Search for New Physics with Monojet in pp collisions at 7 TeV

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Many questions without an answer :

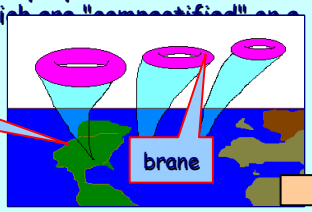
How many dimensions does our Universe have?

Why gravity is so weak compared to the other forces?

How to solve the hierarchy problem between electroweak and Planck scale?

Large extra-dimensions models:

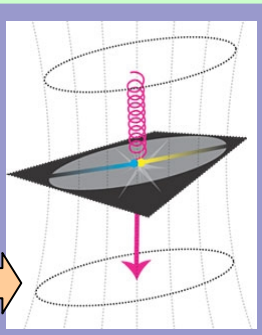
In 1998 Arkani-Hamed, Dvali and Dimopoulos proposed a model where the Universe has new extra dimensions, which are "compactified" on a small scale R



- our ordinary space is confined to the
- usual 3-dimensions (on a brane)
- gravity may additionally expand in the extra-dimensions

→ Gravity gets diluted and becomes weak

→ $M_{PL}^2 = M_D^{2+\delta} R^\delta$ (M_{PL}: Planck mass, δ : number of extra-dimensions)



Graviton/Unparticle direct production:

If the Λ and M_D are ≈TeV, Graviton/Unparticle can be produced in LHC collision together with a gluon or quark

- they live mostly in a hidden sector and will go undetected through the detector → large momentum imbalance →missing energy in transverse plane (MET)
- recoils against a single jet resulting from the associated parton

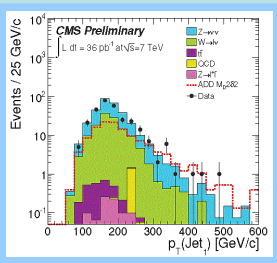
We looked for an excess in the MET + monojet spectrum in 2010 data (*PAS EXO 2011-003*):

DATA have to be cleaned from:

- unphysical signals in the calorimeters (noise and instrumental effects)
- Beamhalo and cosmic muons
- events with multiple primary vertexes

DATA and Monte Carlo are preselected:

- trigger selection based on high MET
- all jets: p_T > 30 GeV
- MET > 150 GeV, Numb. of Jets: 1 or 2
- Leading Jet (jet1): p_T > 110 GeV, |η|<2.4
- Δφ(jet1,jet2) < 2.0



Monojet signal sample:

Leptons have to be rejected

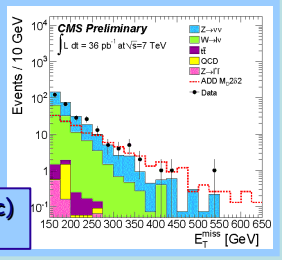
- rejection of isolated muon
- rejection of track with TIV<0.1
- rejection of e/μ p_T>10 GeV

$$TIV = \frac{1}{p_T(\text{tk } 1)} \sum_{R \in \Delta R} p_T^j$$

(an example of ADD signal is represented)

→ Z(νν)+jet is the main SM background, followed by W(lν)+jet

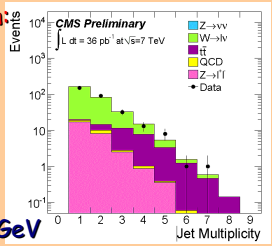
→ there's no significant evidence of excess

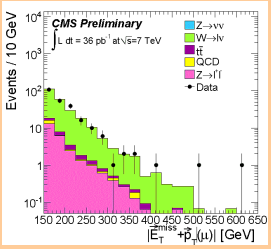


Data-driven Background estimation:

Leptons have to be included

- selection of isolated, well reconstructed, prompt μ p_T>10 GeV
- the purity is improved by reconstrucing a W: 50 < M_T(μ+MET) < 100 GeV
- cross-checked with 81<M(μμ)<101 GeV



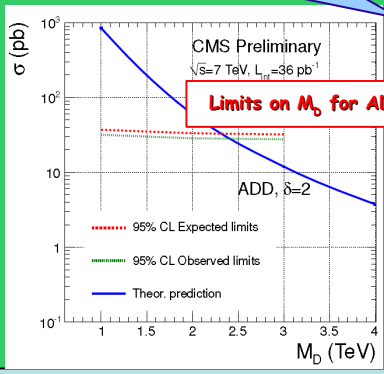


→ Kinematic and topological variables show good agreement

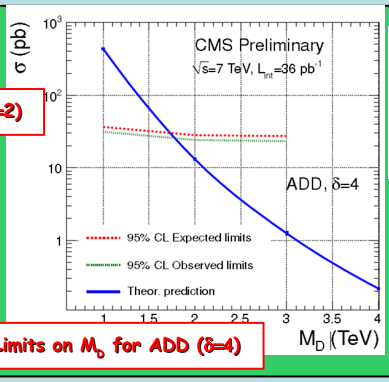
→ the number of events in the control region is rescaled by the W/Z different cross-section, branching ratio, muon efficiency and acceptance

→ Good agreement between data-driven method, MC and cross-checks

main systematics (instrumental, theoretic) effects included



Limits on M_D for ADD (δ=2)



Limits on M_D for ADD (δ=4)

δ	K-factor	LO Exp.	LO Obs.	NLO Exp.	NLO Obs.
2	1.5	2.09	2.16	2.28	2.37
3	1.5	1.77	1.83	1.92	1.98
4	1.4	1.62	1.67	1.72	1.77
5	1.4	1.55	1.59	1.64	1.68
6	1.4	1.49	1.53	1.58	1.62

After 36 pb^{-1}, 95% C.L. Limits excluded regions are much larger than previous experiment

L.Benucci,Search for New Physics with Monojet in pp collisions at 7 TeV, Physics at LHC 2011, June 6-11th, 2011, Perugia, ITALY