

ATLAS searches for extra dimensions using the full Run 2 ee and μμ datasets

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ATLAS collaboration

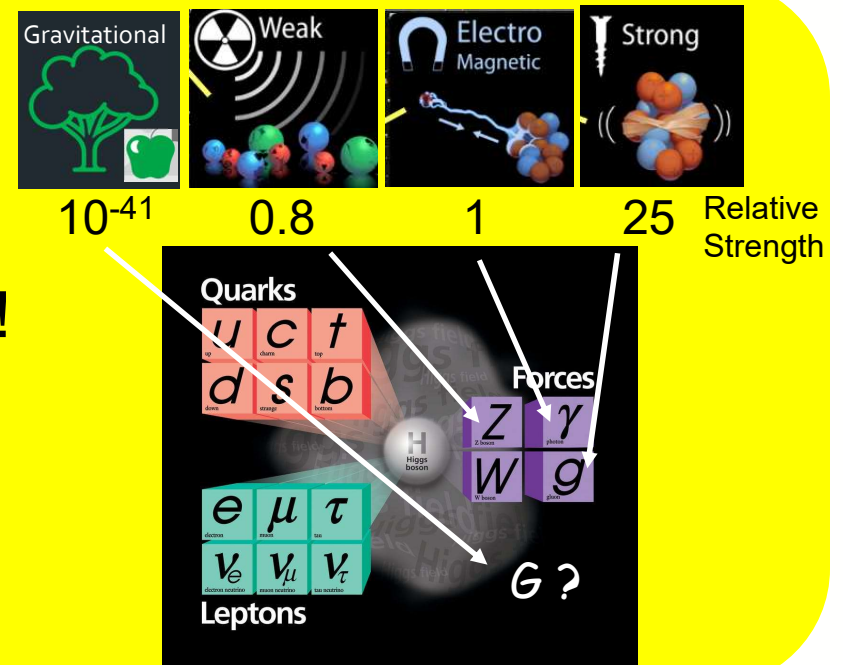
LHCP2021, 10th June

Why search for Extra Dimensions (ED)?

4 forces in Standard Model
 3 of the forces' carriers known
 Graviton not (yet) observed
 Gravity interacts with all particles!
 Why is gravity so weak?

$$M_{EW} (1 \text{ TeV}) \ll M_{Planck} (10^{16} \text{ TeV})$$

Solution? Extra Dimensions



What to search for in extra dimensional models

Model:
Number n:
Weakness
Solution:
Signature:

RS^[1]
1 ED
exp. warp



narrow resonance

ADD^[2]
3+ ED
large radius (R)

$$M_{Pl}^2 \sim M_D^{(2+n)} R^n$$

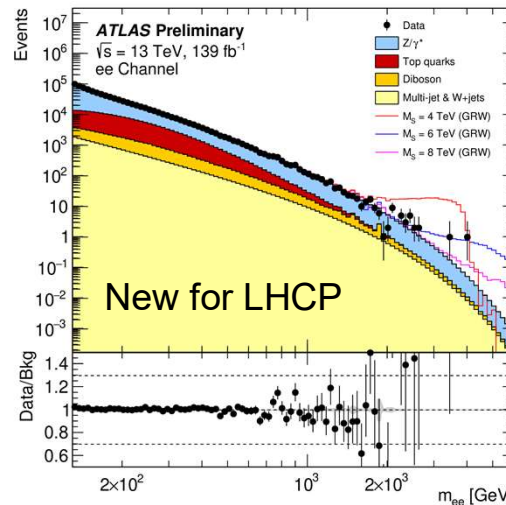
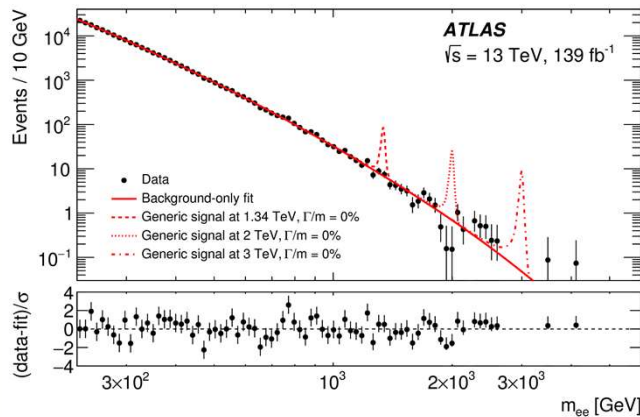
broad excess

Clockwork^[3,4,5]
1 ED
gears/scaling

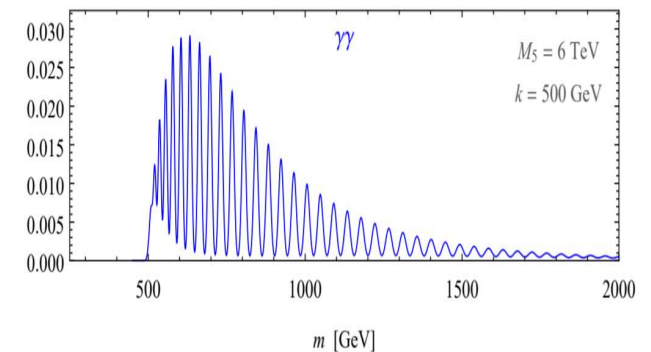


periodic resonances

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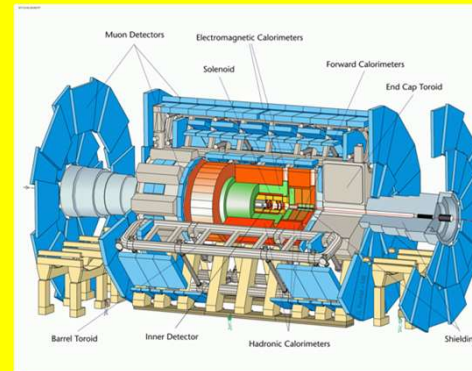


JHEPo6(2018)009



Where to search for extra dimensions

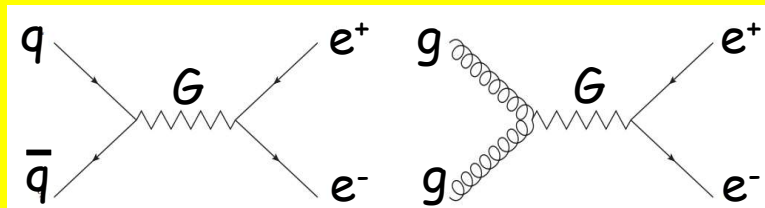
@ the Large Hadron Collider
 @ highest energy in the world
 in pp collisions @ $\sqrt{s} = 13$ TeV
 with the ATLAS detector



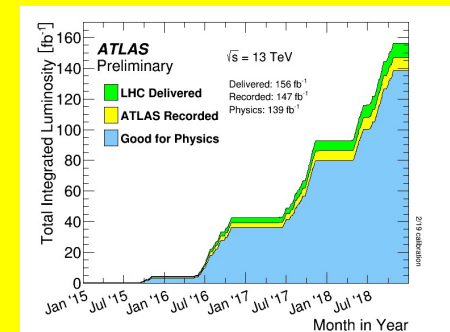
G

G exchange

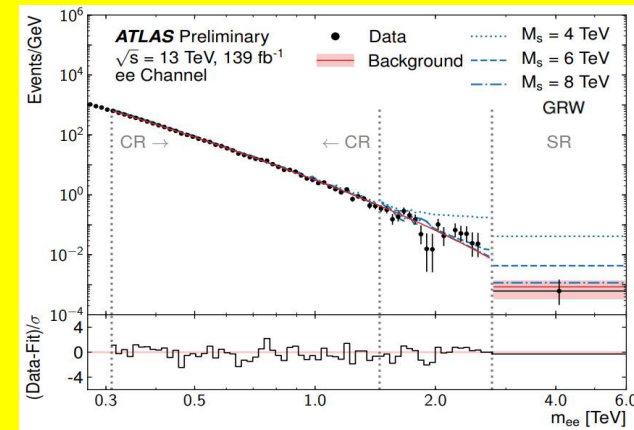
Best search channels: ee , $\mu\mu$ or $\gamma\gamma$



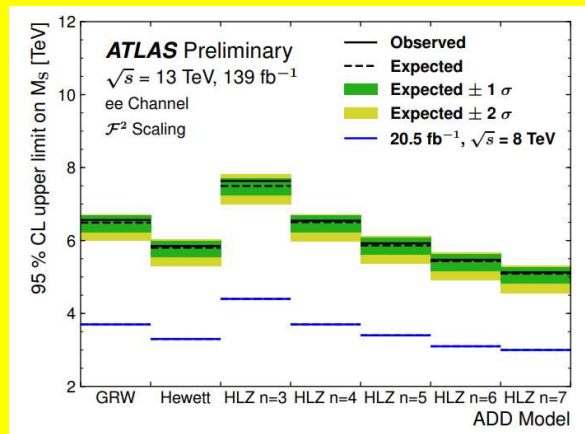
Search in Run 2 data



- Data-driven background estimate
Fit in low-mass Control Region (CR)
Extrapolate to high-mass Signal R (SR)
- Single-bin search
- Frequentist limit setting



What have we found ?



Future Outlook

- G not yet discovered
- Mass limits on G exceed Run 1
- Clockwork search coming soon
- Look forward to LHC Run 3

Thanks

Simen Hellesund, Magnar Bugge,
Farid Ould-Saada, ATLAS Collaboration