

Exotics searches in dilepton channel with ATLAS 13 TeV data

Ivan Yeletsikh,
JINR, Dubna

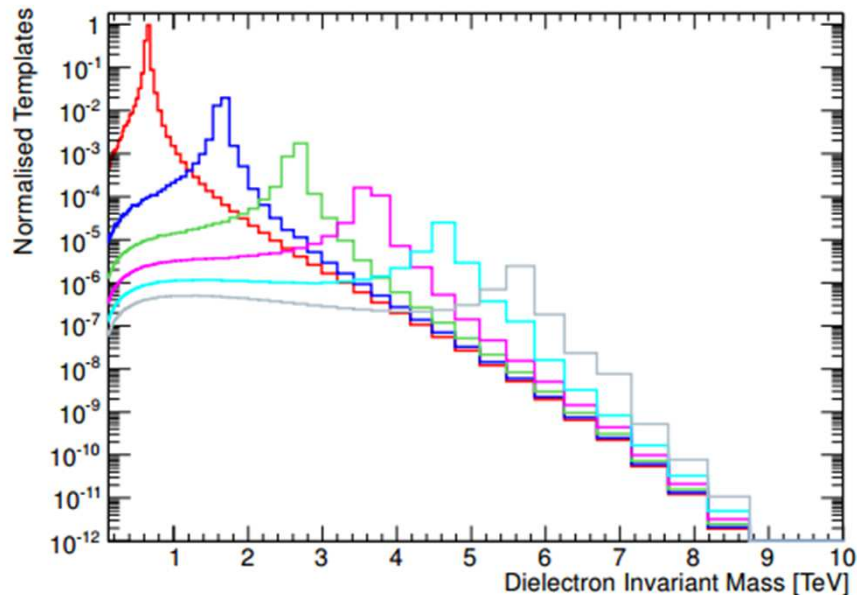
1. Theoretical models for dilepton search;
2. Data/MC dilepton kinematics comparison;
3. Results: limits on theoretical models;
4. Summary and outlook;

Theoretical models for dilepton search

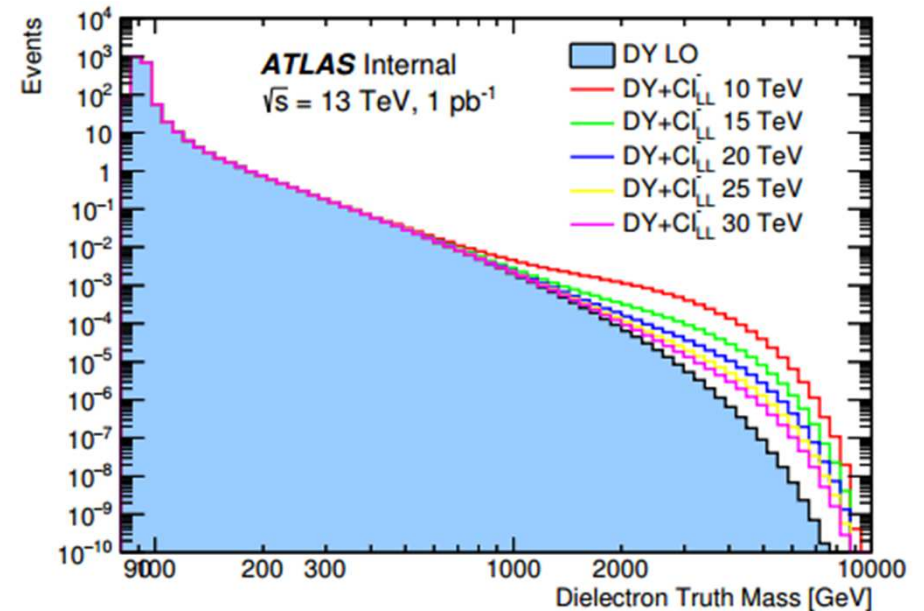
Z'. Additional Spin-1 Gauge Boson. SSM: Simple extension to the SM invoking an additional heavy boson, with same couplings as Z. Also motivated by Grand Unified Theories (GUT), such as E6. Can be observed as massive dilepton resonance, similar to Z.

CI. Contact Interactions model. Predicts instantaneous ('contact') interaction between fermions (in part., quarks and leptons). Can be observed as broad excess over SM background distribution.

Z' signals of different masses



Signals of different CI scales



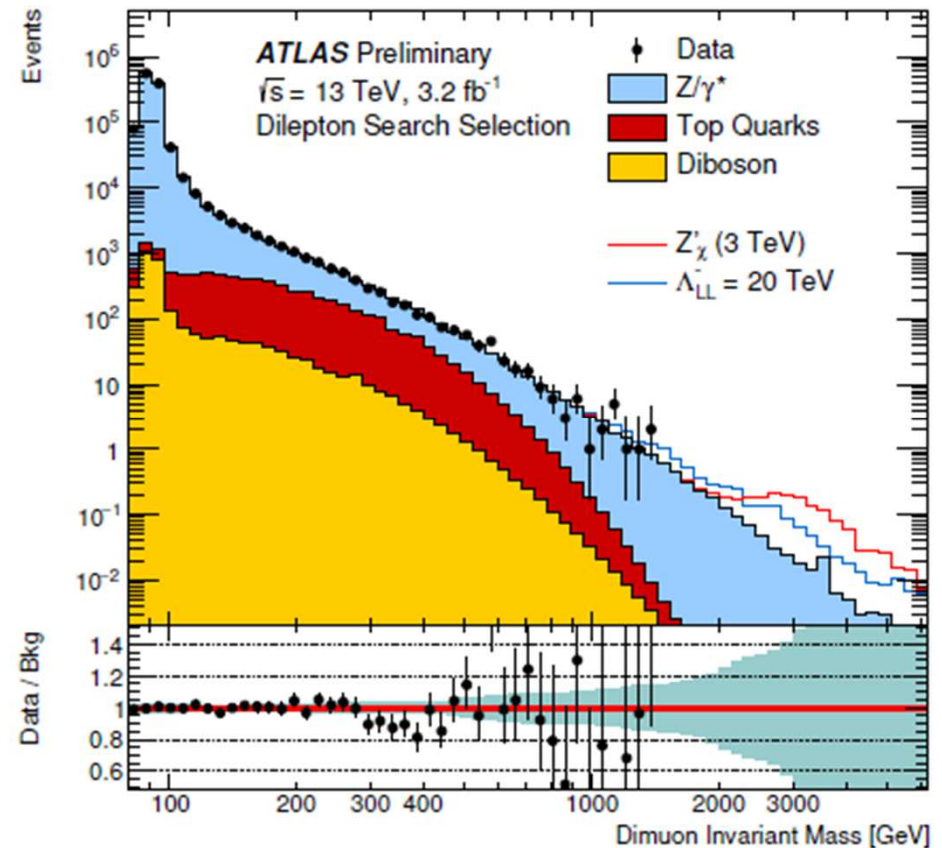
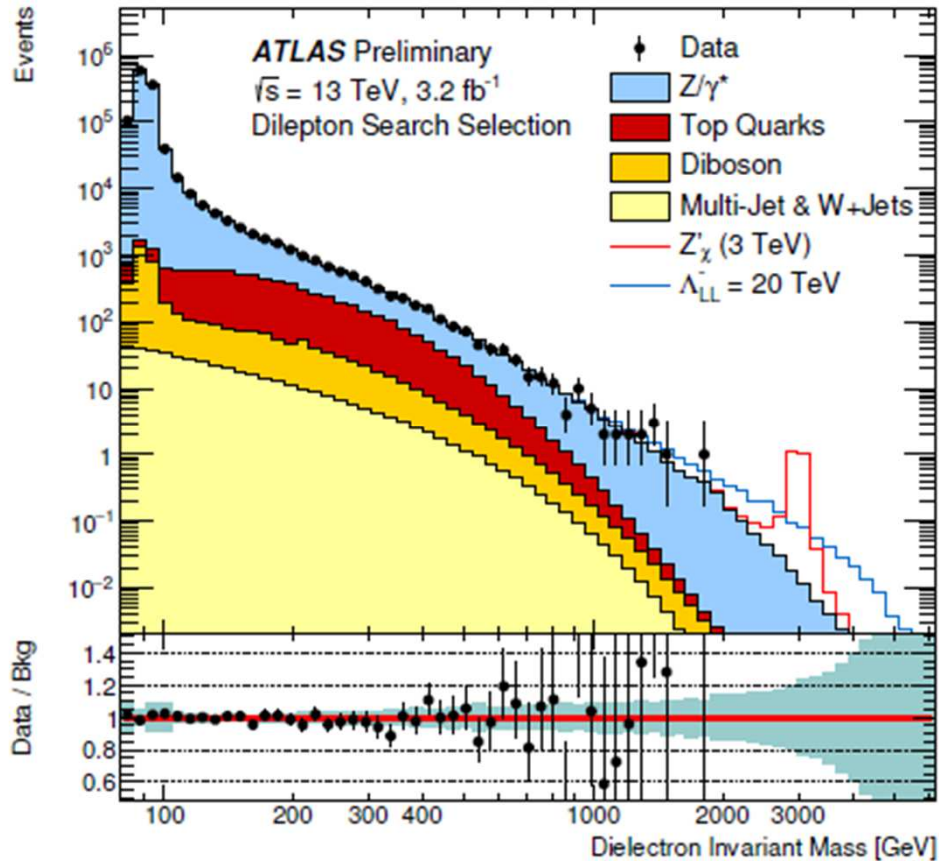
Data/MC dilepton kinematics comparison

<https://cds.cern.ch/record/2110214>

Invariant mass distributions:

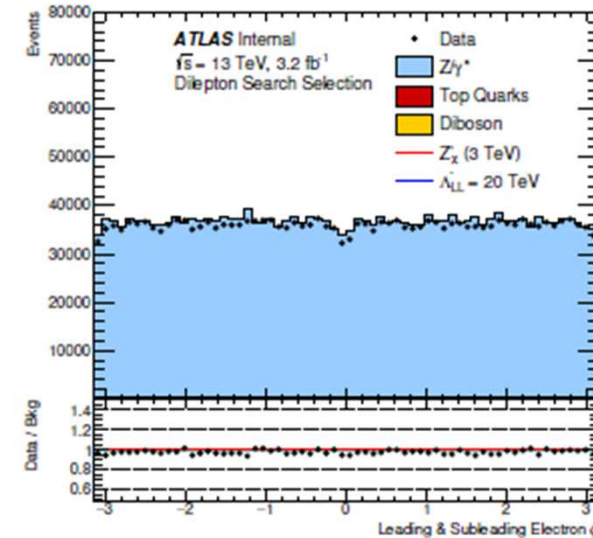
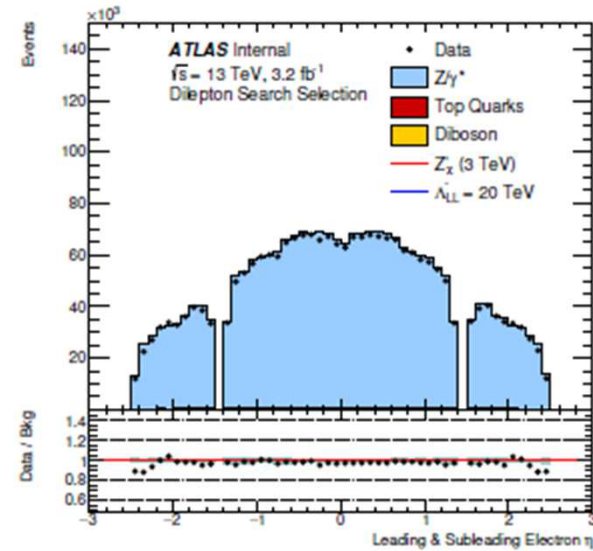
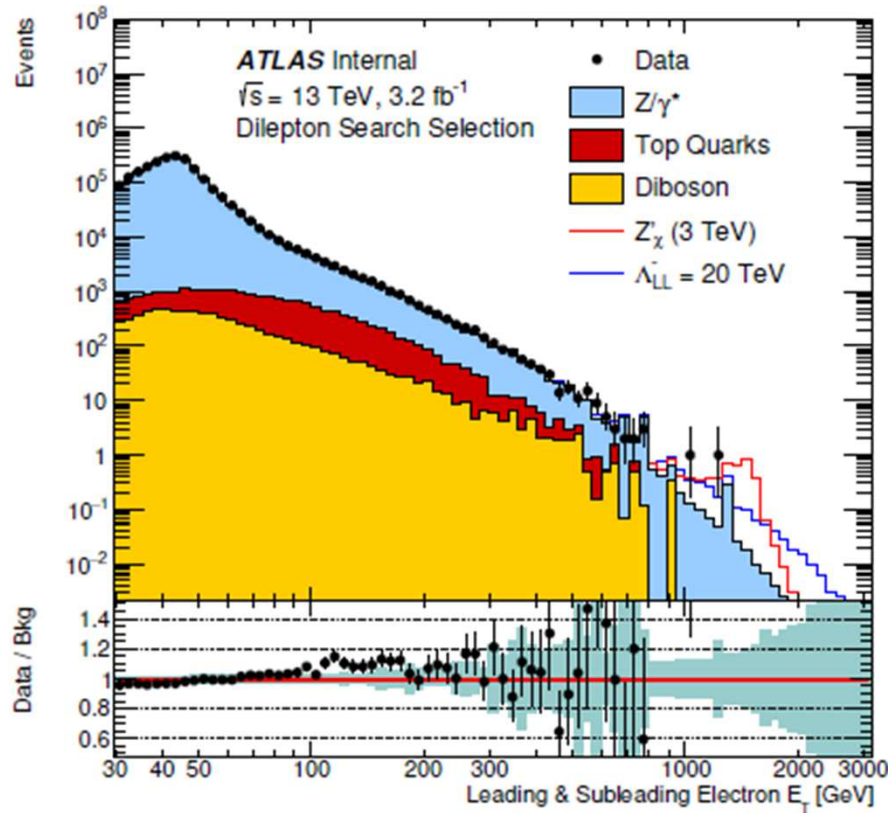
electron channel

muon channel



Data/MC dilepton kinematics comparison

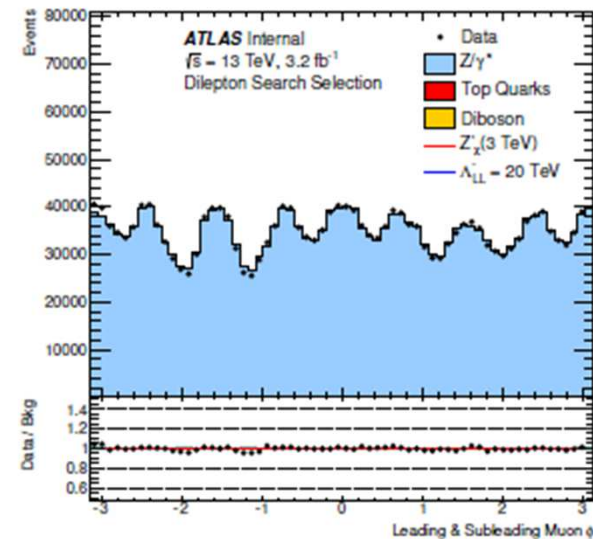
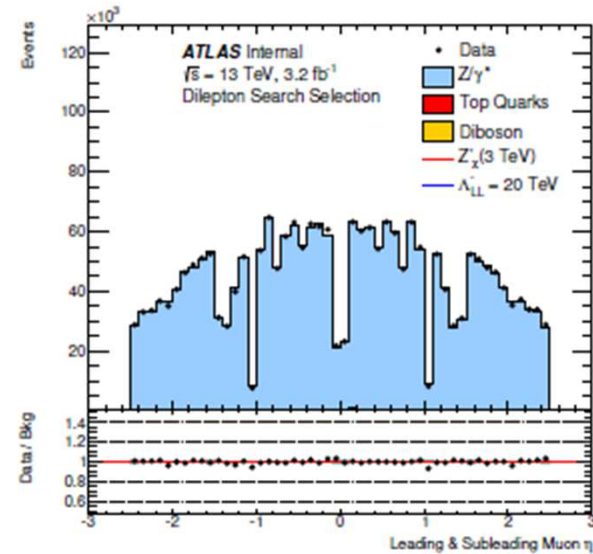
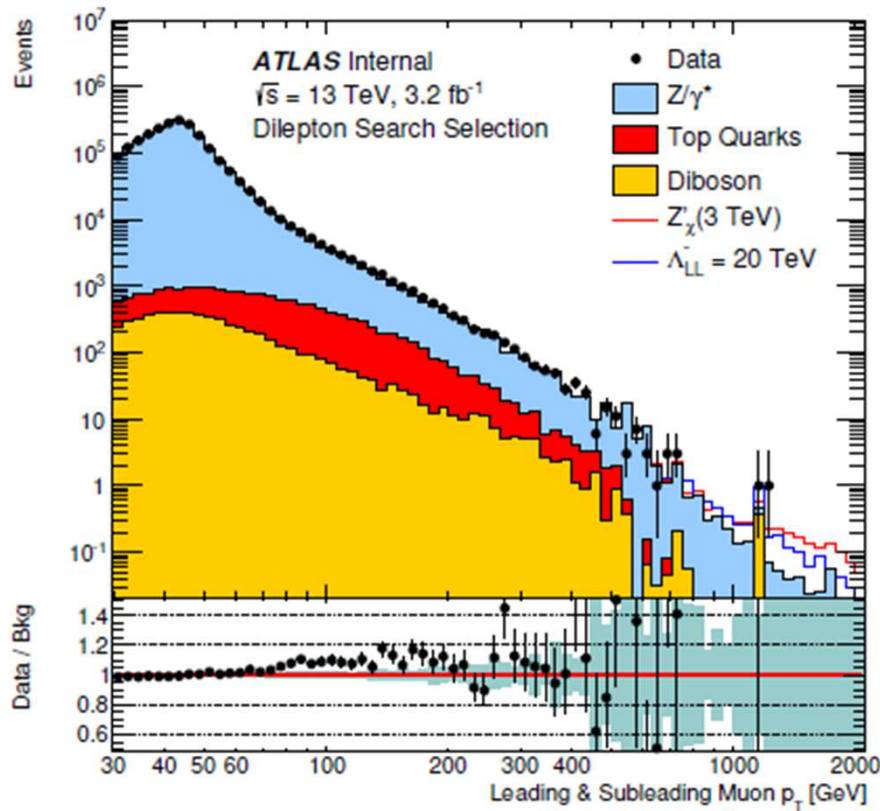
Electron channel kinematics:



<https://cds.cern.ch/record/2025566>

Data/MC dilepton kinematics comparison

Muon channel kinematics:

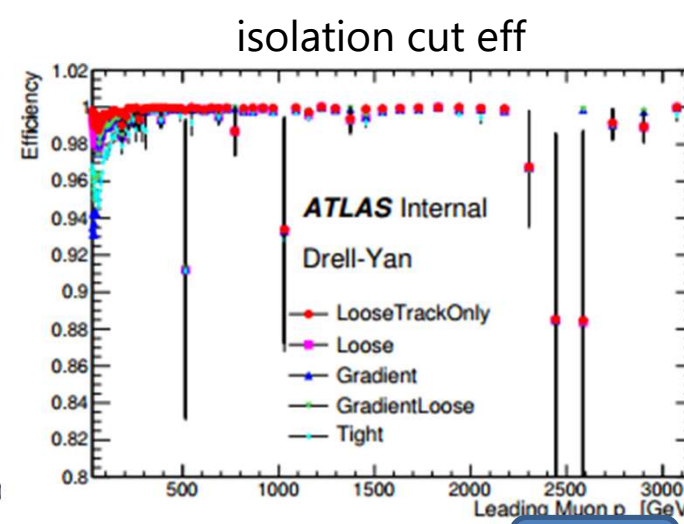
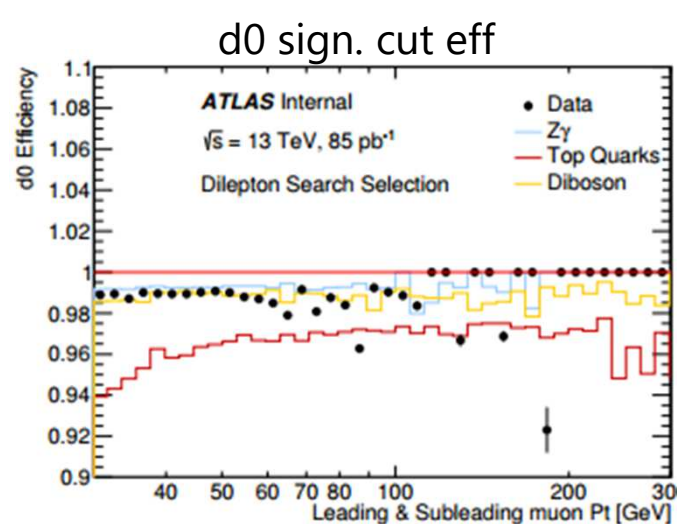
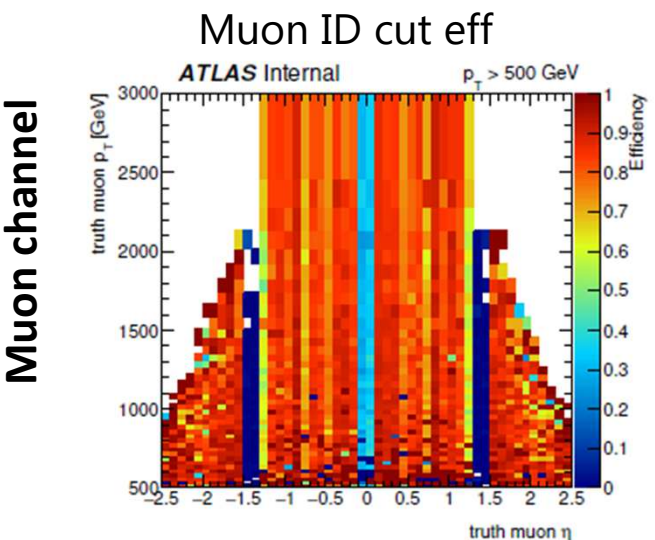
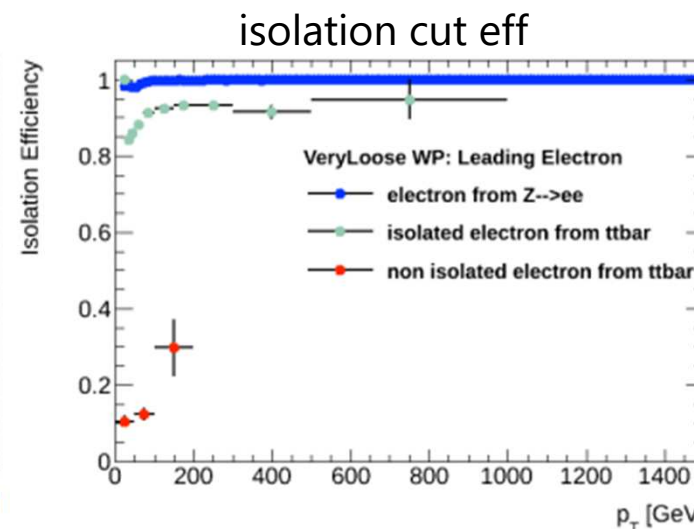
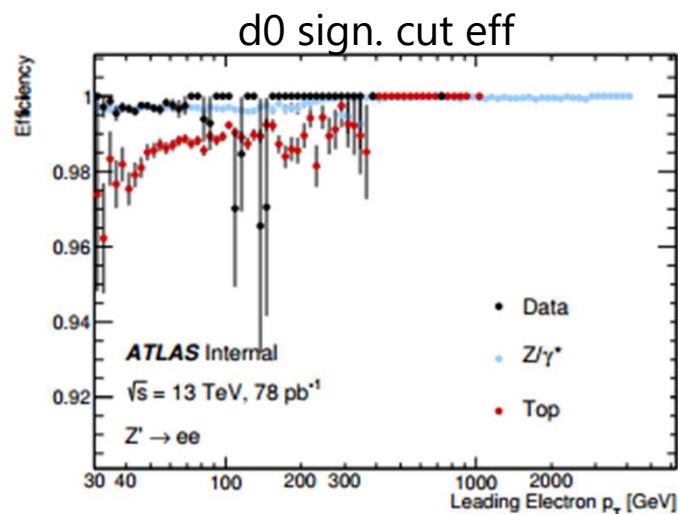
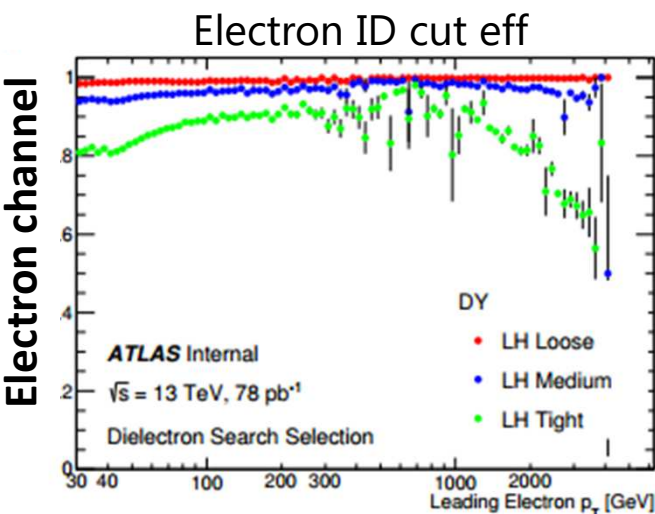


<https://cds.cern.ch/record/2025566>

Data/MC dilepton kinematics comparison

Selection efficiencies:

<https://cds.cern.ch/record/2025566>

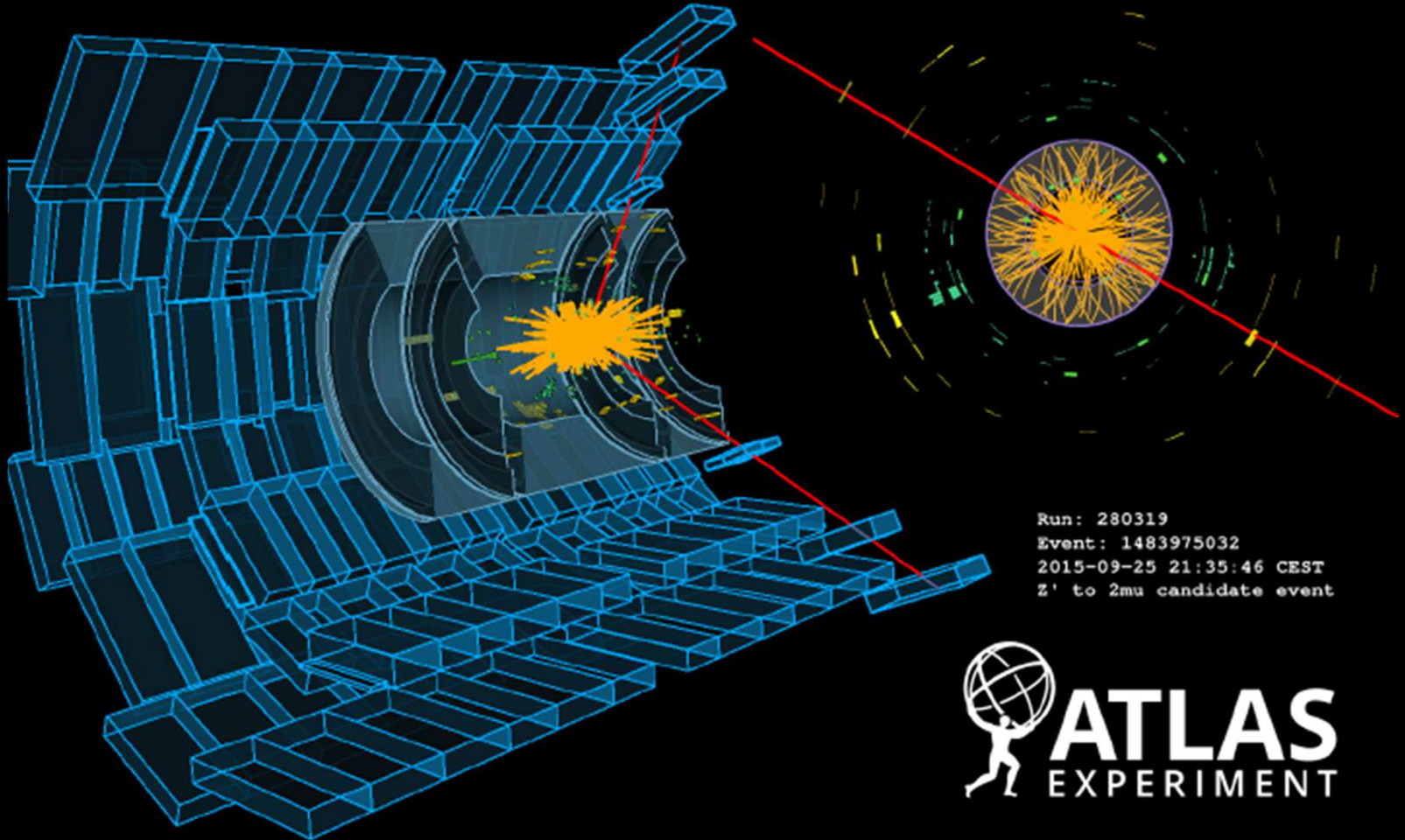


Highest mass dimuon event:

Pt1=712GeV
 $\eta_1 = 0.87$

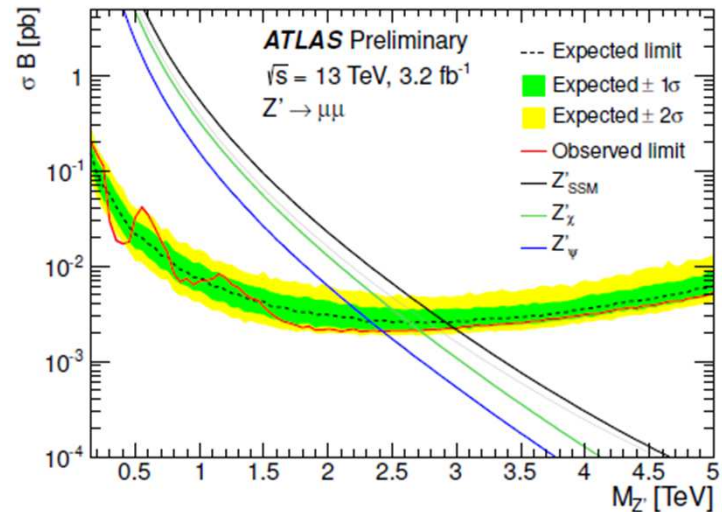
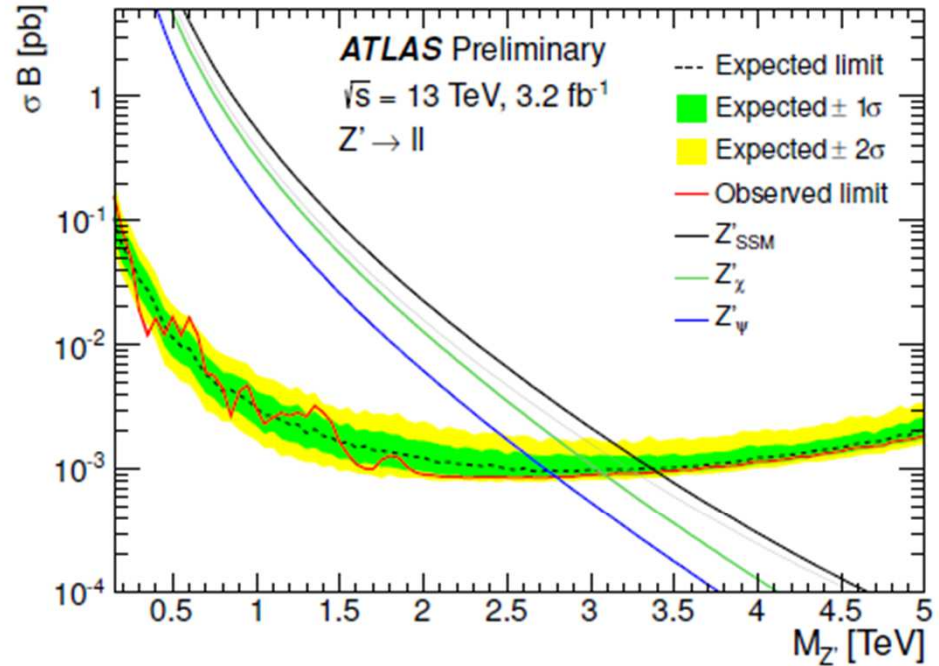
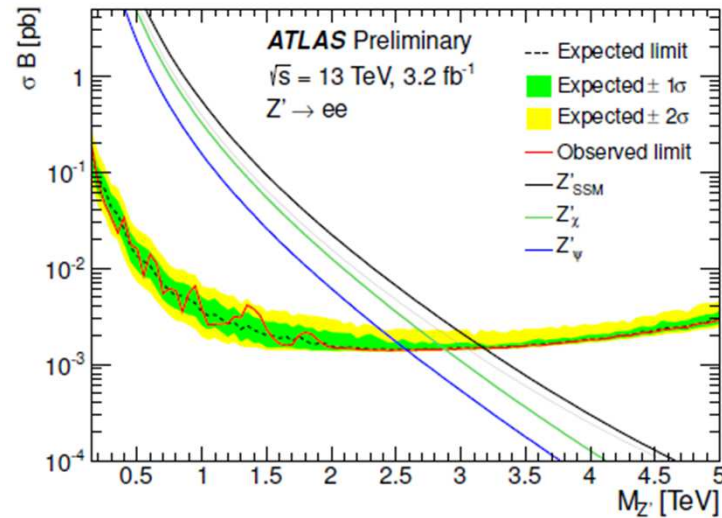
Pt2=676GeV
 $\eta_2 = 0.95$

mass = 1390GeV



Support note: extensive dilepton studies with first (50ns) data

Upper limits on the cross-section times branching ratio $Z' \rightarrow \ell\ell$



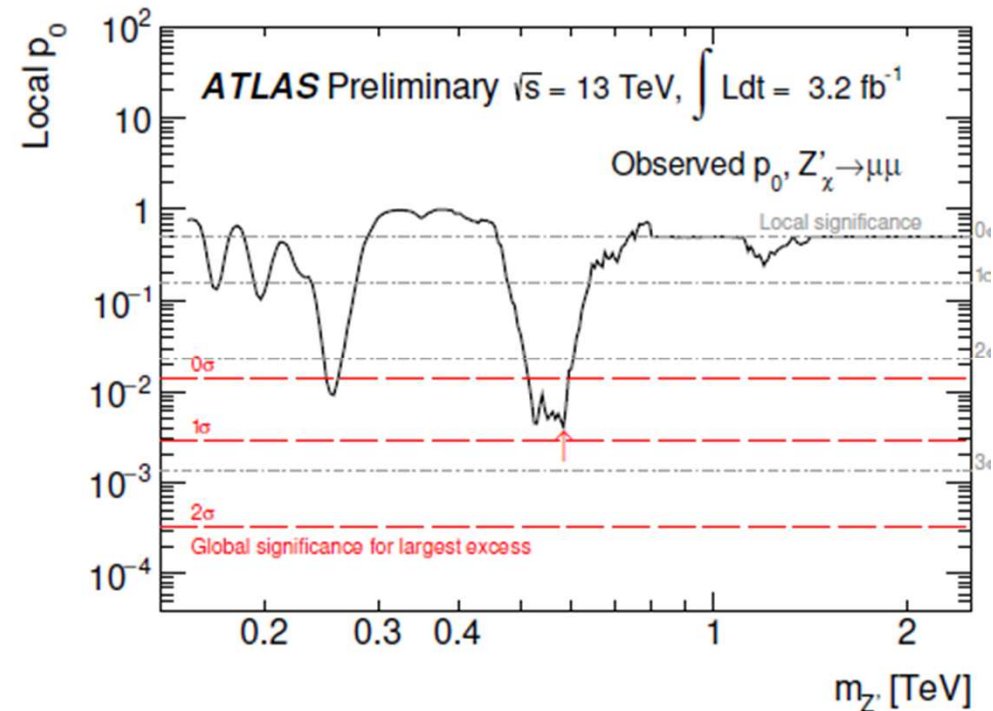
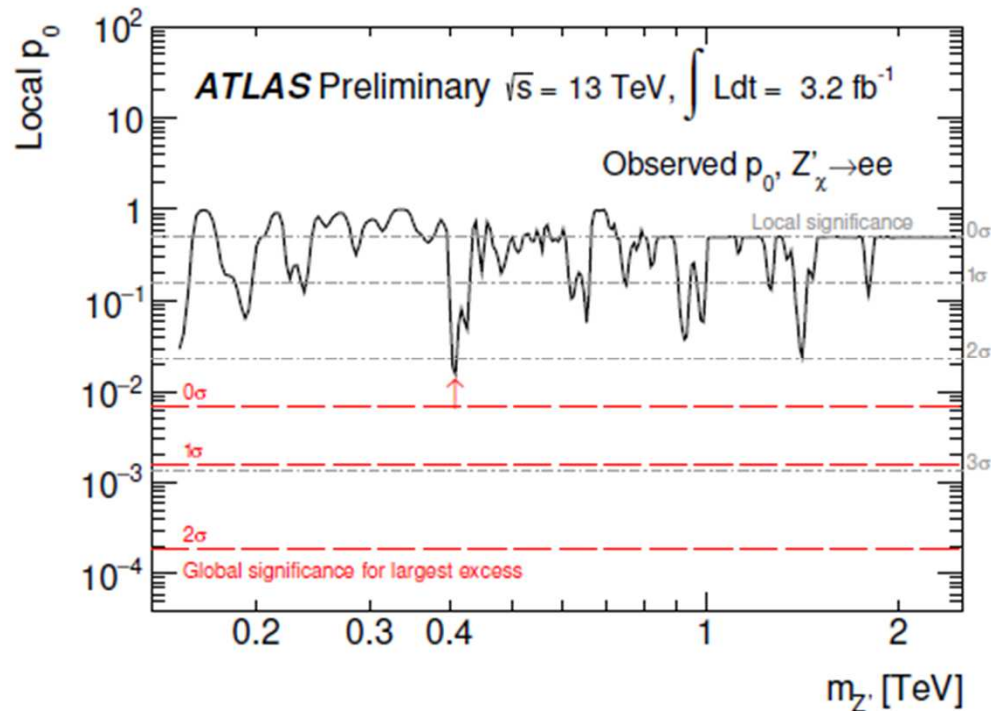
| Model | Width [%] | ee [TeV] | | $\mu\mu$ [TeV] | | $\ell\ell$ [TeV] | |
|-------------------|-----------|------------|------|----------------|------|------------------|------|
| | | Exp | Obs | Exp | Obs | Exp | Obs |
| Z'_{SSM} | 3.0 | 3.17 | 3.18 | 2.91 | 2.98 | 3.37 | 3.40 |
| Z'_{χ} | 1.2 | 2.87 | 2.88 | 2.64 | 2.71 | 3.05 | 3.08 |
| Z'_{S} | 1.2 | 2.83 | 2.84 | 2.59 | 2.67 | 3.00 | 3.03 |
| Z'_{I} | 1.1 | 2.78 | 2.78 | 2.53 | 2.62 | 2.95 | 2.98 |
| Z'_{N} | 0.6 | 2.64 | 2.64 | 2.38 | 2.48 | 2.81 | 2.85 |
| Z'_{η} | 0.6 | 2.64 | 2.65 | 2.38 | 2.48 | 2.81 | 2.85 |
| Z'_{ψ} | 0.5 | 2.58 | 2.58 | 2.32 | 2.42 | 2.74 | 2.79 |

- 13TeV data showed good agreement with SM predicted background;
- Sensitivity compared to 8 TeV data is improved – mainly due to energy increase, but also due to detector ID, MS upgrade;
- New cross section and mass limits are set on Z' and CI models;

Backup

Observed signal p-values

Local p-values for dielectron (left), dimuon (right) channels for Z' -chi signal of different pole masses.



Systematics studies: summary

| Source | Dielectrons | | Dimuons | |
|----------------------------|--------------------|----------------------|----------------------|----------------------|
| | Signal | Background | Signal | Background |
| Normalisation | 4.0% (4.0%) | N/A | 4.0% (4.0%) | N/A |
| PDF Choice | N/A | 9.1% (17.2%) | N/A | 5.3% (7.4%) |
| PDF Variation | N/A | 5.3% (10.5%) | N/A | 4.4% (6.5%) |
| PDF Scale | N/A | 1.8% (2.3%) | N/A | 1.7% (1.9%) |
| Photon-induced corrections | N/A | 3.4% (5.4%) | N/A | 3.2% (3.8%) |
| Efficiency | 5.1% (5.0%) | 5.1% (5.0%) | 13.4% (18.5%) | 13.4% (18.5%) |
| Scale & Resolution | <1.0% (<1.0%) | 7.8% (9.1%) | 20.2% (26.2%) | 20.2% (45.9%) |
| Multi-jet & W +jets | N/A | <1.0% (<1.0%) | N/A | N/A |
| MC Statistics | <1.0% (<1.0%) | <1.0% (<1.0%) | <1.0% (<1.0%) | <1.0% (<1.0%) |
| Total | 6.5% (6.4%) | 14.6% (23.5%) | 24.6% (32.3%) | 25.5% (50.6%) |

Systematics studies: muon channel (top), electron channel (bottom)

