



#askCERN

# Hangout with CERN: Extra dimensions

**25 April 2013**





# Today's trivia question

- The pull of the magnet is stronger than the pull of the Earth's gravity, but how much stronger? (order of magnitude)



SUISSE  
FRANCE

CMS

LHCb

ATLAS

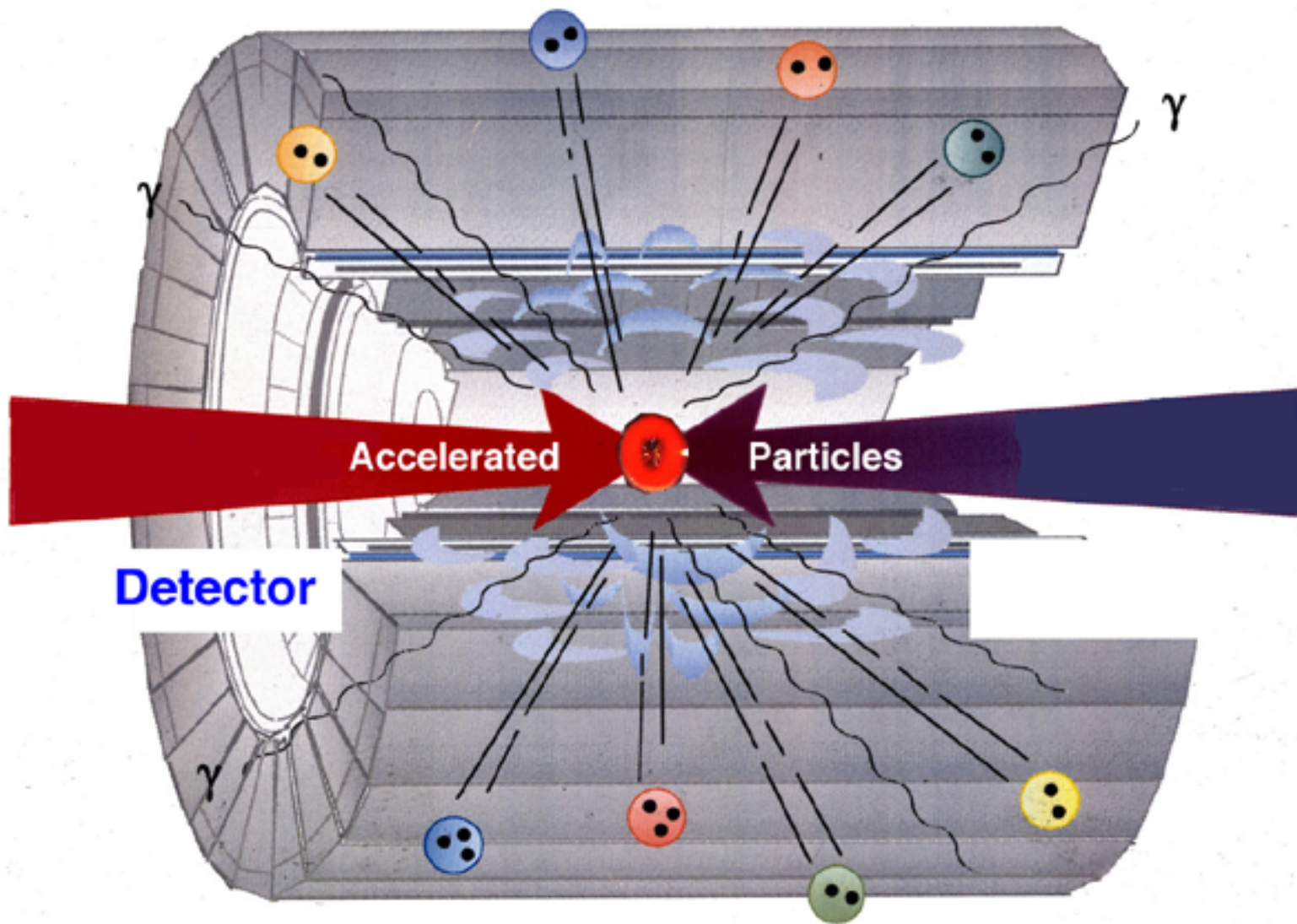
CERN Meyrin

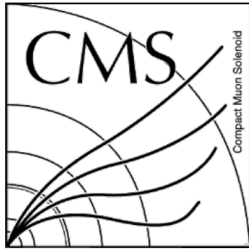
CERN Prevestin

SPS 7 km

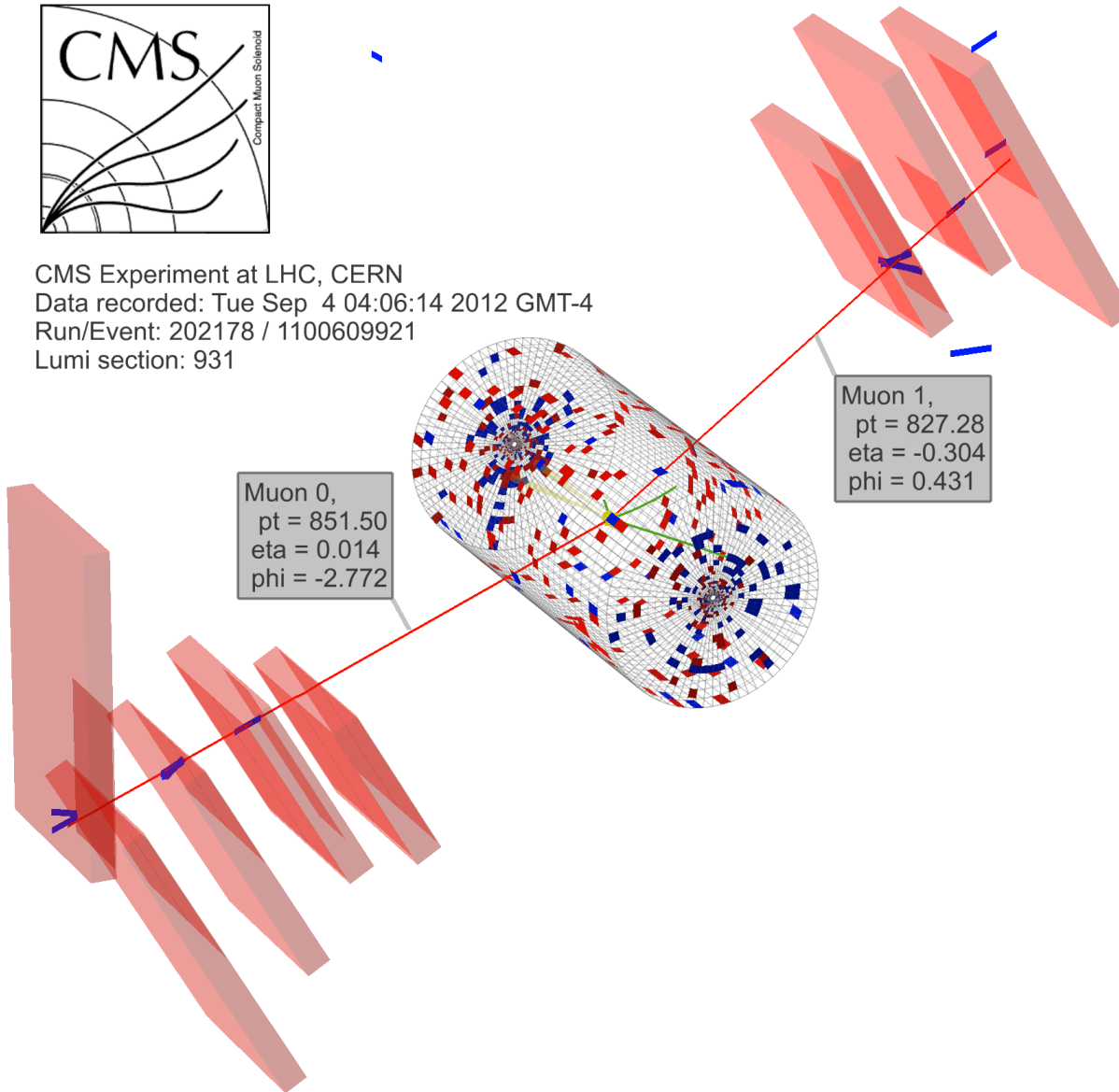
ALICE

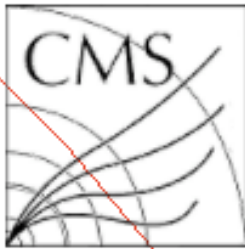
LHC 27 km



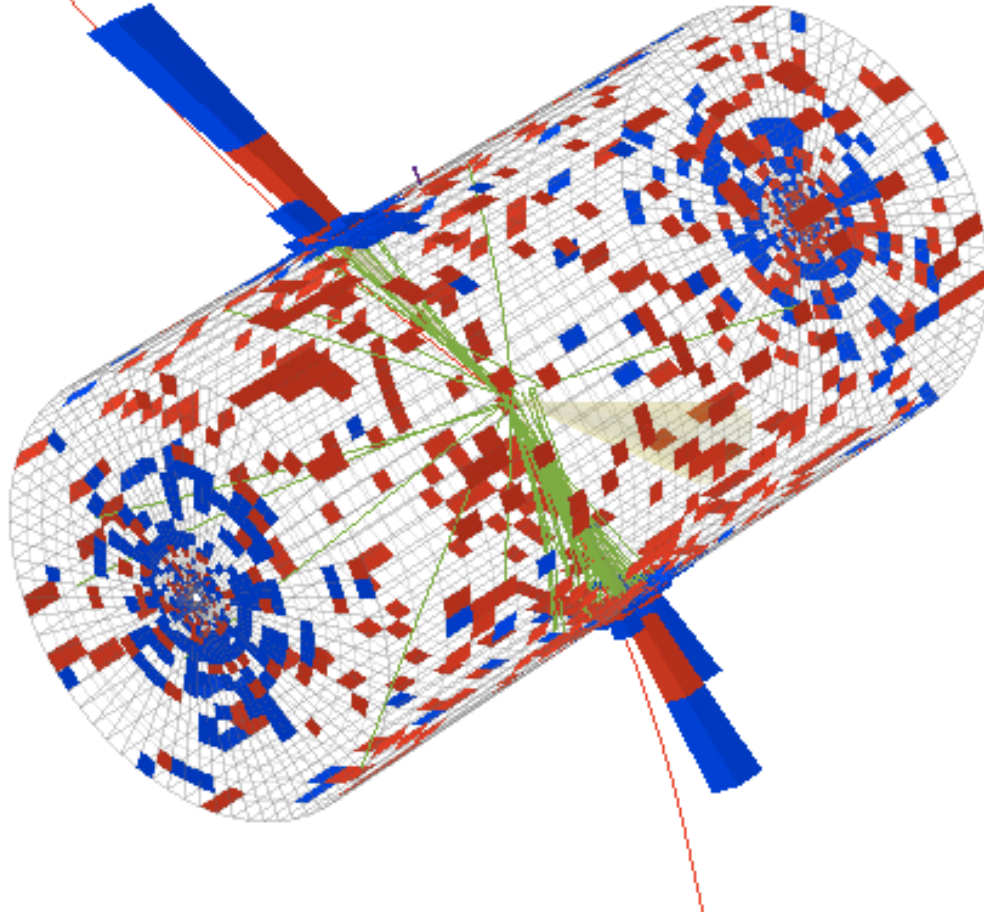


CMS Experiment at LHC, CERN  
Data recorded: Tue Sep 4 04:06:14 2012 GMT-4  
Run/Event: 202178 / 1100609921  
Lumi section: 931





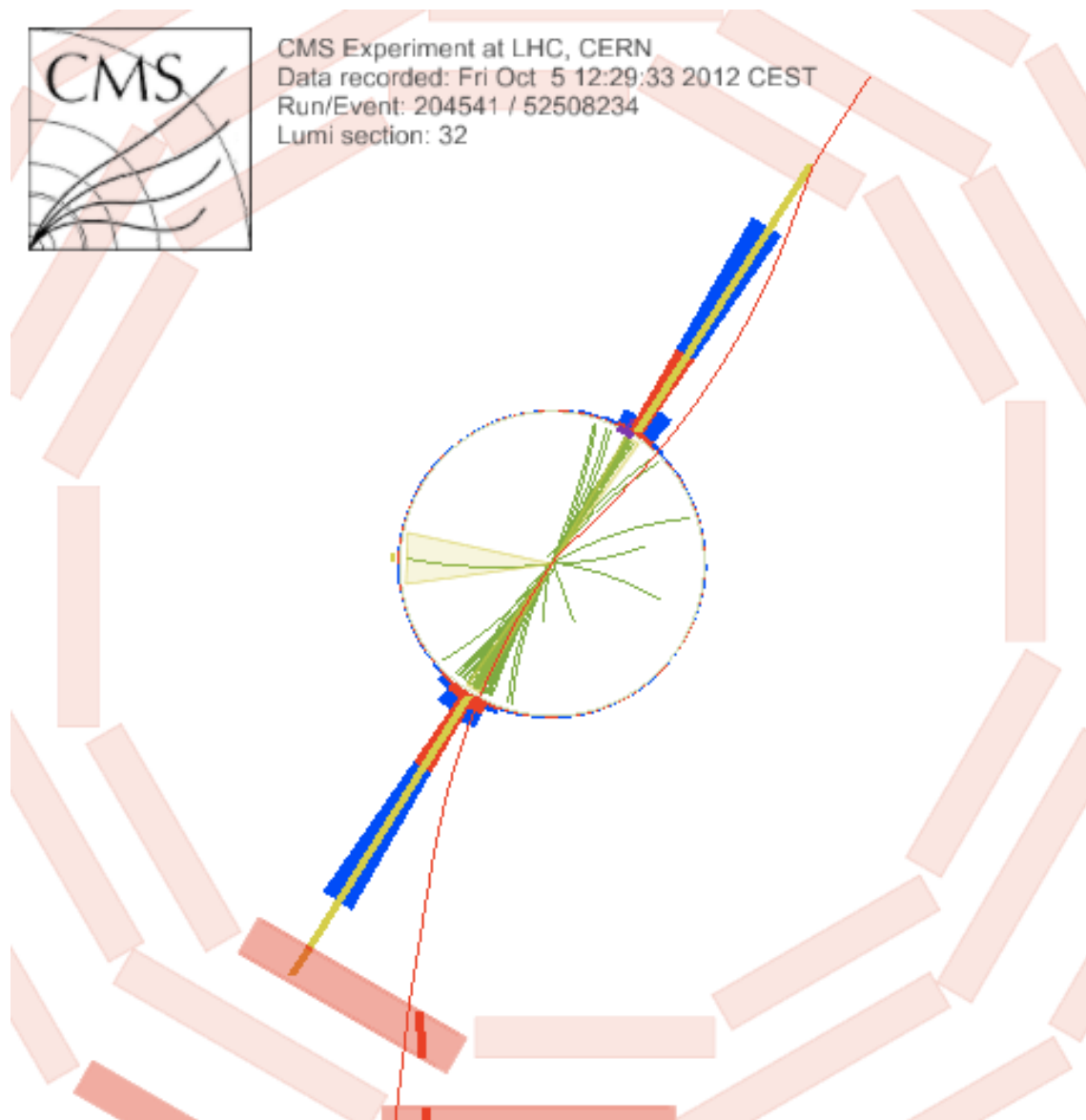
CMS Experiment at LHC, CERN  
Data recorded: Fri Oct 5 12:29:33 2012 CEST  
Run/Event: 204541 / 52508234  
Lumi section: 32

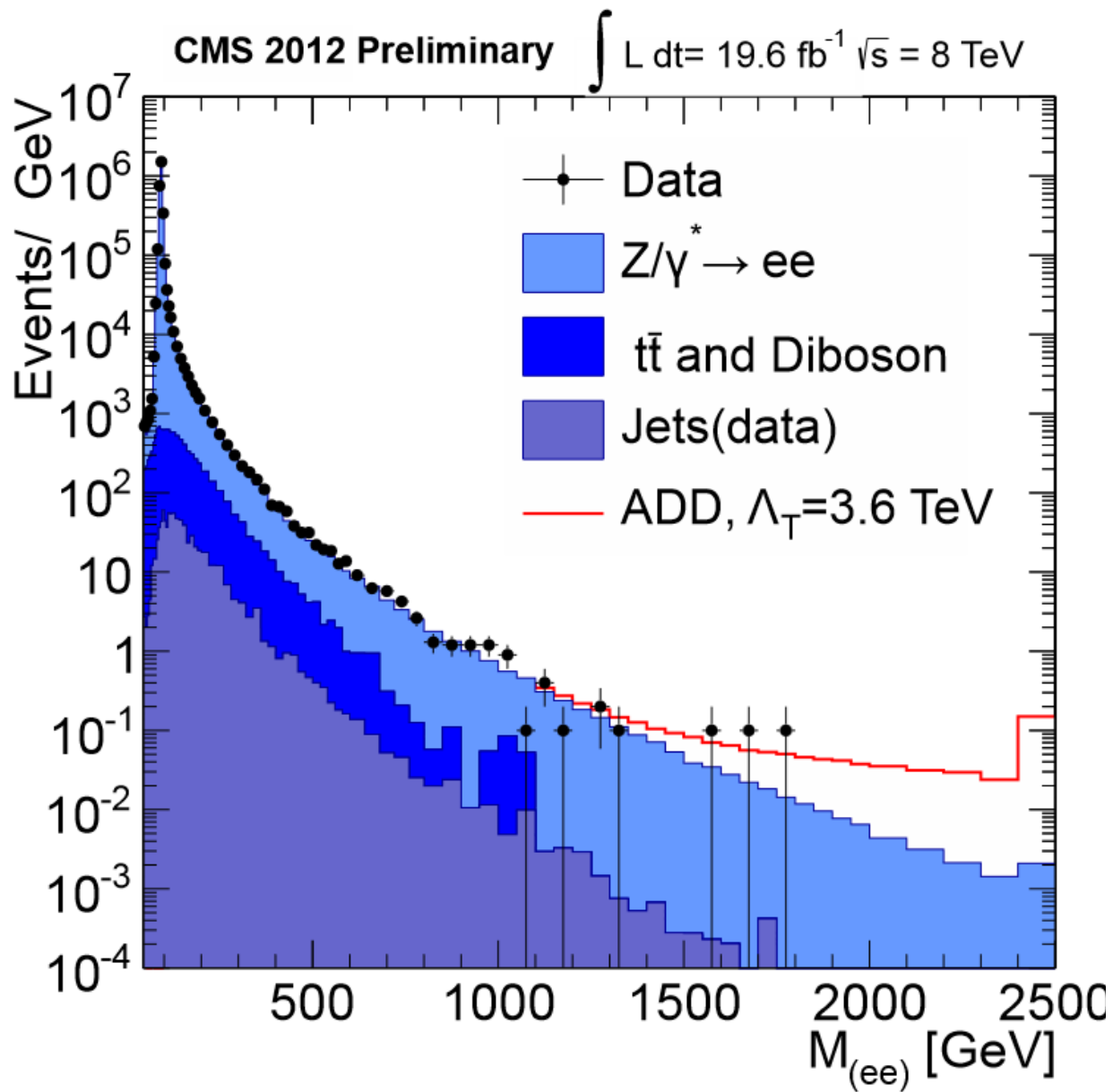


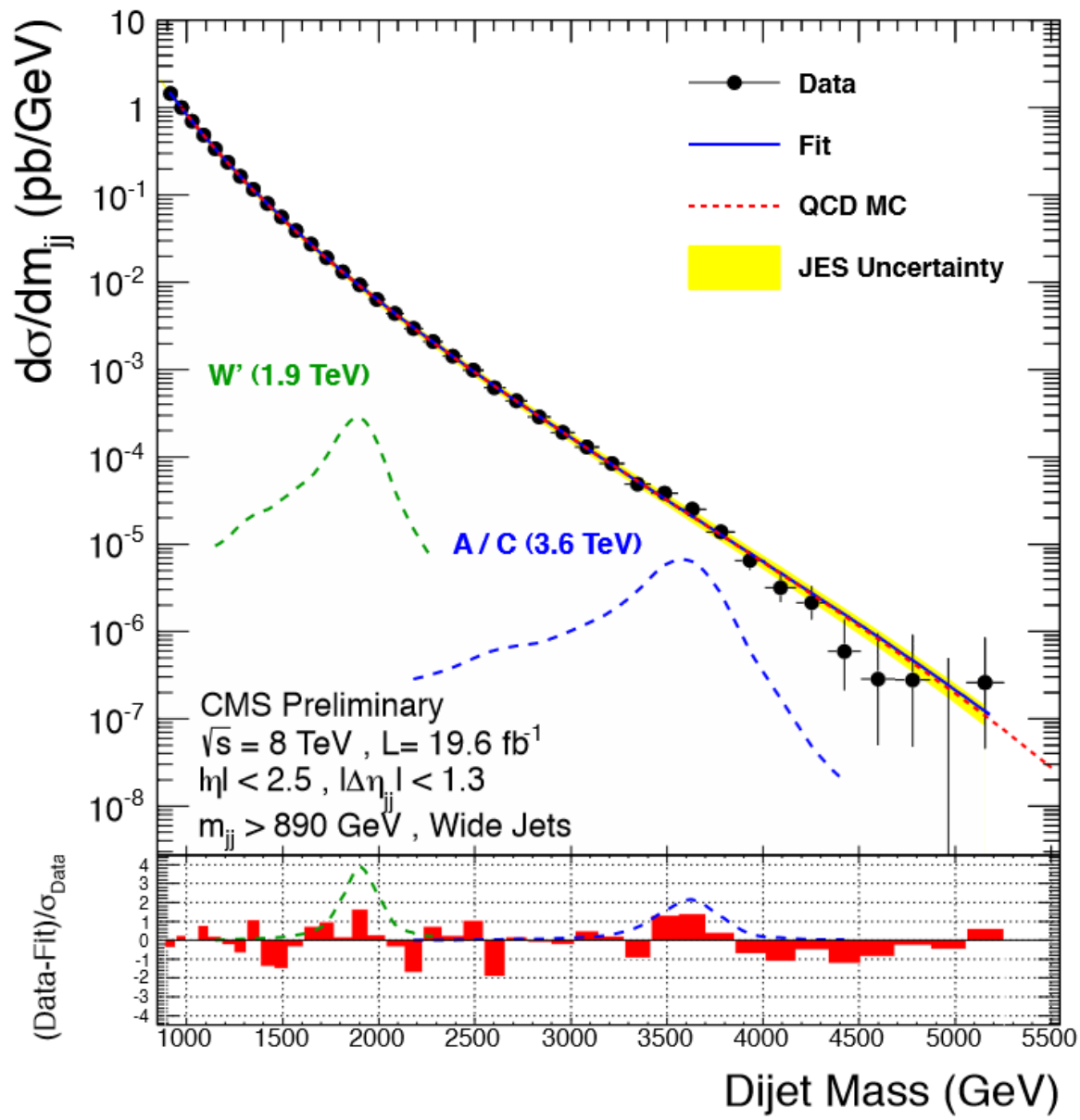




CMS Experiment at LHC, CERN  
Data recorded: Fri Oct 5 12:29:33 2012 CEST  
Run/Event: 204541 / 52508234  
Lumi section: 32







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With a new preface on the Higgs discovery

HOW PHYSICS AND SCIENTIFIC THINKING ILLUMINATE THE UNIVERSE AND THE MODERN WORLD

"Just might make you think differently."  
—PRESIDENT BILL CLINTON



# LISA RANDALL

BESTSELLING AUTHOR OF *WARPED PASSAGES*

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"A dazzlement of new concept . . . sure to open the mind and enlarge the vocabulary of anyone who reads it."  
—ADAM GOPNIK



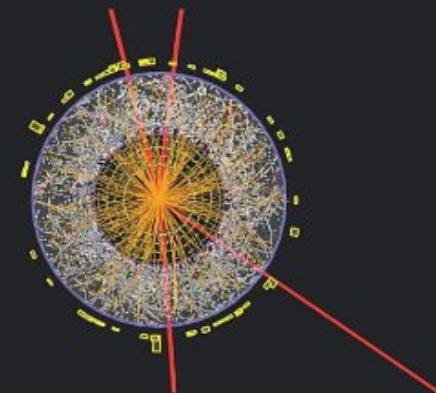
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# HIGGS DISCOVERY

THE POWER OF EMPTY SPACE



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AUTHOR OF *KNOCKING ON HEAVEN'S DOOR*

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# Today's trivia answer

Q. The pull of the magnet is stronger than the pull of the Earth's gravity, but how much stronger?  
(order of magnitude)

A. 10 to the power of 36

# cern.ch/LHCathome


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**LHC@home**

LHC@home is a platform for volunteers to help physicists develop and exploit particle accelerators like CERN's [Large Hadron Collider](#), and to compare theory with experiment in the search for new fundamental particles.

By contributing spare processing capacity on their home and laptop computers, volunteers may run simulations of beam dynamics and particle collisions in the [LHC's giant detectors](#).




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Help us to study the LHC machine and its upgrade to understand the fundamental laws of the universe.

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### Huge impact from a tiny decay

The [Hadron Collider Physics Symposium](#) opened on November 12 in Kyoto on a grand note. For the first time, the [LHCb](#) collaboration operating at the [Large Hadron Collider](#) (LHC) at [CERN](#) showed evidence for an extremely rare type of events, namely the decay of a  $B_s$  meson into a pair of muons (a particle very similar to the electron but 200 times heavier). A meson is a composite class of particles formed from a quark and an antiquark. The  $B_s$  meson is made of a bottom [quark](#)  $b$  and a strange quark  $s$ . This particle is very unstable and decays in about a picosecond (a millionth of a millionth of a second) into lighter particles.

Decays into two muons are predicted by the theory, the [Standard Model of particle physics](#), that states it should occur only about 3 times in a billionth of decays. In scientific notation, we write  $(3.54 \pm 0.30) \times 10^{-9}$  where the value of 0.30 represents the error margin on this theoretical calculation. Now, the LHCb collaboration proudly announced that they observed it at a rate of  $(3.2^{+1.5}_{-1.2}) \times 10^{-9}$ , a value very close to the theoretically predicted value, at least within the experimental error.

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◀ [Mixing it up](#) [Le mystère plane toujours sur le boson de Higgs](#) ▶  
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### The mystery remains on the Higgs boson

Ever since the discovery of what might be the [Higgs boson last July](#), physicists from the [CMS](#) and [ATLAS](#) experiments have been trying to pinpoint its true identity. Is this the Higgs boson expected by the [Standard Model of particle physics](#) or some "Higgs-like boson" befitting a different theoretical model?

To tell the difference, we must check all its properties, like how often this boson decays into different types of particles, and determine its spin and parity, two properties of fundamental particles.

Since the new boson has a short lifetime, it breaks apart immediately after being created. There are five ways a Standard Model Higgs boson should decay that we can study at the [Large Hadron Collider](#) (LHC): breaking into two photons, two W or two Z bosons, two b quarks or two tau leptons in well defined proportions. We must check both the presence of and the rate at which each decay mode occurs.

Last summer, just after the discovery of the new boson, both experiments reported unambiguous observations in only three channels. Unfortunately, the data sample was still too small to really be able to check if the new boson could decay into a pair of b quarks or tau leptons.

With more data available, the two experiments have just shown results for all channels today at a [conference](#) held in Kyoto as shown on the two figures below.

# Next week's Hangout with CERN

- Thursday 2 May, same time 17:00 CEST
- **Multiplying dimensions**, with special guests from TEDxCERN (<http://tedxcern.ch/>)



**TED<sup>x</sup>CERN**  
**x = independently organized TED event**



# Participants

Christophe Clement, ATLAS Physicist, Stockholm University, SE

Sam Harper, CMS Physicist, Rutherford Appleton Laboratory, UK

Raman Sundrum, Theorist, University of Maryland, US

Lisa Randall, Theorist, Harvard University, US

Taylor Bayouth, CERN Visitor from Los Angeles, US

Fraser Cain, Publisher of Universe Today, Courtenay, British  
Columbia, CA [Maybe]

# Credits

Steven Goldfarb — Host

Achintya Rao — Q&A from Social Media

Kate Kahle and Achintya Rao — Production

Thank you for watching!



[www.cern.ch](http://www.cern.ch)