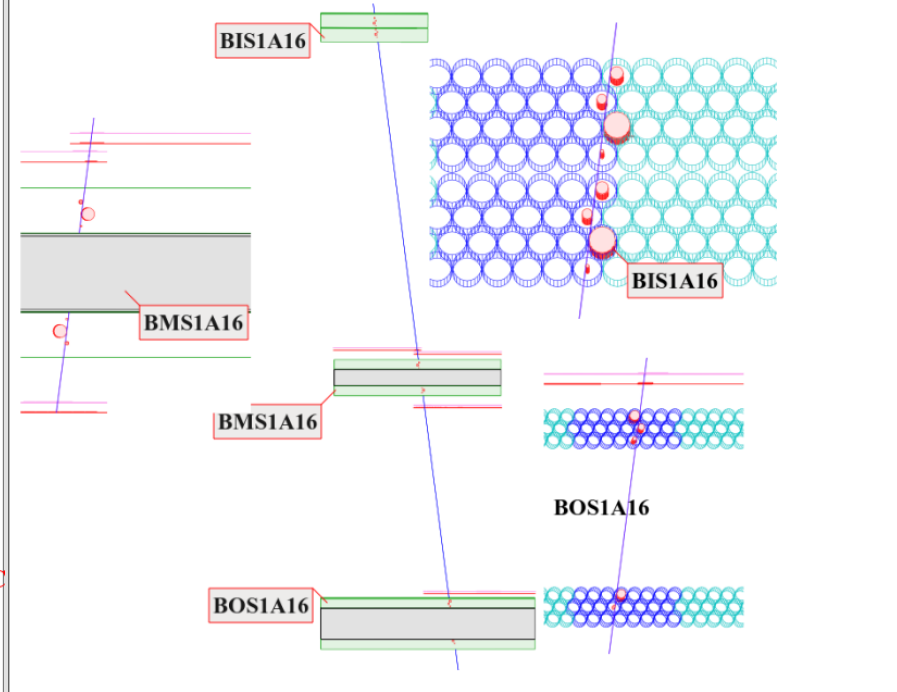
YZ view



XY view



Run Number: 180149, Cells: Tiles, EMC
Event Number: 25360846
Date: 2011-04-22, 20:17:34 CET

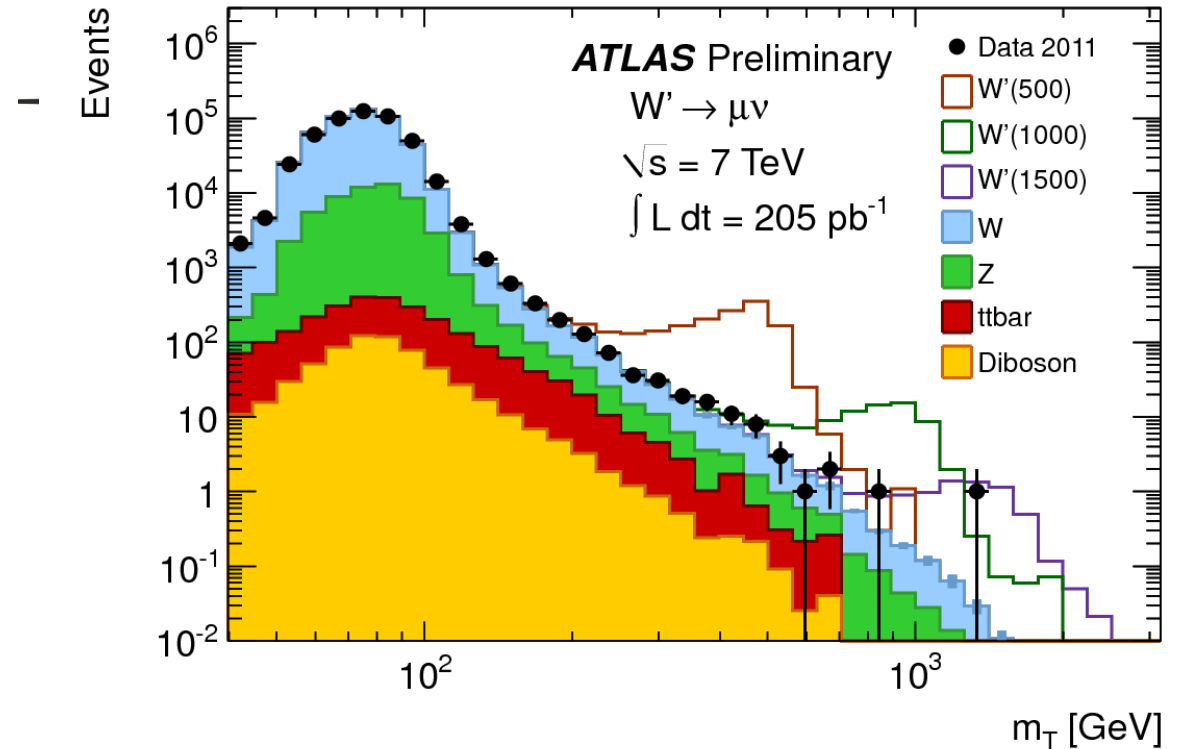
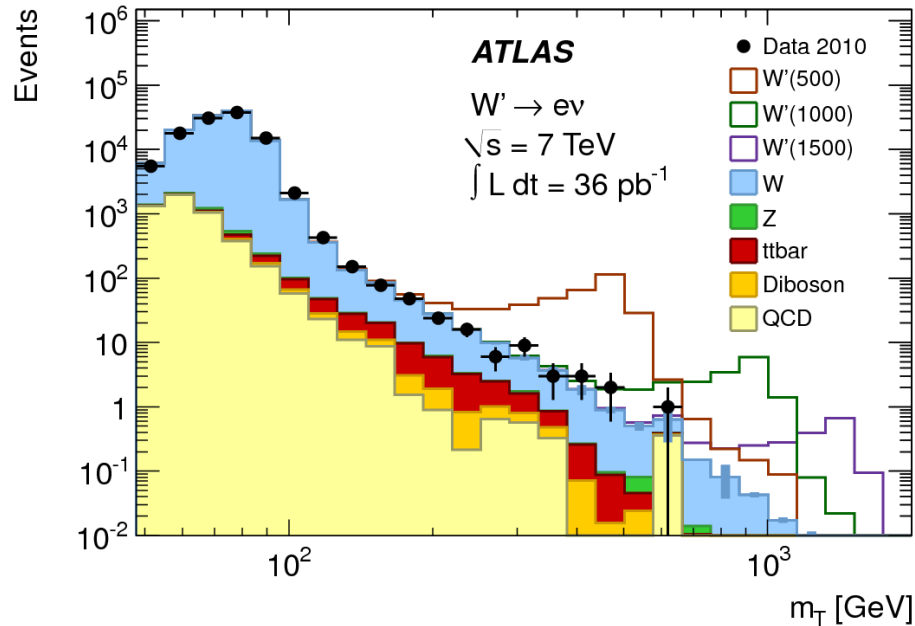


Search for:

W' SSM

W^* chiral boson

Lepton+MET final states



➤ Observable

- Transverse mass

➤ Selection

- Select events with just one high pt lepton (e, μ) and high missing energy (MET).

➤ Background

- Main background SM W.
 - Electron channel : QCD fakes.
- So far no evidence of signal found.

Lepton+MET final states

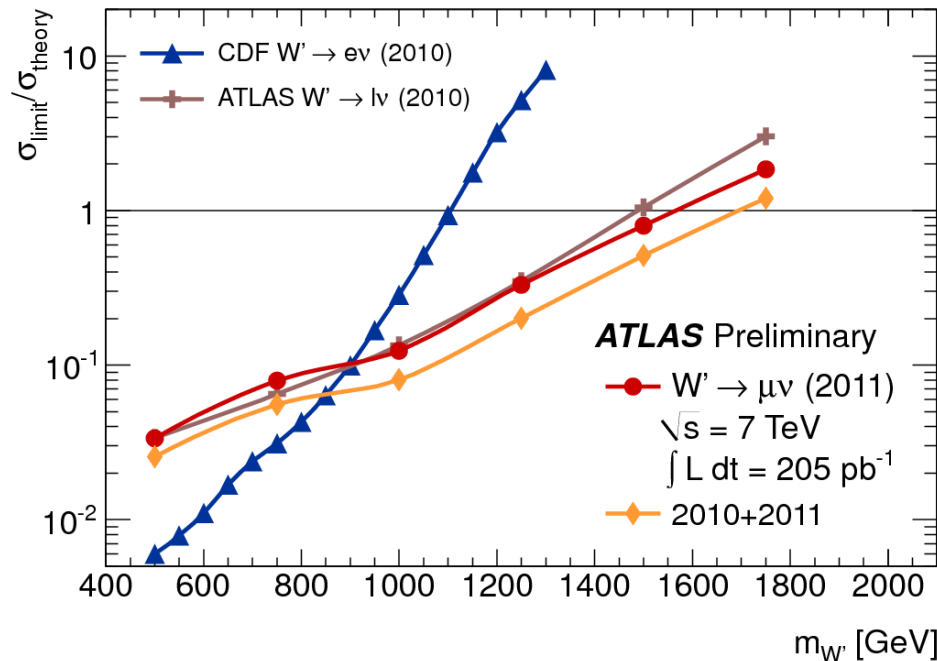
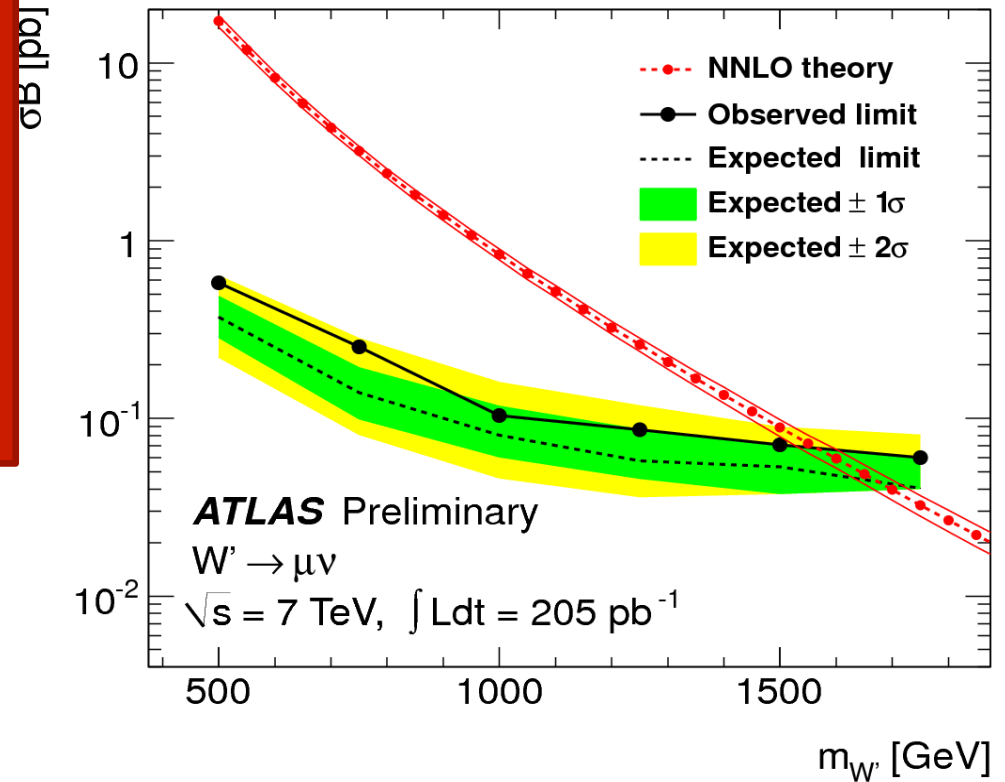
95% C.L. Limits Observed (Expected)
(2011)

✓ W' SSM $M > 1.7$ (1.76) TeV

95% C.L. Limits Observed (Expected)
(2010)

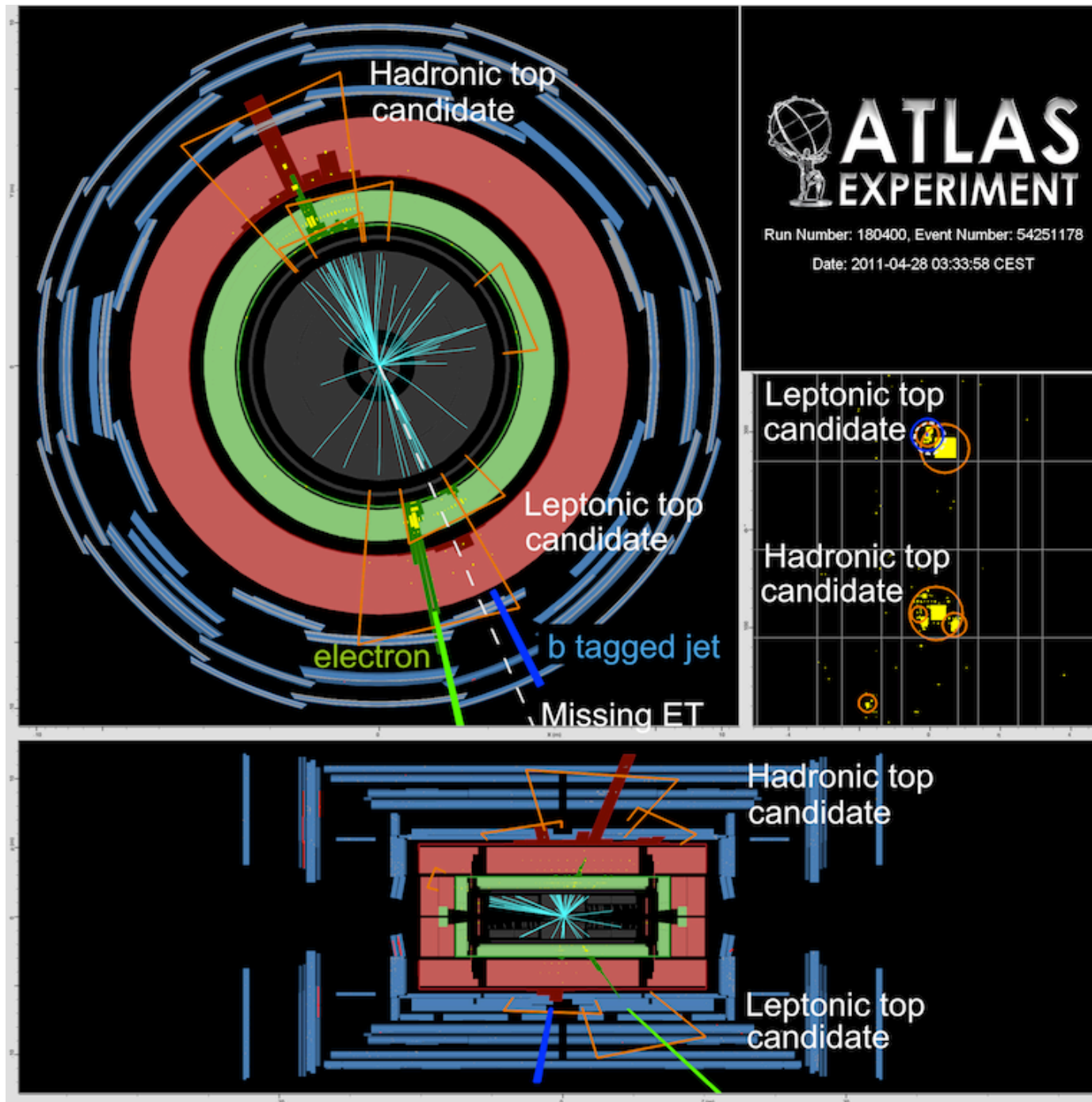
✓ W^* (chiral boson) $M > 1.35$ (1.31) TeV

ATLAS-CONF-2011-082



Published 2010 analysis:
Phys. Lett. B 701 (2011) 50
Update: ATLAS-CONF-2011-082

Semileptonic $t\bar{t}$ final states



$$m_{t\bar{t}} = 1602 \text{ GeV}$$

Semileptonic $t\bar{t}$ final states

Search for $t\bar{t}$ resonances:

- Z' (TC2 leptophobic)
- Kaluza-Klein gluon
- Quantum Black Holes

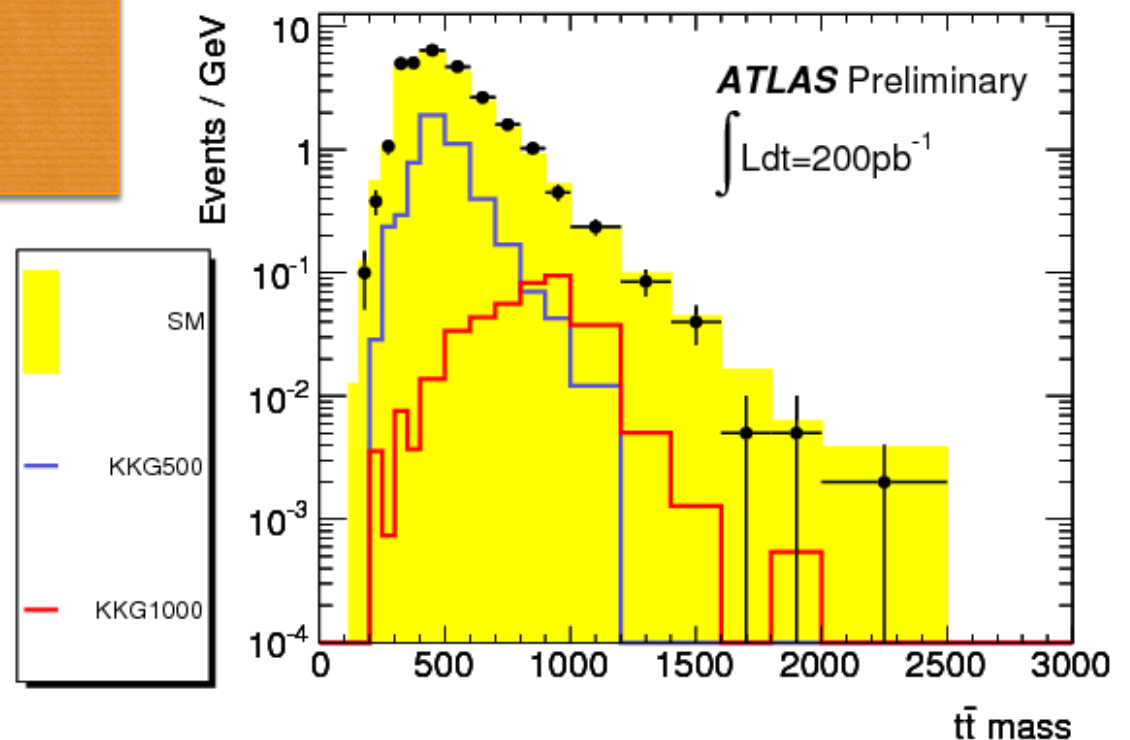
➤ Observable

- invariant mass of the jets, electron/muon and MET.

➤ Selection

- ≥ 4 non-b jets.
- ≥ 1 b-jet.
- just one lepton, $p_T > 25$ GeV.
- large missing energy.

ATLAS-CONF-2011-087

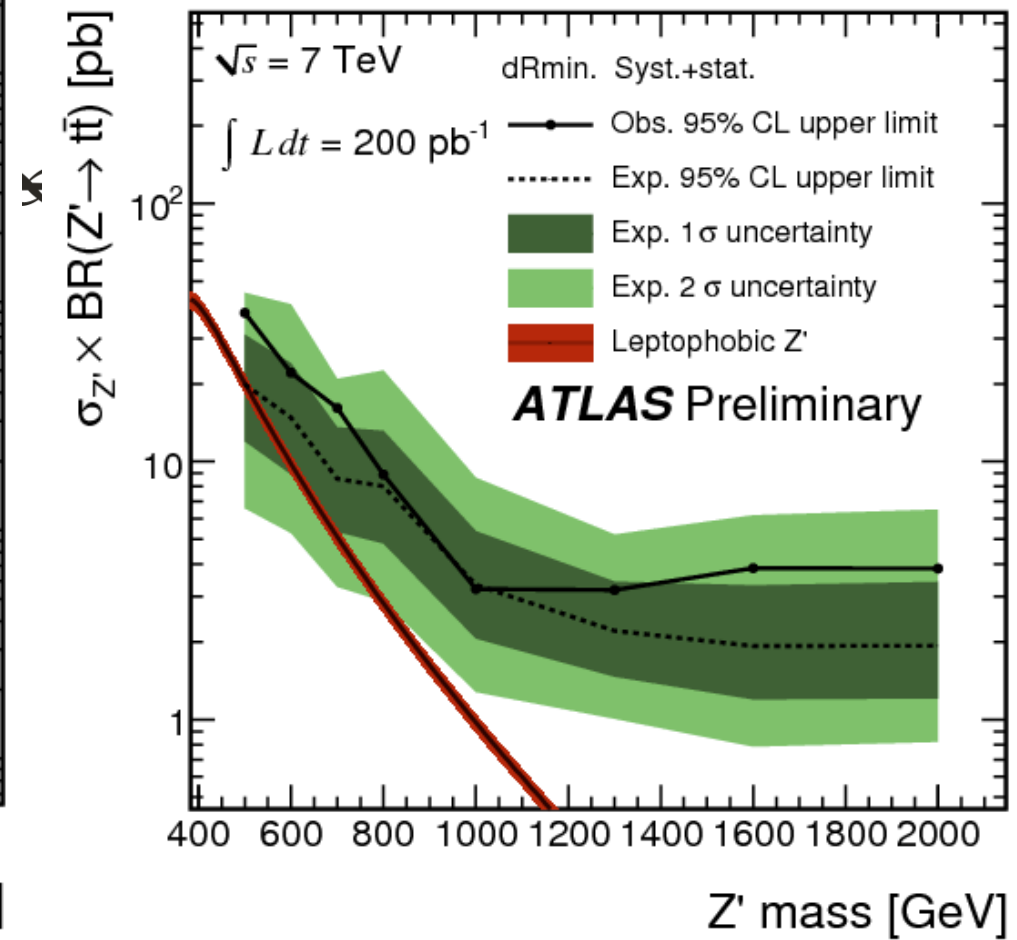
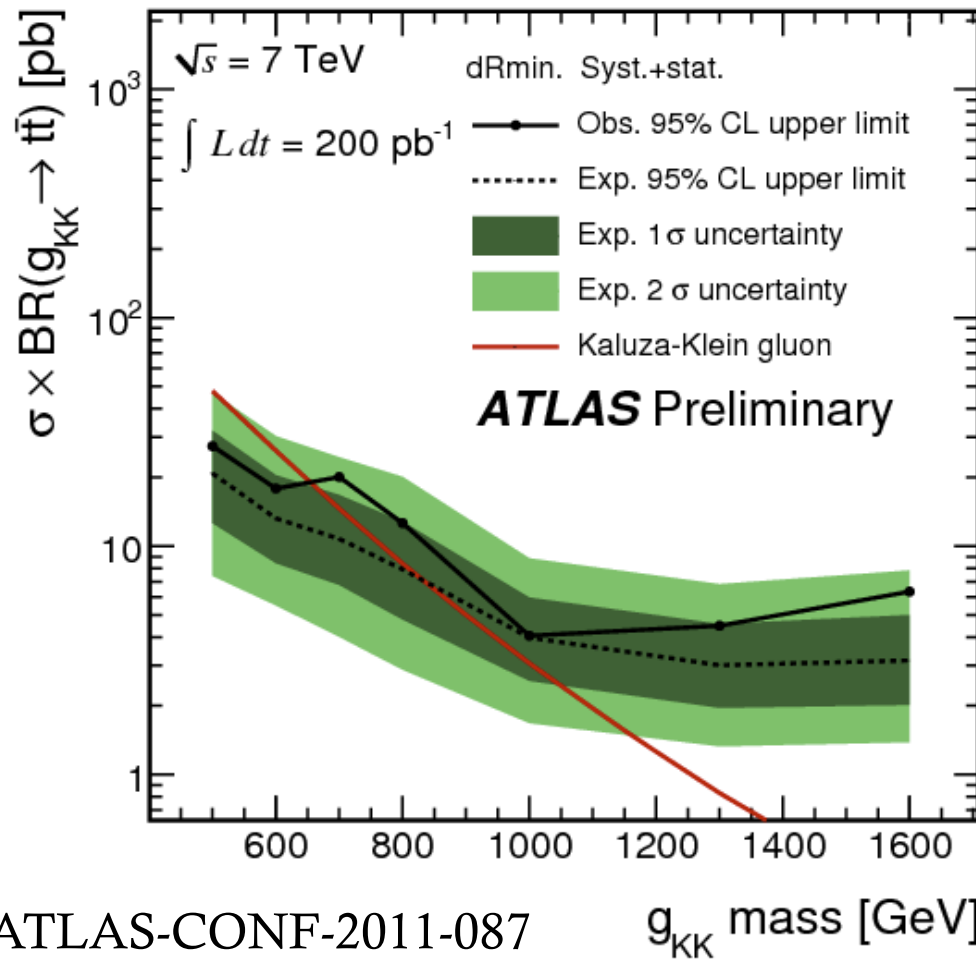


➤ Background

- Main background SM $t\bar{t}$.

➤ So far no evidence of signal found.

Semileptonic $t\bar{t}$ final states



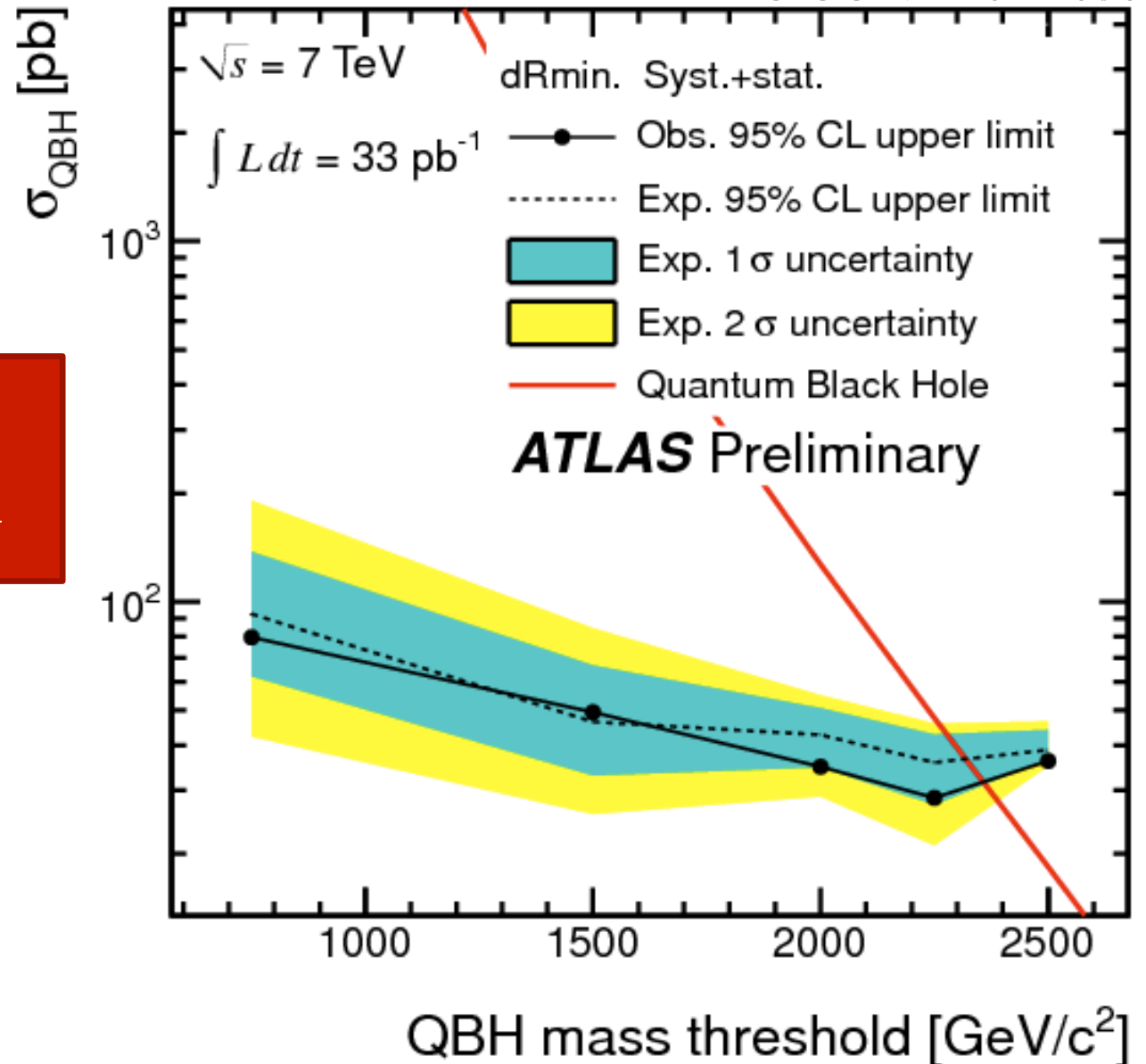
95% C.L. Limits Observed (Expected)
 (2011)
 ✓ KK-gluon $M > 650$ (825) TeV

(No limit)
 ✓ Z' TC2 Leptophobic

Semileptonic $t\bar{t}b\bar{a}$ final states

ATLAS-CONF-2011-070

95% C.L. Limits Observed
(Expected) (2010)
✓ QBH $M > 2.35$ (2.32) TeV



Channel	Model/particles	Limit [TeV]
Di-jet	Excited Quarks	2.49
	Axigluon	2.67
	RM QBH	3.64
	Contact Interaction	5.72
Di-lepton	Z'	1.41
	E6 Z'	1.12-1.26
	Contact Interaction	4.9
Di-photon	RS Graviton	0.54-0.92
Lepton+MET	W'	1.7
	W*	1.35
Lepton+Jets	KK-gluon	0.65
	QBH	2.35

- ∞ 2010 data already allowed us to set limits beyond Tevatron results.
- ∞ Very successful LHC run in 2011, more than 1 fb^{-1} of data collected so far.
- ∞ Many TeV scale limits have been set, some of them world's best limits.

In Orange Best Worlds Limits

BACKUP

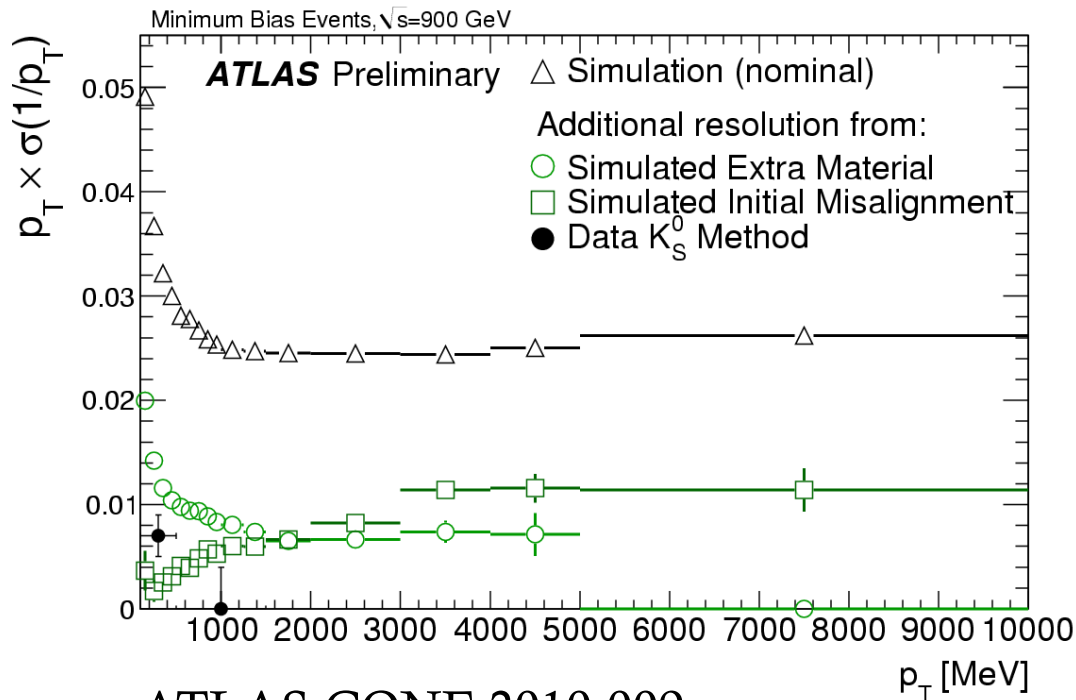




	ATLAS
Weight	7000 tons
Diameter	22 m
Length	46 m
Peak B Field	2T solenoid, 3.9T (peak) BA toroid, 4.1T (peak) EC toroids

Electrons

☞ The QCD cross sections at LHC are 10 to 100 times higher than at the Tevatron



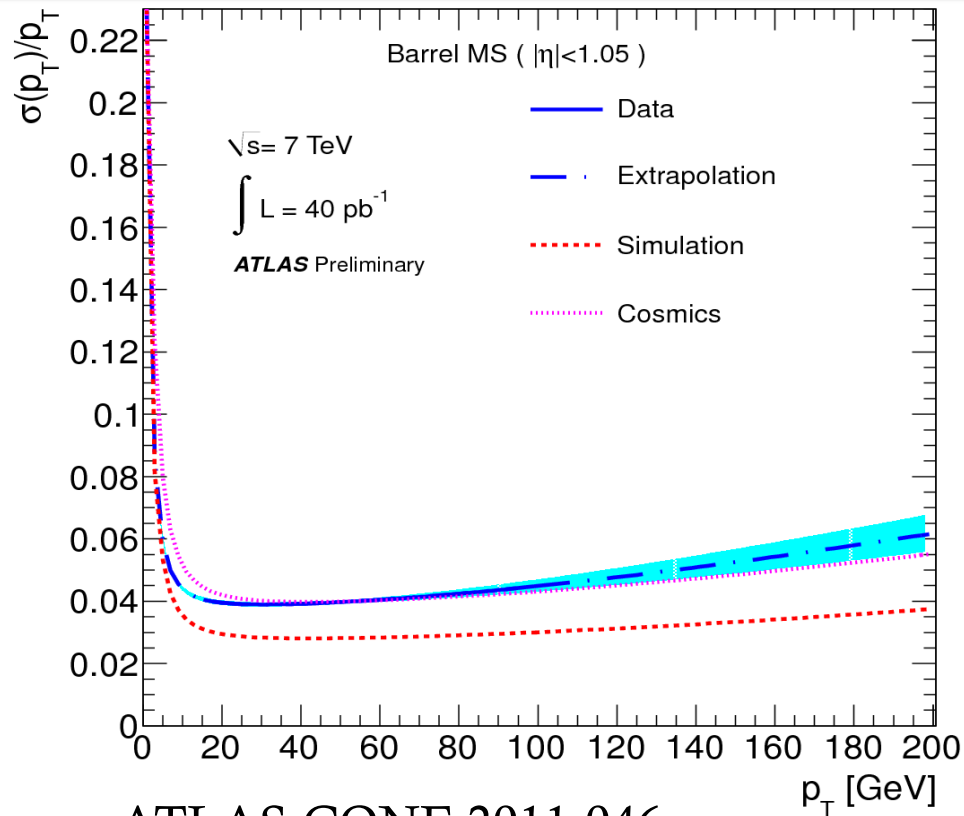
ATLAS-CONF-2010-009

Transverse momentum resolution as a function of p_T obtained using the nominal Monte Carlo simulation, as well as the additional resolution estimated using the Monte Carlo simulation method and the data driven Kshort method.

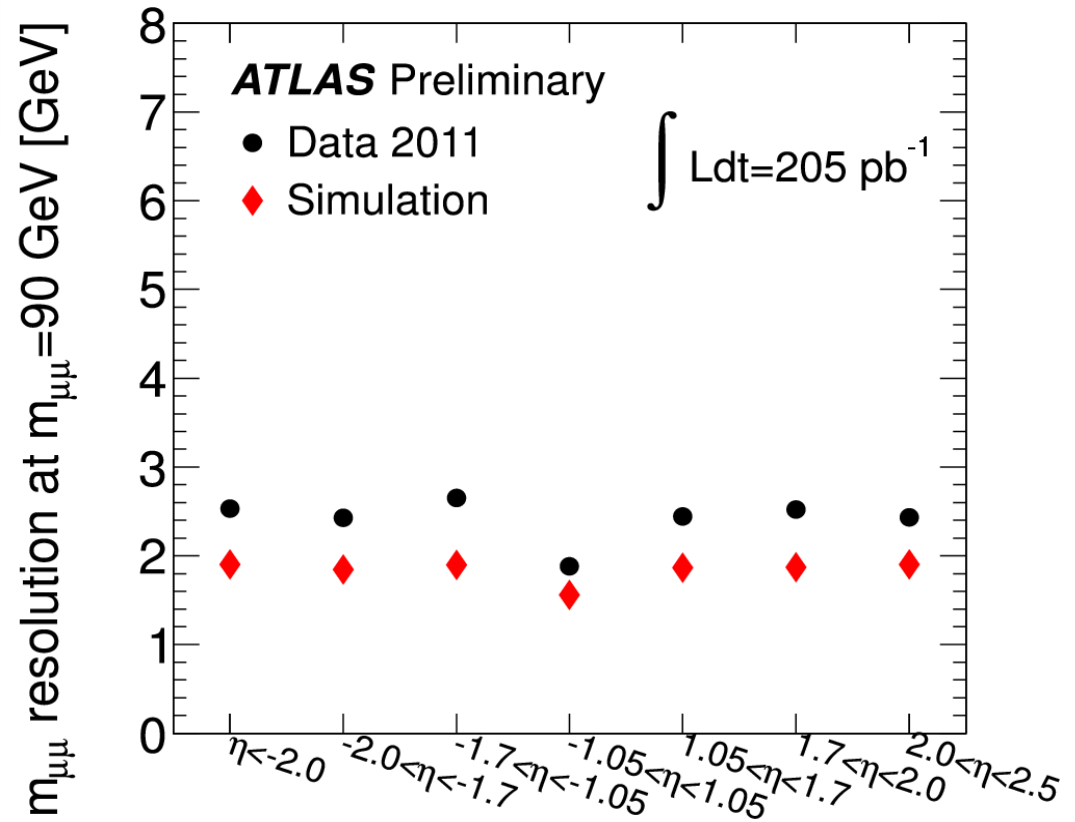
Muons

Resolution curve from the fitted parameter values of the Muon Spectrometer in collision data and simulation as a function of the muon p_T , for the "barrel" region $0 < |\eta| < 1.05$.

<https://twiki.cern.ch/twiki/bin/view/AtlasPublic/MuonPerformancePublicPlots>



ATLAS-CONF-2011-046



Dimuon mass resolution of combined muons in different pseudorapidity regions.