A detailed 3D cutaway diagram of the CMS detector, showing its complex internal structure with various layers and components in different colors like red, blue, and yellow. The diagram is semi-transparent, allowing the text to be overlaid on it.

# Searches for long-lived particles at CMS

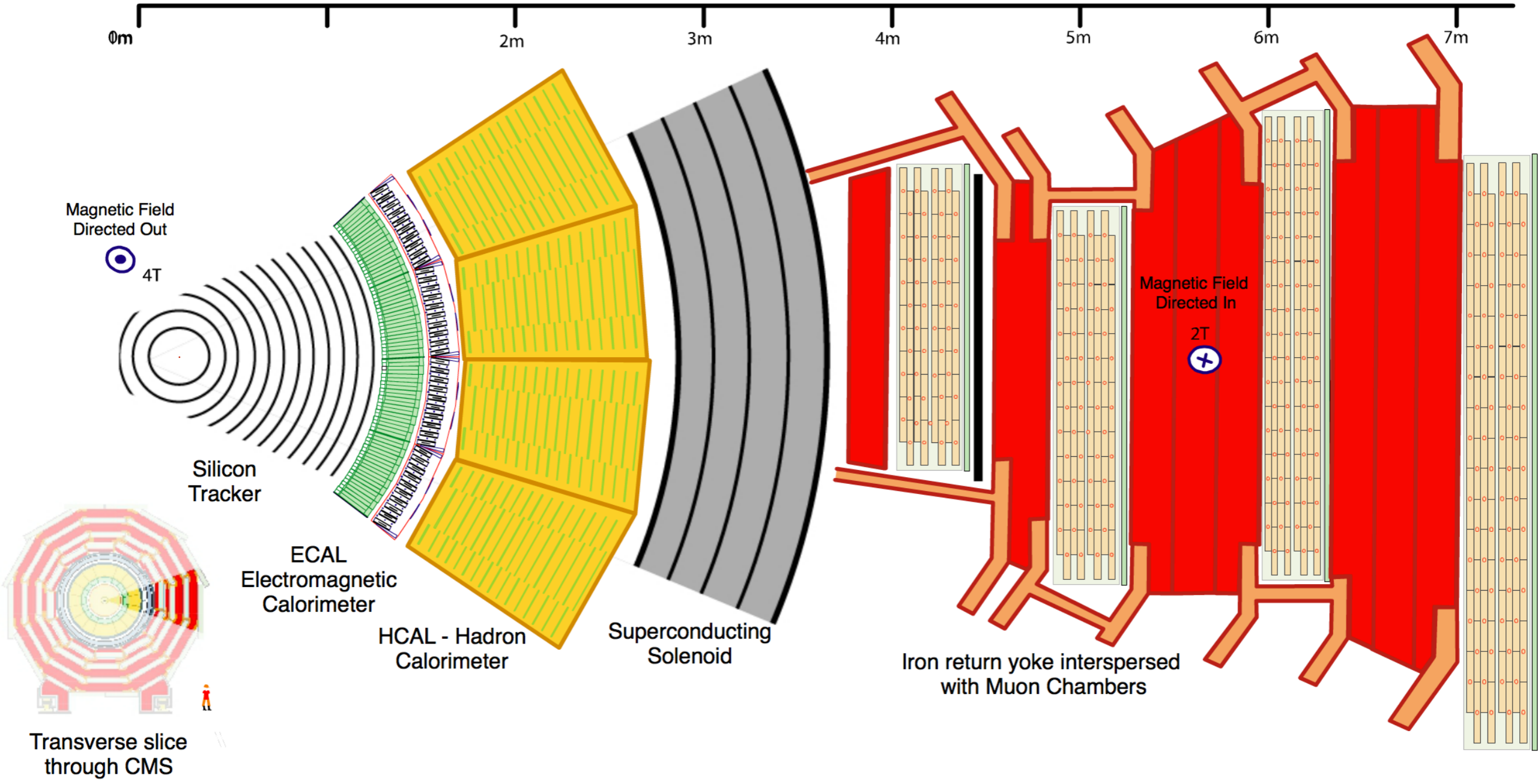
*Jamie Antonelli*



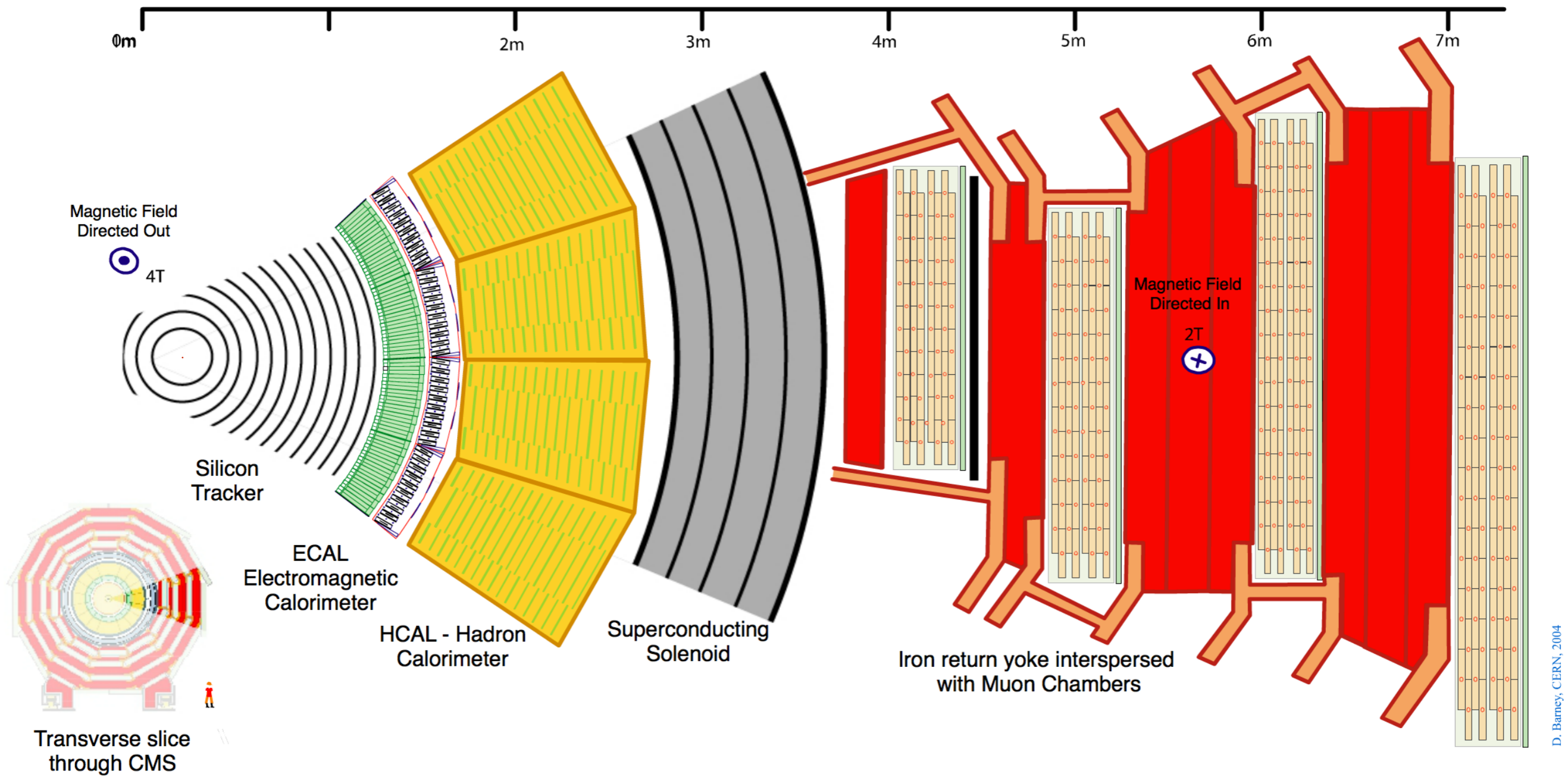
**THE OHIO STATE UNIVERSITY**

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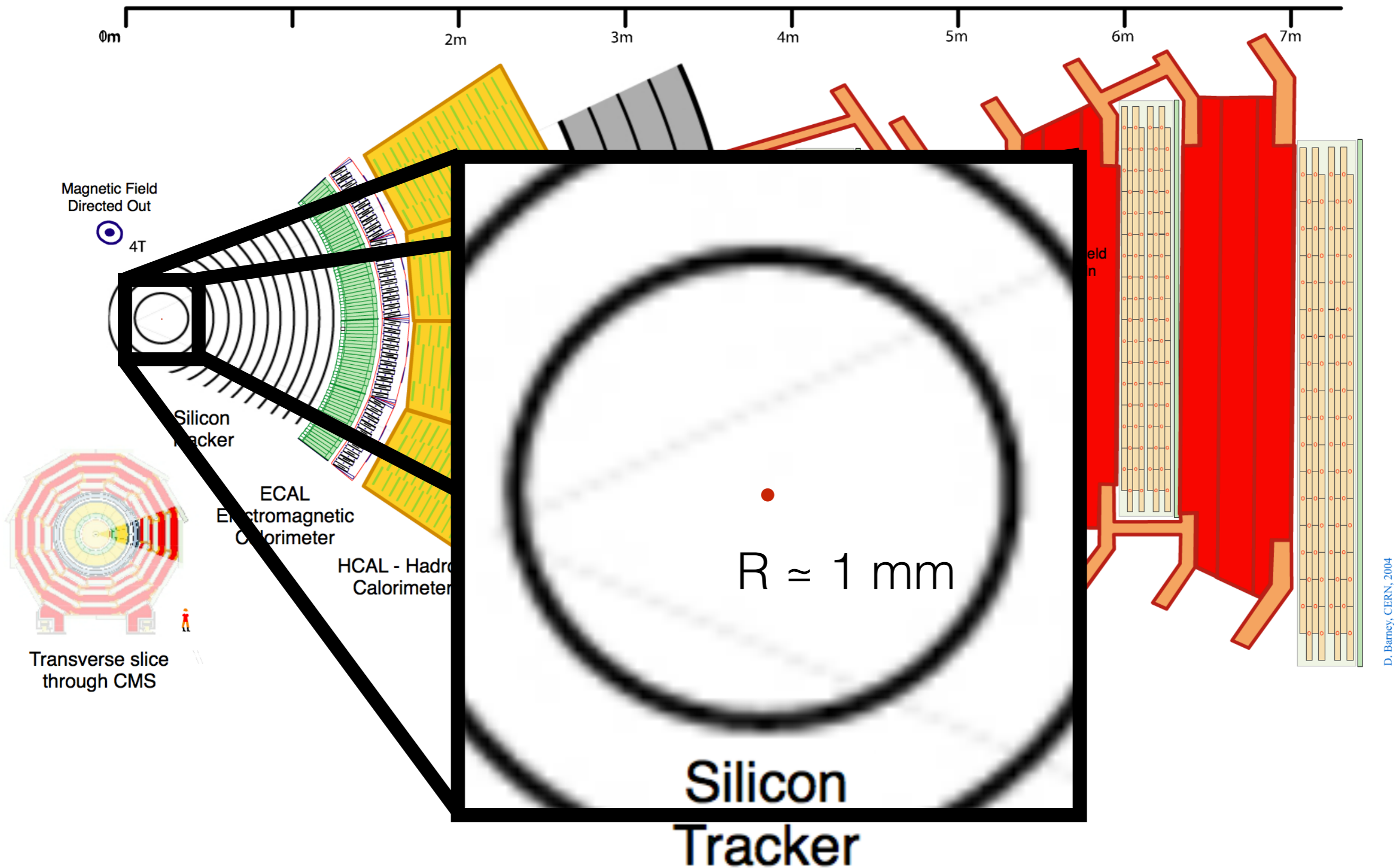
# Most people look inside the dot



# What dot, you ask?



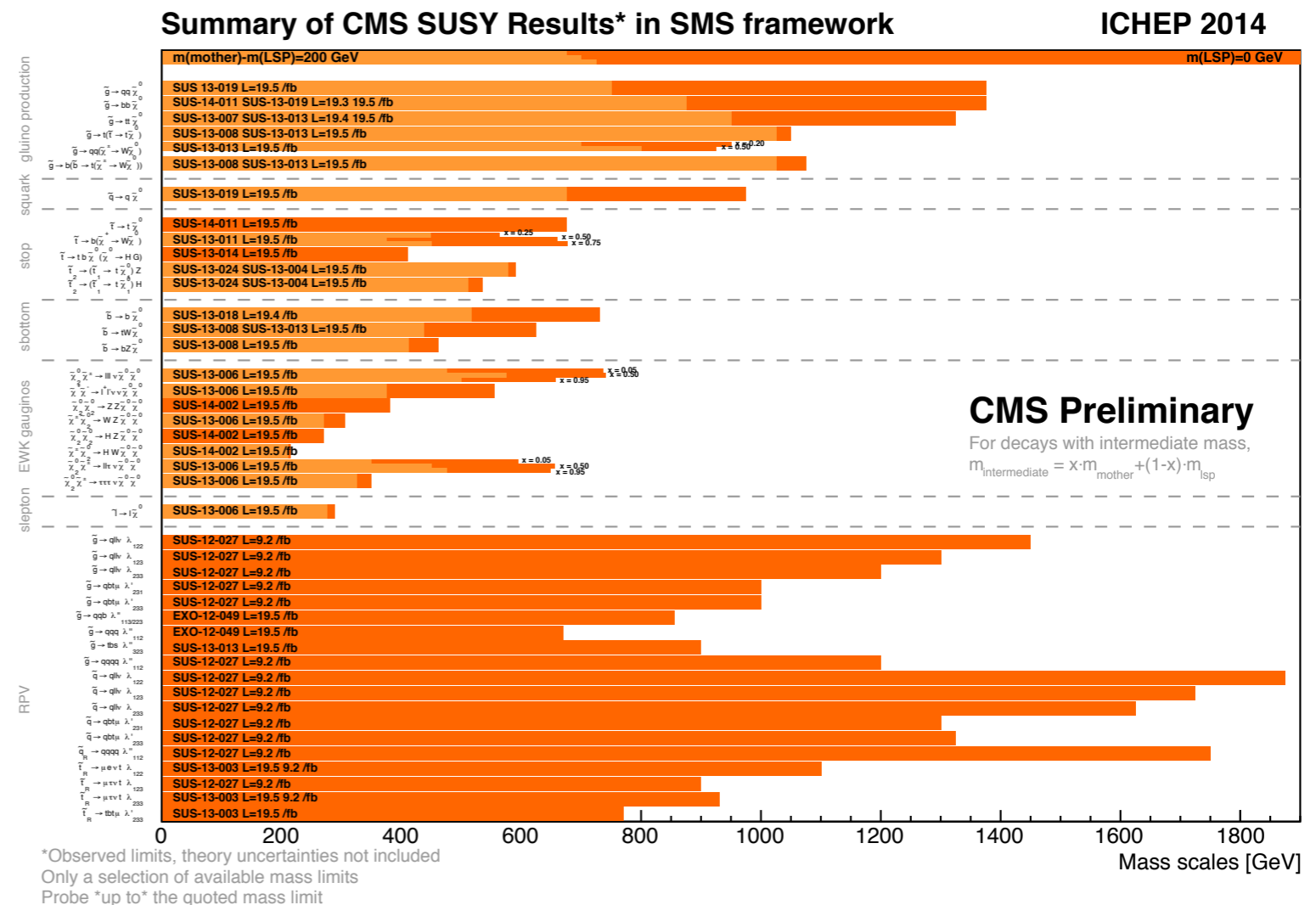
# That dot



# Why look outside the dot?

- There might be something there!
- Easy way for new physics to slip through the cracks
- Naturalness arguments

Summary of everything we have successfully not found



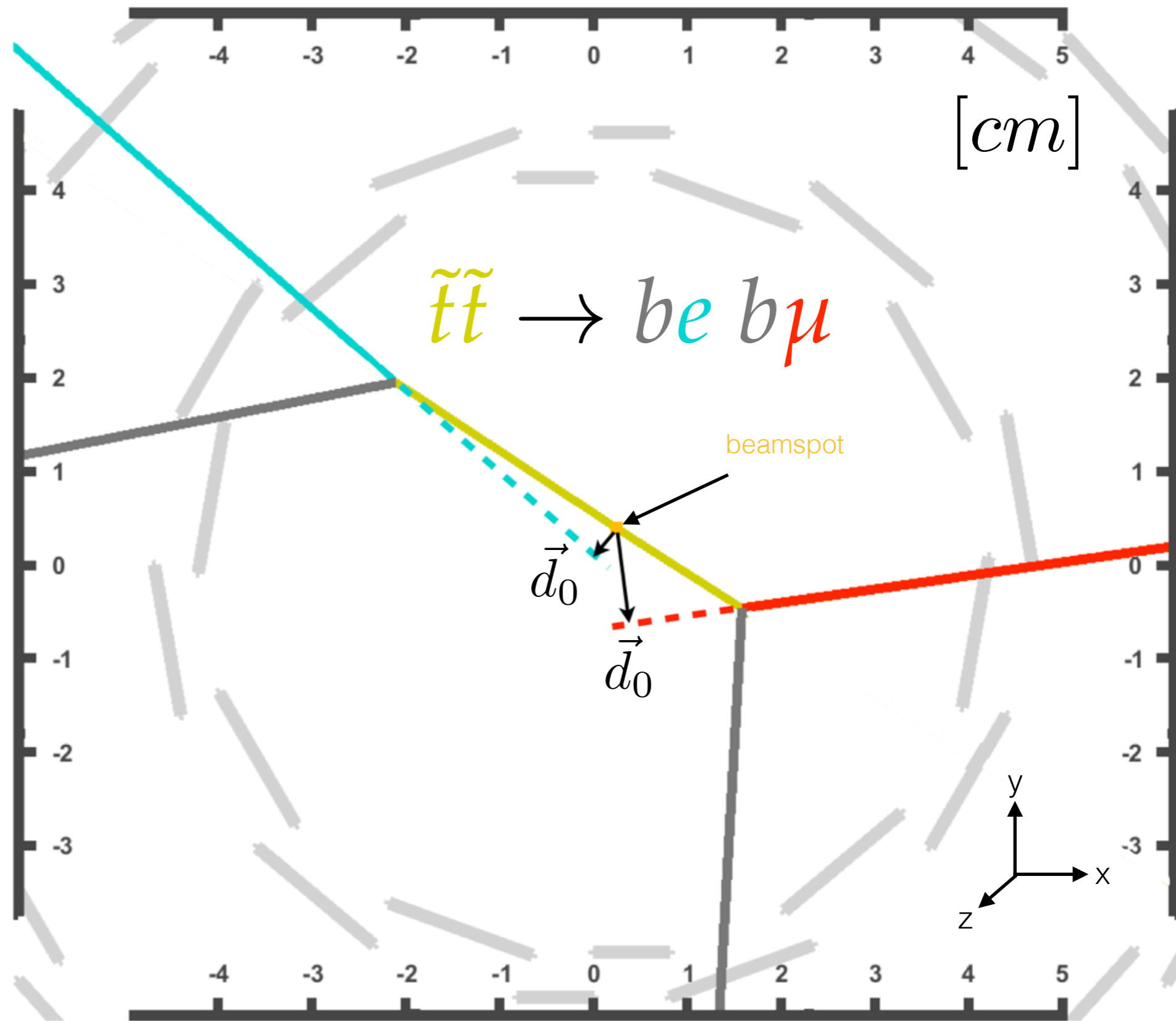
# Why not look outside the dot?

- It's hard!
- Lots and lots of assumptions that no longer hold
- CMS software is optimized to handle prompt decays

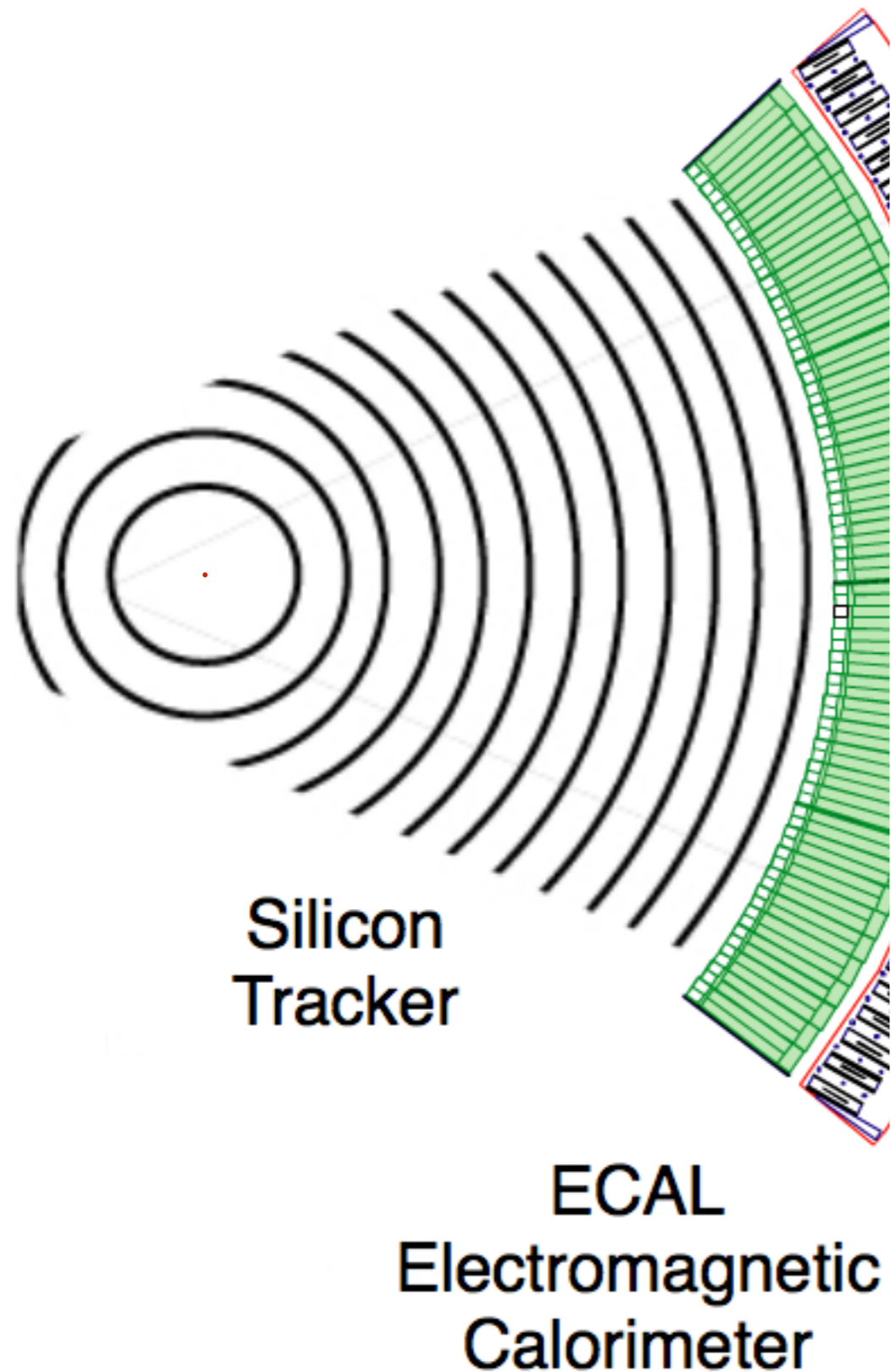
I'll give a survey of some of the novel searches CMS has performed -  
working from the center of CMS outwards

# Displaced Leptons

look for leptons  
whose tracks  
don't point back  
to the original PP  
collision



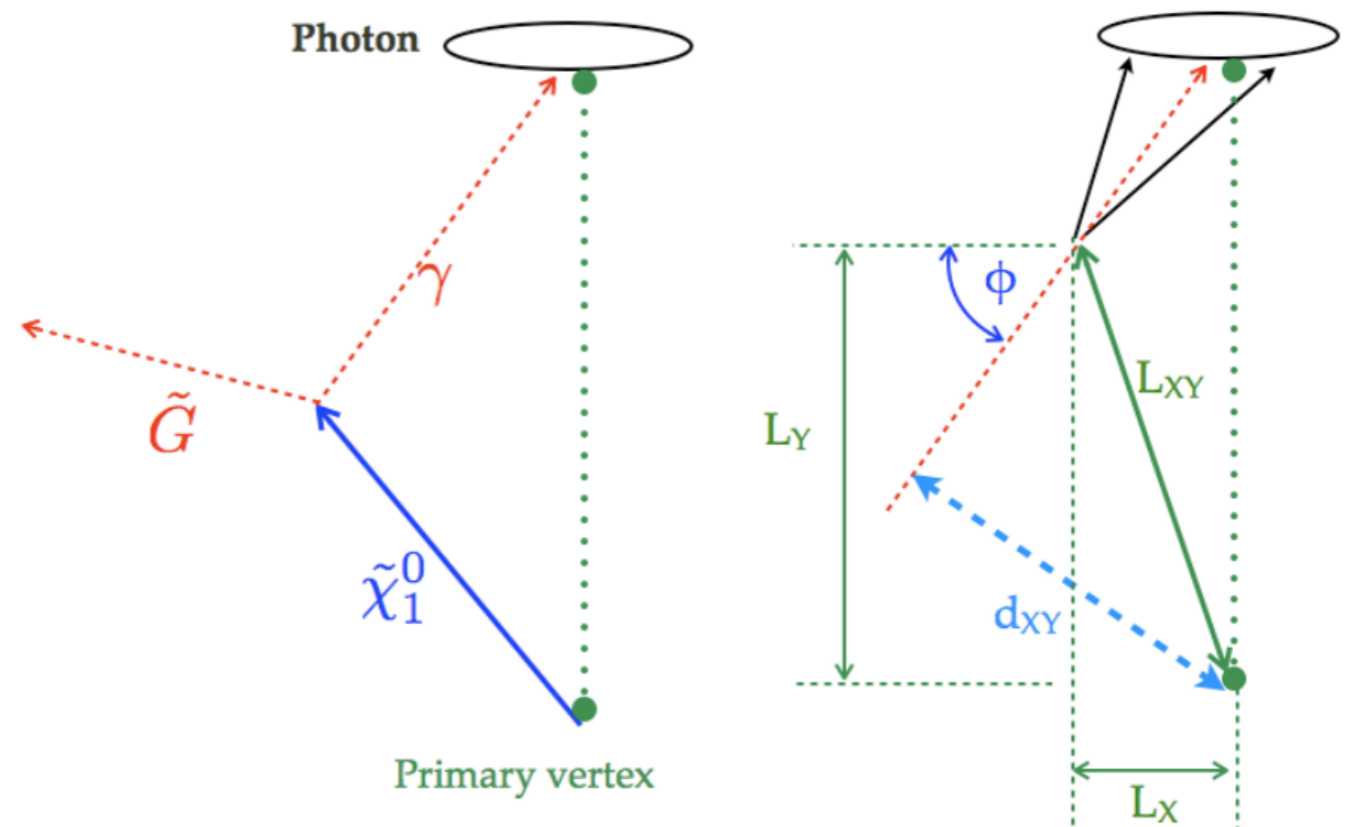
# Displaced Photons



photons don't leave tracks...

but they often convert! ( $\gamma \rightarrow e^+e^-$ )

normally an annoyance, but not for these guys



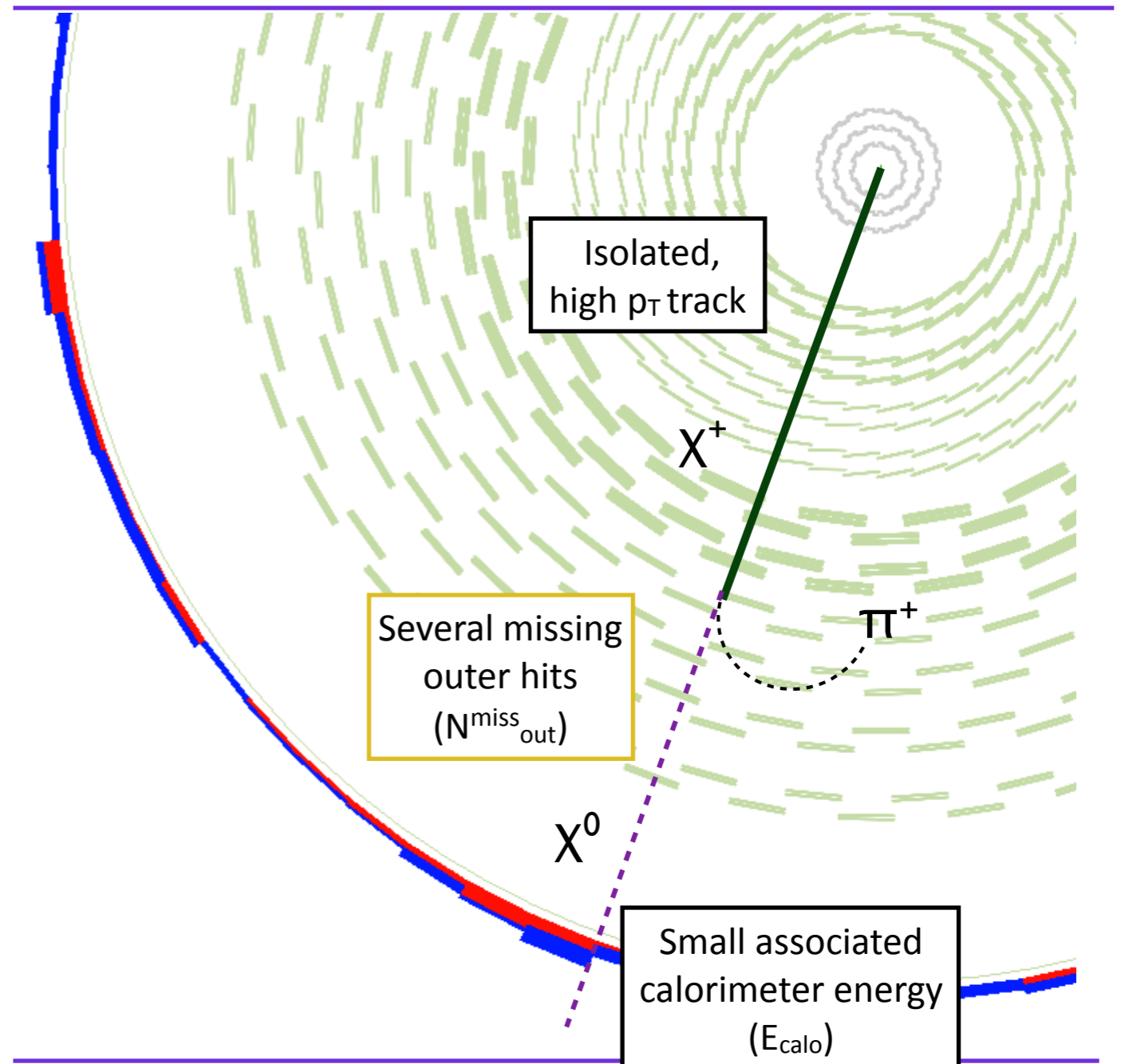


# Disappearing Tracks

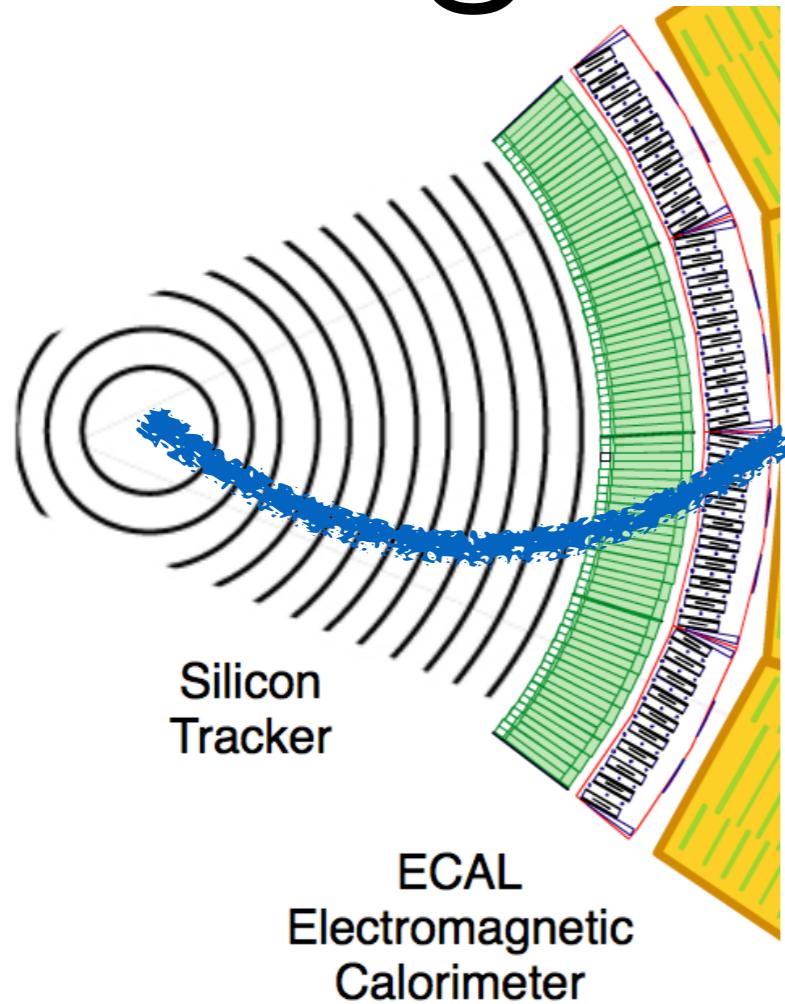
new charged BSM particle  
is created ( $\chi^+$ )

it decays to something  
invisible ( $\chi^0$ )

leaves a short track  
pointing to nothing

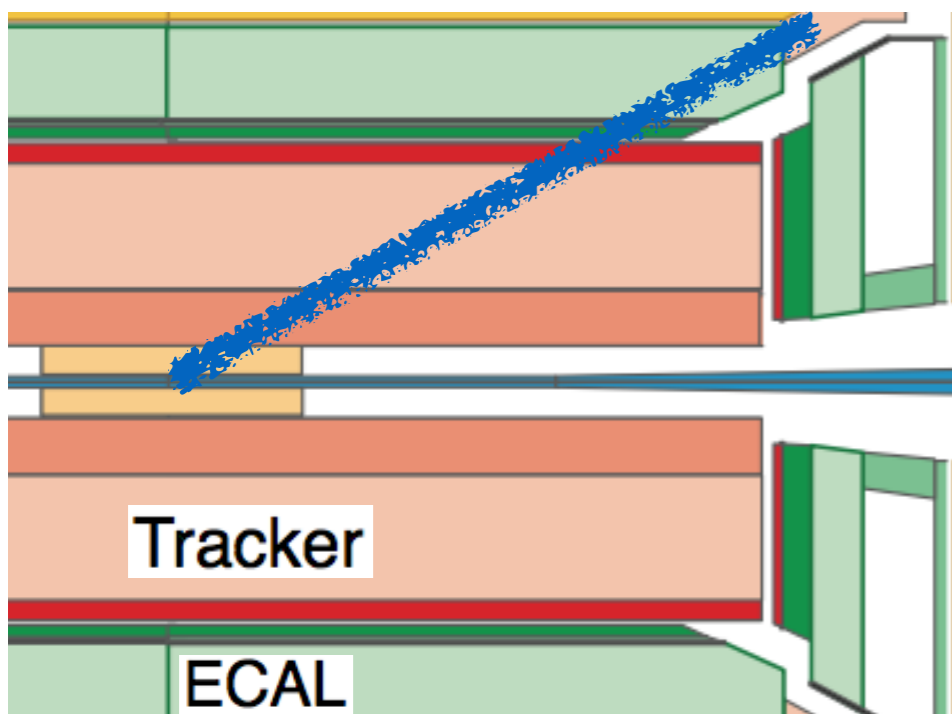


# Magnetic Monopoles

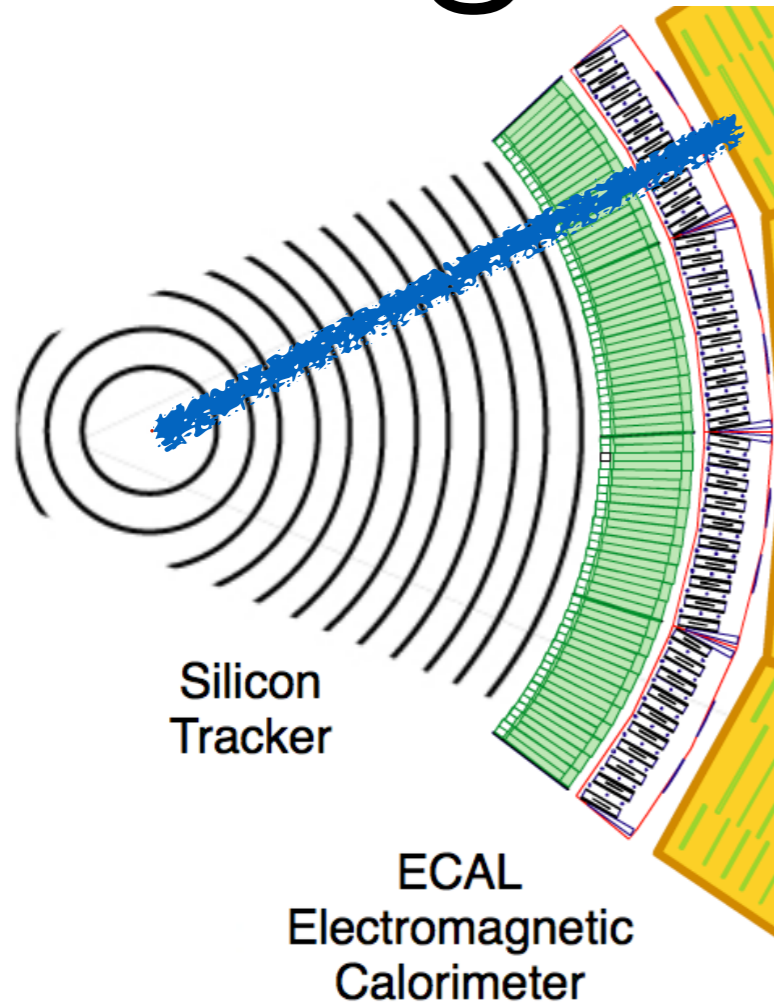


electrically-charged particles curve in  $\phi$  due to the magnetic field

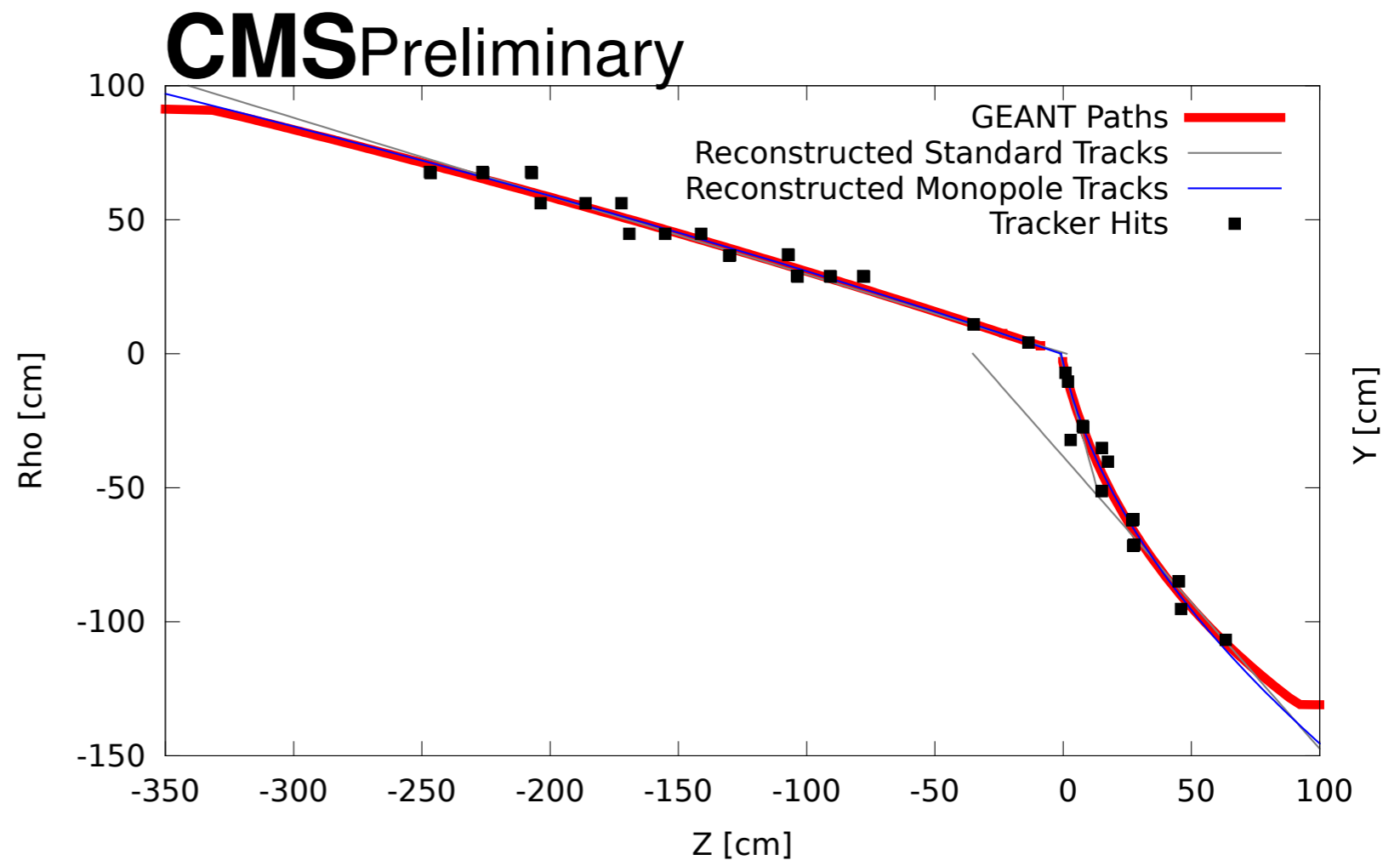
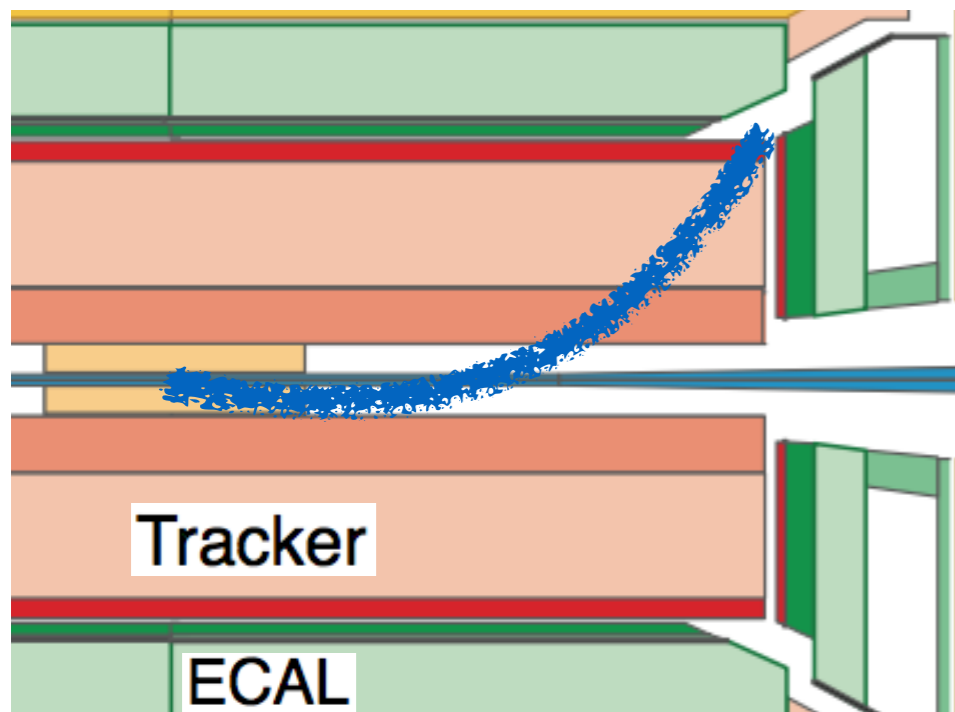
(as pictured)



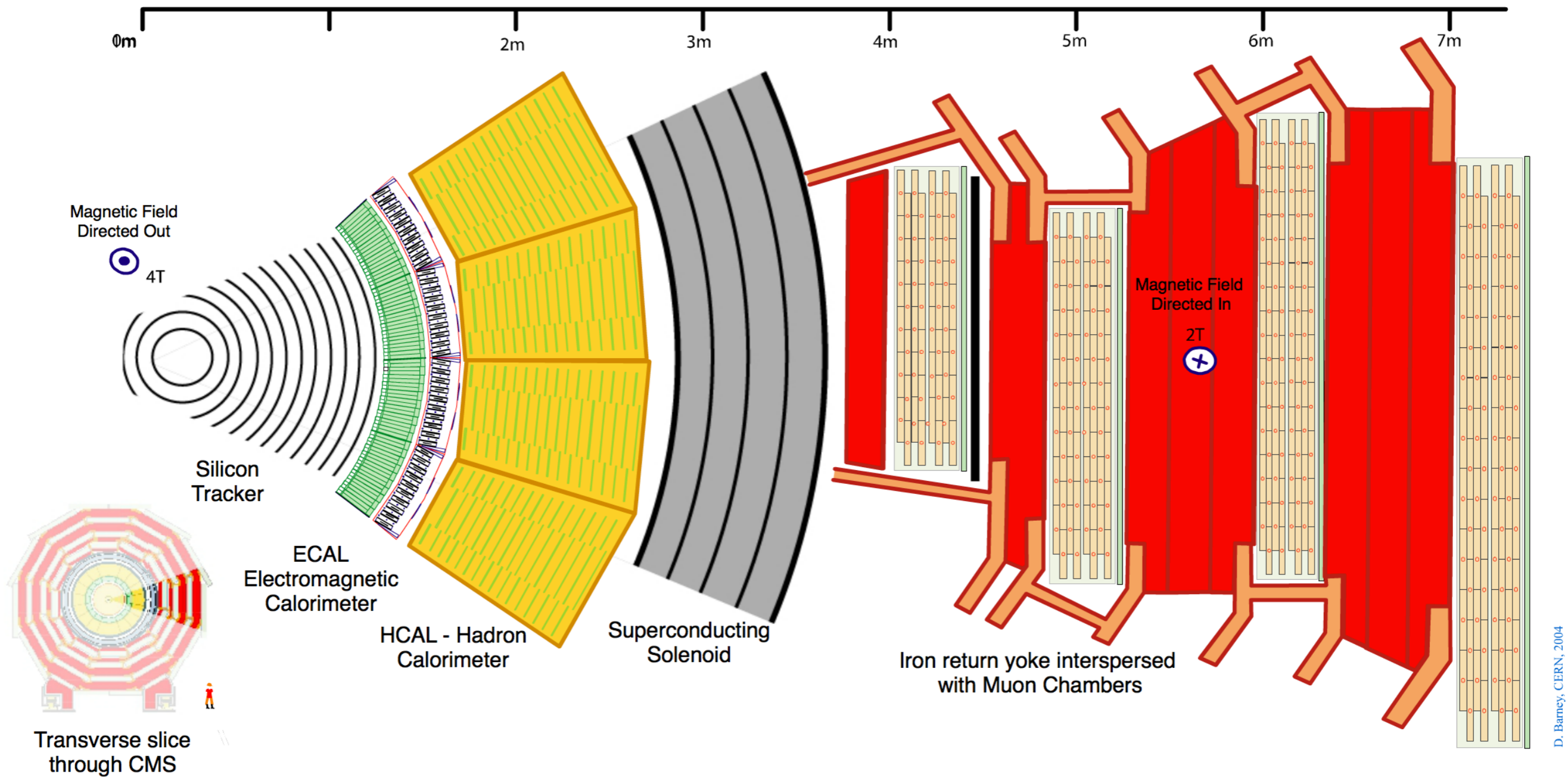
# Magnetic Monopoles



*magnetically*-charged particles would curve in *eta*! (as pictured)

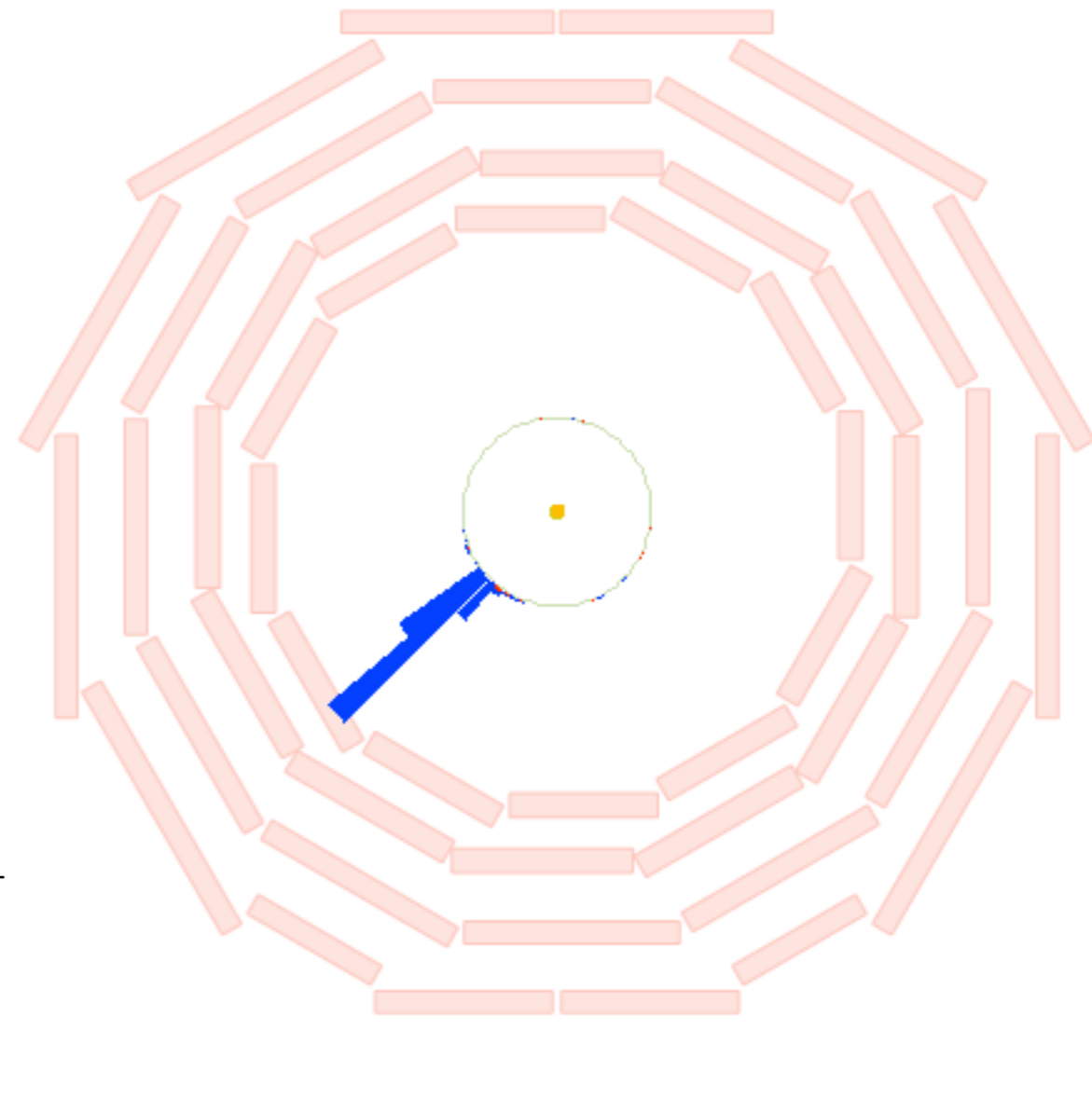
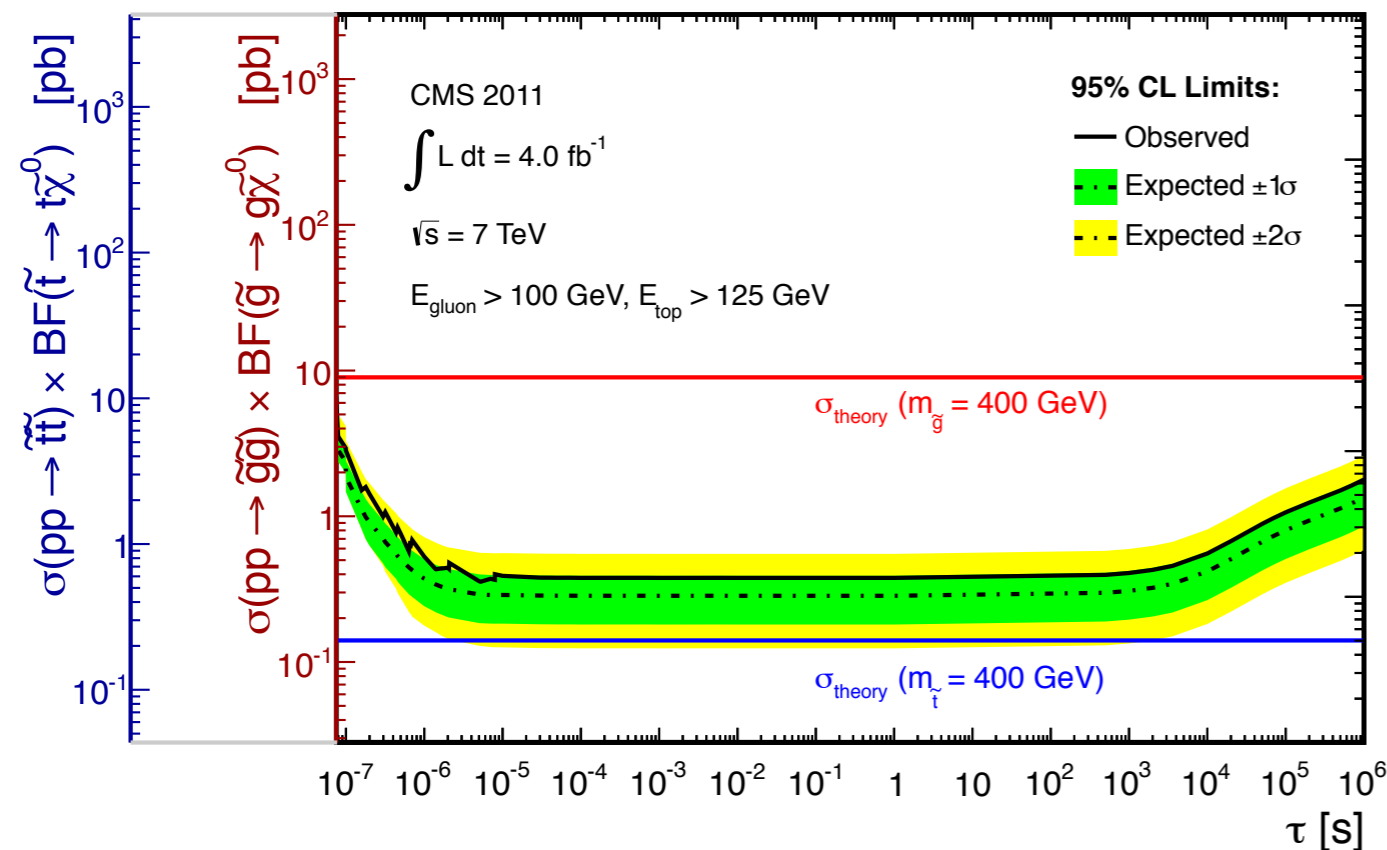


# Stopped particles



# Stopped particles

uses data taken specifically when pp collisions are *not* happening!



$\sigma \times \text{BF} \times \epsilon_{\text{stop}} \times \epsilon_{\text{det}}$  [pb]

sensitive to particles stuck in the detector for days before decaying!