# Fundamental Particle Physics

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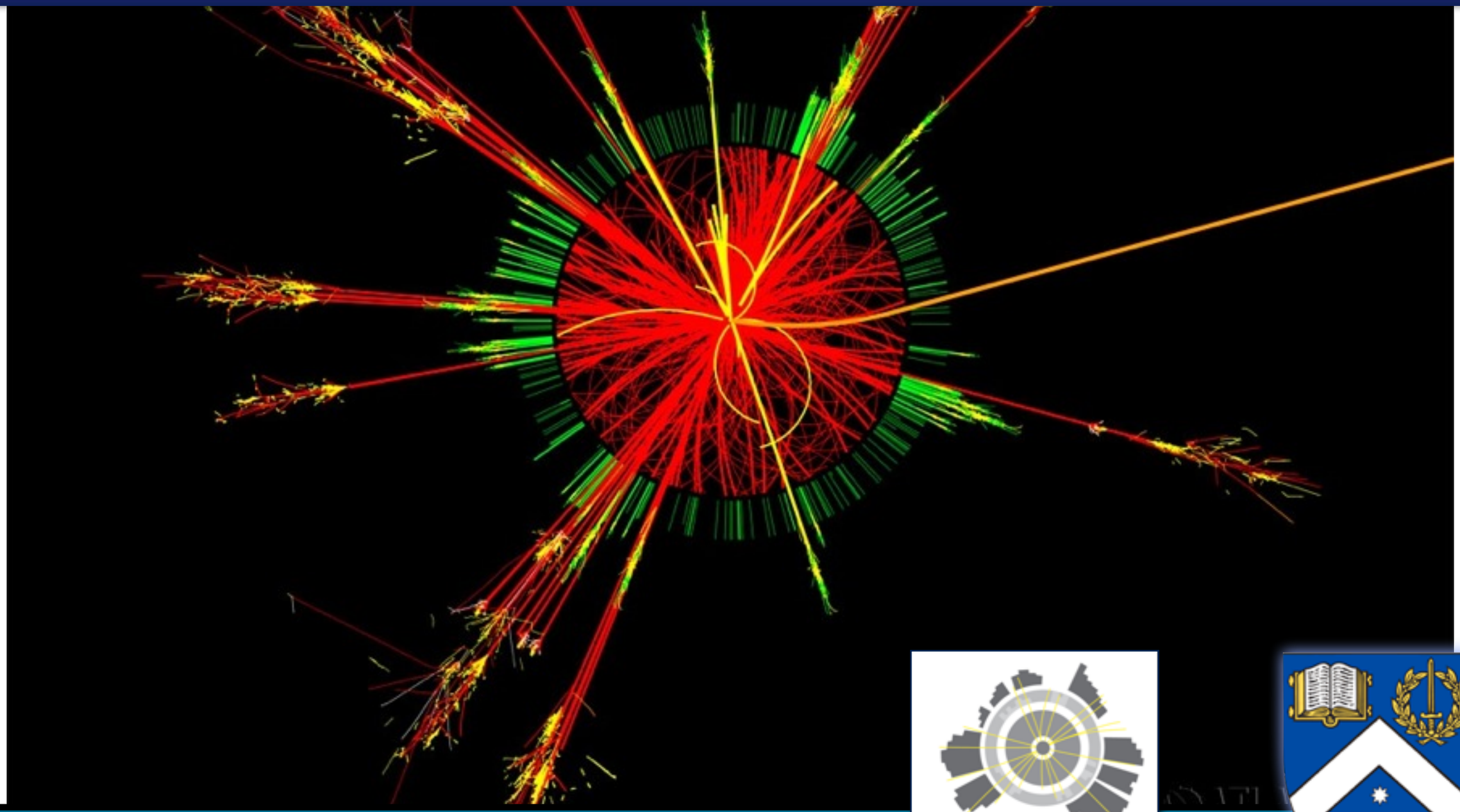

Monash University
Open Day - 2015

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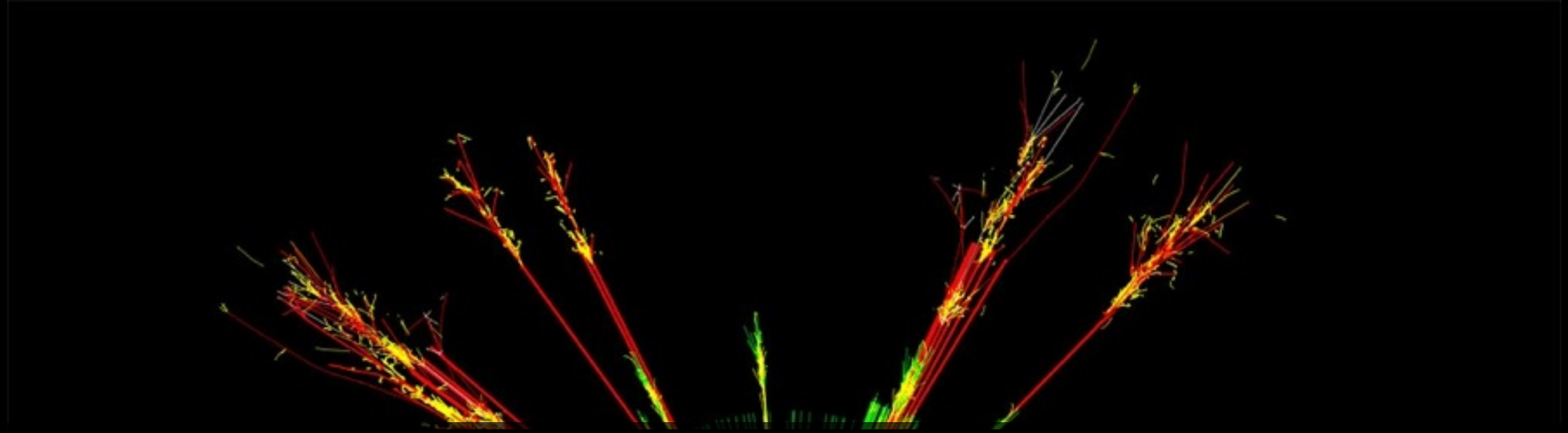
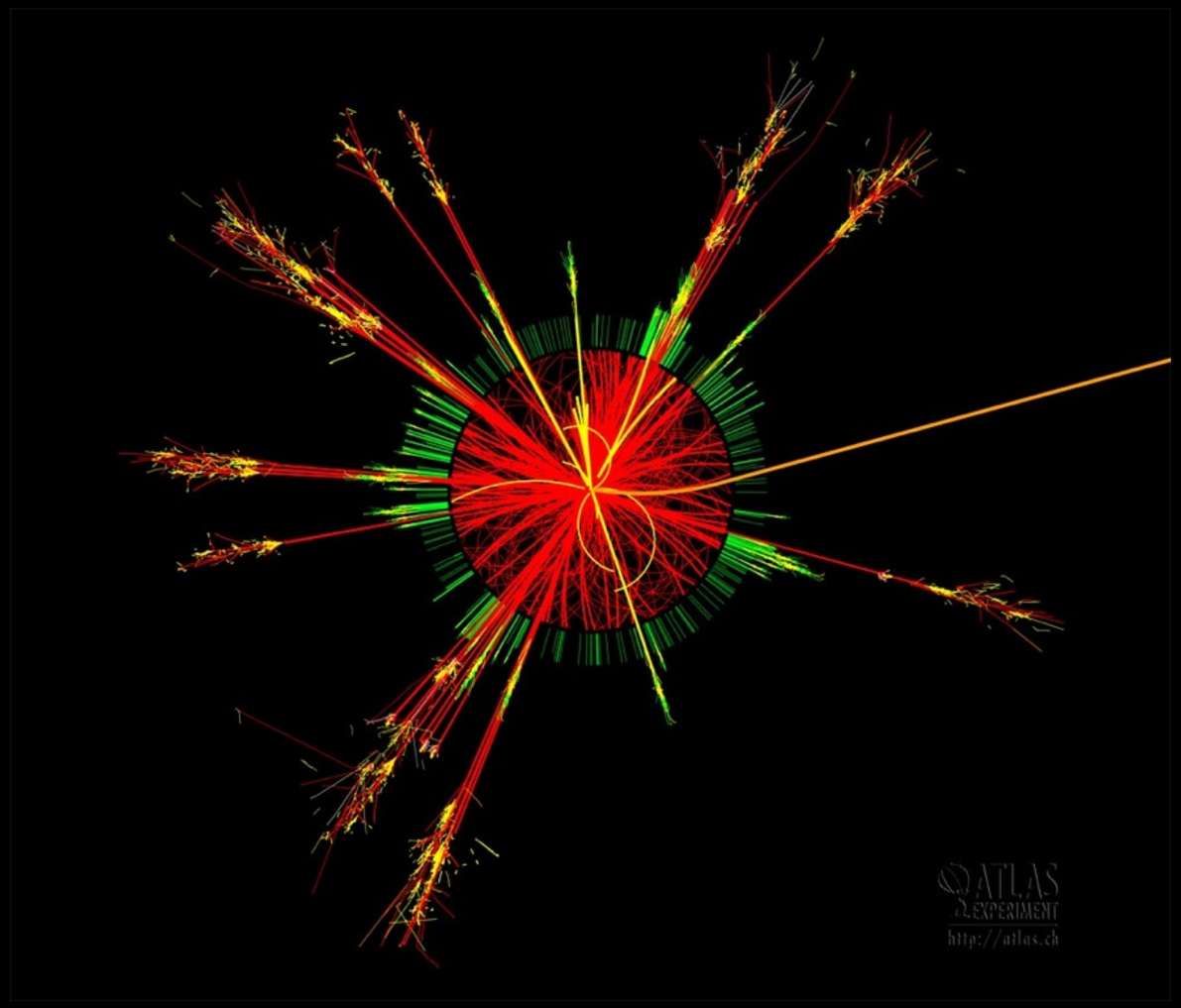


The aim of **particle physics** is to study matter and force


at the most fundamental level

# Theory




This particular picture is actually a simulation

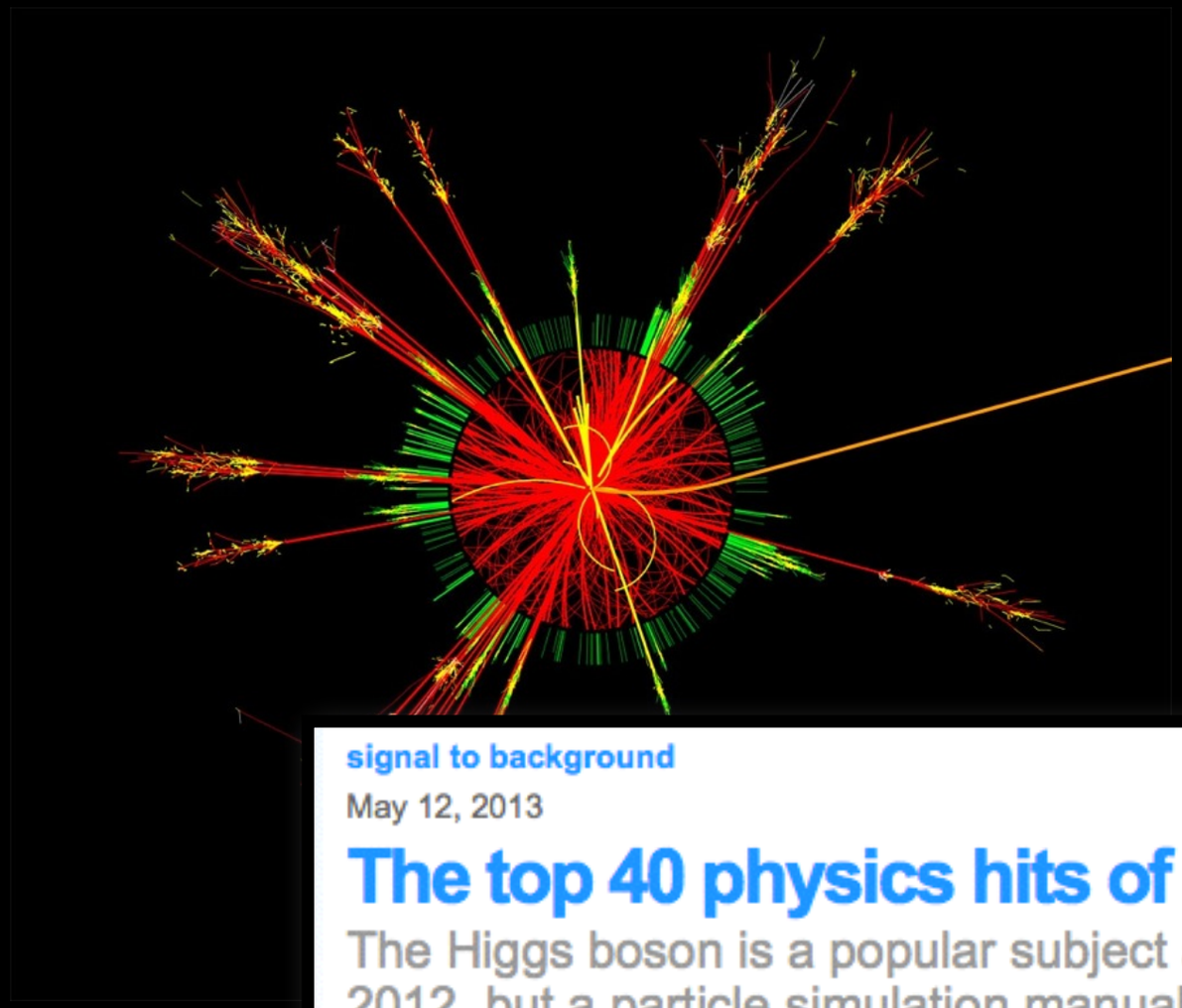
**Research in theoretical high-energy physics at Monash:**

Virtual Colliders: computer models of particle physics

Dark Matter & Physics beyond the Standard Model

Quantum Chromodynamics & Supersymmetry

# (Shameless self-promotion)



This particular picture is actually a simulation

signal to background

May 12, 2013

## The top 40 physics hits of 2012

The Higgs boson is a popular subject among the most-cited physics papers of 2012, but a particle simulation manual takes the top spot.

By Glenn Roberts Jr.

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**Related *symmetry* content**

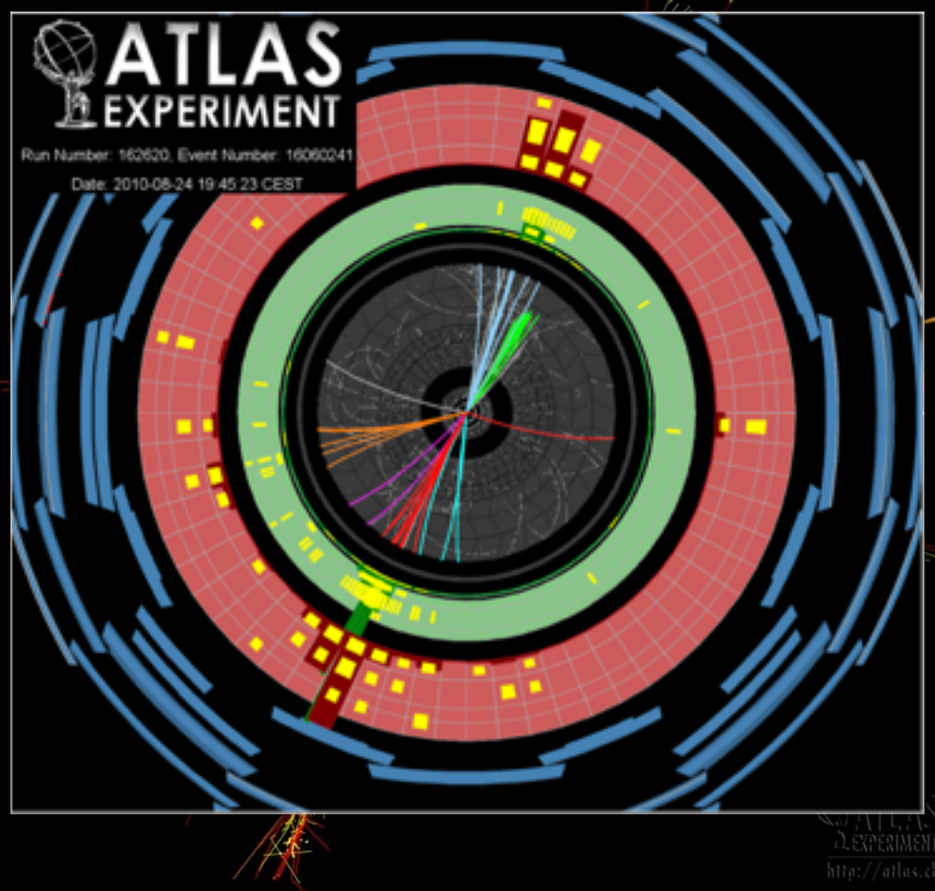
Breaking: Physicists, start your searches:

Think of it as a particle physics version of pop radio's "top 40" countdown: INSPIRE, a database of particle-physics publications, has released its annual list of most-cited articles.

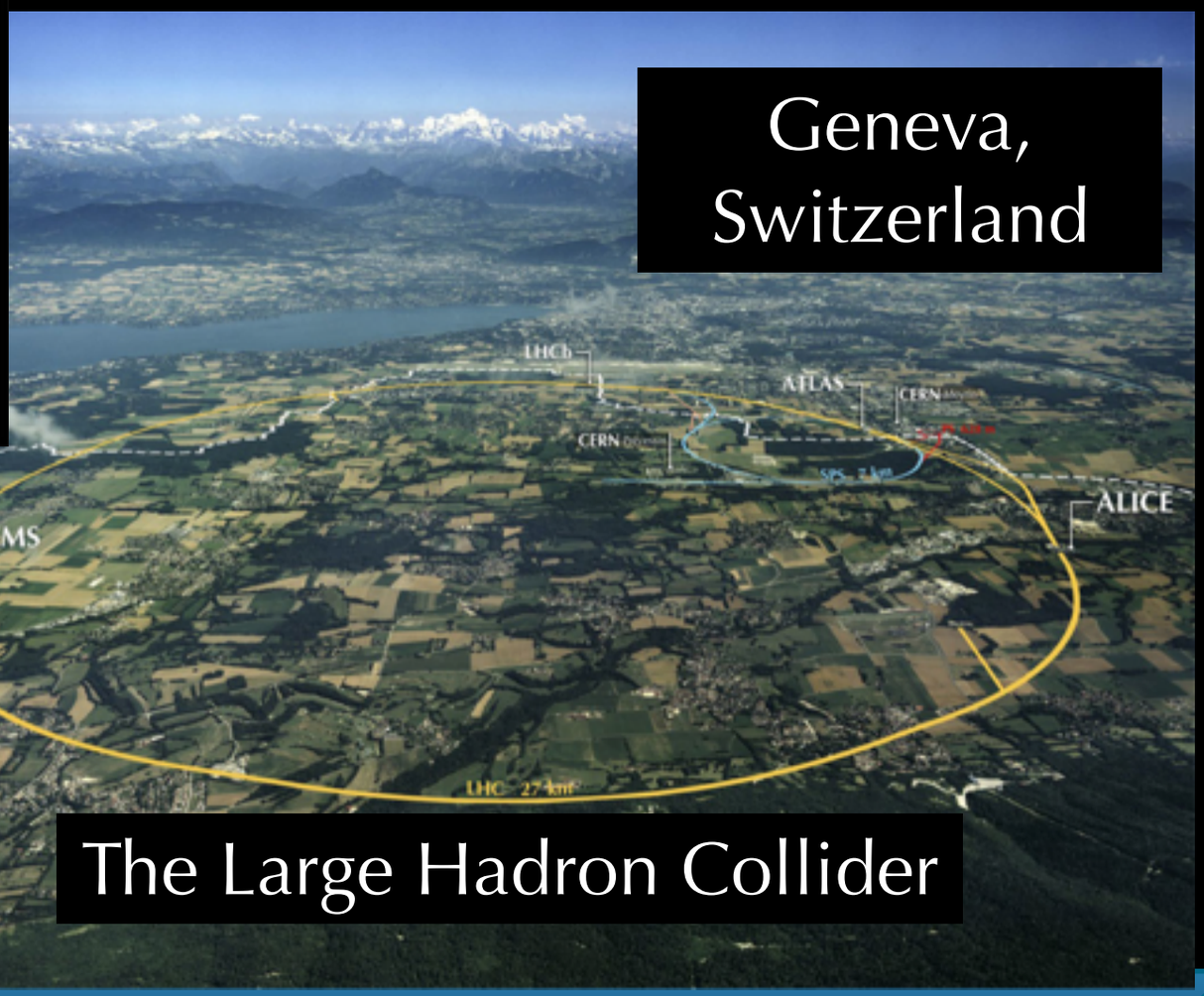
Topping the charts in 2012 are articles about the Higgs boson, which made up about 20 percent of the list.

But the most-cited publication of 2012 is a 583-page manual about PYTHIA, a program for simulating particle collisions and their byproducts.

# Experiment




We get to compare our calculations to some of the largest scientific experiments on Earth



# The Quantum Fields of Nature

## The *"Standard Mod*
## = the story so fa

### Quarks

| | | |
|---|---|---|
| *u* up | *c* charm | *t* top |
| *d* down | *s* strange | *b* bottom |

### Forces

| | |
|---|---|
| *Z* Z boson | *γ* photon |
| *W* W boson | *g* gluon |

*H* Higgs boson

### Leptons

| | | |
|---|---|---|
| *e* electron | *μ* muon | *τ* tau |
| $\nu_e$ electron neutrino | $\nu_\mu$ muon neutrino | $\nu_\tau$ tau neutrino |

Then there is
solving it...

# So, what do we know?

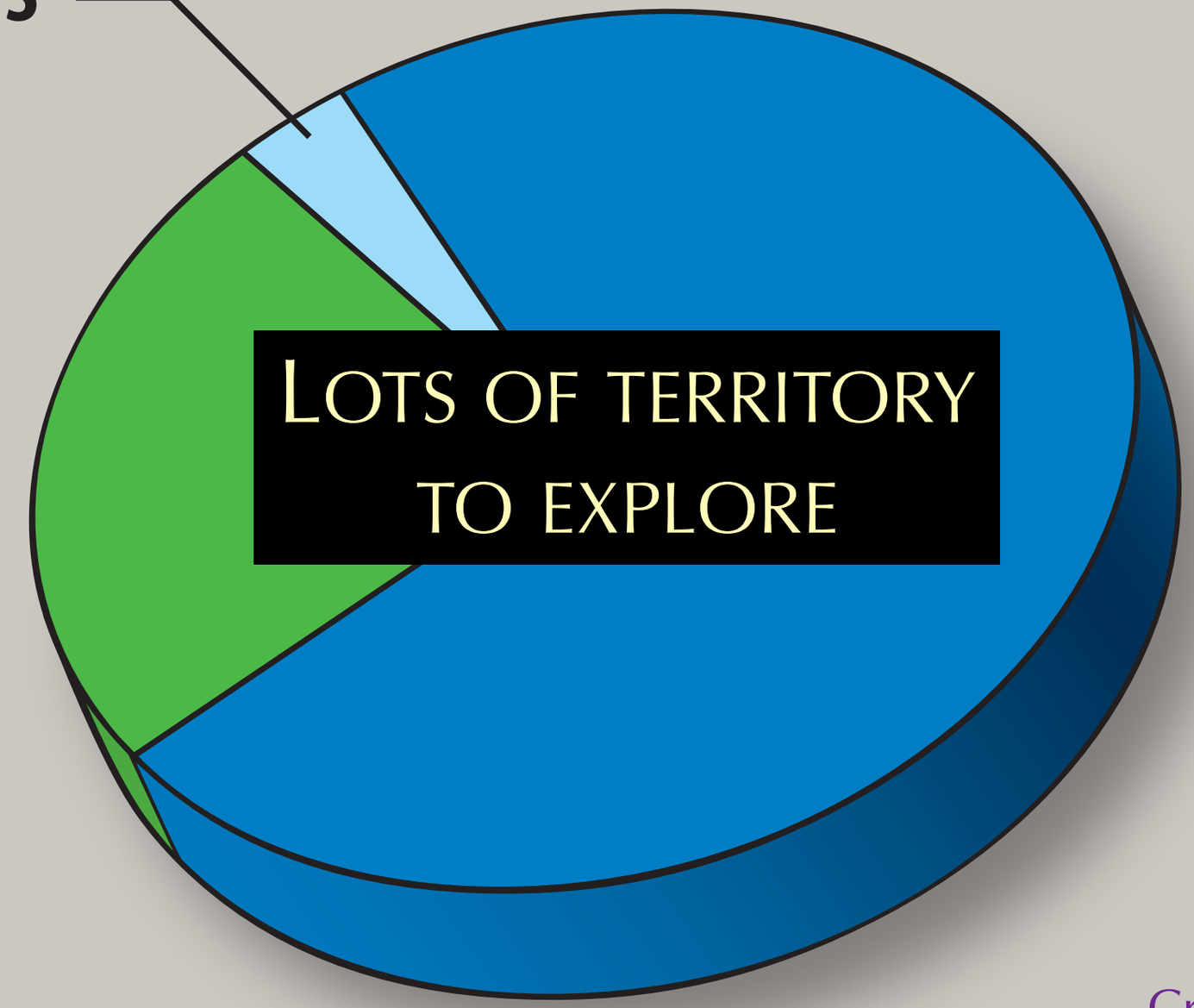
Energy budget of the Universe

The Standard Model

**Atoms 4.6%**

**Dark Matter 24%**

Unknown (but we have some ideas)




**Dark Energy 71.4%**

Extremely unknown. Makes space expand

TODAY

Data from WMAP 9-year Survey + Supernovae + Clusters

Credit: NASA / WMAP Science Team