8 TeV Non-Resonant Dilepton Search at ATLAS

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Theoretical Motivation

Contact Interactions (CI)

CI encompasses a range of new physics, we are looking at quark-lepton compositeness.

Broad excess deviation from SM[1] invariant mass spectrum, parameterised by the compositeness binding energy scale , Λ.

$$\sigma_{\mathrm{tot}} = \sigma_{\mathrm{DY}} - \eta_{ij}\frac{F_{\mathrm{I}}}{\Lambda^2} + \frac{F_{\mathrm{C}}}{\Lambda^4}$$

3 chiral structures are investigated (η_{LL} , η_{LR} ,η_{RR}).

Constructive and destructive interference effects between CI and SM are investigated.

Large Extra Dimensions (LED)

To solve the hierarchy problem;

$$M_{Pl} \sim 10^{16}\ \mathrm{TeV} >> M_{EW} \sim \mathrm{TeV},$$

ADD[2] postulated n additional LED.

Gravitons propagate in these LEDs and are observable as a KK[3] tower of mass states.

Mass splitting ~1/R (observable broad excess from SM invariant mass spectrum)

$$\sigma_{\mathrm{tot}} = \sigma_{\mathrm{DY}} + \mathcal{F}\frac{F_{\mathrm{int}}}{M_S^4} + \mathcal{F}^2\frac{F_G}{M_S^8}$$

Search parameter M_S is related to fundamental Planck scale M_D (~M_{EW}).

$\mathcal{F}$ is a chosen formalism – 3 are investigated.

1: Standard Model 2: Arkani-Hamed, Dimpoulos, and Dvali 3: Kaluza-Klein

Analysis

Searching for non resonant signatures in the dilepton (electron & muon) channel

Event Selection

- Search is conducted in the dielectron and dimuon channels.
- Select two highest p_T, well isolated leptons, with opposite sign charges.

Background Estimation

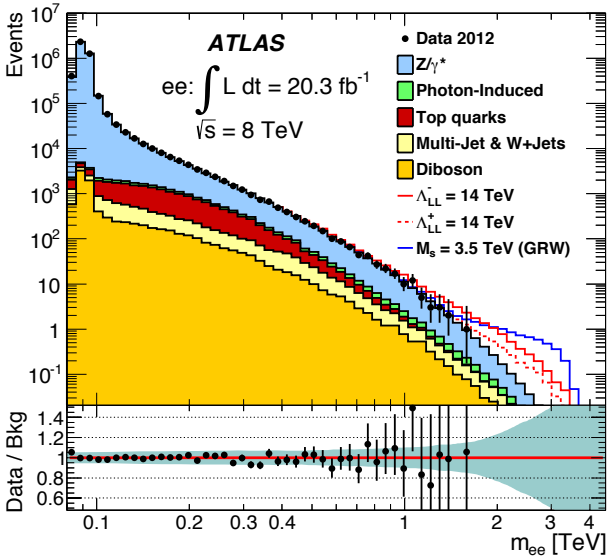
- Dominant and irreducible Drell-Yan (DY) modeled with Monte Carlo (MC).
- Irreducible Photon-Induced and reducible Top and Diboson processes estimated with MC.
- Multi-jet and W+jets contribution estimated using a data-driven method.

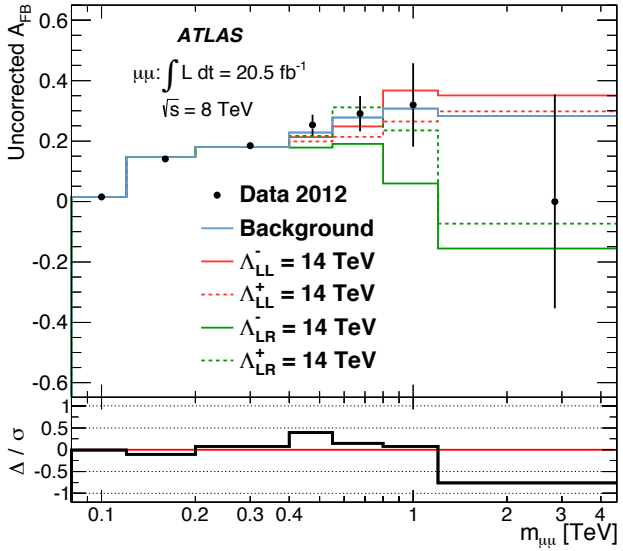
Search Strategy

CI - 6 mass bins – split into forward & backward events depending on decay angle.
LED - single high mass bin, chosen to produce the strongest expected limit.

Results

- Dilepton invariant mass is used as the discriminating variable in both non-resonant searches.





- Lepton decay angle also has high discriminating power from DY events for some CI models.

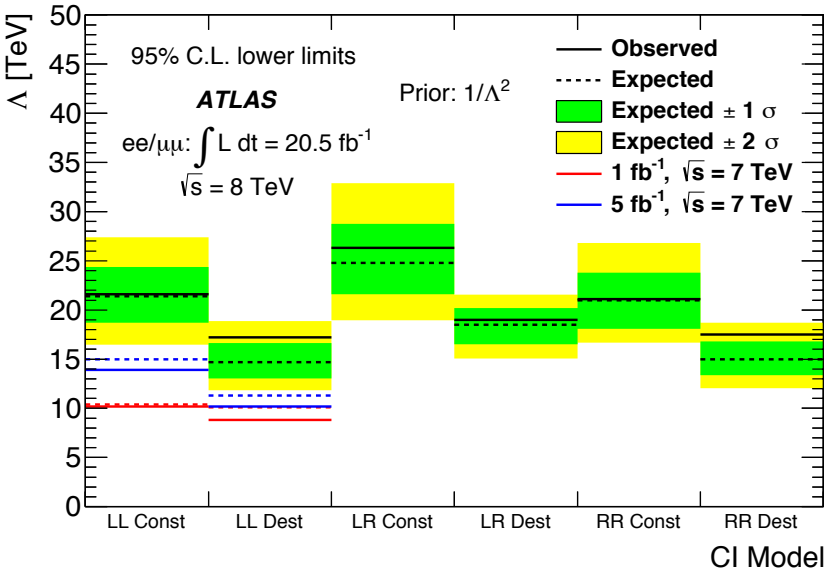
Good agreement is observed between the data and the SM in both the dilepton mass and A_{FB} distributions.

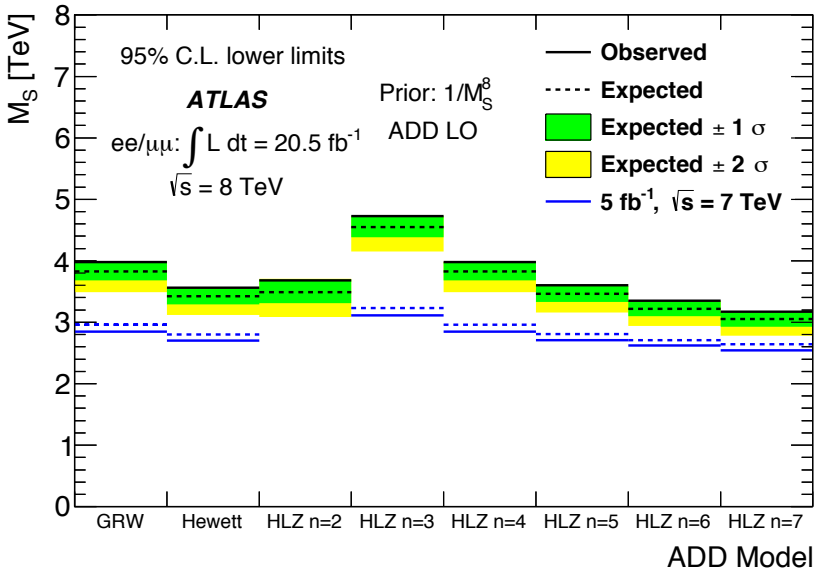
Statistical Interpretation

A Bayesian approach was used to quantify any excess.

Prior probabilities flat in $1/\Lambda^2$ or $1/\Lambda^4$ for CI and $1/M_S^4$ or $1/M_S^8$ for LED – motivated by cross-sections.

No significant deviation is observed and lower limits on Λ & M_S are calculated at 95% credibility level.





Increased limits from 7TeV analysis – including a wider range of models!

Please see me at my poster for more details and questions!