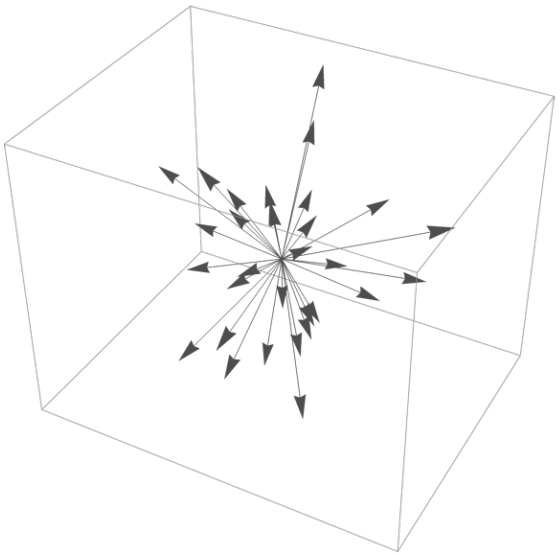
SUEPs* to Jets:

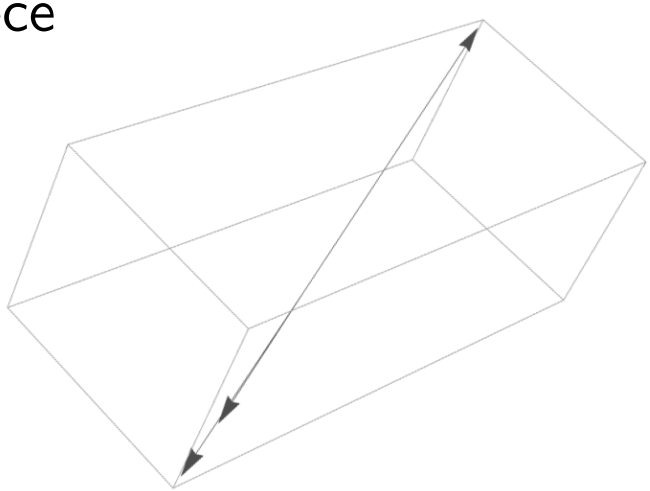
A Toy Model for New Physics at the LHC



C. Cesarotti, M. Reece
M. Strassler

Harvard University

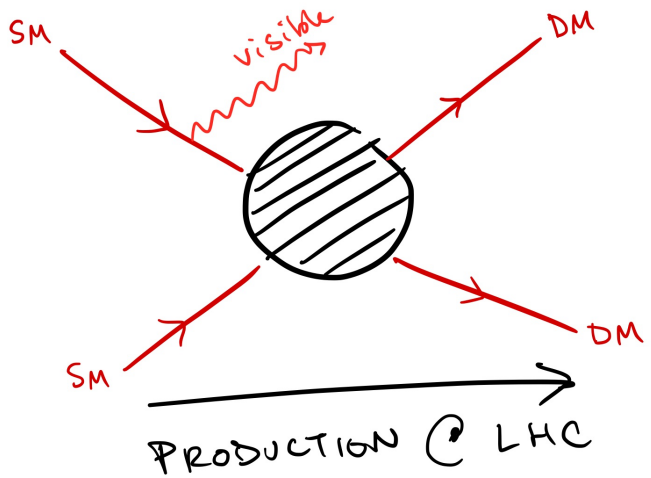
July 11, 2018



*Soft unclustered energy patterns

Motivation

- LHC is a remarkable tool
- Triggering restricts scope of searches
- Long Lived Particle (LLP) search at CERN
- Ex. previous new DM searches: mono-X, missing E_T
- Generalized trigger broadens search

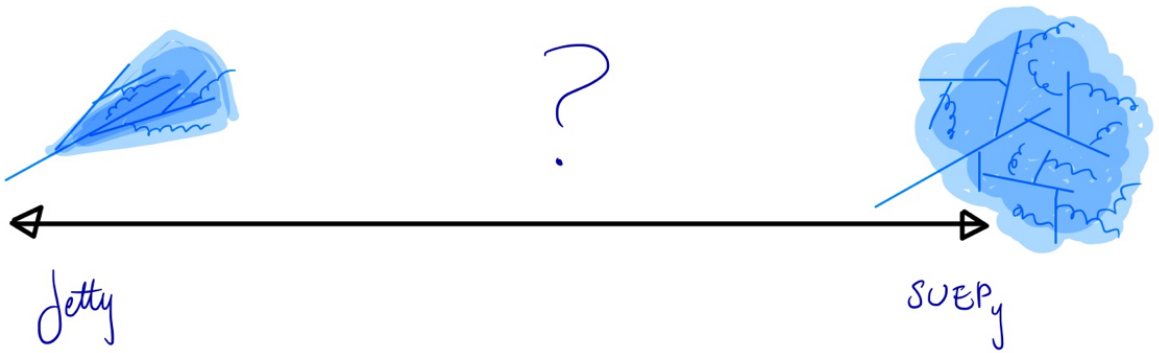


Hidden Valleys

- Defining a full search is model dependent
- Physics of the mediator is independent of the hidden sector dynamics
- General qualities for our discussion
  - Long lifetime
  - Heavy mediator
  - Confining
- Our focus: event shape in dark sector (hidden valley)

Event Shapes

- Confinement and shape are independent
- Extremely unconstrained problem
- Theoretic predictions in 't Hooft (λ) coupling limits
  - SUEP-y (spherical) events $\rightarrow$ large λ
  - Jetty events $\rightarrow$ small λ
  - Intermediate regime?



Toy Model (AdS/CFT)

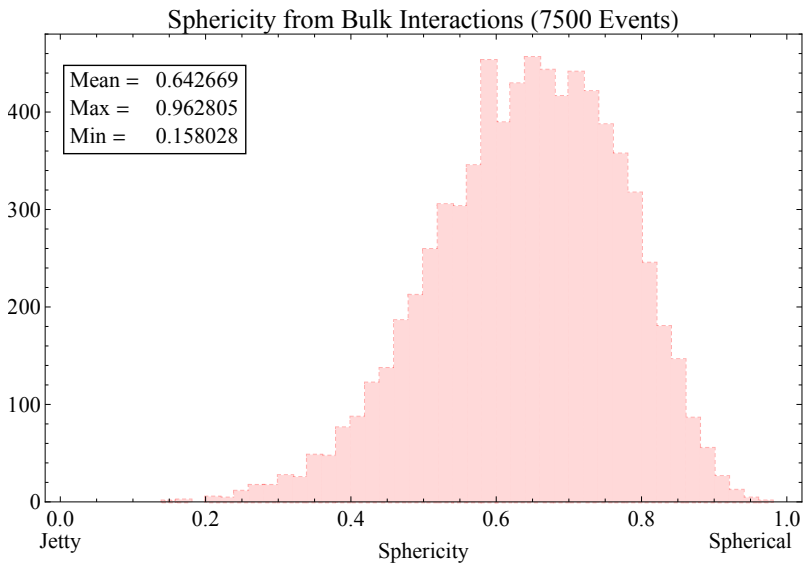
- Fields in the slice of AdS dual to the hadronic states in the confining field theory

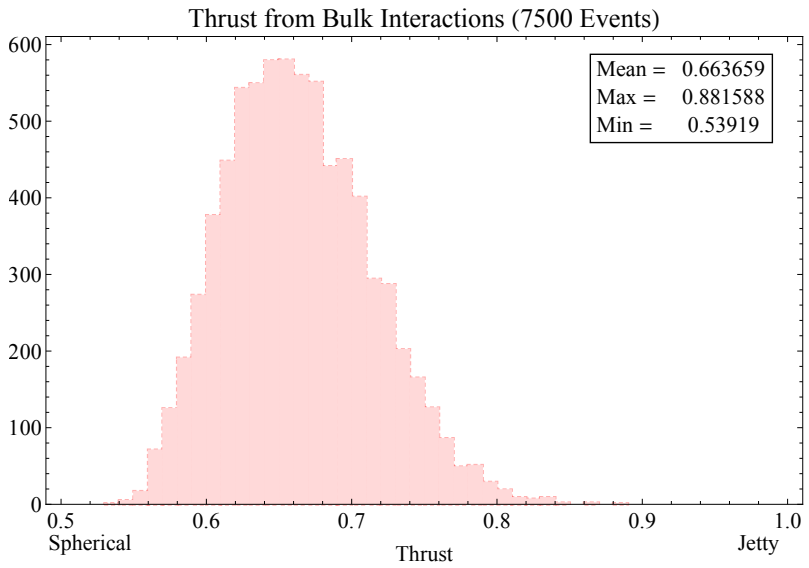
AdS		**CFT**
(toy)		(want to understand)
Slice in AdS	$\Longleftrightarrow$	Quasi-conformal confining field theory
Bulk Scalar Field		4D Field operators
Kaluza-Klein Modes		Hidden sector hadrons

Simulation (cubic in bulk)

$$\mathcal{L}_5 \supset -\frac{g}{3!}\phi^3$$

7.5×10^3 trials Parent KK# = 80





Back-ups

Toy Model (AdS/CFT)

- Break conformal invariance / distort AdS in IR limit with hard-wall

CFT	**AdS**
Energy floor	Hard wall cut-off at z_{IR}
Operator in Lagrangian	Non-normalizable modes at z_{UV}
$\mathcal{L}_{\text{CFT}} \to \mathcal{L}_{\text{CFT}} + j(x^\mu)\mathcal{O}_\Delta$	$\lim_{z\to z_{UV}} \Phi(x^\mu, z) \to j(x^\mu) z^{d-\Delta}$
Operator vev	Normalizable modes at z_{UV}
$\langle \mathcal{O}_\Delta \rangle = v$	$\lim_{z\to z_{UV}} \Phi(x^\mu, z) \to v z^{\Delta}$