Complementarity of Observables in the Search of New Vector Bosons

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IMPRS Workshop, Munich
June 28, 2016

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Introduction and Motivation

- Present and future
  - S.XX Neutron $\rightarrow$ Top quark
  - Higgs Boson (2012)
- Essential for the Standard Model (SM)
  - It gives mass to Gauge bosons and fermions
  - Confirms the SM
- Is the SM the ultimate theory?

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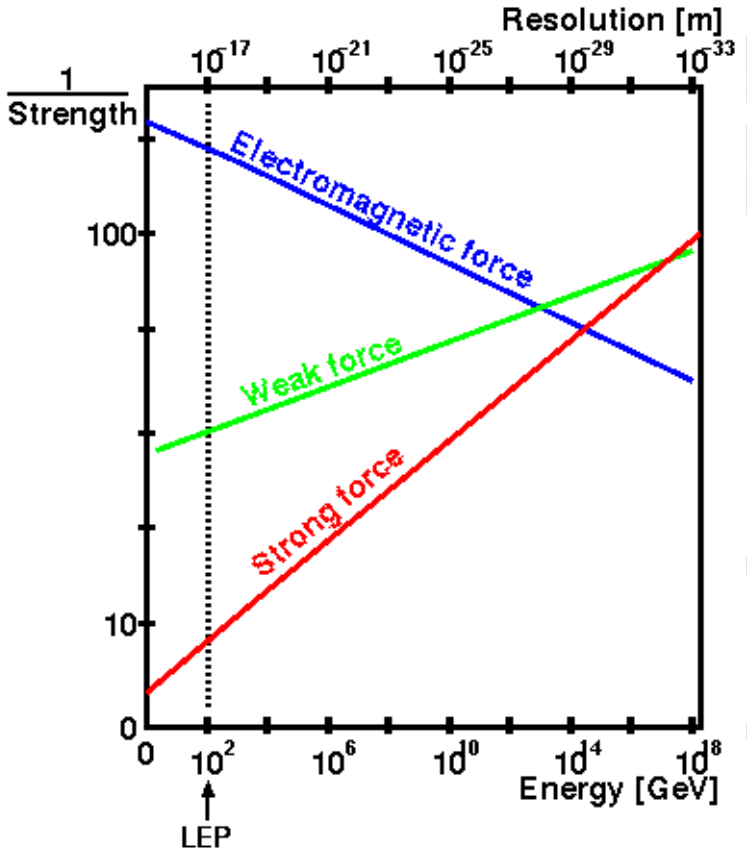
SM problems

- Neutrino Masses
- Gravity
- Unification
- Dark Matter
- Matter-antimatter
- Strong CP problem
- Hierarchy problem

Beyond SM

- Supersymmetry
- Grand Unification Theories
- Extra Dimensions
- Minimal Extensions



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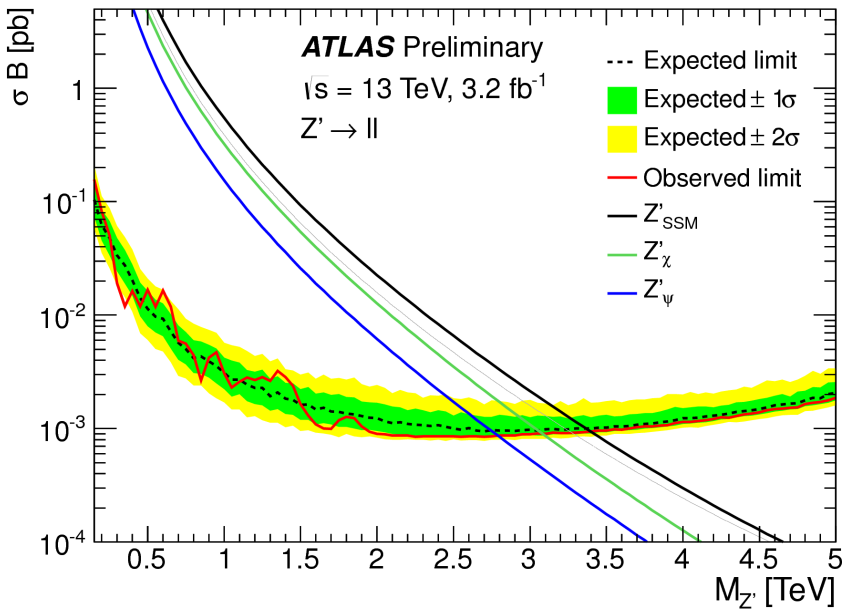
Limits

- Z' searches by ATLAS [2] and CMS[1]
- Dilepton and dijet channels
- No signal $\rightarrow$ Limits



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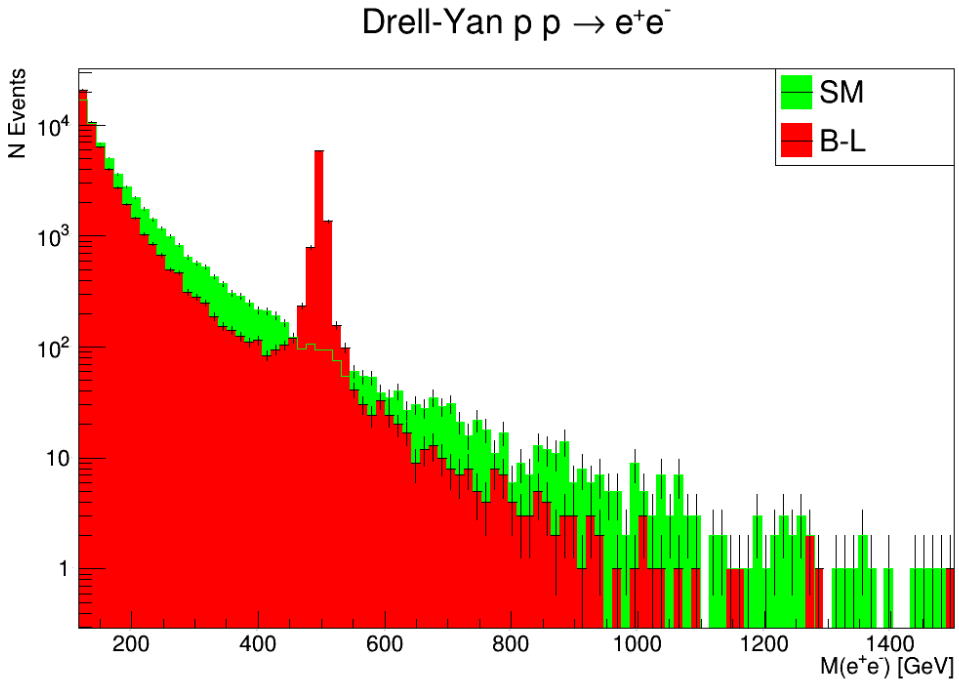

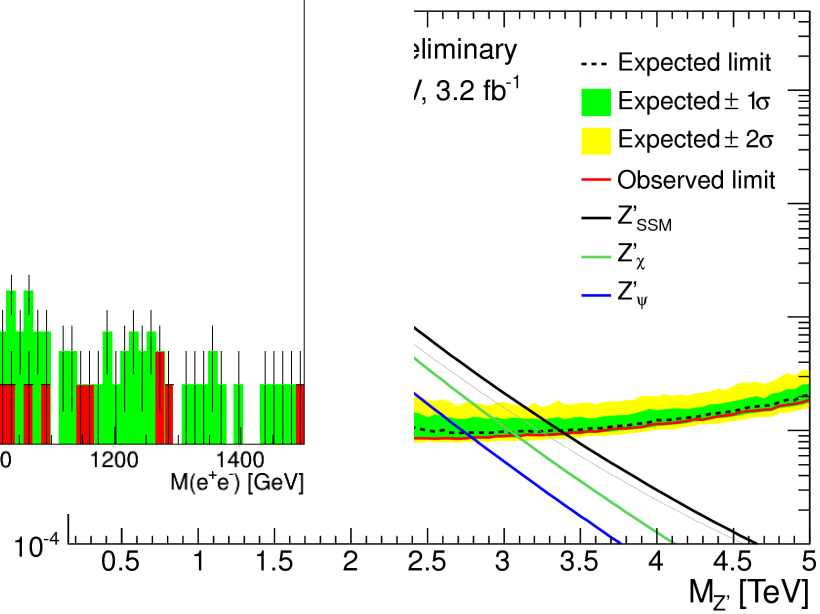

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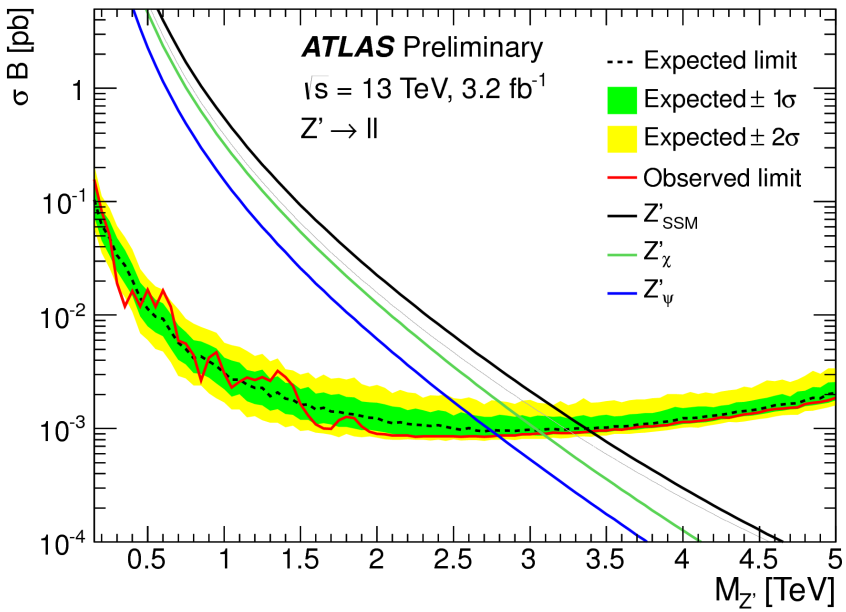


Model

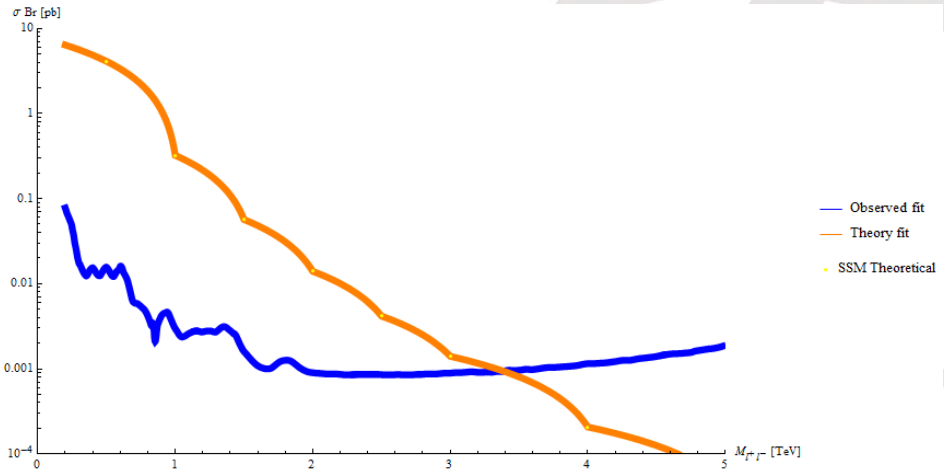
- Cross section

  $\times$

  Branching ratio
- Madgraph5 model
  - DY-SM[3] + Modifications:
    - Convenient parametrization
    - Framework
    - Add new couplings
    - Run FeynRules

Test

- Test our MG5 model
- Sequential Standard Model
- Compare with ATLAS results
- LO while ATLAS NNLO
  - No k-factor provided



Channel	ATLAS	Ours
e^+e^-	3.18 TeV	2.99 TeV
$\mu^+\mu^-$	2.98 TeV	2.86 TeV
l^+l^-	3.40 TeV	3.39 TeV

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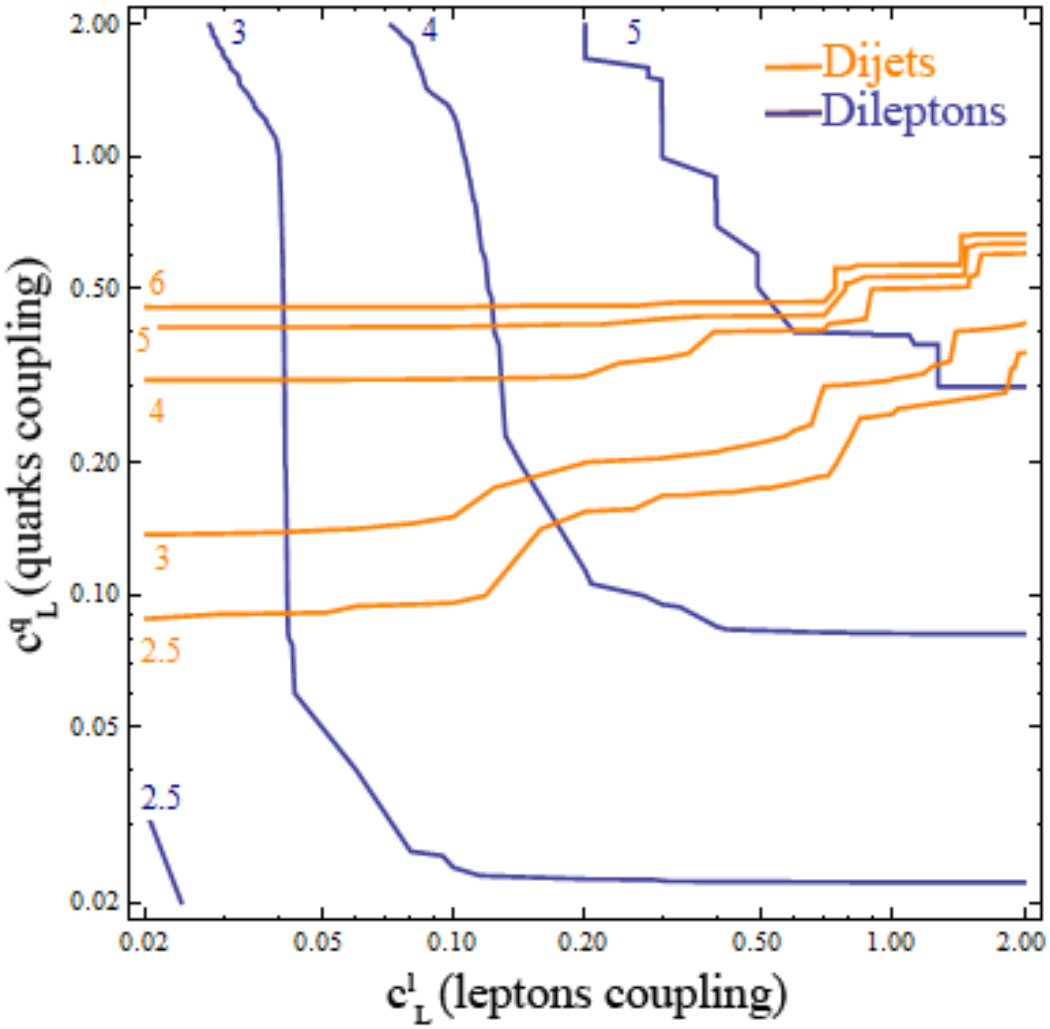
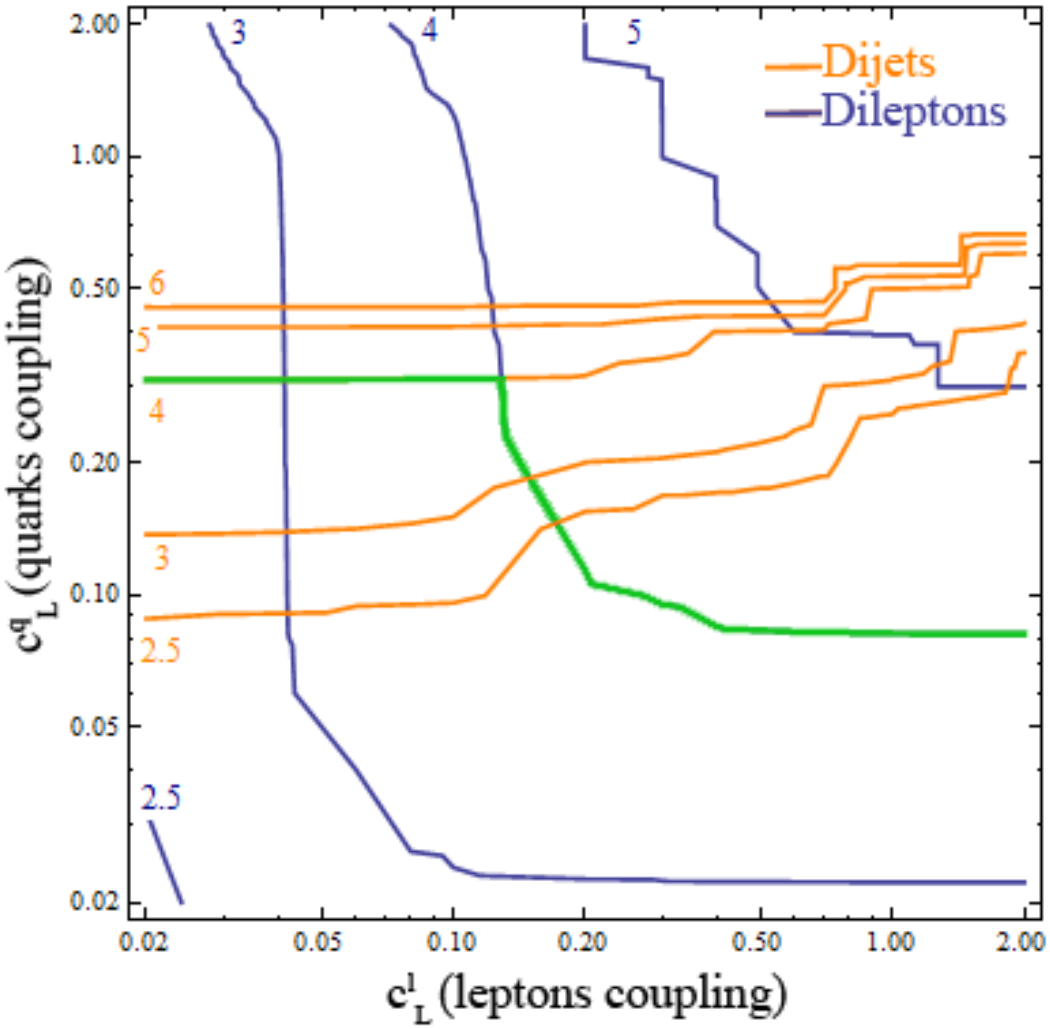
Models

- Goal: model independent parametrization
- Two assumptions analysed:
  - Couplings to first family
  - Couplings to all SM fermions
- Madgraph5 $\rightarrow \sigma \times Br$
- Intersection between experimental limit and theoretical prediction
- Contourplot dijet [1] + dilepton [2]
  - $g_L = g \cdot c_L$
  - c_L =0.02-0.08 with 0.02 step
  - c_L =0.1-2 with 0.1 step

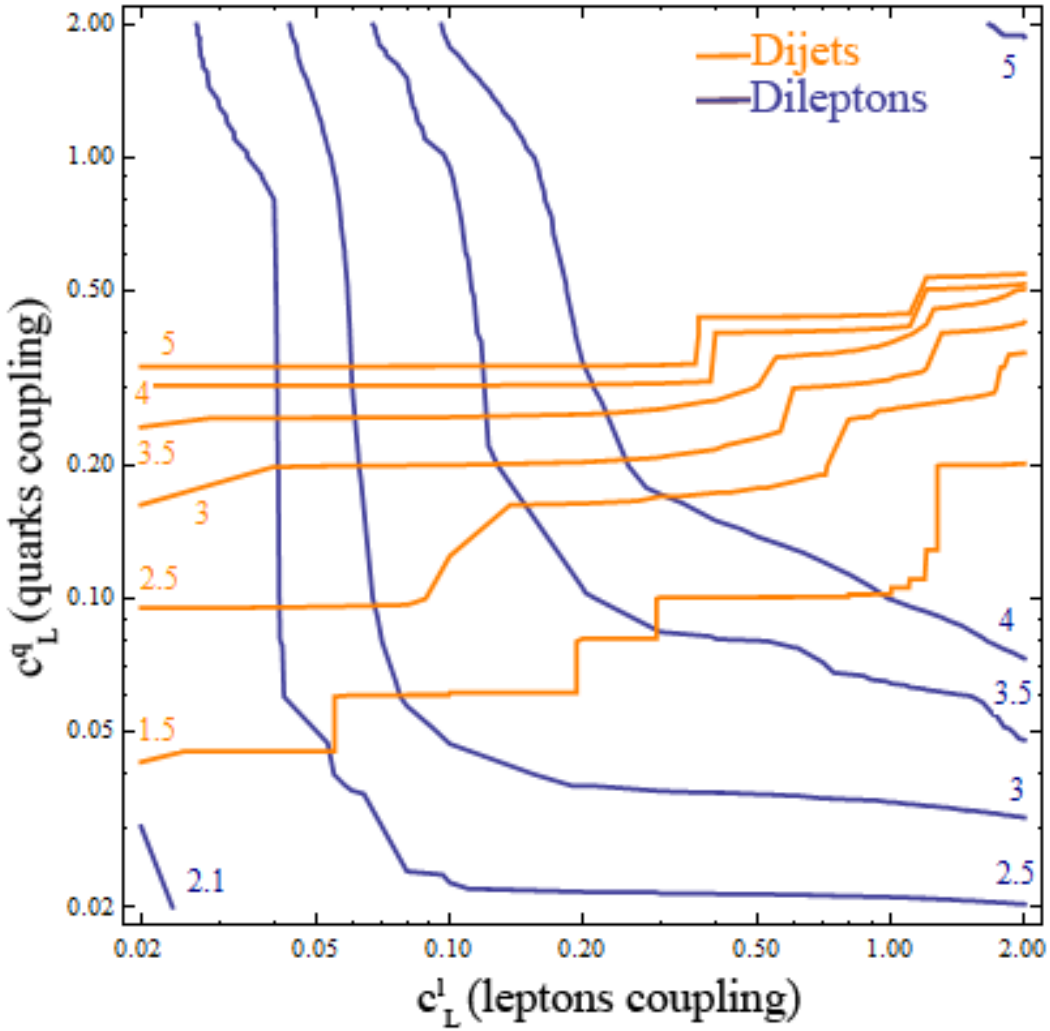
First Family



First Family



All SM fermions



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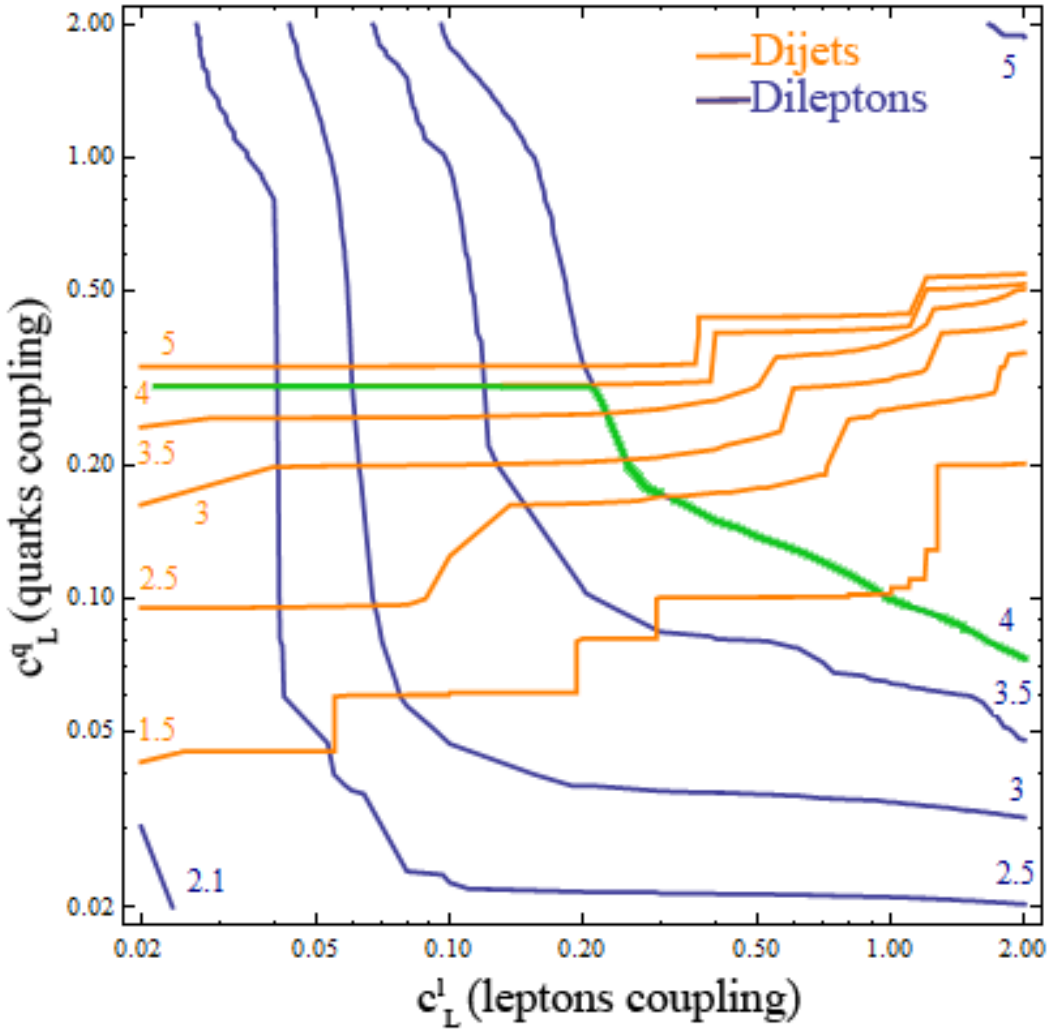

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Summary and Outlook

- Theory
  - Standard Model
  - Something beyond?
  - Beyond SM models
- Analysis
  - Model independent
  - Test
- Results
  - Coupling to first family
  - Coupling to all fermions
  - Contourplot dilepton + dijet channels

Open questions

- Combine with Electroweak precision tests (EWPT)
  - LEP
- Consider angular observables and c_L, c_R
- Generalize c_u and c_d formalism to combine with dijet searches

Bibliography I

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Search for narrow resonances decaying to dijets in proton-proton collisions at $\sqrt{(s)} = 13$ TeV
ARXIV:1512.01224, 2016

[2] **The ATLAS collaboration**
Search for new phenomena in the dilepton final state using proton-proton collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector
ATLAS-CONF-2015-070, 2015

[3] **Chiang, Cheng-Wei and Christensen, Neil D. and Ding, Gui-Jun and Han, Tao**
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