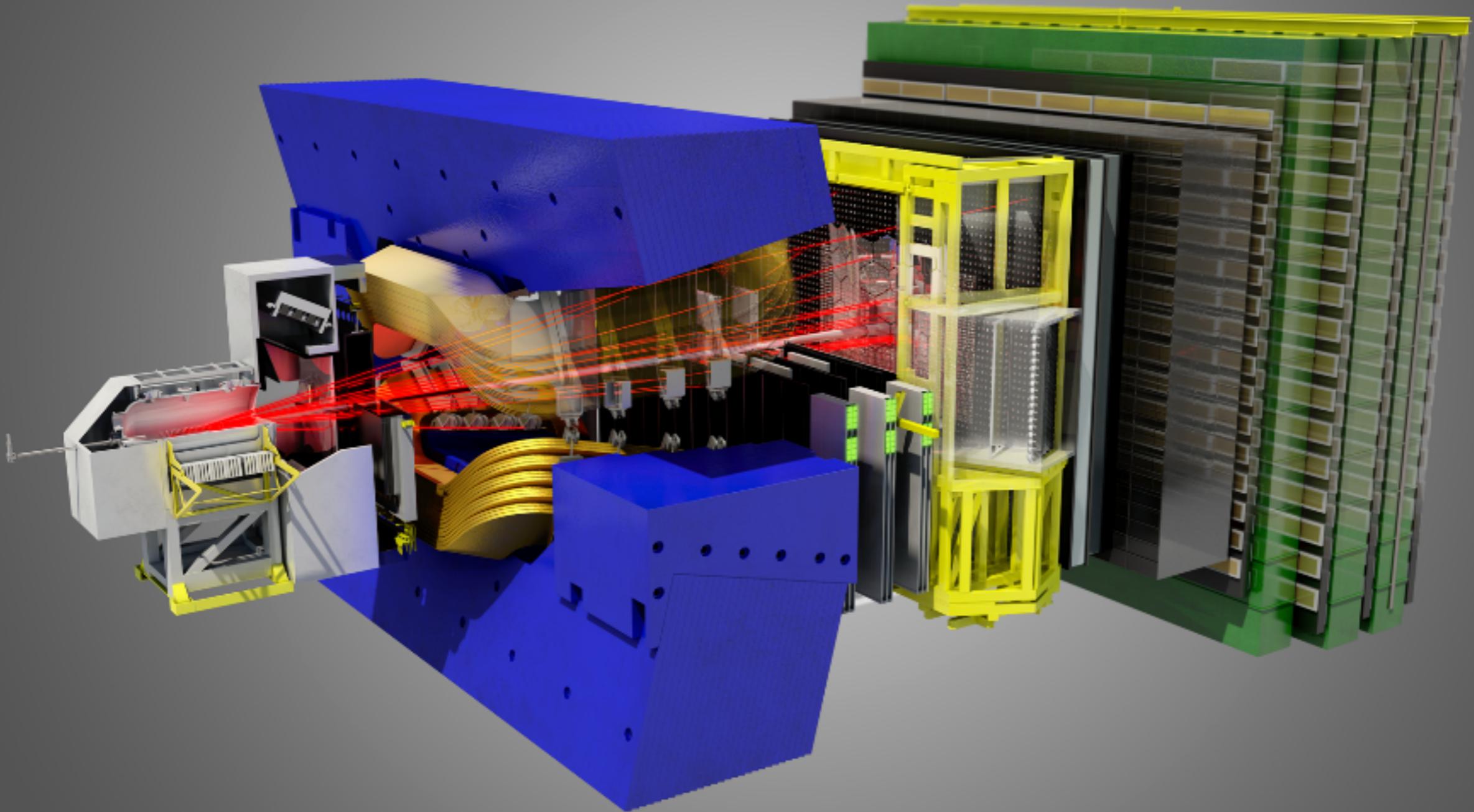
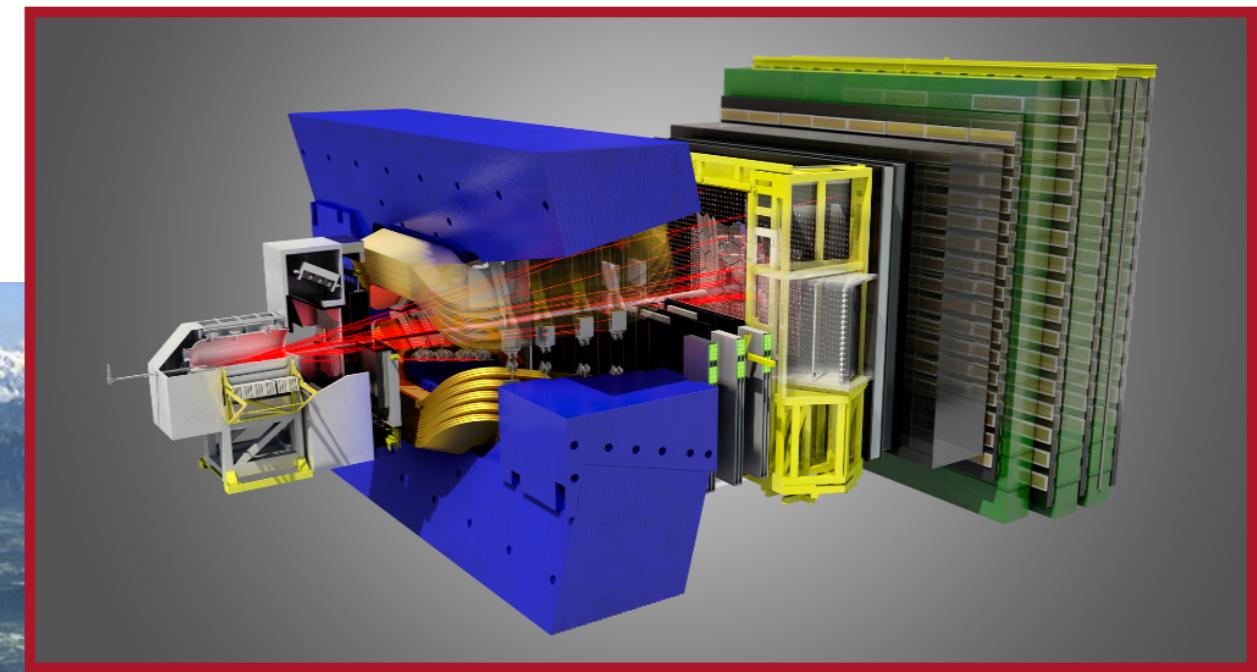
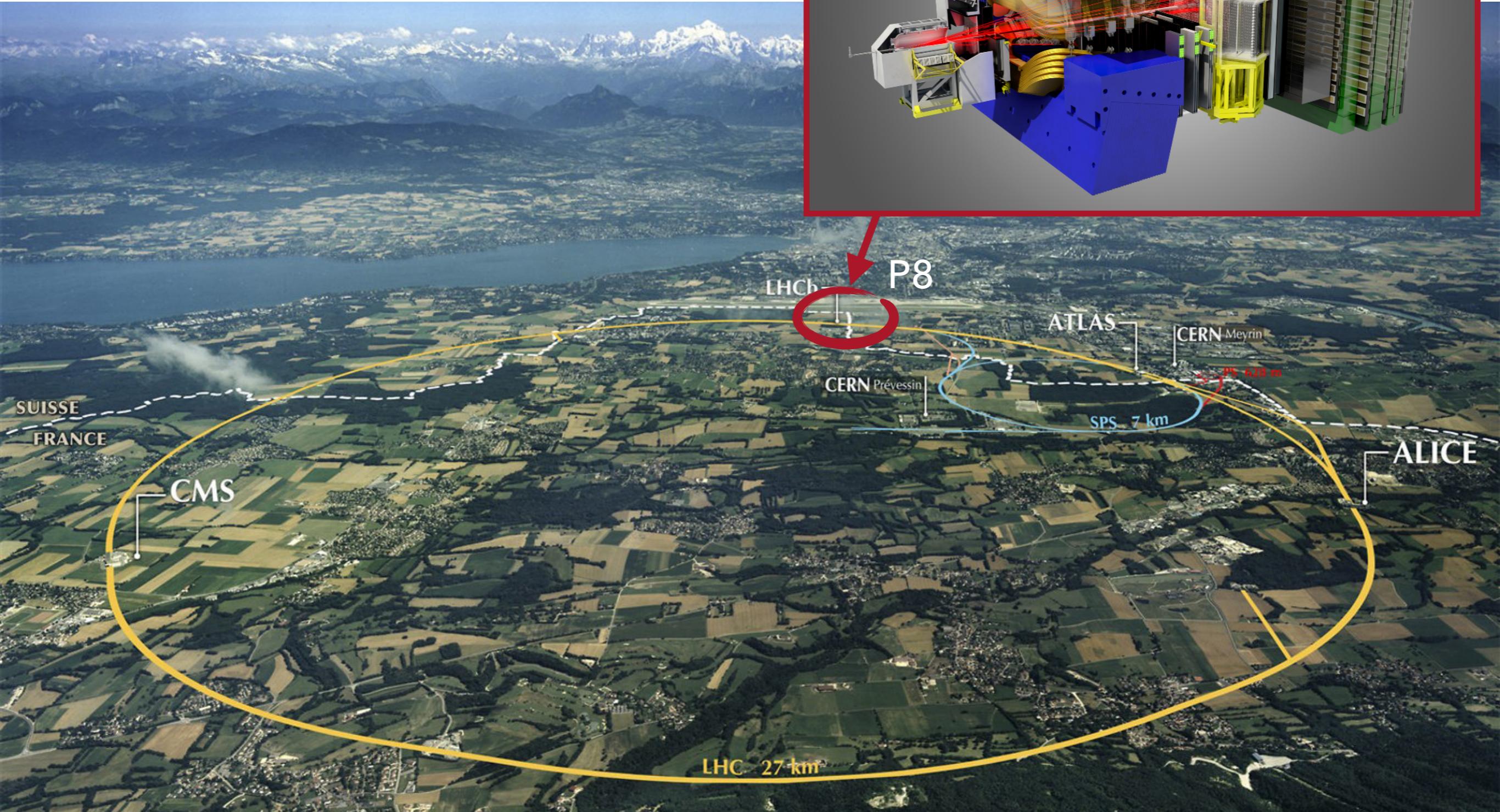


LHCb Masterclass

Violaine Bellée ~ 04 September 2021

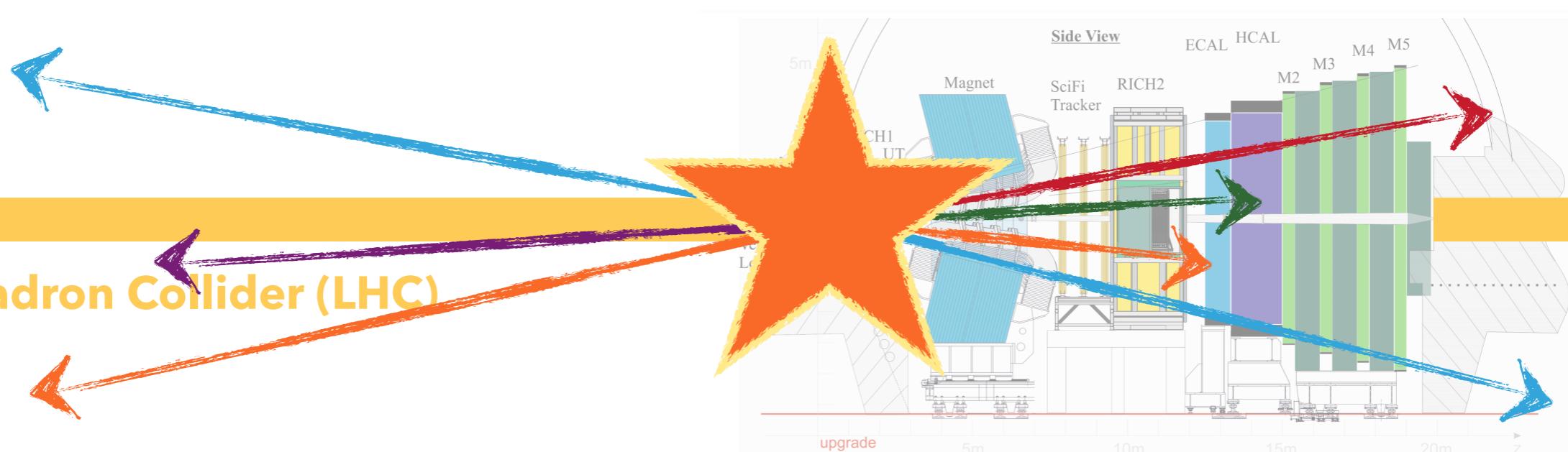


THE LHCb EXPERIMENT @ CERN



PROTON COLLISIONS FROM THE SIDE

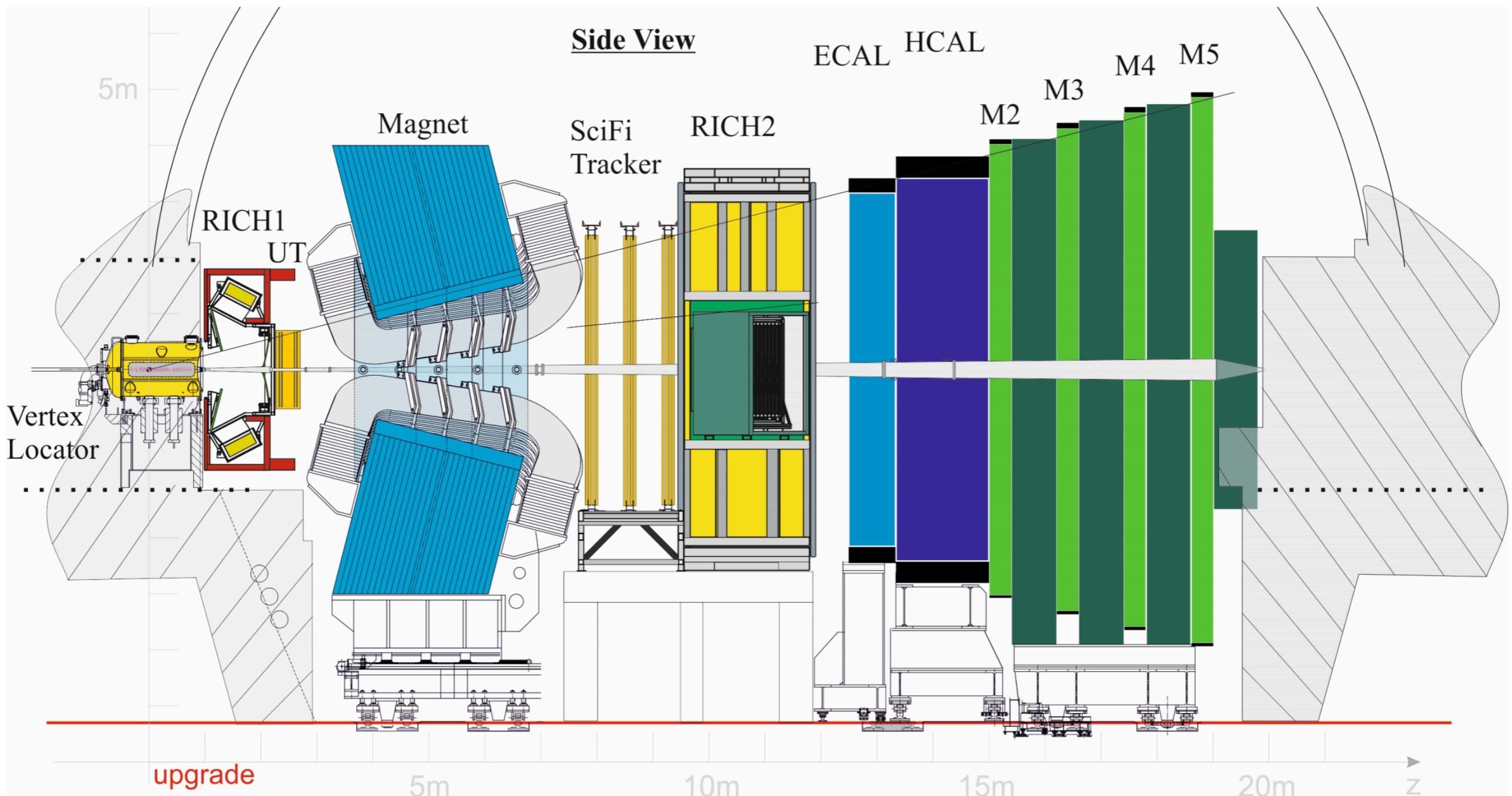
3



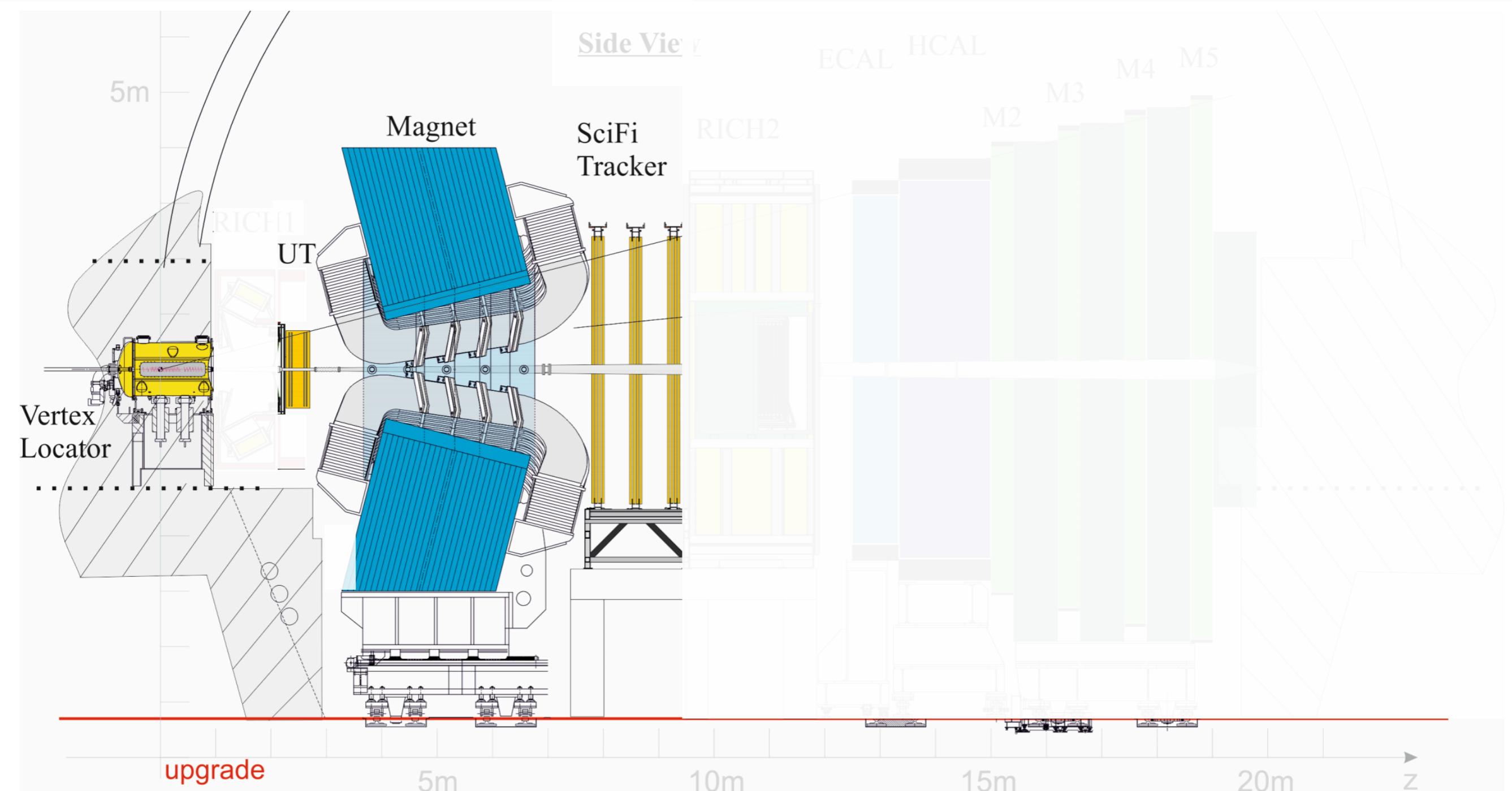
THE LHCb DETECTOR

4

- Measures the **trajectory** of charged particles
- **Identifies** particles
- Measures the **energy** of electromagnetic and hadronic particles



THE TRACKING SYSTEM: WHAT IS THE TRAJECTORY OF PARTICLES?



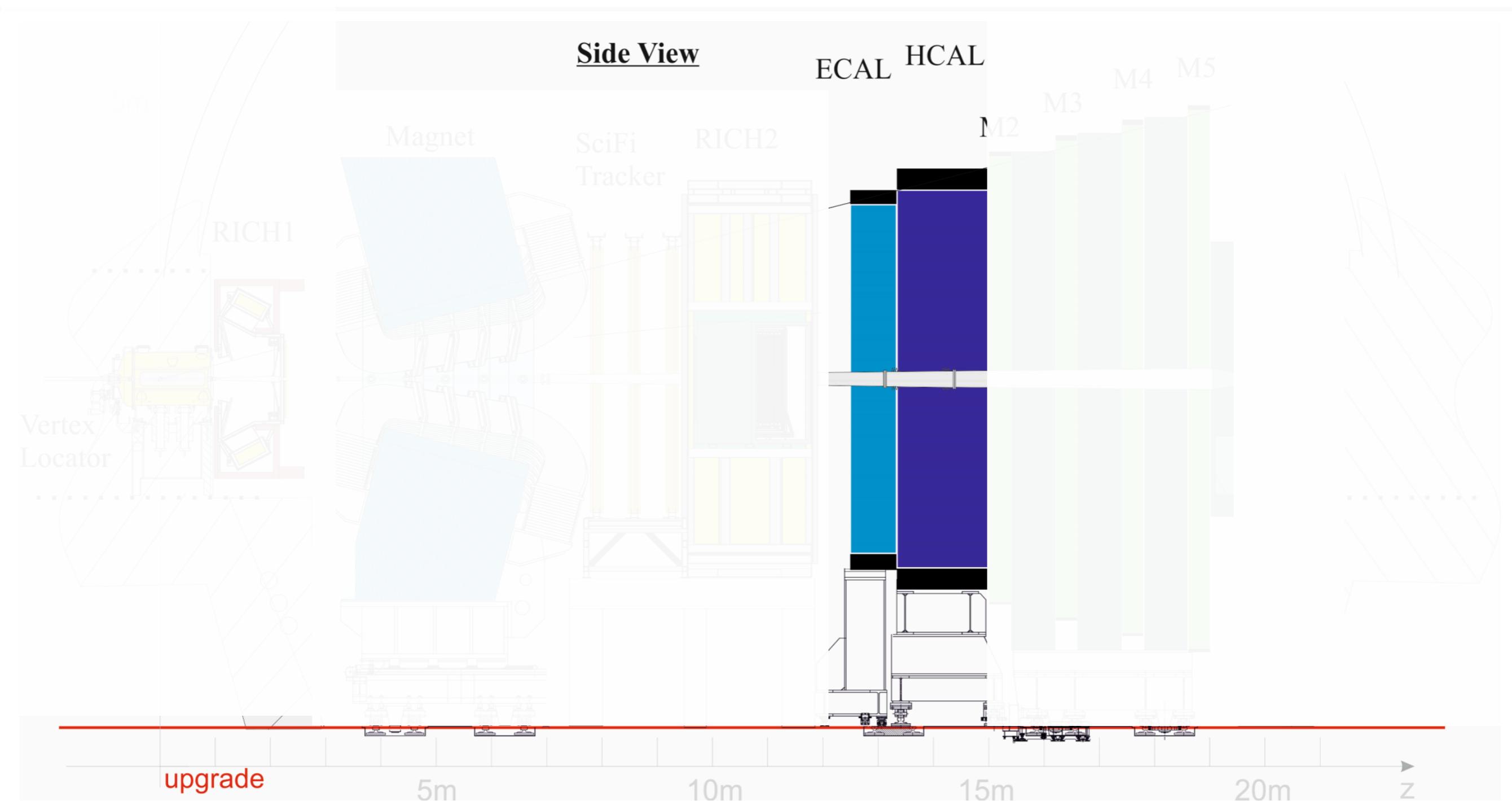
THE PARTICLE IDENTIFICATION SYSTEM: WHAT ARE THESE PARTICLES?

6

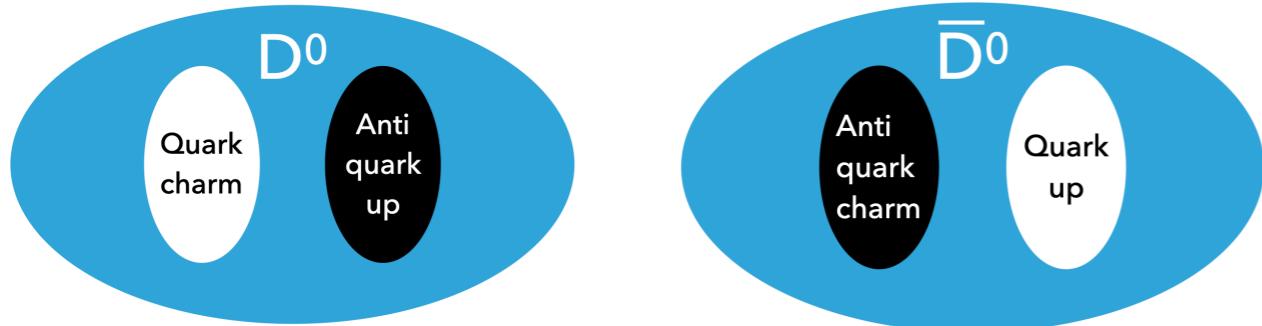


THE CALORIMETERS: WHAT IS THE ENERGY OF PARTICLES?

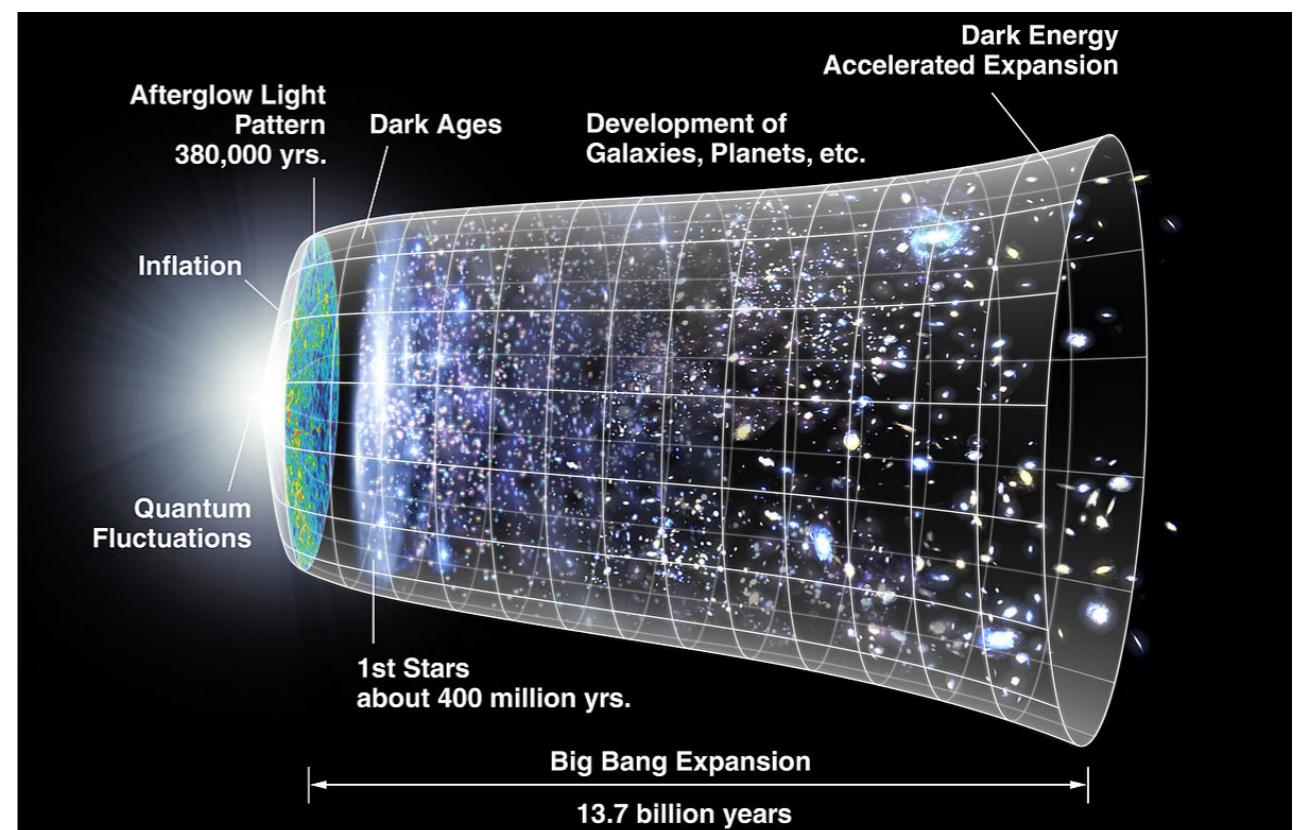
7

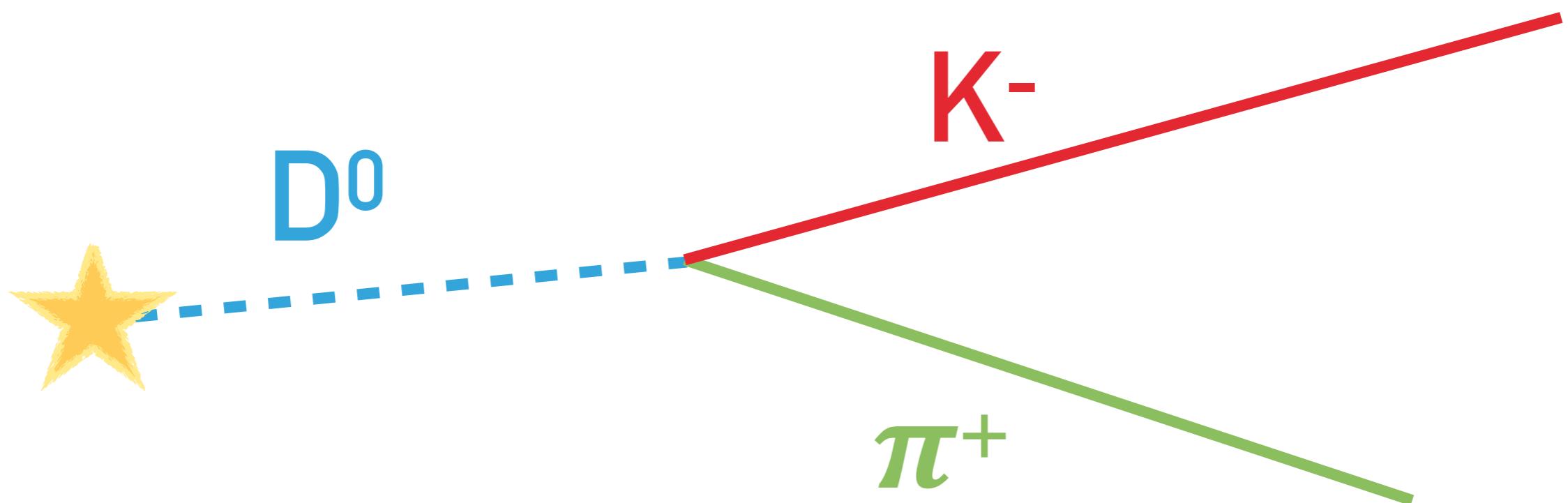


OUR GOALS: SELECT D^0 MESONS AND MEASURE THEIR LIFETIME



- D^0 mesons are interesting because they oscillate in their antiparticle
- This oscillation allows for the measurement of a CP violation in this system





THE LINK OF THE EXERCISE

10

Here:

<https://lhcb-d0.web.cern.ch/>

Firstname

Violaine

Surname

Bellée

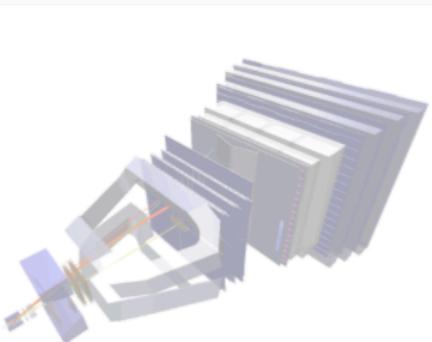
Grade

Clearly out of high school

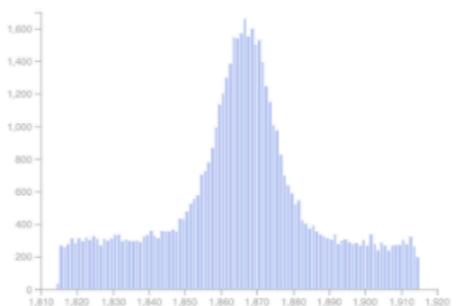
Combination

Combination 3

Save ▾



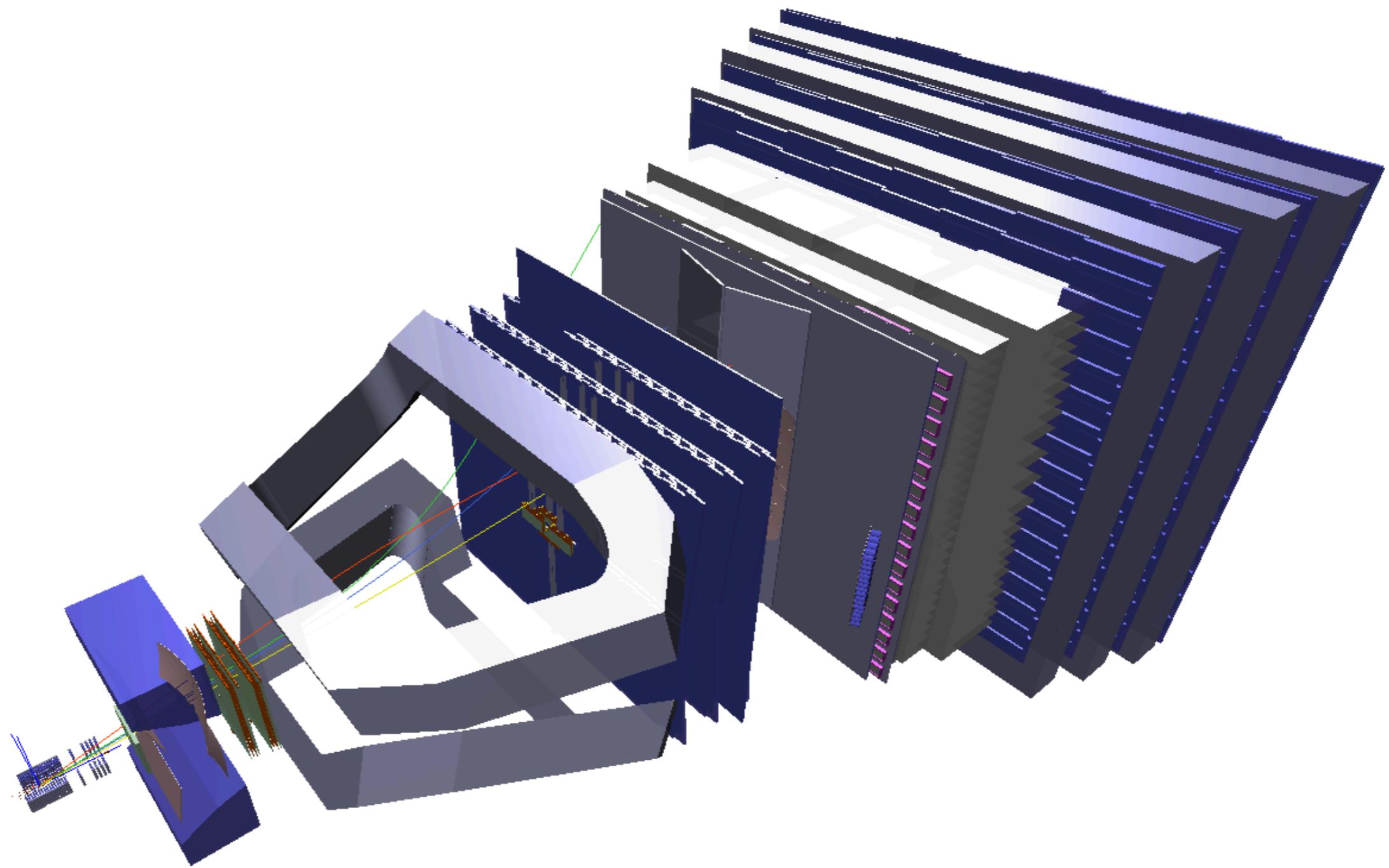
Event Display



D0 Lifetime

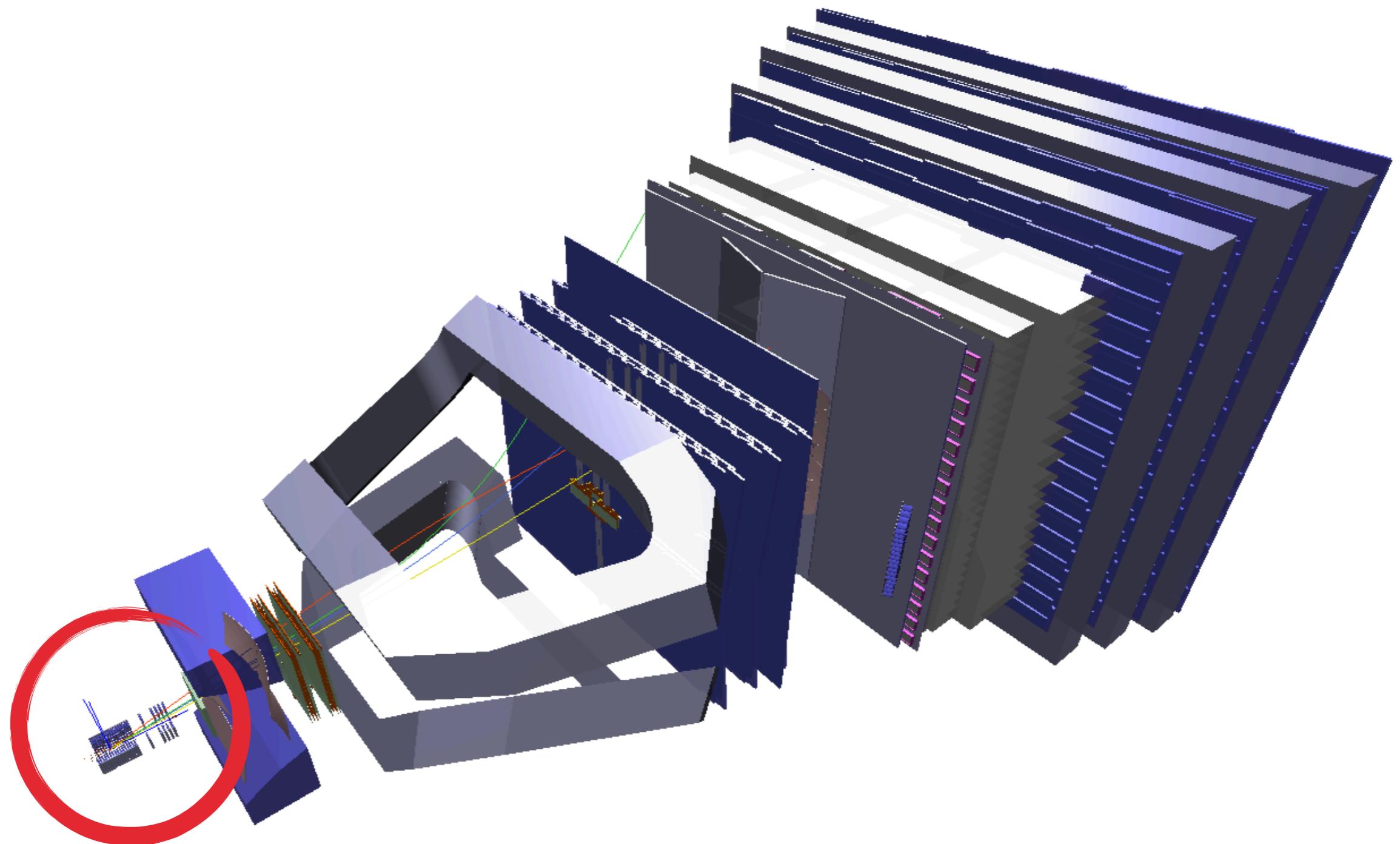
1) FIND THE D⁰S

11



1) FIND THE D⁰S

12



1) FIND D₀S

13

[LHCb Masterclass](#)[About](#)
[Language](#)

Event Display Exercise

Event handler

event_3_0.json

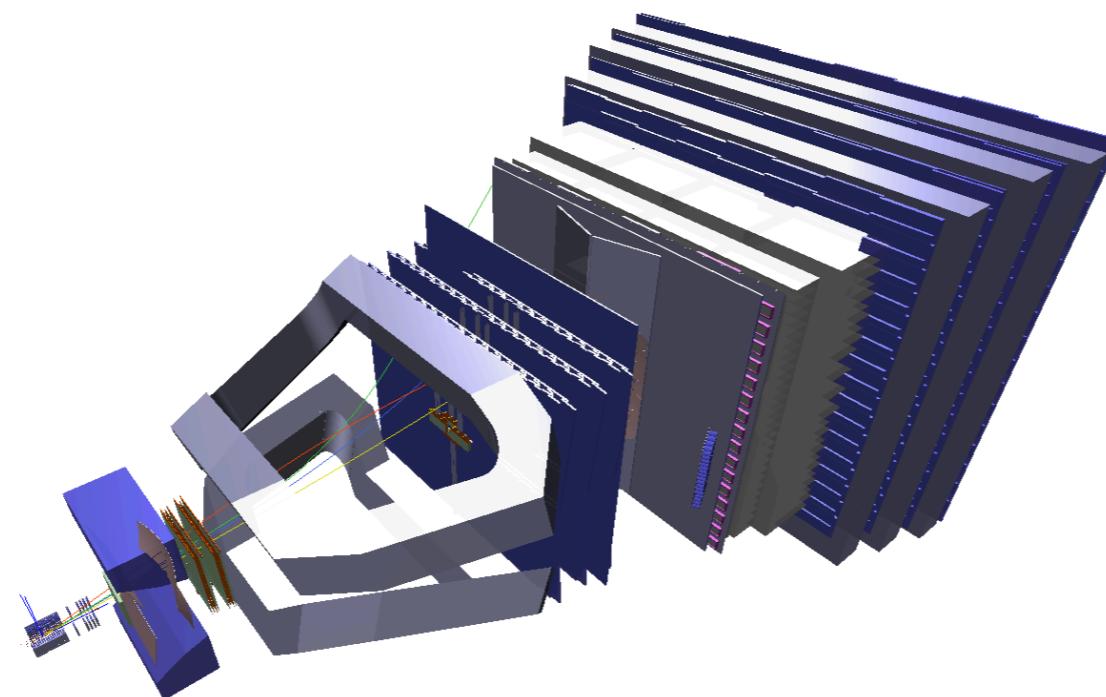
[previous](#)[next](#)

View

 Zoom Detector Help

View

Side

 Auto rotate

Legend

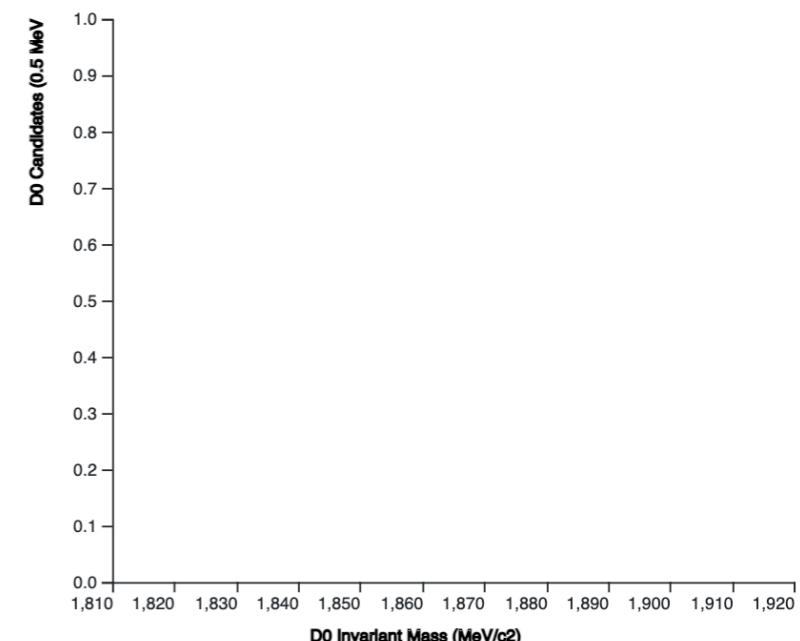
K⁻K⁺pi⁺pi⁻D⁰[Read instructions](#)

v0.1

Particle information

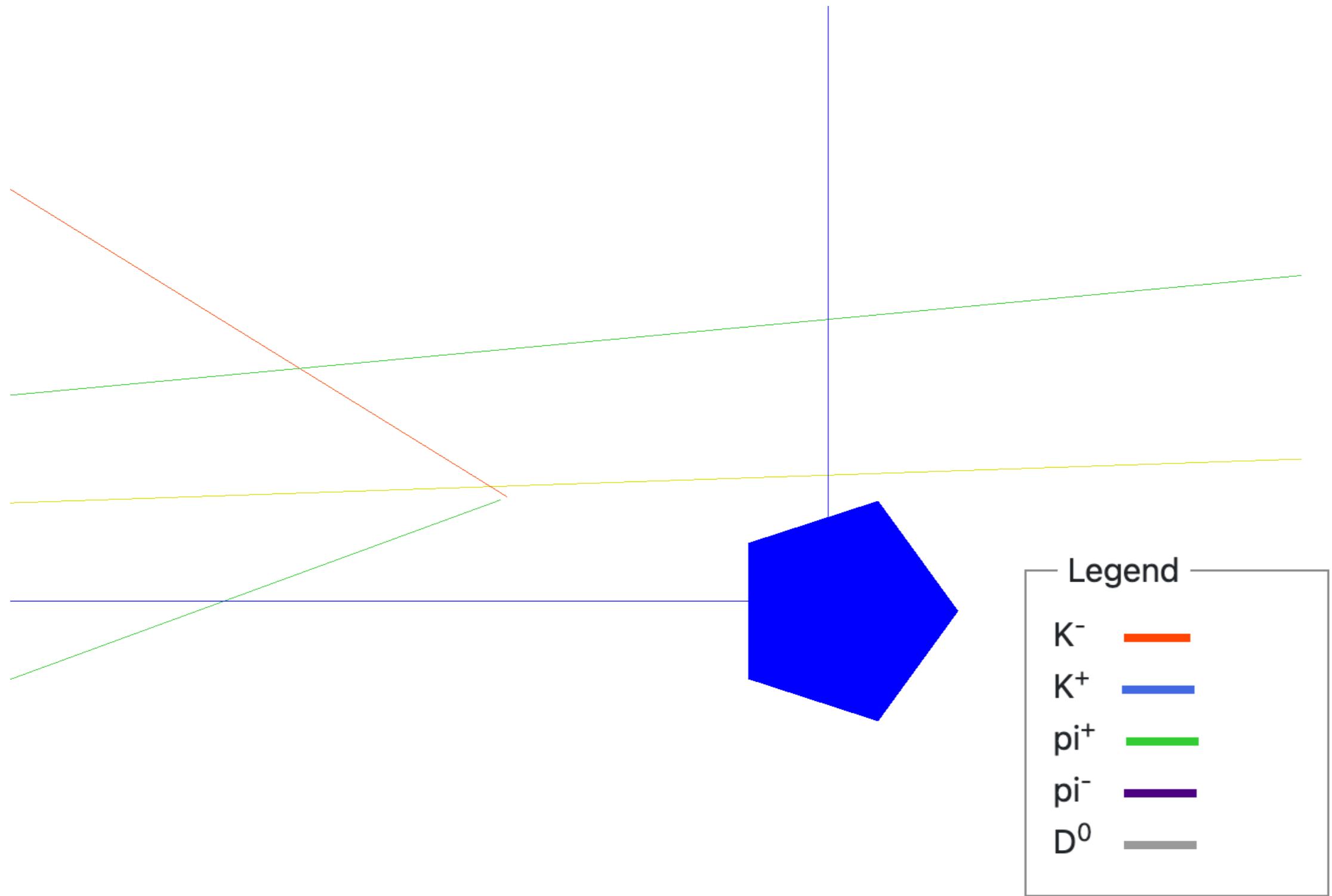
E	19612.373	MeV
chi2	1.152	
ipchi2	272.949	
mass	139.570	MeV/c ²
name	pi+	
ZFstM	49.322	

My particles

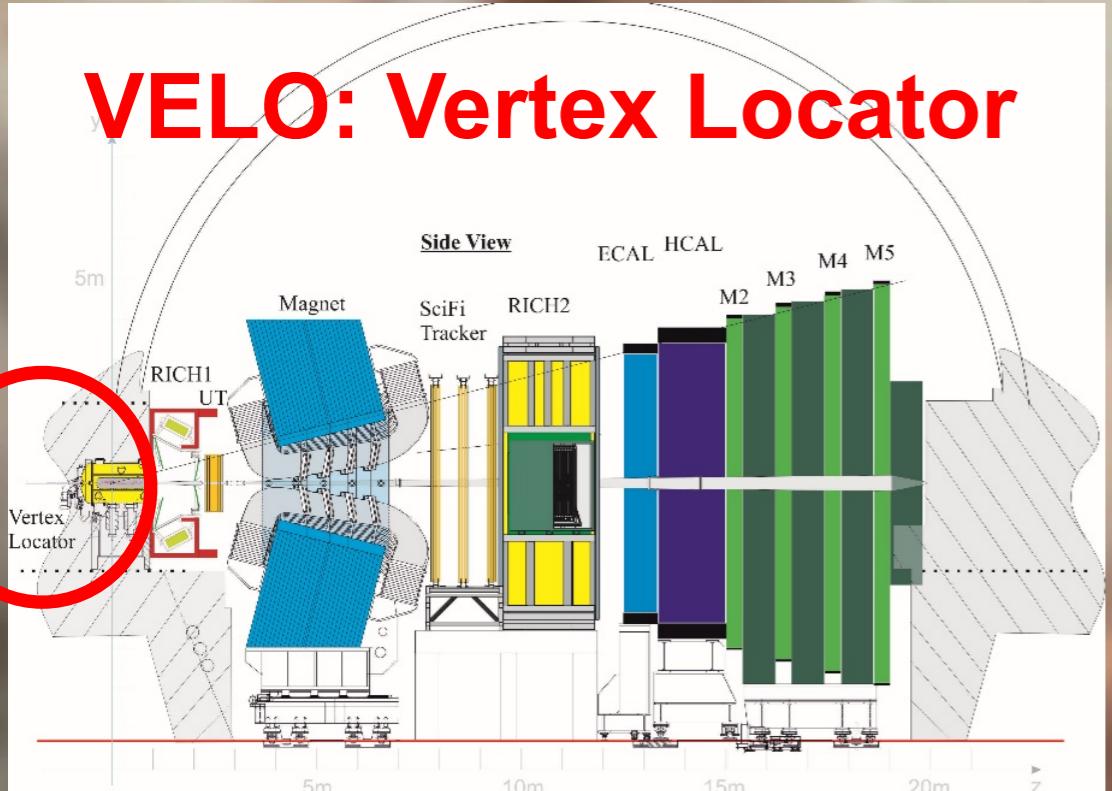
Mass
MeV/c²[Add](#)

1) FIND D⁰s

14



VELO: Vertex Locator



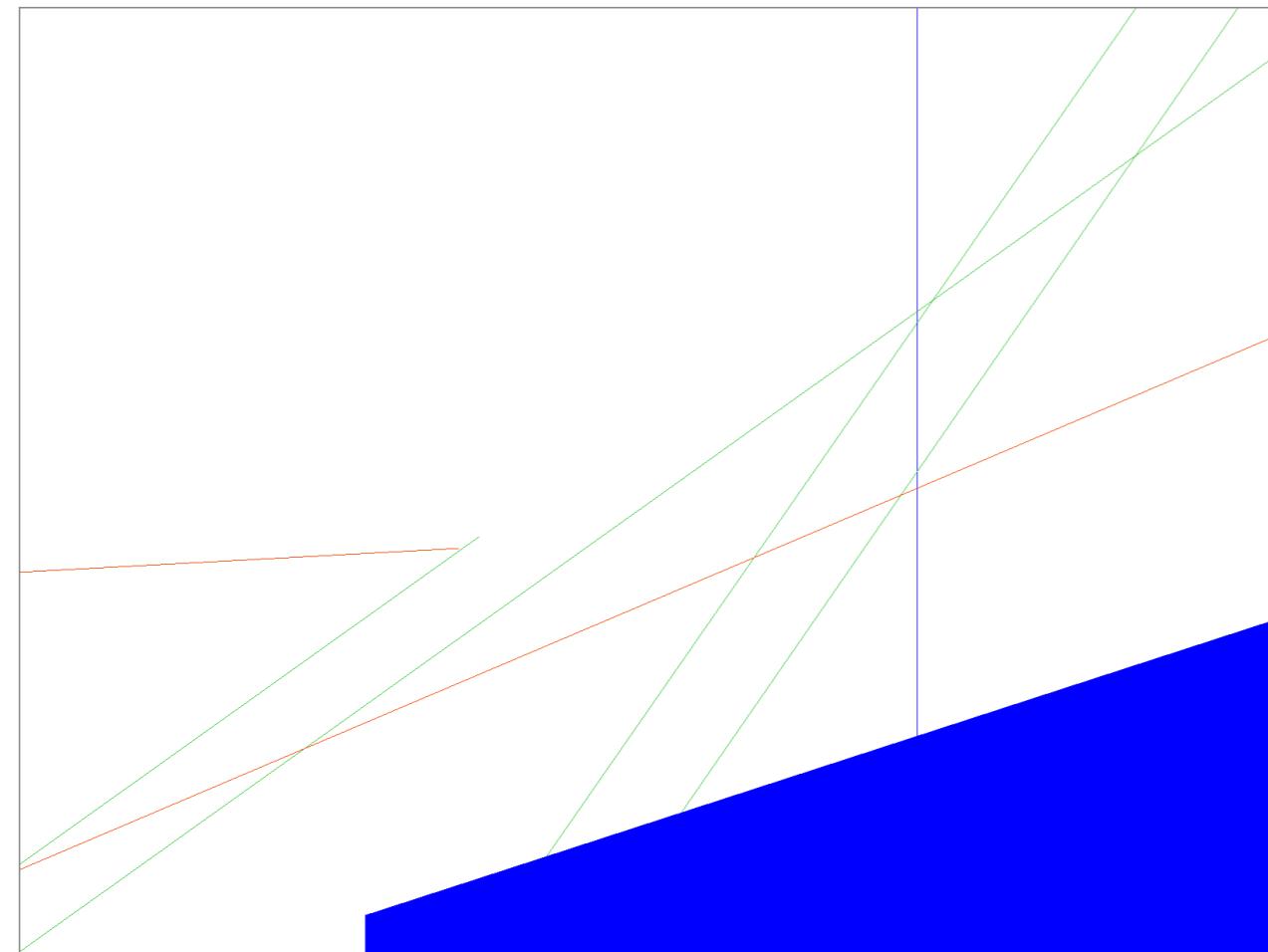
Previous VELO



Upgraded VELO

2) DRAW HISTOGRAMS

16



Particle information		
E	4142.202	MeV
chi2	2.805	
ipchi2	16.987	
mass	139.570	MeV/c ²
name	pi+	
ZFstM	49.322	

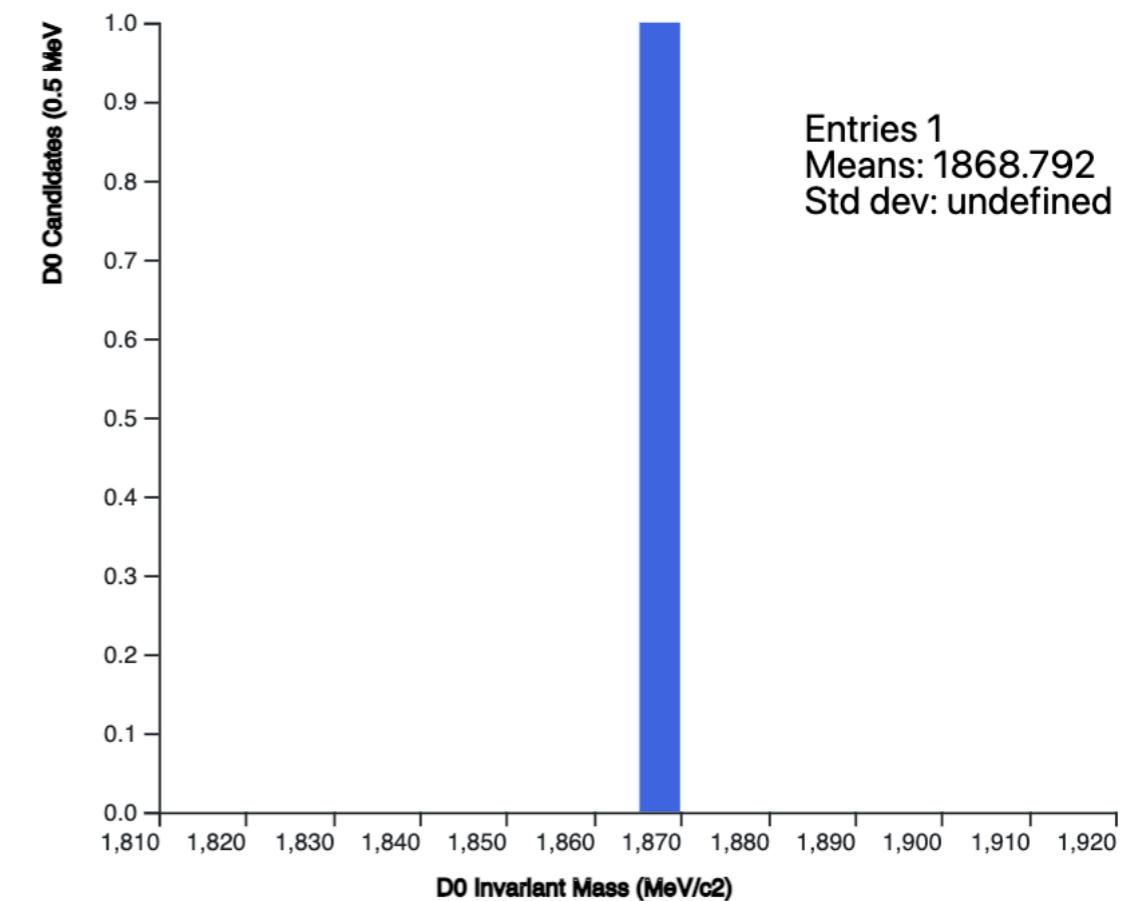
My particles

pi+
K-

Mass

1868.792 MeV/c²

Add



3) MASS FIT AND BACKGROUND SUBTRACTION

17

D⁰ lifetime Exercise

Analysis tools

Background substr.

Signal range

1810

Variable range

D⁰ PT

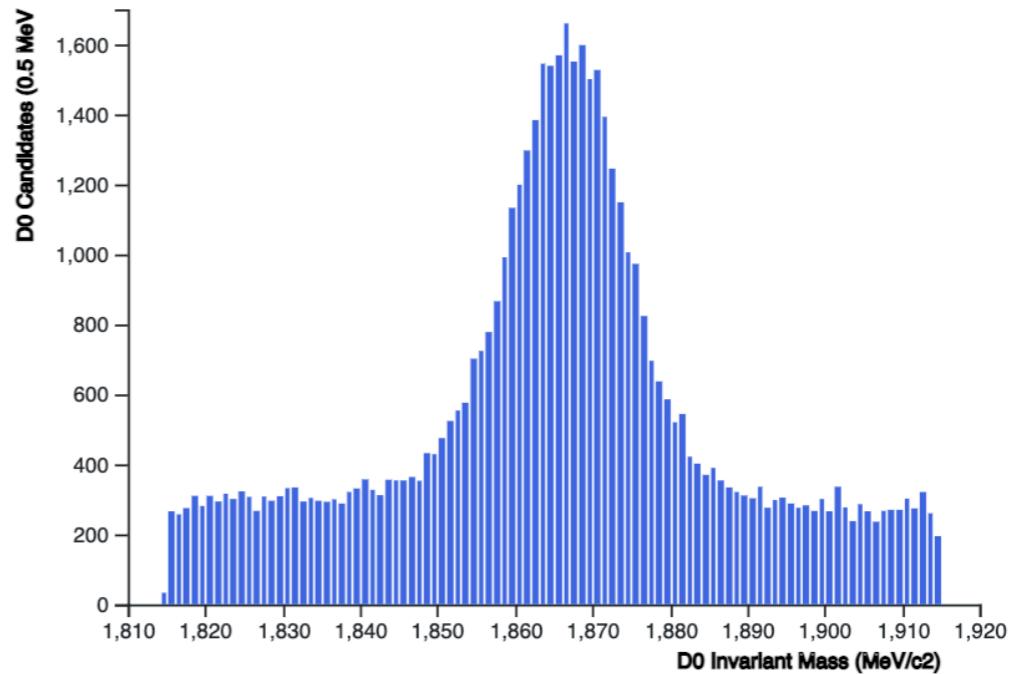
2.5

D⁰ TAU

0

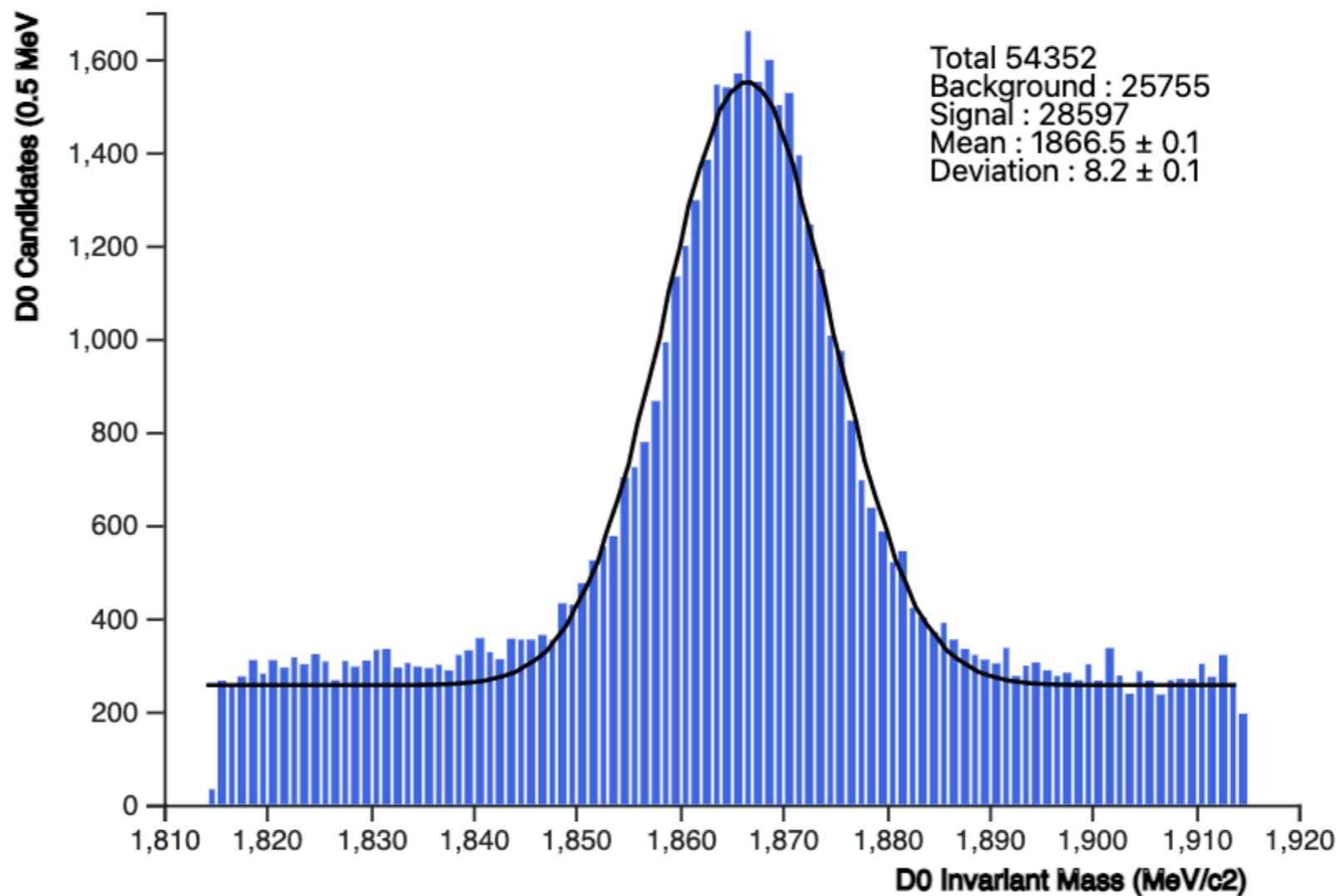
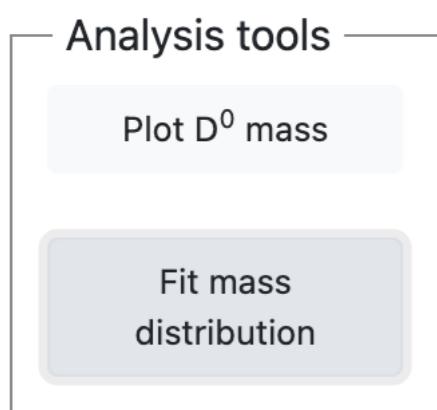
D⁰ IP

-4



3) MASS FIT AND BACKGROUND SUBTRACTION

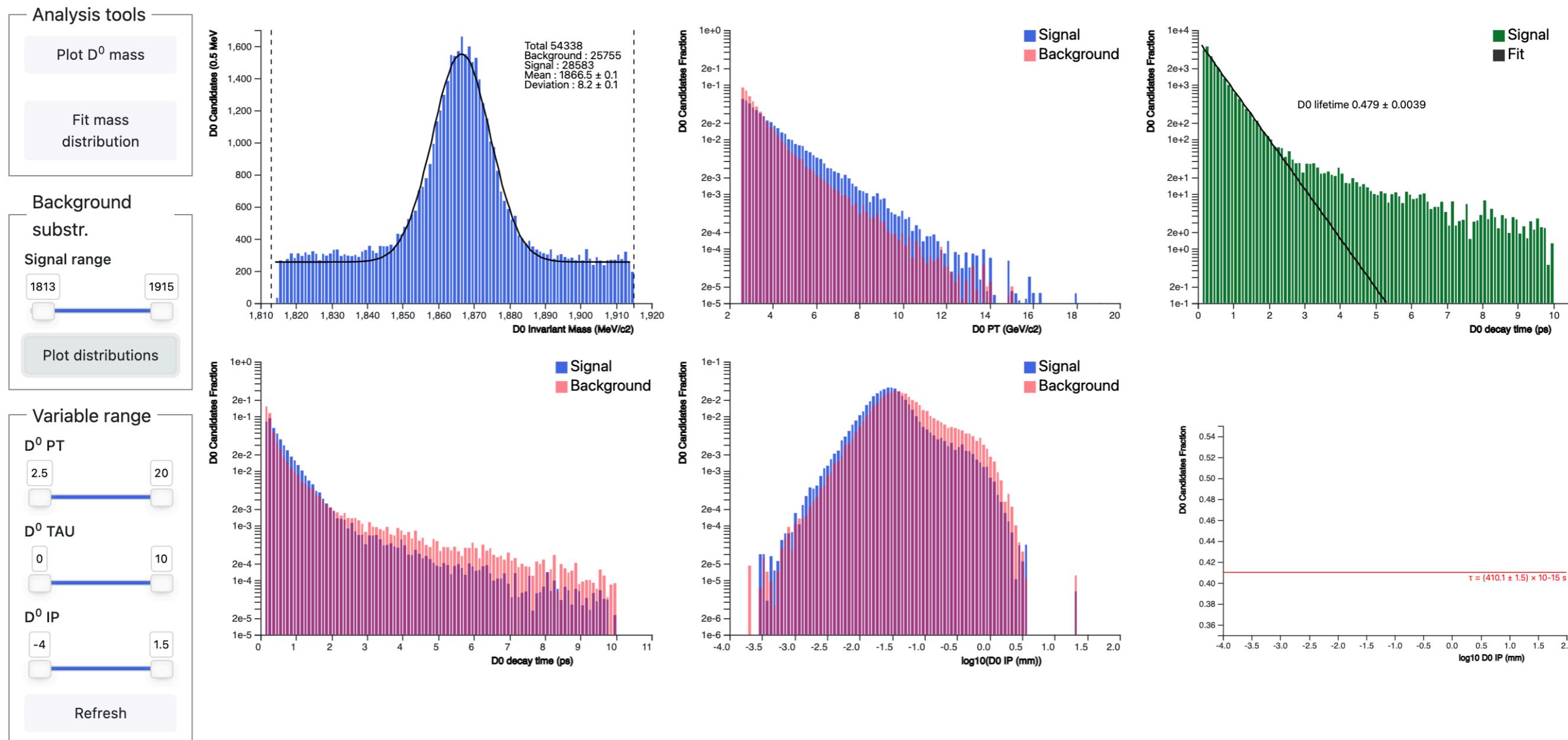
18



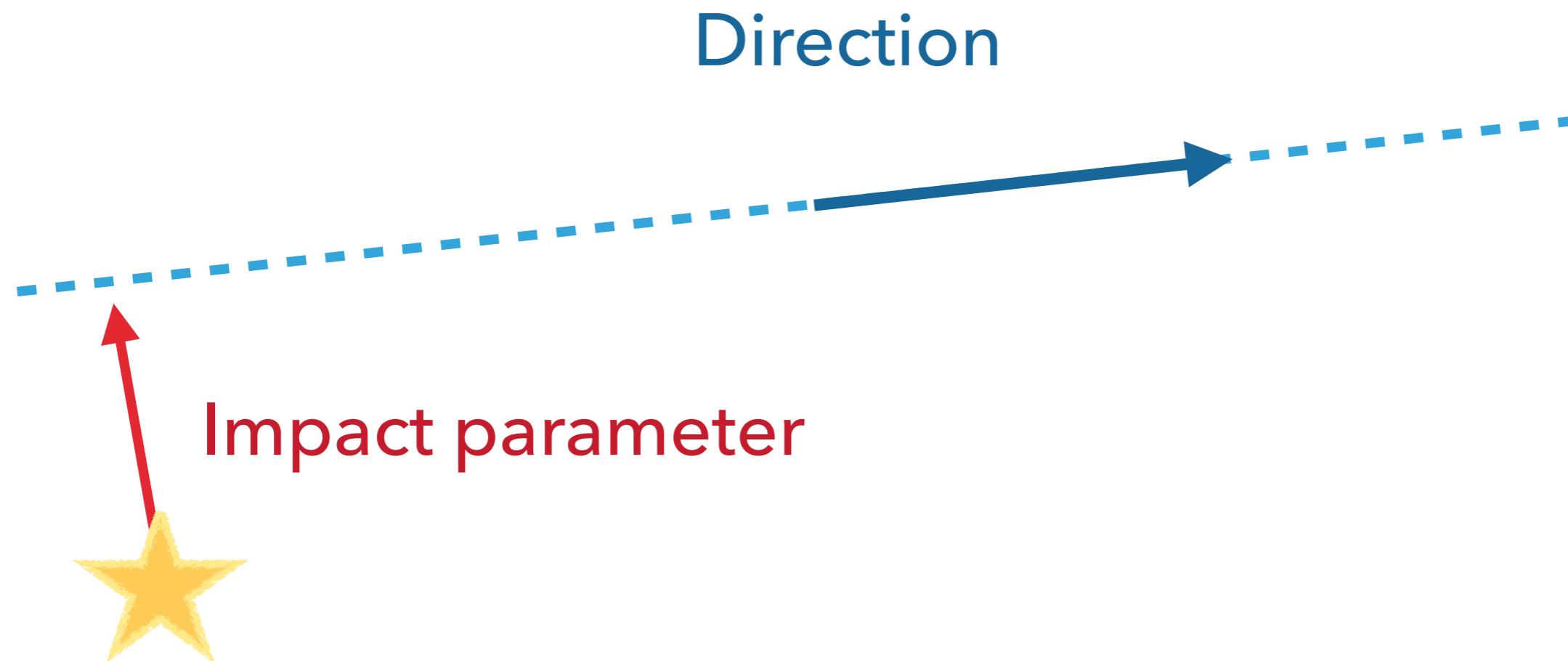
4) CUT ON DISCRIMINATING VARIABLES AND FIT FOR LIFETIME

19

D⁰ lifetime Exercise



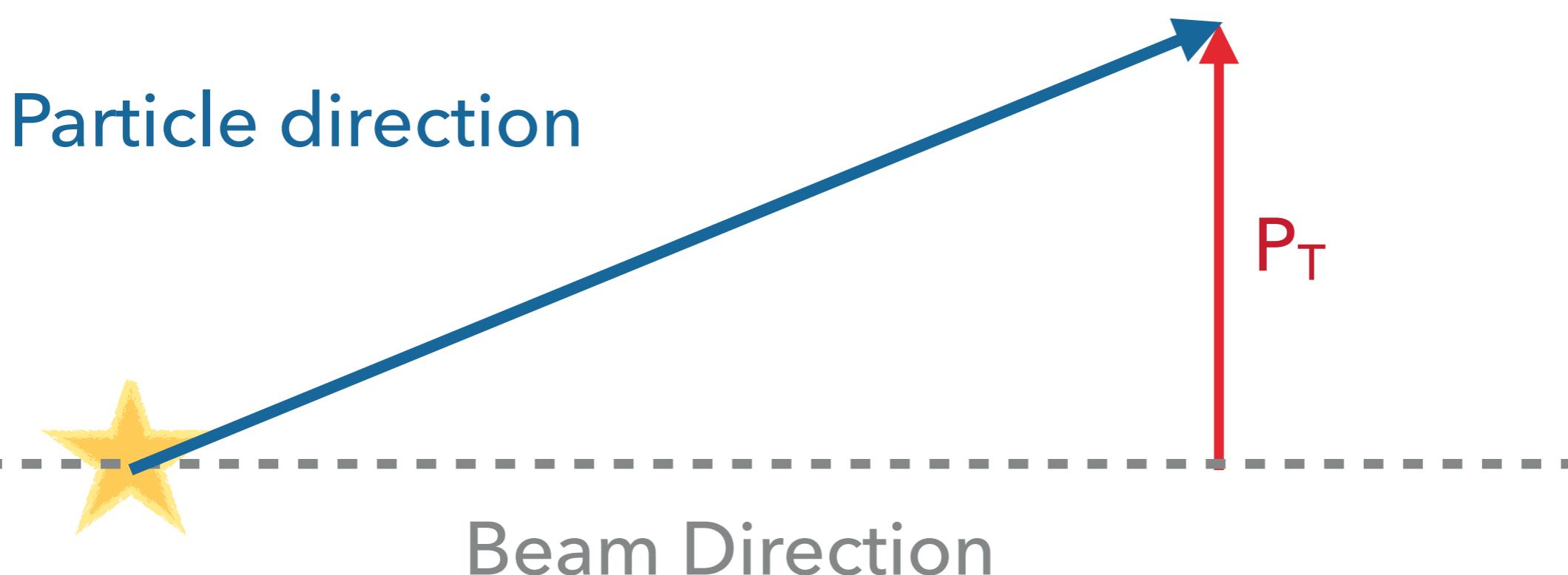
v0.1



4) CUT ON DISCRIMINATING VARIABLES AND FIT FOR LIFETIME

21

Transverse Pt



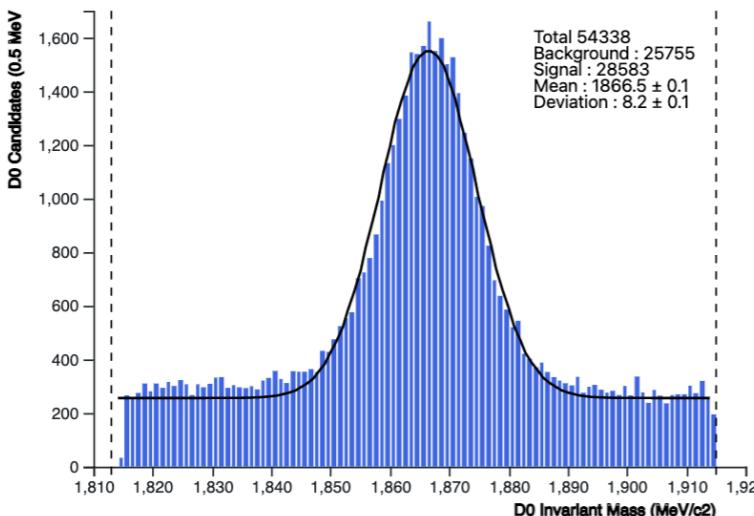
4) CUT ON DISCRIMINATING VARIABLES AND FIT FOR LIFETIME

22

D⁰ lifetime Exercise

Analysis tools

-
-

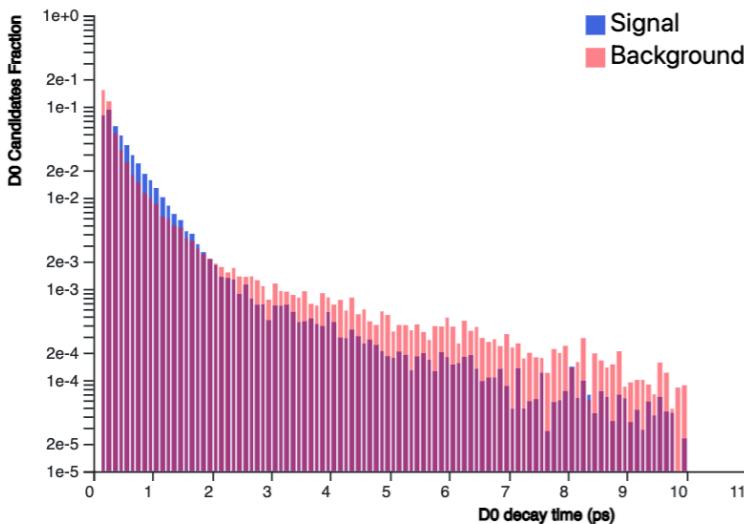


Background substr.

Signal range

1813 1915

Plot distributions



Variable range

D⁰ PT

2.5 20

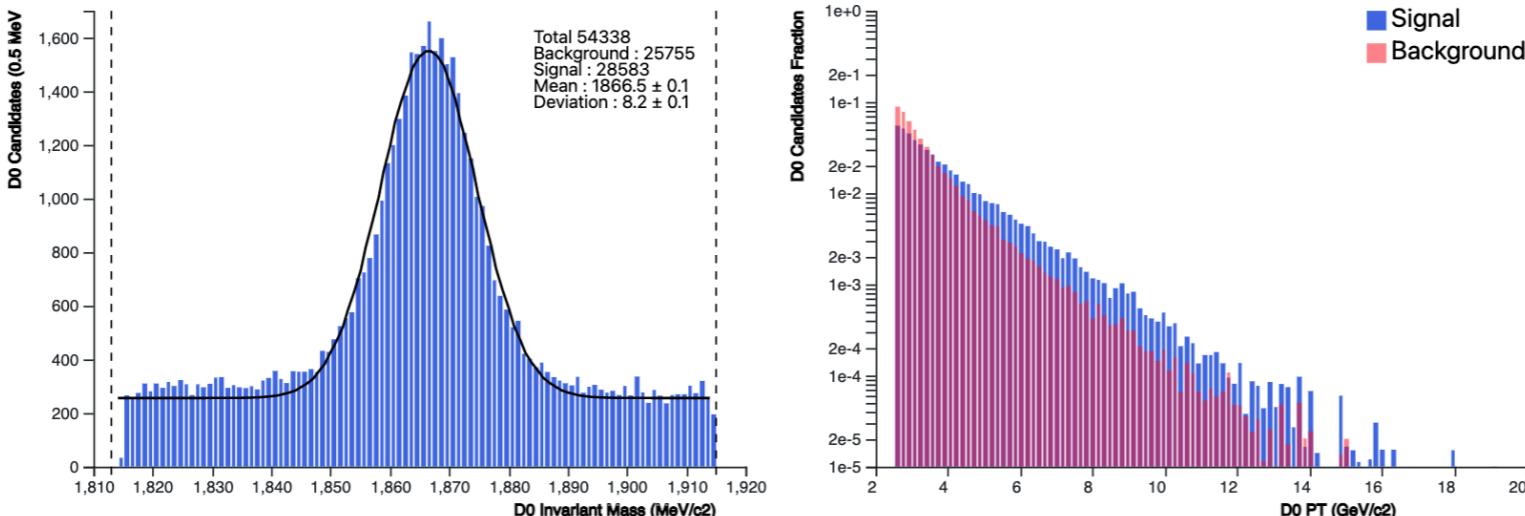
D⁰ TAU

0 10

D⁰ IP

-4 1.5

Refresh

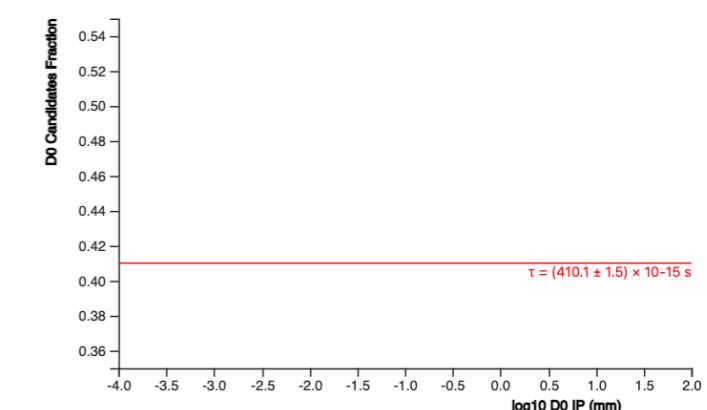
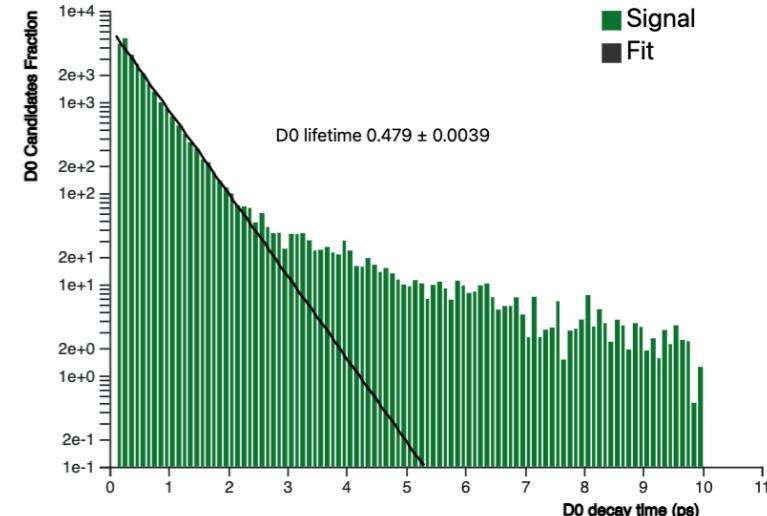
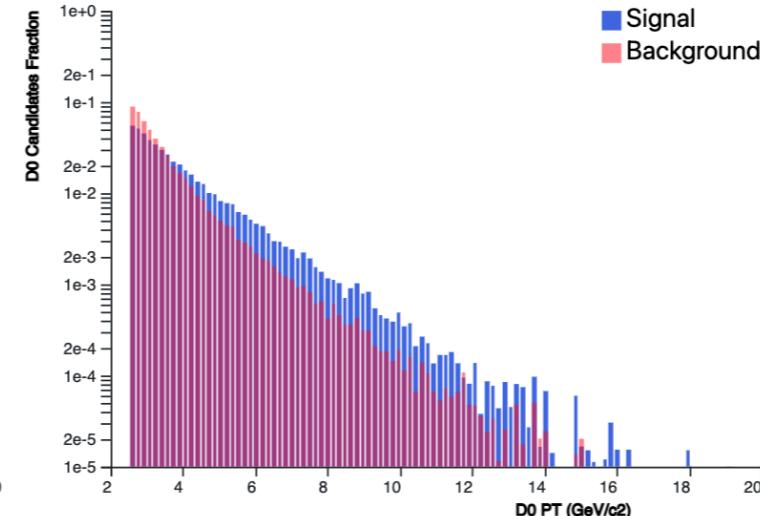


Time fit

Fit result

Error (ps) 0.0039
0.479

Save result



v0.1

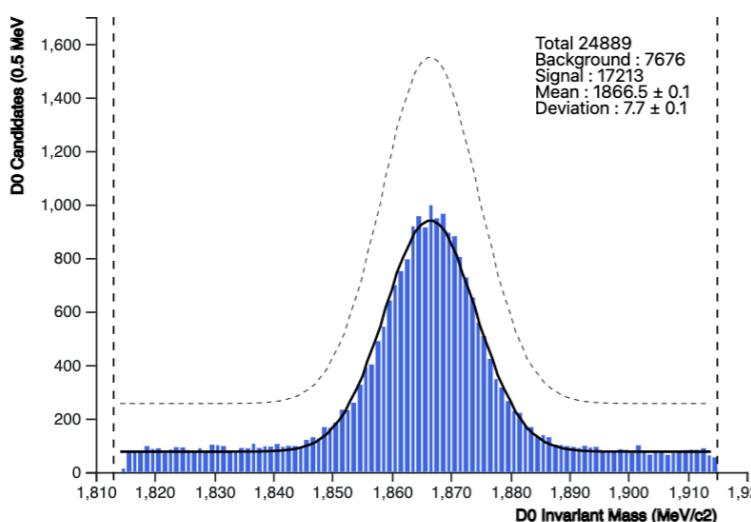
Copyright © 2019 CERN

D⁰ Lifetime Exercise

4) CUT ON DISCRIMINATING VARIABLES AND FIT FOR LIFETIME

Analysis tools

- Plot D⁰ mass
- Fit mass distribution

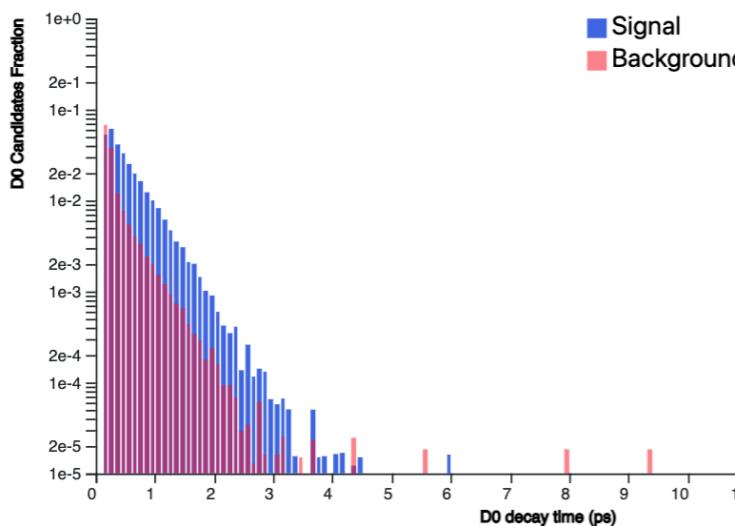


Background substr.

Signal range

1813 1915

Plot distributions



Variable range

D⁰ PT

2.5 20

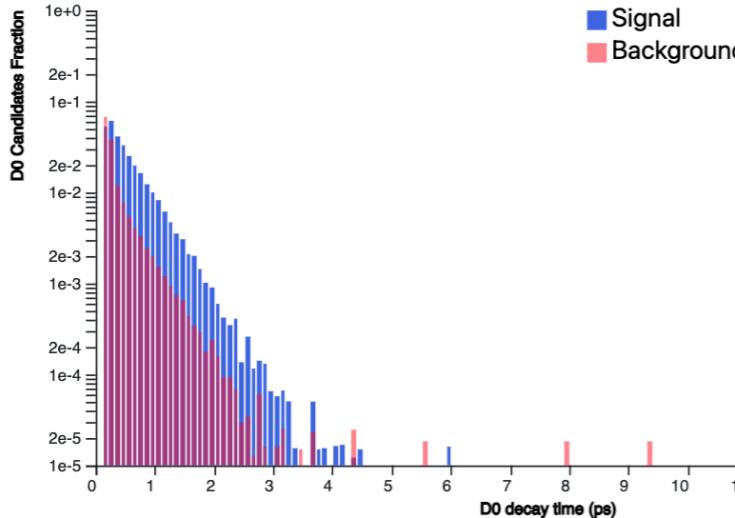
D⁰ TAU

0 10

D⁰ IP

-4 -1.5

Refresh

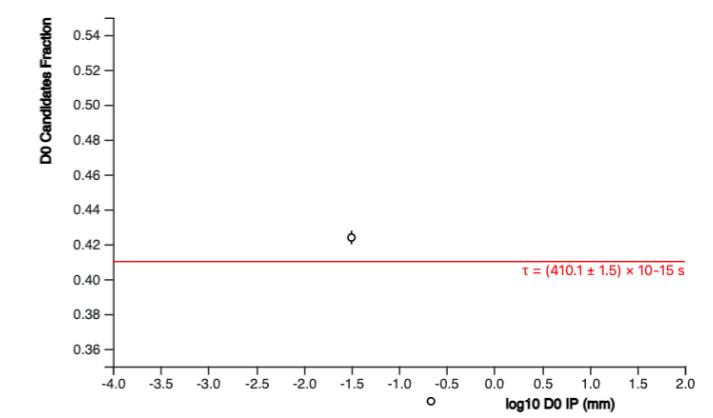
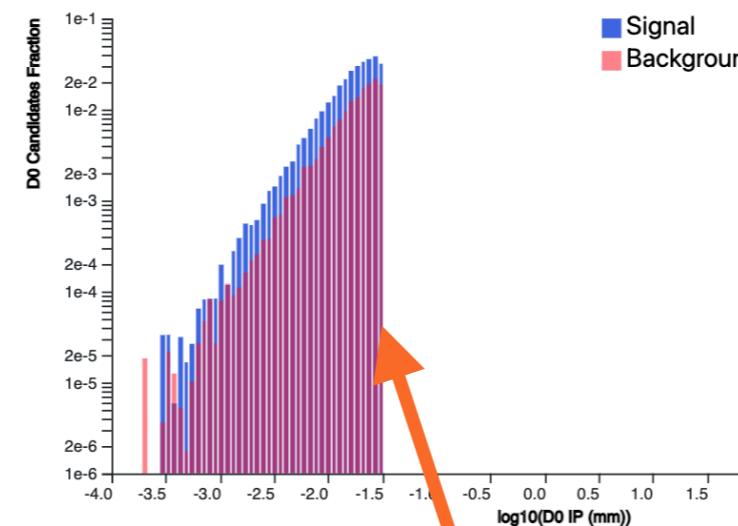
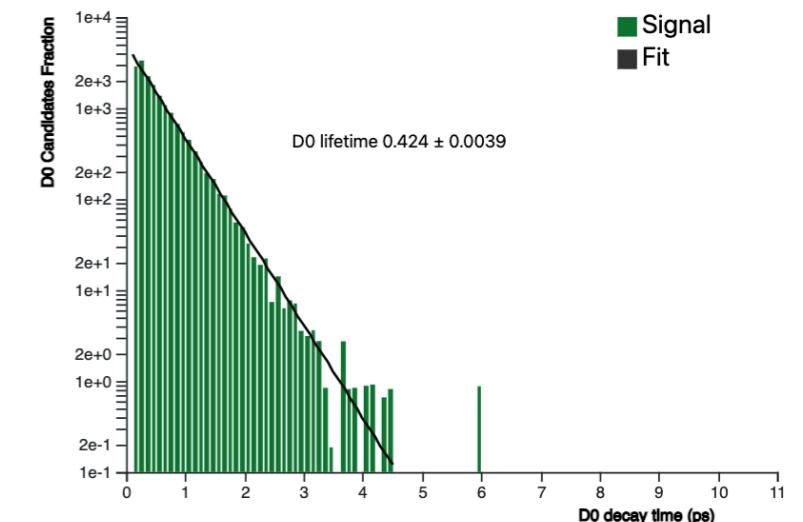
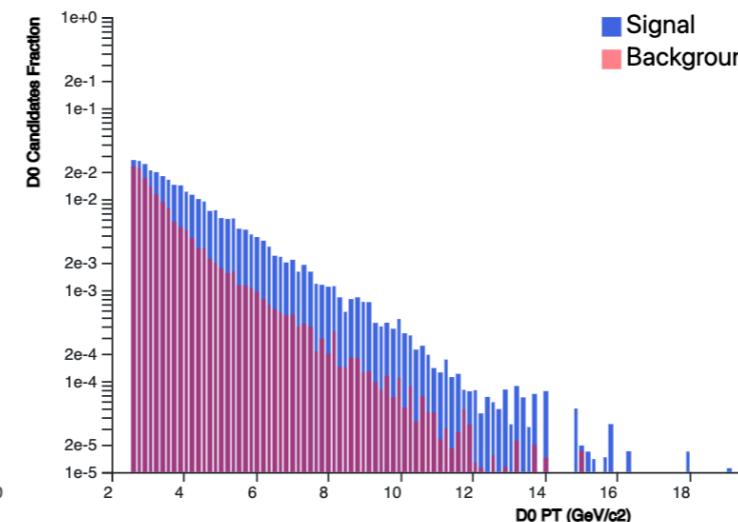


Time fit

Fit result

(ps) 0.0039
0.424

Save result



Cut on impact parameter

v0.1

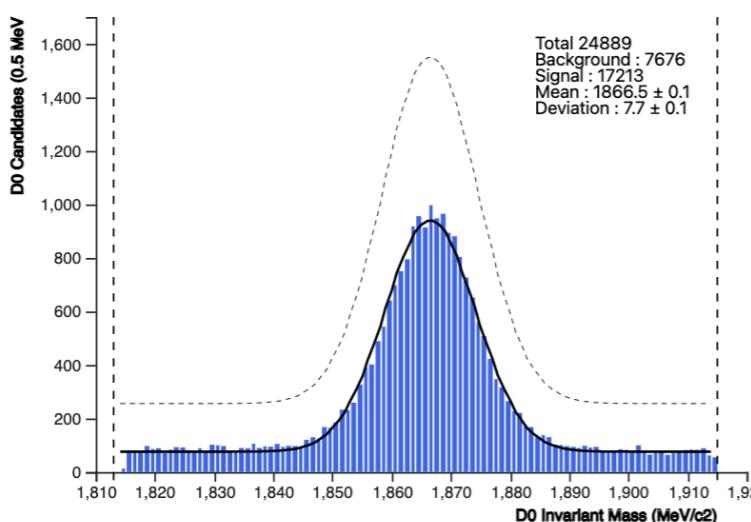
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D⁰ Lifetime Exercise

4) CUT ON DISCRIMINATING VARIABLES AND FIT FOR LIFETIME

Analysis tools

- Plot D⁰ mass
- Fit mass distribution

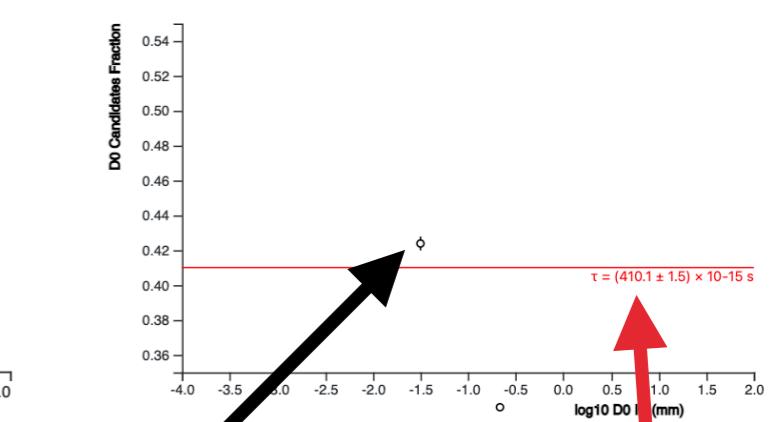
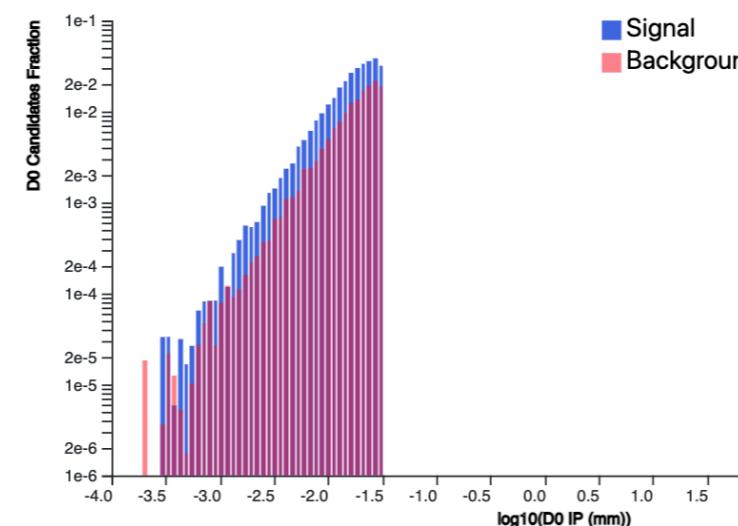
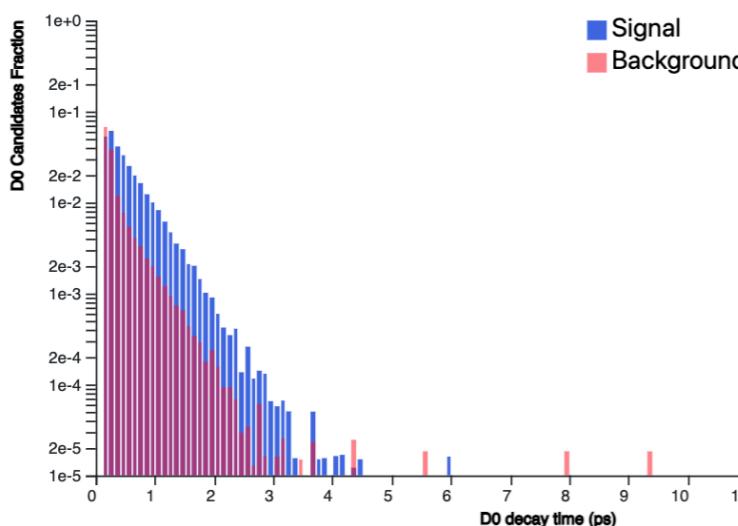
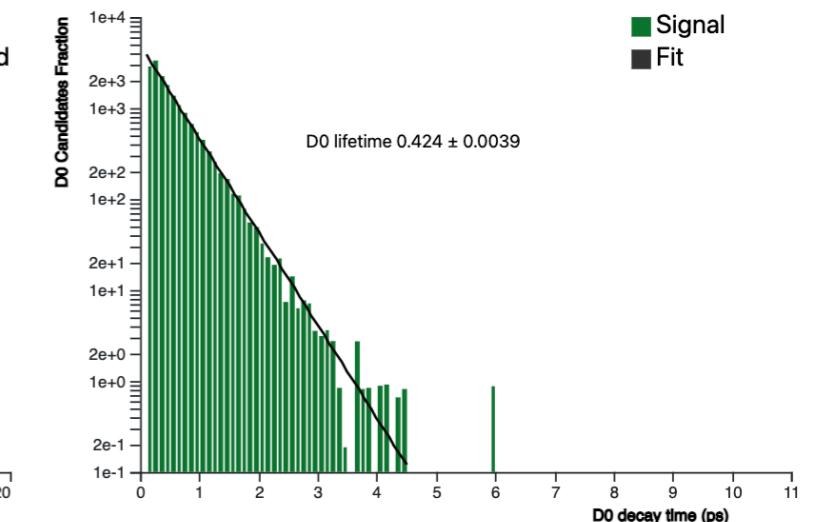
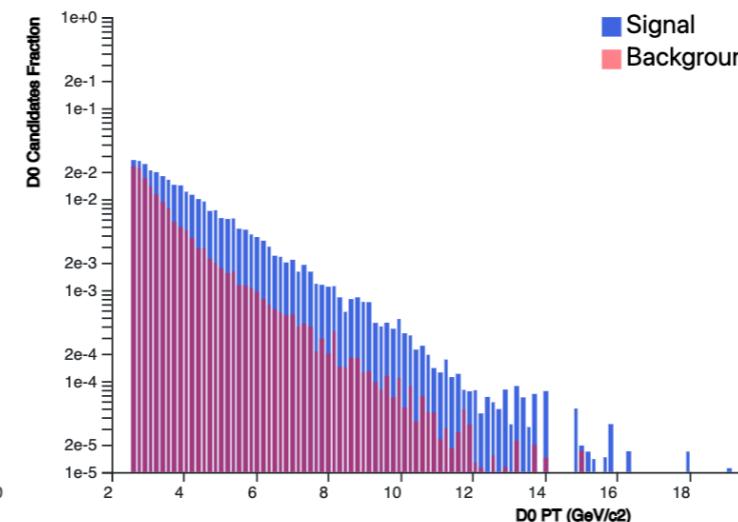


Background substr.

Signal range

1813 1915

Plot distributions



Variable range

D⁰ PT
2.5 20

D⁰ TAU
0 10

D⁰ IP
-4 -1.5

Refresh

Time fit

Fit result Fit Error (ps)
0.424 0.0039

Save result

Time fit

Fit result Fit Error (ps)
0.424 0.0039

Save result

PDG value

THANKS!

