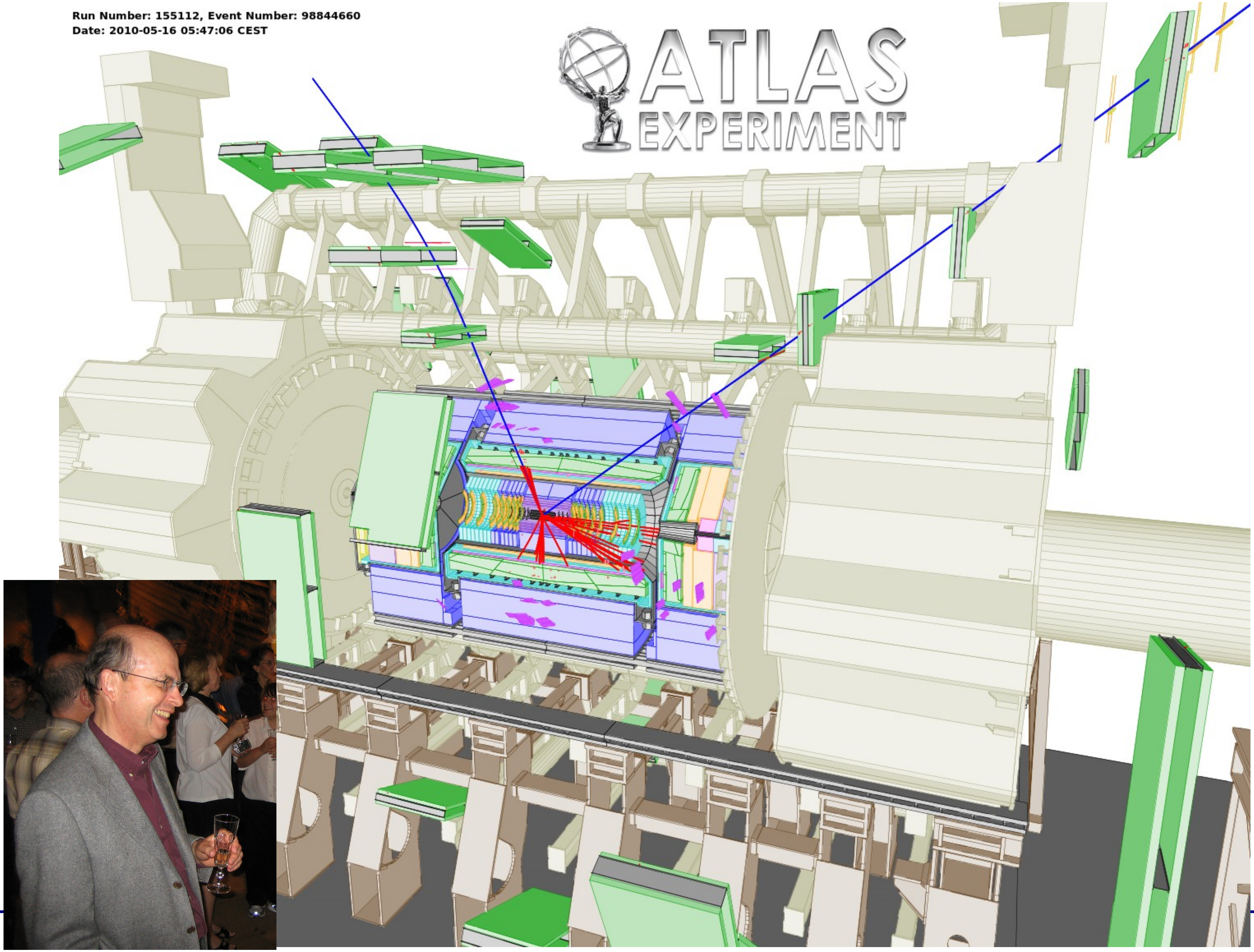
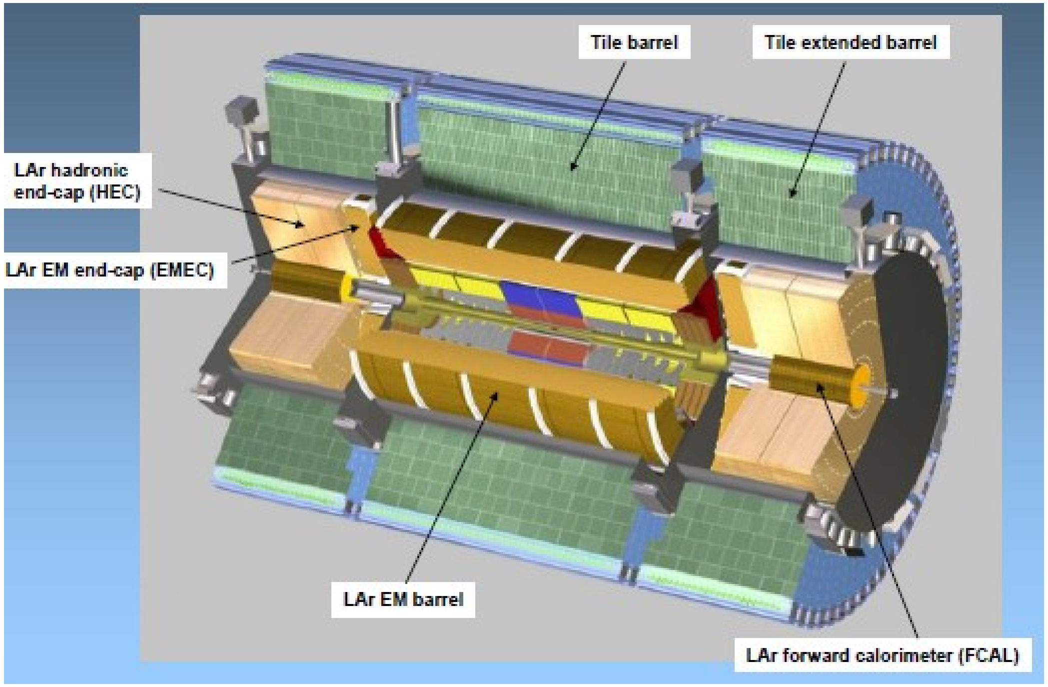
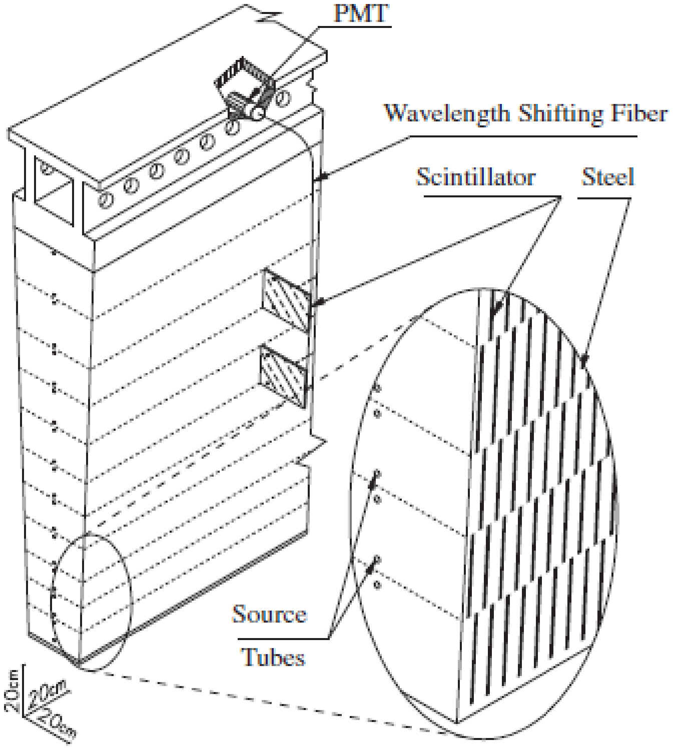
Preparing for collisions to search for exotics



TileCal in 2004

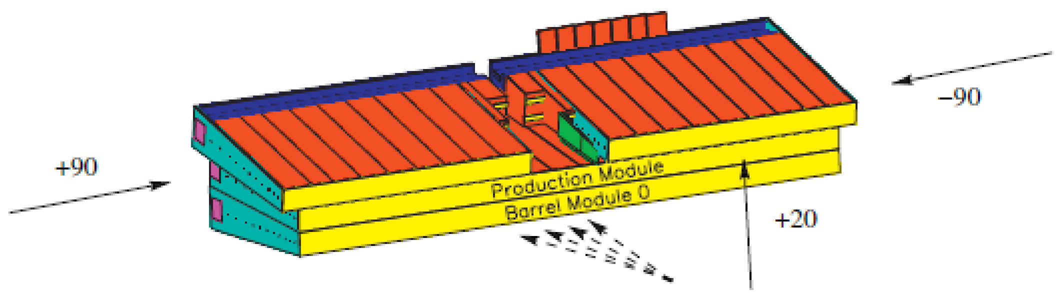
TileCal


Tile barrel
Tile extended barrel
LAr hadronic end-cap (HEC)
LAr EM end-cap (EMEC)
LAr EM barrel
LAr forward calorimeter (FCAL)


PMT
Wavelength Shifting Fiber
Scintillator
Steel
Source
Tubes
20cm
20cm
20cm

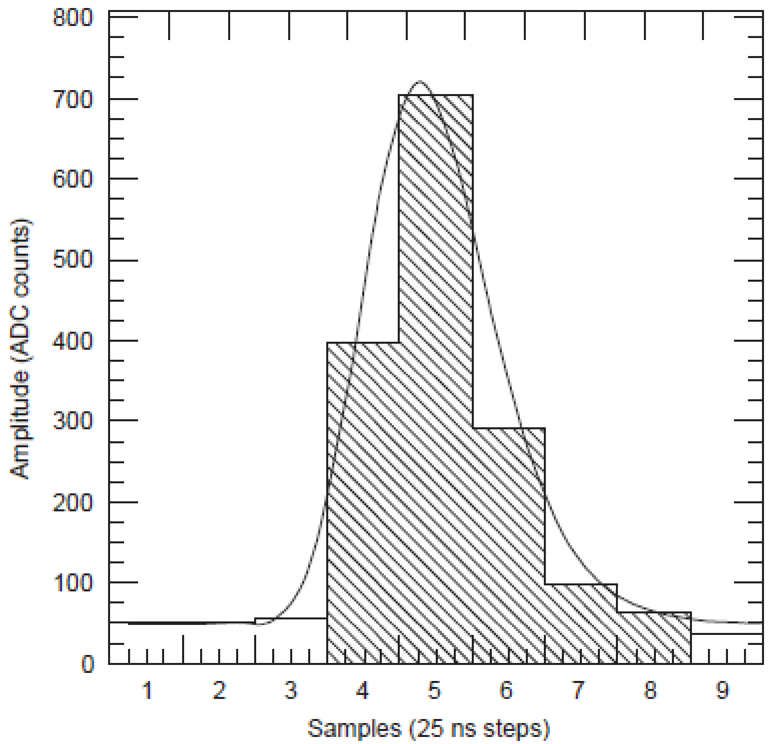
Test beams

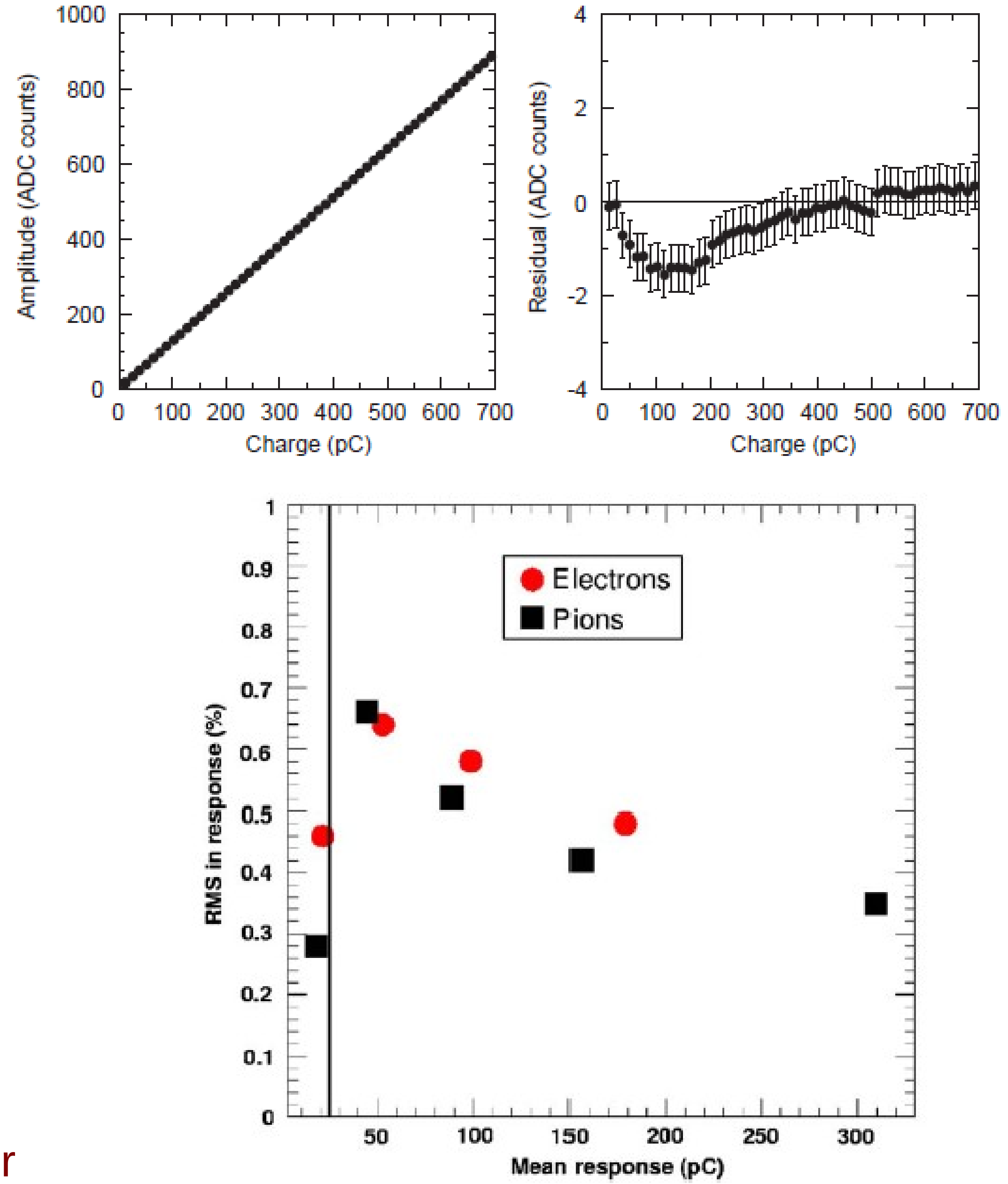
- Expose wedges (modules) of TileCal to beams of electrons, muons, and hadrons at known energies



- Studies to understand geometry and response
  - Map out geometrical details affecting energy response using muons
  - Calibrate energy scale using electrons
  - Understand hadronic energy scale and resolution
  - Important input to Geant-based simulation of ATLAS detector
- Test of electronics, readout chain, and calibration systems

Electronic calibration system



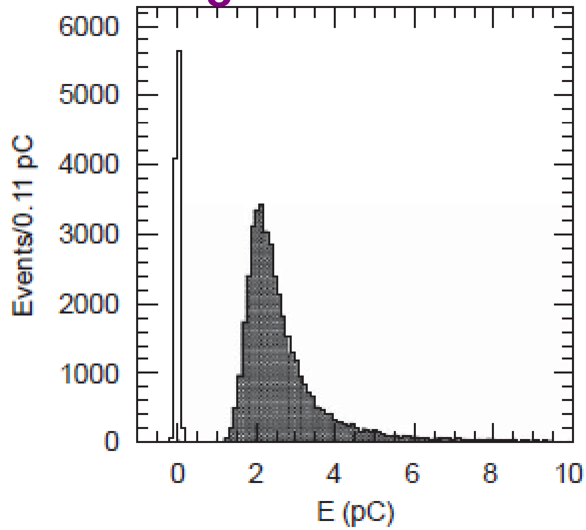


MH, I. Jen-La Plante, J. Pilcher, R. Teuscher

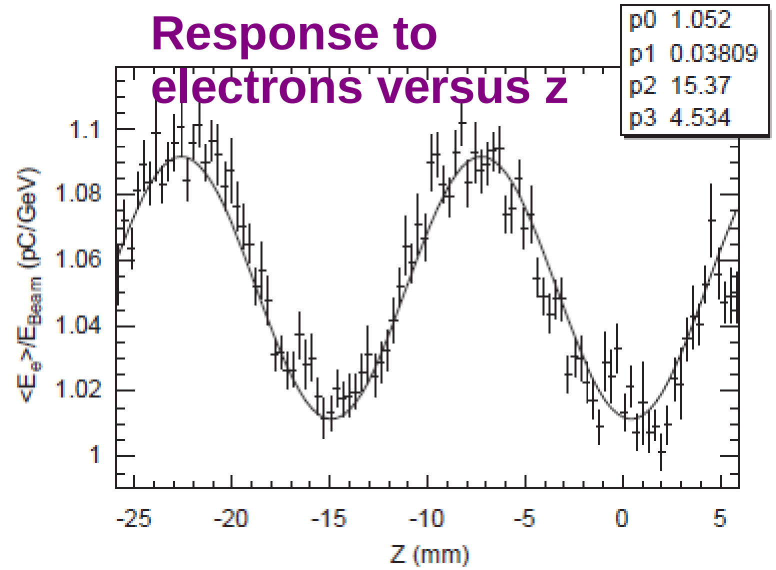
TileCal testbeam studies

P. Adragna et al., Testbeam studies of production modules of the ATLAS Tile calorimeter, Nucl. Instrum. Meth. A 606 (2009) 362–394

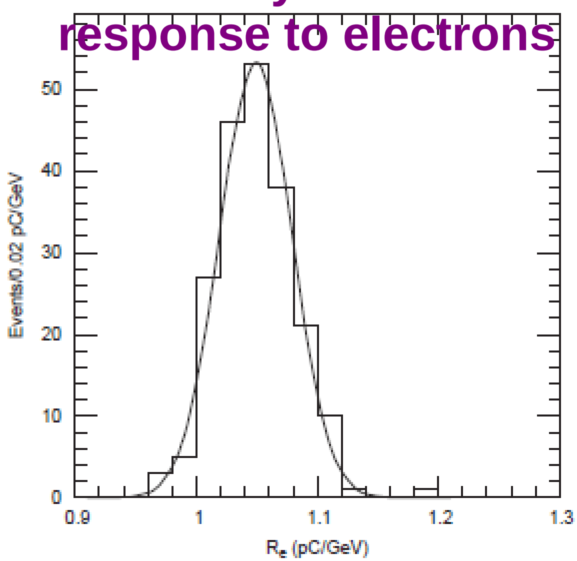
Muon signal in TileCal tower



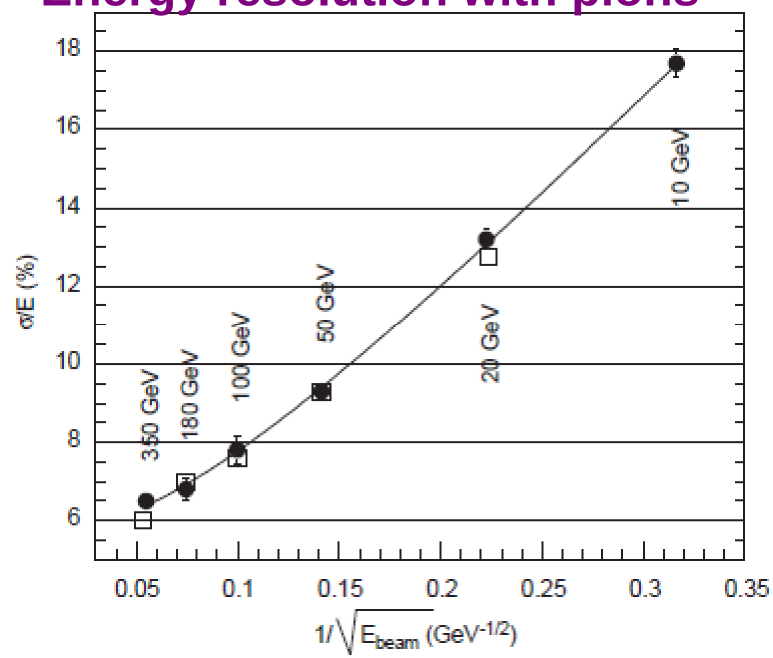
Response to electrons versus z



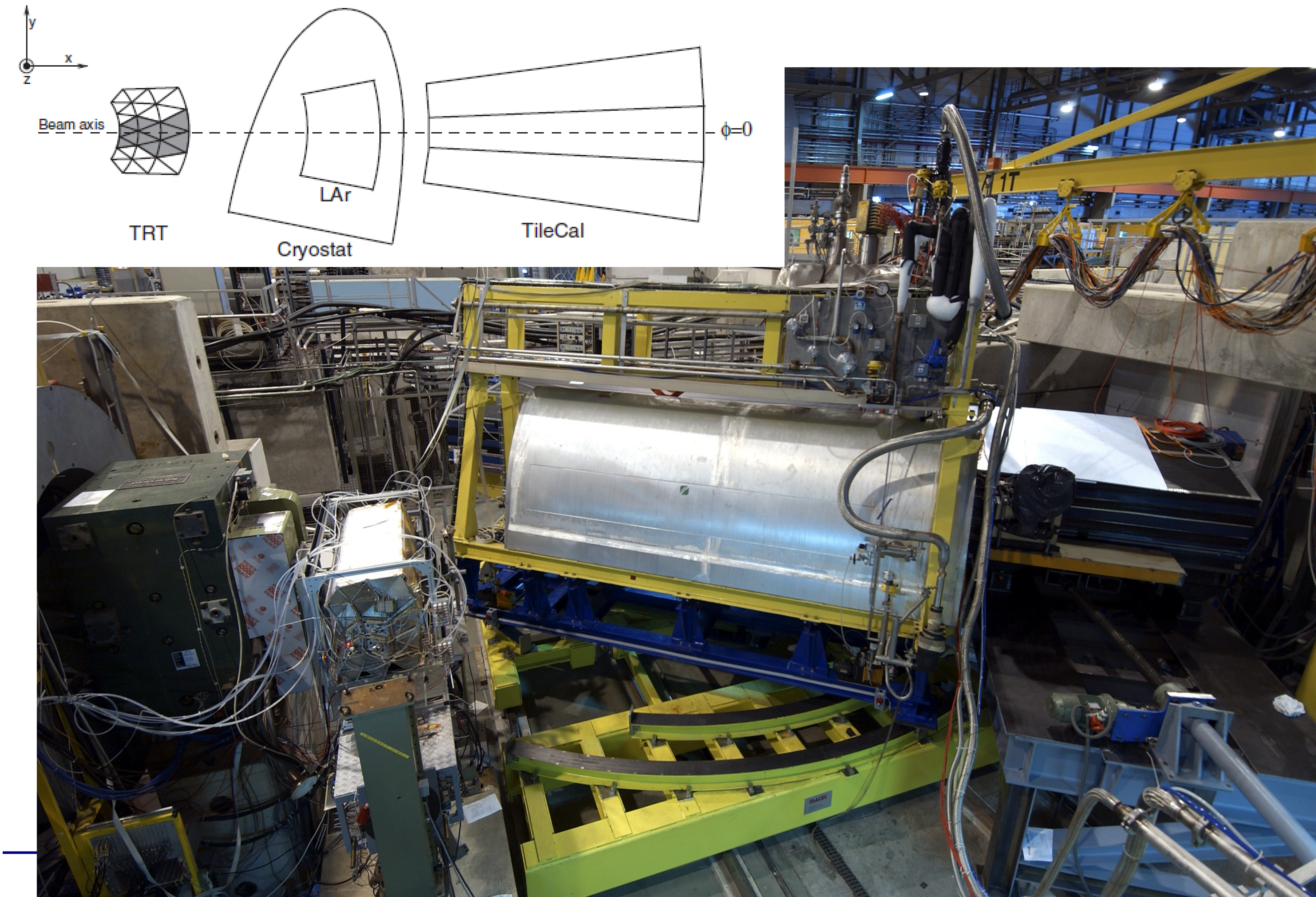
Uniformity of response to electrons



Energy resolution with pions



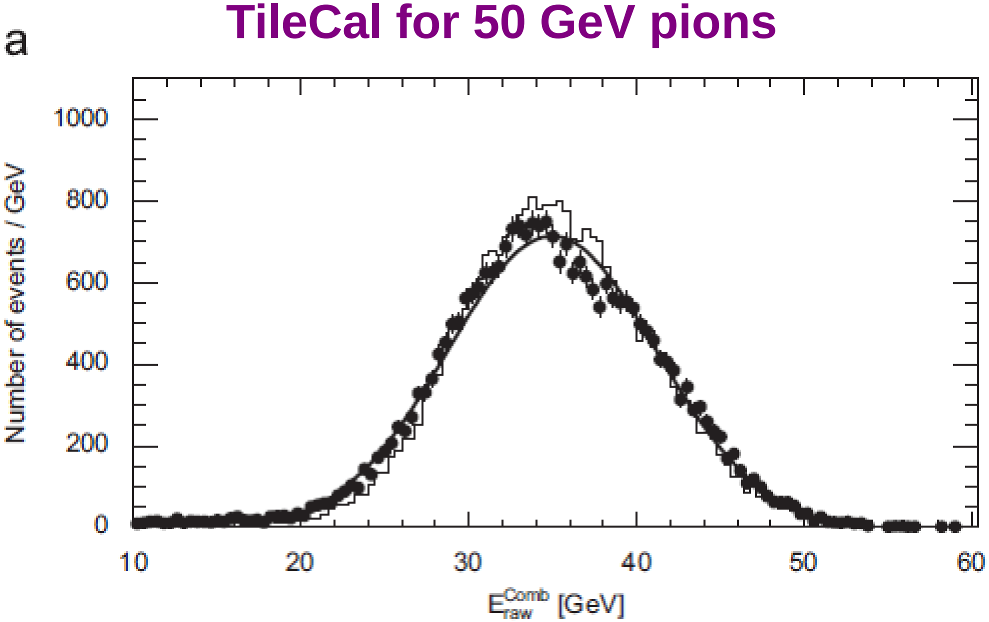
Combined test beam



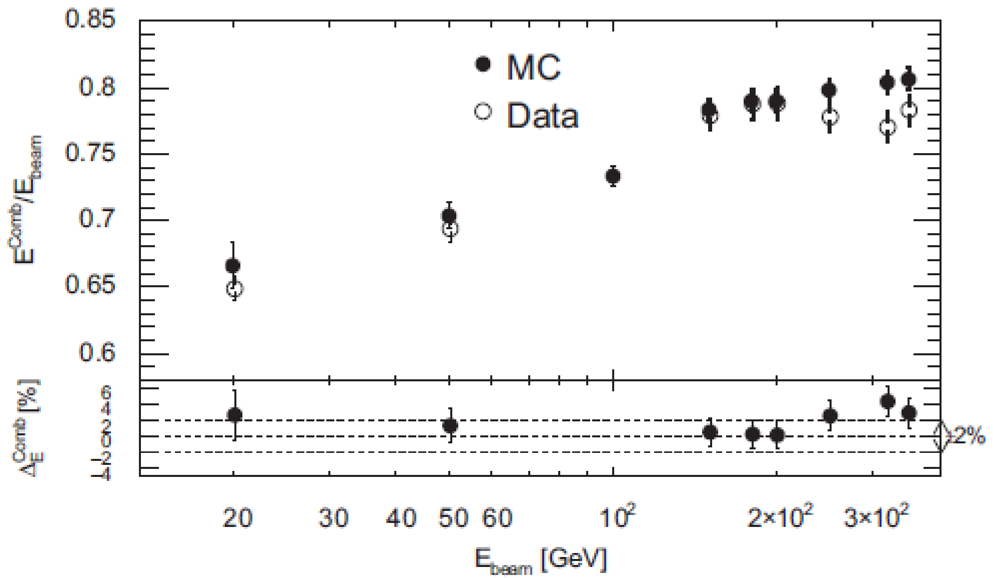
LAr plus TileCal testbeam

E. Abat et al., Study of energy response and resolution of the ATLAS barrel calorimeter to hadrons of energies from 20 GeV to 350 GeV,
Nucl. Instrum. Meth. A 621 (2010) 134–150.

Energy deposited in LAr + TileCal for 50 GeV pions



Response versus beam energy



Further detector preparation

- TileCal was eventually assembled in ATLAS cavern
- Chicago maintained large and active team at CERN during commissioning years
  - Postdocs, students, technicians
  - Every year, two "technicians" who had just finished their undergraduate degrees
- Many areas of involvement
  - TileCal electronics testing and calibration
  - Cosmic ray commissioning
  - Data quality monitoring and assessment
  - Operations and shifts
  - Assembly

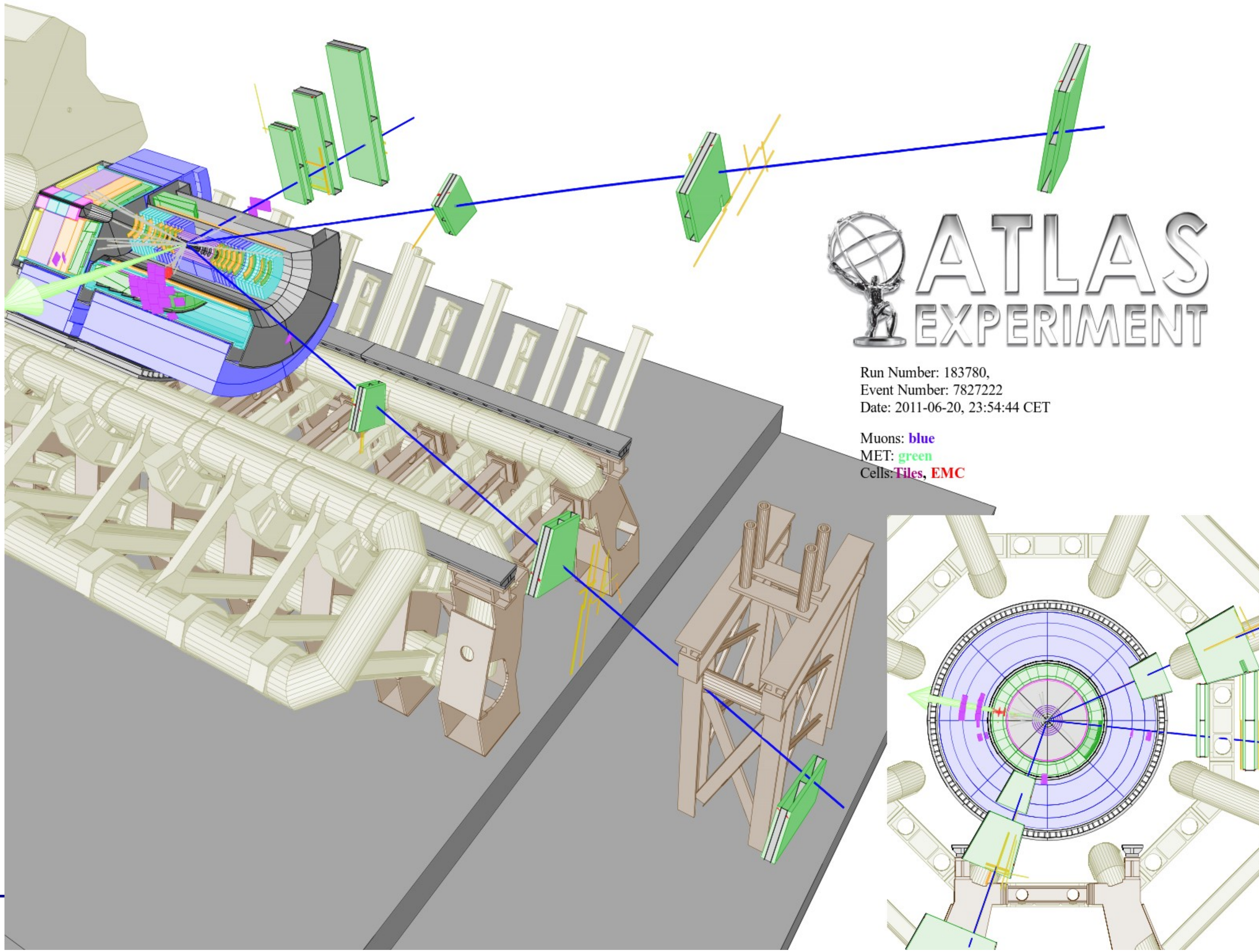
M. Dunford, E. Feng, MH, K. Krum, D. Lawlor, K. Lepo, D. McKeen, D. Miller, M. Miller, I. Jen-La Plante, J. Pilcher, J. Rasmussen, R. Teuscher, C. Tunnell, G. Usai, J. van Santen, S. Zenz

TileCal BBQs: grill commissioning



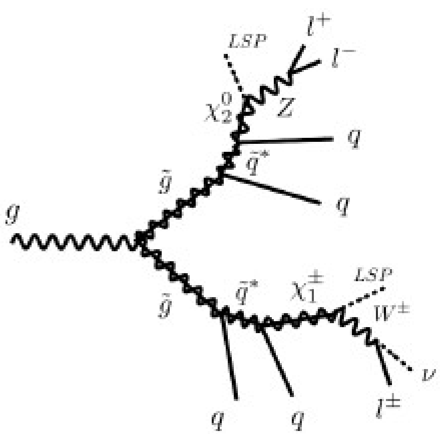


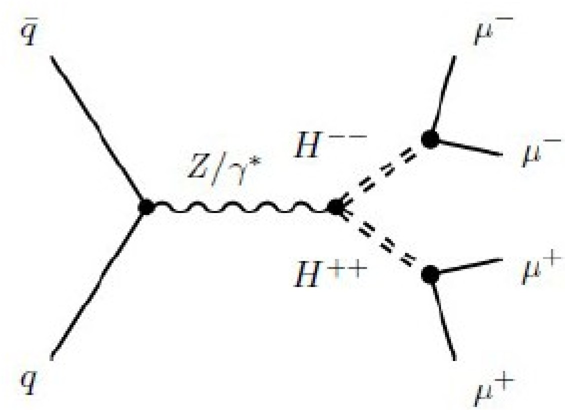

Some searches with leptons: 2011-2012

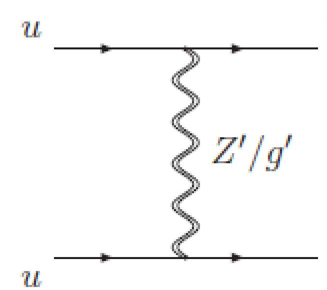


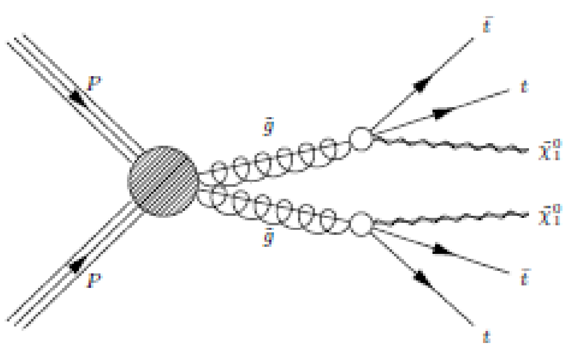
Search for anomalous like-sign dilepton production

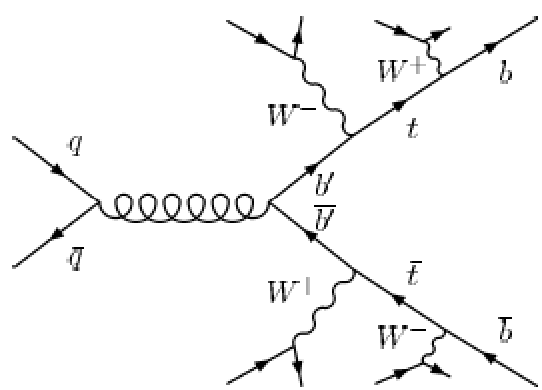
- ATLAS-CONF-2012-069, PRD 88 (2012) 032004
  - J-F Arguin, MH, B. Heinemann, E. Lytken, D. Olivito, L. Skinnari
- Events containing two isolated leptons with the same electric charge occur in many new physics scenarios but are relatively rare in the Standard Model







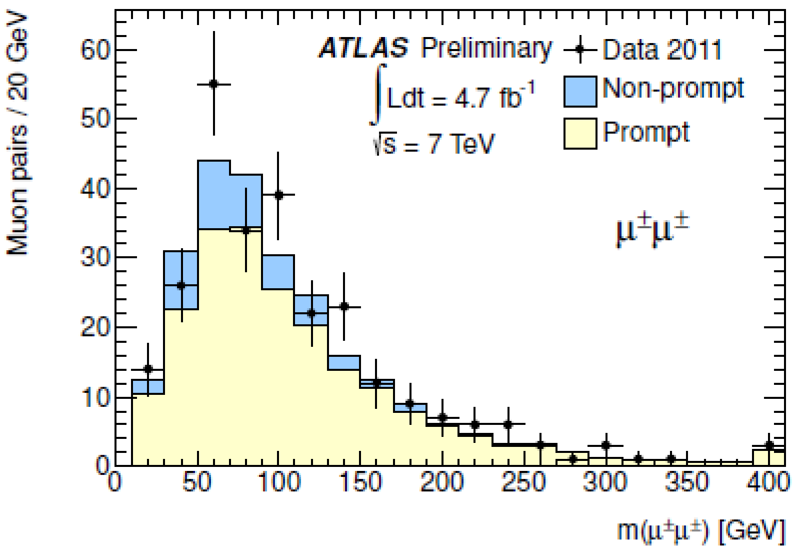


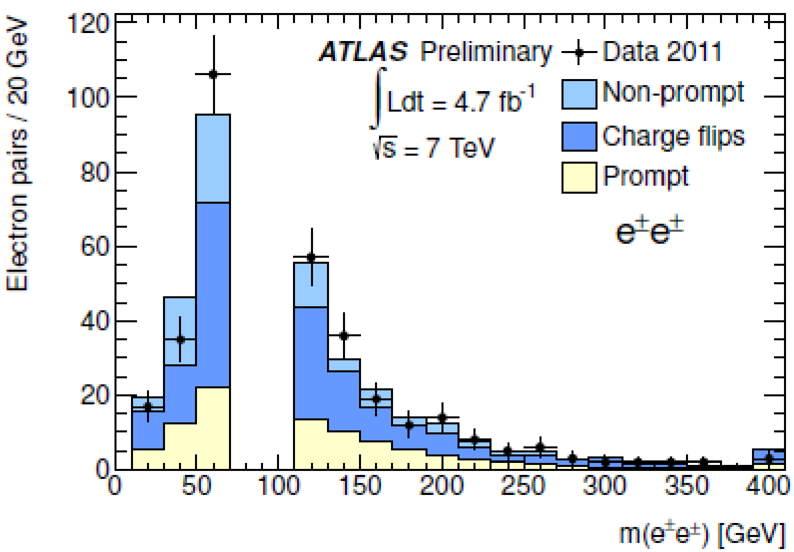


Something else??

Inclusive search

- Require only presence of two leptons with same electric charge
- Standard Model backgrounds
  - "Prompt": WZ → lνll, ZZ → llll, ttW, ttZ, WW
    - Based on Monte Carlo simulation
  - Hadronic decays / fakes
    - Use data sidebands to estimate rate and kinematics
  - Charge misidentification or conversion
    - Wγ, Zγ, and e → eγ → eee
    - Negligible for muons





Result interpretation

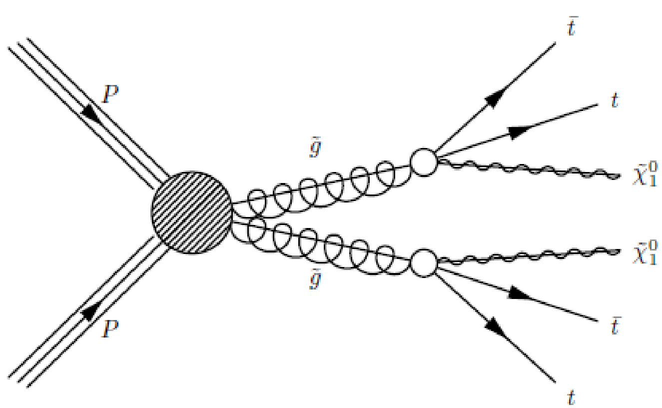
- Set limits on new processes contributing to specific events:

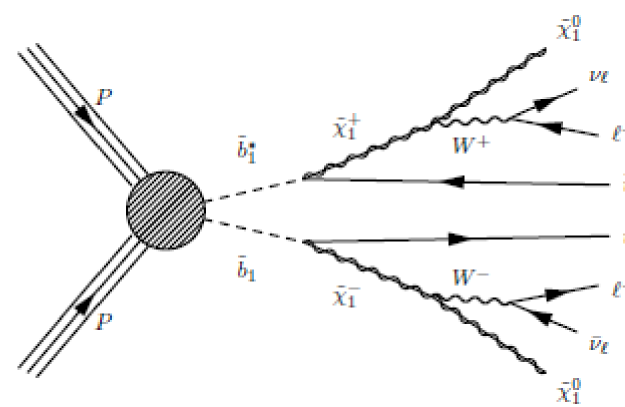
	Electron requirement	Muon requirement
Leading lepton p_T	$p_T > 25$ GeV	$p_T > 20$ GeV
Sub-leading lepton p_T	$p_T > 20$ GeV	$p_T > 20$ GeV
Lepton η	$\|\eta\| < 1.37$ or $1.52 < \|\eta\| < 2.47$	$\|\eta\| < 2.5$
Isolation	$p_T^{\text{cone}0.3}/p_T < 0.1$	$p_T^{\text{cone}0.4}/p_T < 0.06$ and $p_T^{\text{cone}0.4} < 4\text{ GeV} + 0.02 \times p_T$

- Translate to model-independent cross-section limit
  - Test efficiency with which events within above region are reconstructed by ATLAS in several different models

Mass range	95% C.L. upper limit [fb]			
	$e^{\pm}e^{\pm}$ expected	$e^{\pm}e^{\pm}$ observed	$\mu^{\pm}\mu^{\pm}$ expected	$\mu^{\pm}\mu^{\pm}$ observed
$M > 15$ GeV	$45.0^{+17.3}_{-12.0}$	45.7	$23.4^{+8.6}_{-5.8}$	29.1
$M > 100$ GeV	$24.3^{+9.1}_{-7.0}$	25.6	$11.9^{+4.4}_{-2.9}$	14.6
$M > 200$ GeV	$8.8^{+3.2}_{-2.9}$	8.1	$4.2^{+1.8}_{-1.1}$	6.6
$M > 300$ GeV	$4.5^{+1.6}_{-1.3}$	3.9	$2.3^{+0.8}_{-0.7}$	2.5
$M > 400$ GeV	$2.9^{+1.1}_{-0.9}$	2.3	$1.6^{+0.6}_{-0.5}$	1.7

3rd generation SUSY searches with leptons



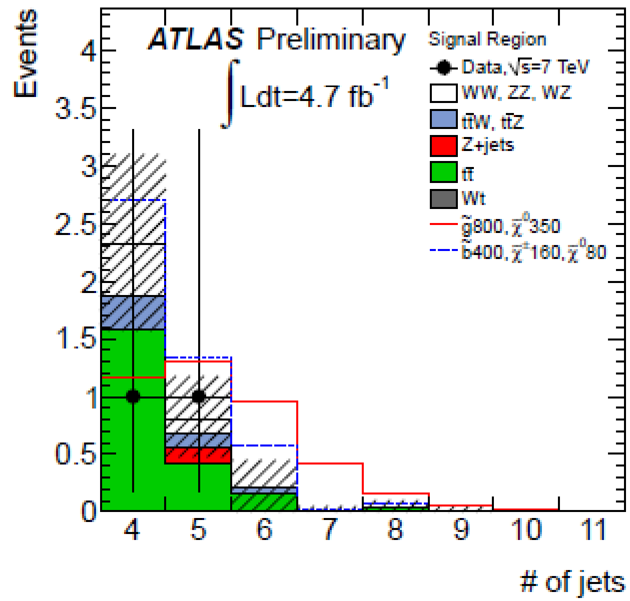


- Busy final state multiple top quarks and W bosons
- Mass of neutralino affects pT spectra of final state particles
- Leptonic final state allows lower pT cuts

Trilepton SUSY search

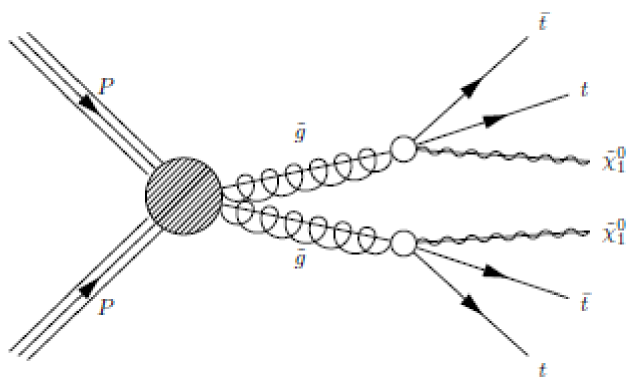
- ATLAS-CONF-2012-108
  - M. Fiascaris, T. Herwig, M. Kruse, D. Nguyen, L. Nodulman, A. Paramanov, J. Pilcher, L-T Wang, C Zhou

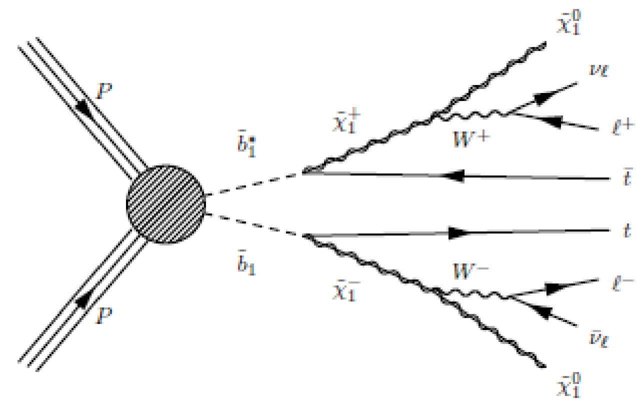
- Leading lepton pT>23 GeV (electrons) and 20 GeV (muons)
- 2[nd] and 3[rd] leptons pT>15 GeV
- Four jets with pT>30 GeV
- MET>50 GeV

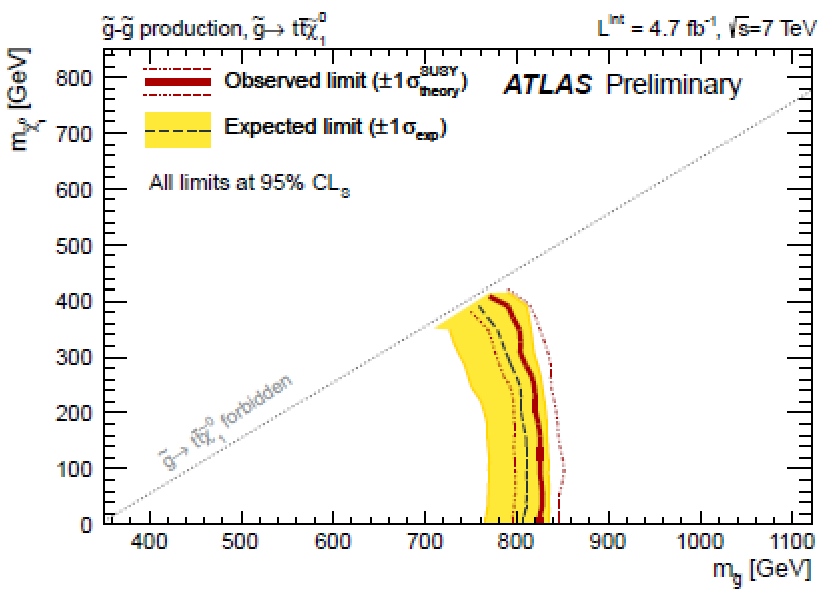


	0e	1eSS	1eOS	2eSS	2eOS	3e	3ℓ
Z+jets and $Z+b\bar{b}$+jets	0±0	0±0	$0.1\ ^{+0.2}_{-0.1}$	0±0	0±0	0±0	$0.1\ ^{+0.2}_{-0.1}$
$t\bar{t}$	0.1±0.1	0.2±0.1	0.4±0.3	0.6±0.4	0.5±0.2	0.4±0.2	2.2±0.9
Wt	0±0	0±0	0±0	0±0	0±0	0±0	0±0
WW, WZ, and ZZ	0.1±0.1	0.0±0.0	0.2±0.1	0.0±0.0	0.1±0.1	0.2±0.1	0.6±0.2
$t\bar{t}+W$ and $t\bar{t}+Z$	0.1±0.1	0.1±0.0	0.1±0.1	0.1±0.1	0.1±0.1	0.0±0.0	0.5±0.4
Total SM	0.3±0.2	0.3±0.1	0.8±0.4	0.7±0.4	0.7±0.3	0.6±0.3	3.4±1.2
Data	0	0	1	0	1	0	2

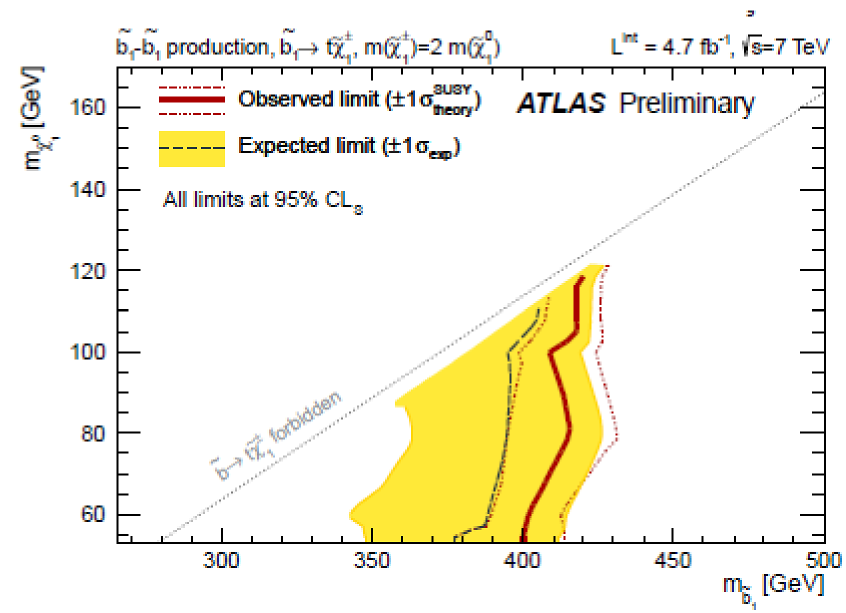
Results







$\tilde{g}$-$\tilde{g}$ production, $\tilde{g}\rightarrow t\bar{t}\tilde{\chi}_1^0$
L^{int} = 4.7 fb^{-1}, $\sqrt{s}$=7 TeV
Observed limit ($\pm1\sigma^{SUSY}_{theory}$)
Expected limit ($\pm1\sigma_{exp}$)
ATLAS Preliminary
All limits at 95% CL_s
$\tilde{g}\rightarrow t\bar{t}\tilde{\chi}_1^0$ forbidden
$m_{\tilde{\chi}_1^0}$ [GeV]
$m_{\tilde{g}}$ [GeV]



$\tilde{b}_1$-$\tilde{b}_1$ production, $\tilde{b}_1\rightarrow t\tilde{\chi}_1^{\pm}$, $m(\tilde{\chi}_1^{\pm})$=2 $m(\tilde{\chi}_1^0)$
L^{int} = 4.7 fb^{-1}, $\sqrt{s}$=7 TeV
Observed limit ($\pm1\sigma^{SUSY}_{theory}$)
Expected limit ($\pm1\sigma_{exp}$)
ATLAS Preliminary
All limits at 95% CL_s
$\tilde{b}\rightarrow t\tilde{\chi}_1^{\pm}$ forbidden
$m_{\tilde{\chi}_1^0}$ [GeV]
$m_{\tilde{b}_1}$ [GeV]


ATTENTION
DESCENTE
PAR LE TELESIEGE