Beauty Quark Lifetime

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LHCb

LHCb’s main goals

Standard model of physics ≈ the cover of a book

Why is the universe made of antimatter?
Why does such matter account for about 5% of what we see?

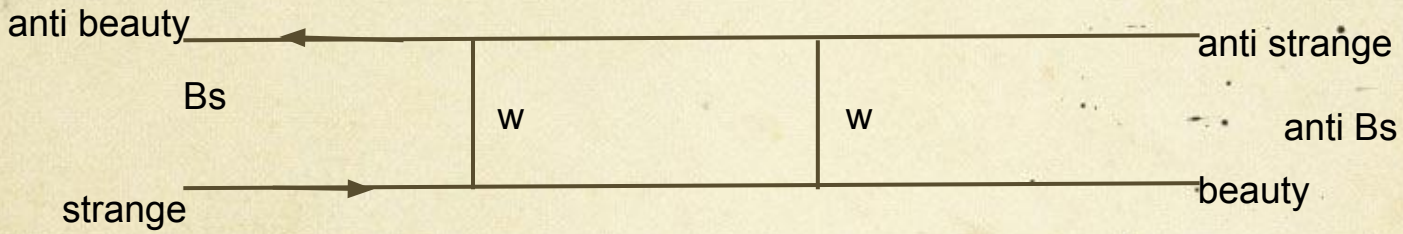
How does the LHCb work?

Craftily

Rather than use the brute force method of ATLAS and CMS, it looks for tiny modifications in known particle decays. These modifications could be evidence of new particles.

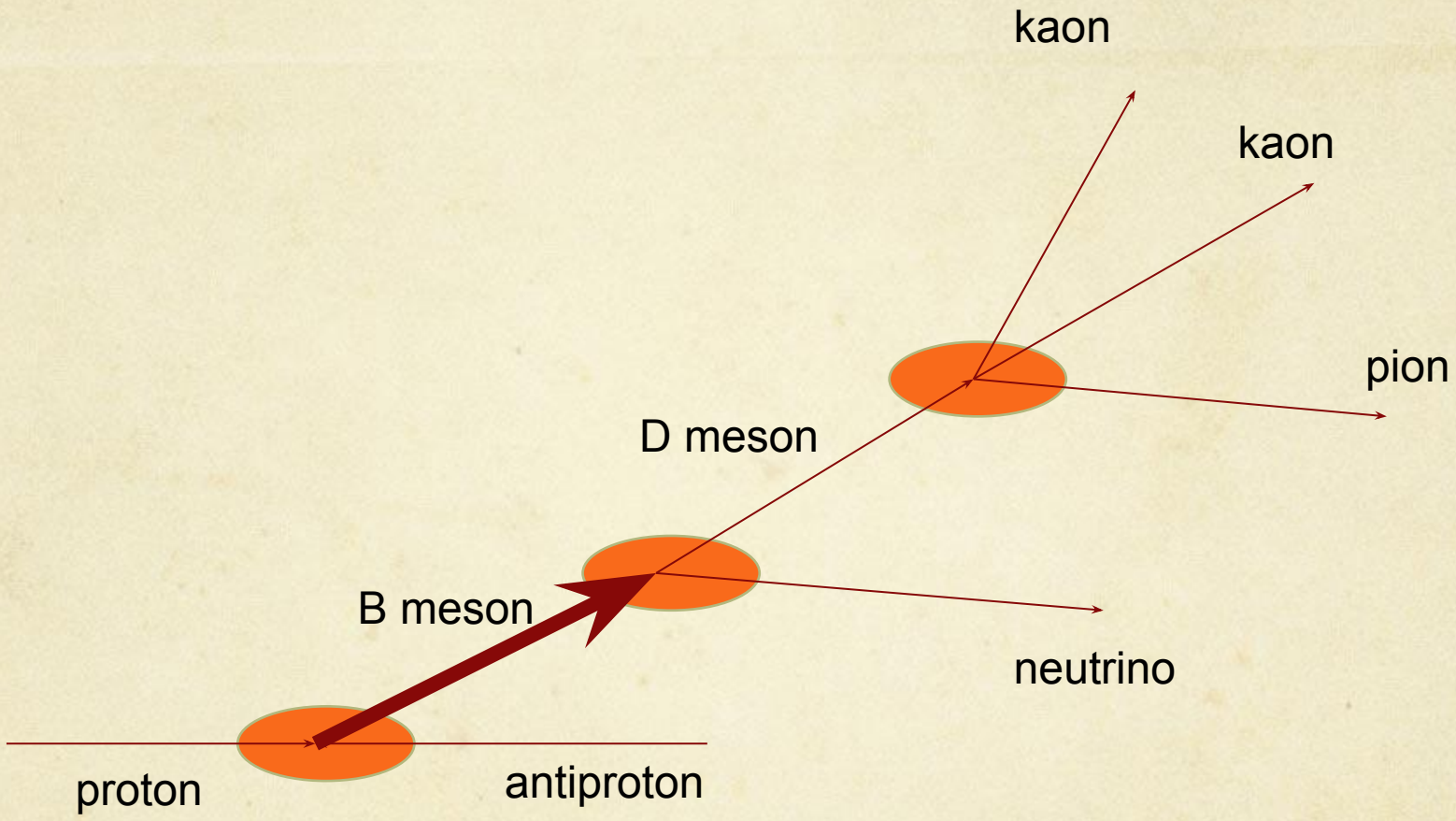
- 40 million collisions per second (for 2 years)
- Few collisions create pairs of beauty particles
- Beauty particles fly a few inches and then decay into other particles
- Measuring the lifetime of beauty particles is important for physics beyond the standard model

Why lifetimes?

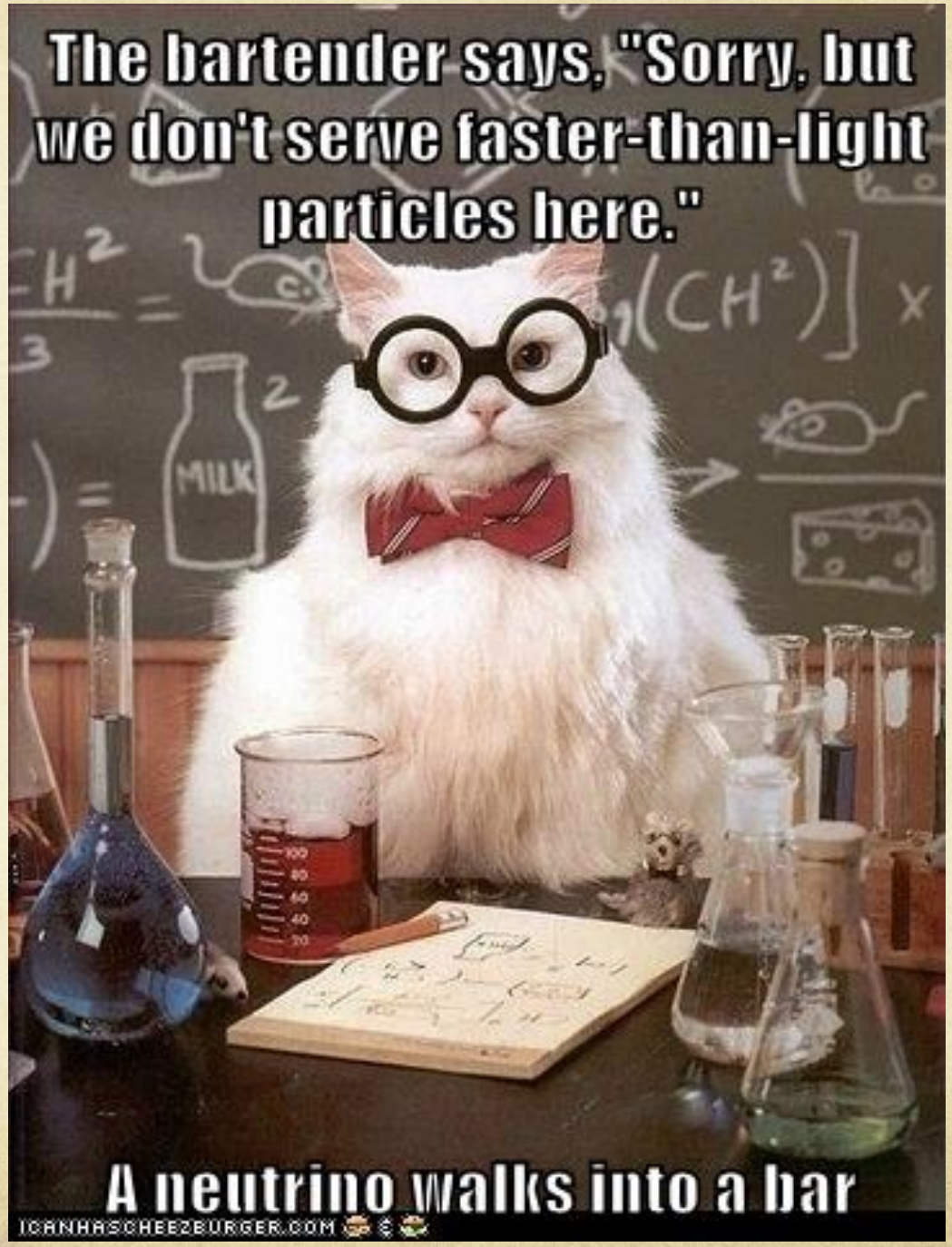


- w ~80 GeV (virtual particle, Bs only has a mass of 5.3 GeV)
- w' could be any mass!
- Above model only accounts for weak interactions, strong interactions also take place, with infinite possibilities.
- Thus the decay rate is very difficult to measure.
- Lifetimes are helpful to measure the rate->New Physics???

Decay



Neutrinos: The Problem Particles



Lifetime Ratios

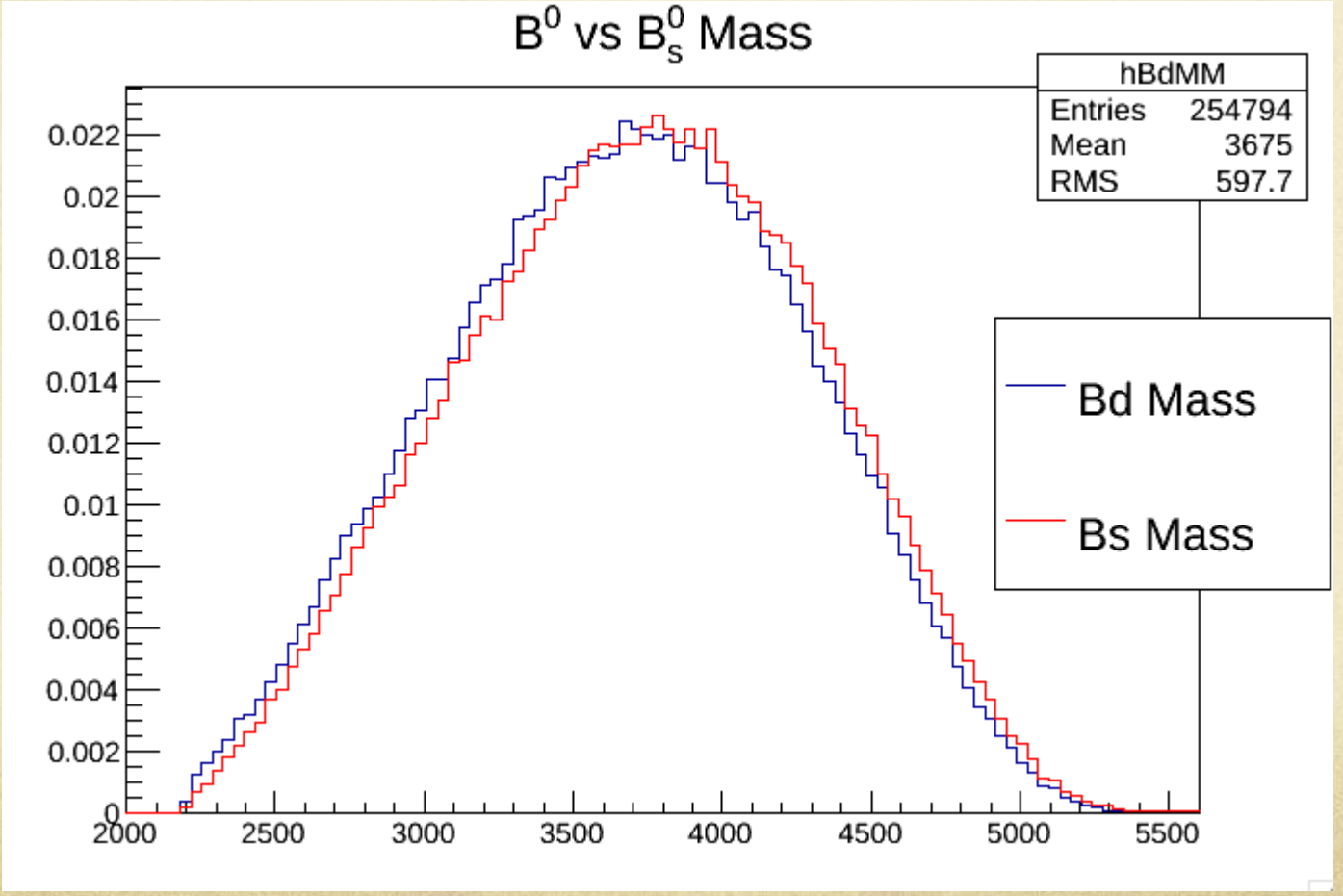
We measure the ratio of observed lifetimes of similar decay channels:

$$B^0 \rightarrow D^-(\rightarrow K^+K^+\pi^-)\mu^+\upsilon$$
$$B_s^0 \rightarrow D_s^-(\rightarrow K^+K^+\pi^-)\mu^+\upsilon$$

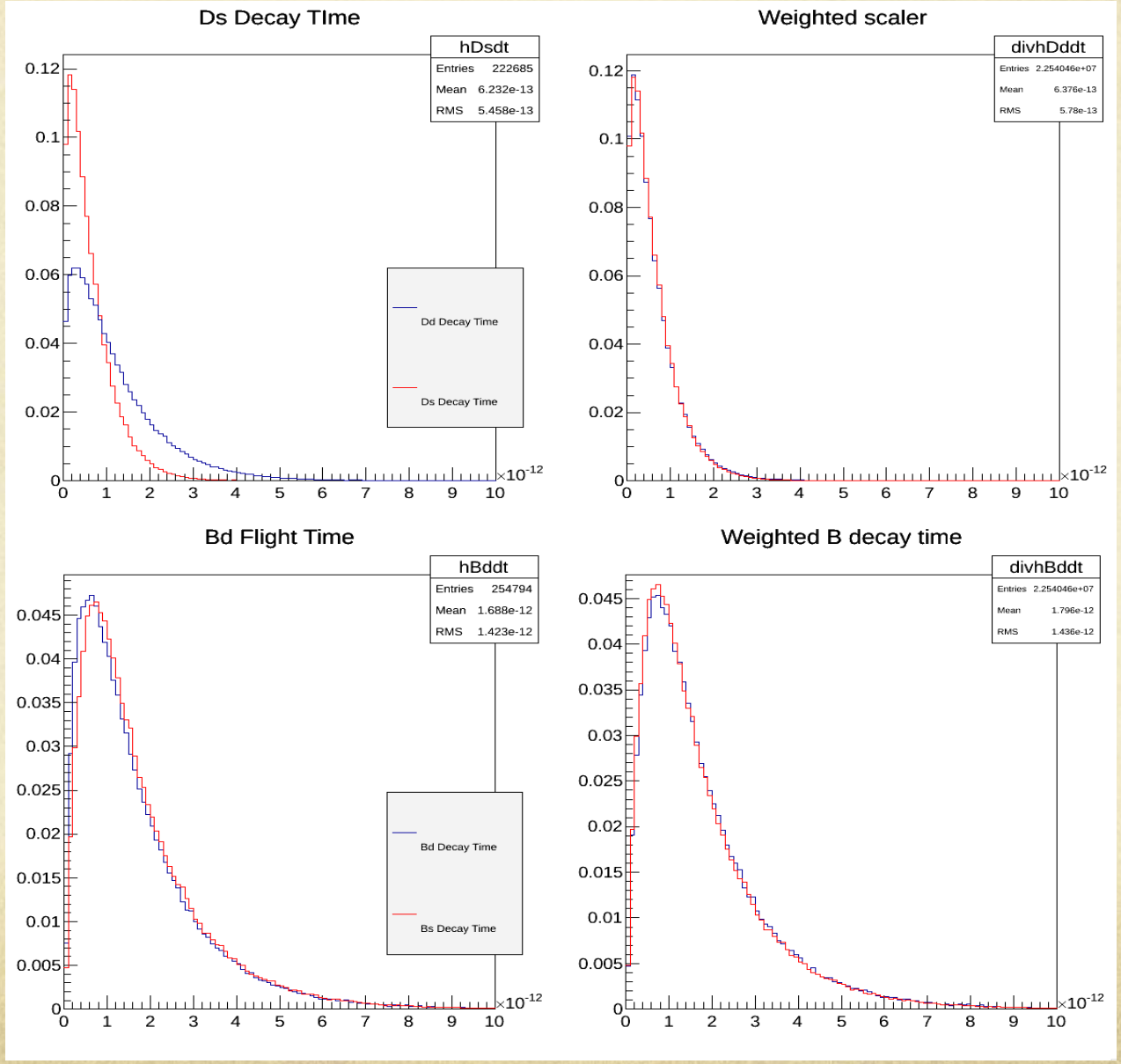
In the ratio, the effect of the neutrino's momentum approximately "cancels."

But $B^0 \neq B_s^0$!

This is where our projects come into play.

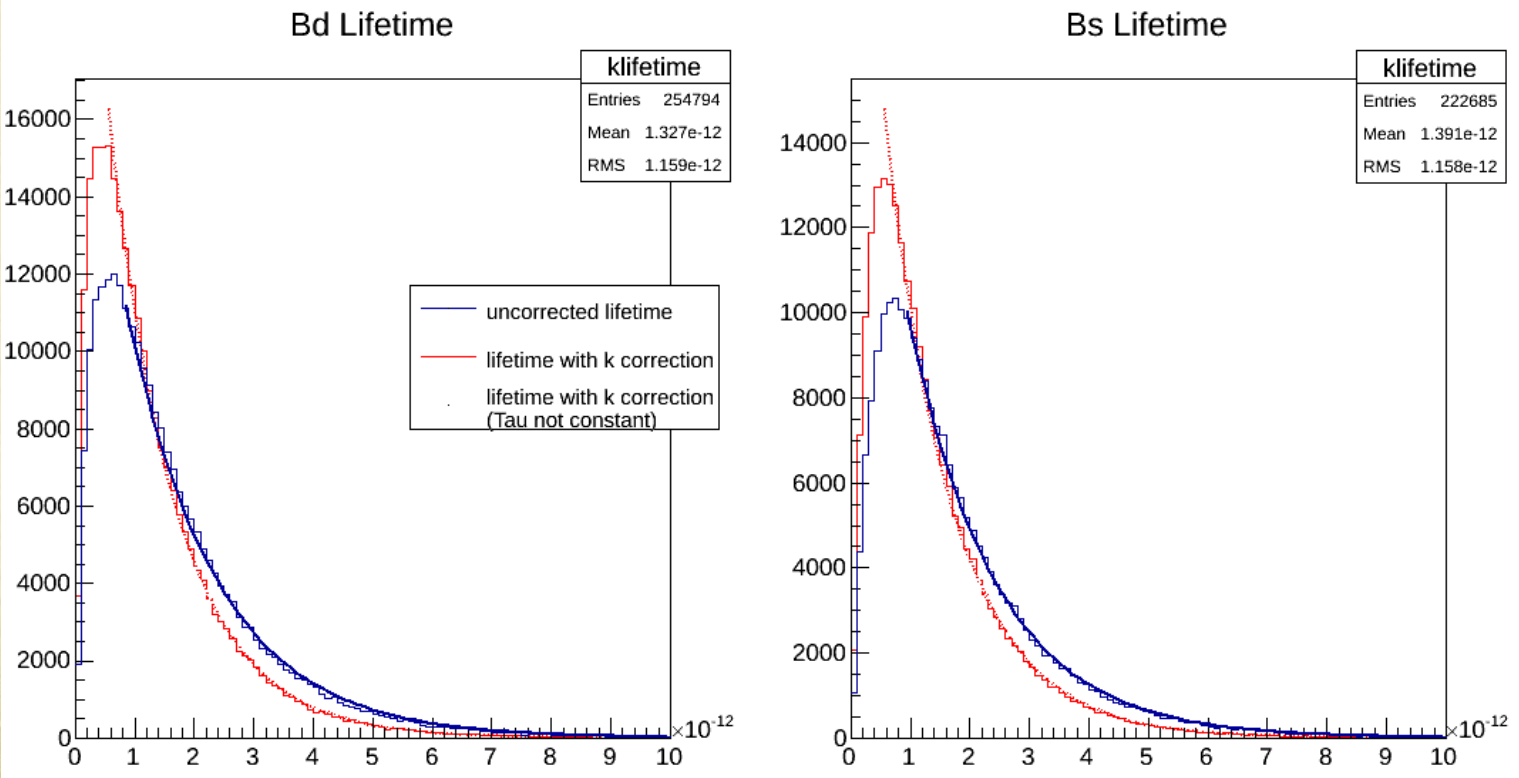


Weighting


Ds Decay TIme
hDsdt
Entries 222685
Mean 6.232e-13
RMS 5.458e-13
Dd Decay Time
Ds Decay Time
Weighted scaler
divhDddt
Entries 2.254046e+07
Mean 6.376e-13
RMS 5.78e-13
Bd Flight Time
hBddt
Entries 254794
Mean 1.688e-12
RMS 1.423e-12
Bd Decay Time
Bs Decay Time
Weighted B decay time
divhBddt
Entries 2.254046e+07
Mean 1.796e-12
RMS 1.436e-12
×10^-12

Detector Acceptance

Rate is important, so we want to see if there is a difference in how B^0 and B_s^0 are detected.



References

- Slide 1: LHCb icon http://lhcb-public.web.cern.ch/lhcb-public/en/lhcb-outreach/multimedia/
- Slide 2: LHCb cavity http://cds.cern.ch/record/1090809/files/bul-pho-2008-019.jpg
- Slide 3: book http://frrl.files.wordpress.com/2013/02/logo_books.jpg
- Slide 4: fox http://parentpreviews.com/legacy-pics/fantastic_mr_fox.jpg
- Slide 5: LHC arial http://www.scifun.ed.ac.uk/pages/pp4ss/images/Exhibits/LHC-sim.jpg
- Slide 8: cat http://cheezburger.com/5810047744
- Slide 14: bottom quark http://www.particlezoo.net/individual_pages/shop_bottomquark.html

The End

(Brought to you by the bottom quark)