TeV scale gravity

hegoi garitaonandia
BND 2009
high invariant mass object search with Atlas
high invariant mass object search with Atlas

extra dimensions search at the TeV scale with Atlas detector
high invariant mass object search with Atlas

extra dimensions search at the TeV scale with Atlas detector

direct search of large extra dimensions with the Atlas detector
high invariant mass object search with Atlas

extra dimensions search at the TeV scale with Atlas detector

direct search of large extra dimensions with the Atlas detector

direct search of large extra dimensions with A Thoroidal Lhc AparatuS detector at the Large Hadron Collider
why all these theories?

10^{+1} \quad 10^{-2} \quad 10^{-38} \quad 10^{-6}
extra dimensions

- In 1920’s Kaluza&Klein attempted to unify EM with gravity in 5D
- In late 1990’s, models built to solve the hierarchy problem
- We observe apparent gravity; actual gravity is stronger and its scale can be as low as $\sim$ TeV
- Many ED models: flat (ADD, TeV$^{-1}$), warped (RS); various particles escaping into “bulk” while SM is confined to our 3-brane

\[
G_N = \frac{1}{(M_{PL(4+n)})^2} \equiv 1/M_D^2
\]

\[
M_{Pl}^2 = M_D^{2+n} R^n
\]

$M_{Pl} \sim 10^{19}$ GeV, $M_{Pl(4+n)} \sim M_{EW}$

1/r$^2$-law valid for $R=44$ $\mu$m @ 95% CL
boom, Atlas, booooom

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BND 2009
black hole formation and decay

\[ T_H = \frac{h c^3}{2 k G M_{BH}} \]

\[ R_s = \frac{2 G M_{BH}}{c^2} \]

N. Brett

number of black holes in 1fb

true black hole mass (GeV)
programming language inventor or serial killer?
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Bertrand Meyer

initial designer of Eiffel language

0 known kills
programming language inventor or serial killer?
programming language inventor or serial killer?

Anatoly Onoprienko

“the terminator” wiped out entire families across Ukraine with a 12 mm

54 confessed kills
programming language inventor or serial killer?
programming language inventor or serial killer?

Torbjorn Sjostrand

(one of) Pythia creator(s)

lecturer BND 2008 on MC generators

0 known kills
decay and analysis strategy

PDG ID of particles decaying from BH

number of particles in 1fb
(true) black hole event properties

![Graph showing the sum Et of the event (GeV) vs. the number of events in 1fb for different categories: BH 6D, BH 10D, BH 11D, W + Jets, Z + Jets, L TTBAR, H TTBAR, and ALL BACKGROUND.](image)
the Atlas TDR analysis

- object selection
- overlap removal
- sum $p_T > 2.5$ TeV
- lepton $p_T > 50$ GeV

\[ p_{BH} = \sum_{i=\text{objects}} p_i + \left( E_T, E_{T_x}, E_{T_y}, 0 \right) , \]

\[ m_{BH} = \sqrt{p_{BH}^2} . \]
the Atlas TDR analysis

- BH 6D
- BH 10D
- BH 11D
- W + Jets
- Z + Jets
- L TTBAR
- H TTBAR
- ALL BACKGROUND
links to ttbar

3-body monojet

number of top quarks in 1 fb

true Pt of top quark
the trigger problem

- processing time per event is constrained by luminosity / DAQ throughput requirements

- black holes are fat events: therefore slow and big (memory limits)

- will they timeout and go to the debug stream on first data taking?
trigger offline system

**Diagram:**
- **Analysis:**
  - Reconstruction, calibration, etc.
- **Data Acquisition:**
  - All streams
- **Storage:**
- **File Catalog:**
- **Manager:**
- **Batch System:**
  - Reprocess Trigger
  - "Event Header" Analysis
- **Reports, Feedback:**
- **DB:**

**Legend:**
- Blue arrow: flow of control info
- Black arrow: flow of data
- Green arrow: shifter feedback