

Grading scheme for Experimental Problem

Experimental Problem - Measurement of D0 lifetime

Exercise 1: Visual search

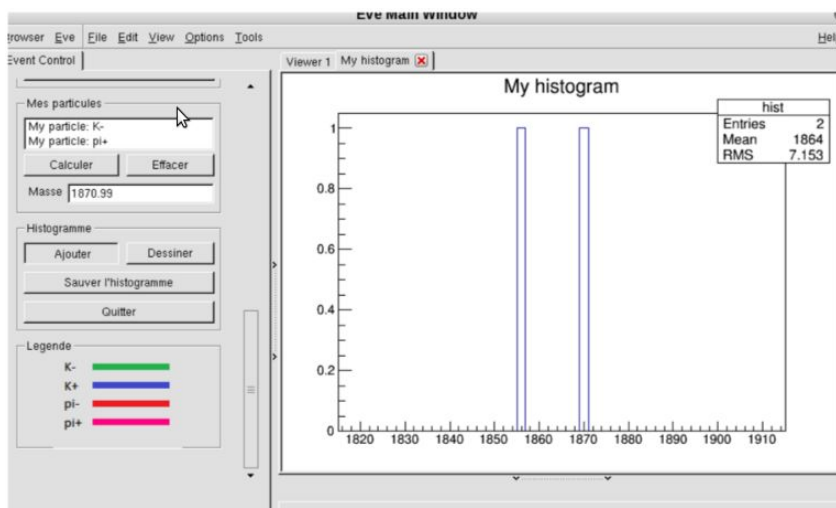
1.1 The table with the entries, maximum of points for all 30 events

2,1p

Evt. no	# D0 mass	# anti - D0 mass
x.1		
x.2		
x.3		
...		
...		

1.2 The histogram (an example below) and the ratio of #D0/# anti-D0

0,5 p

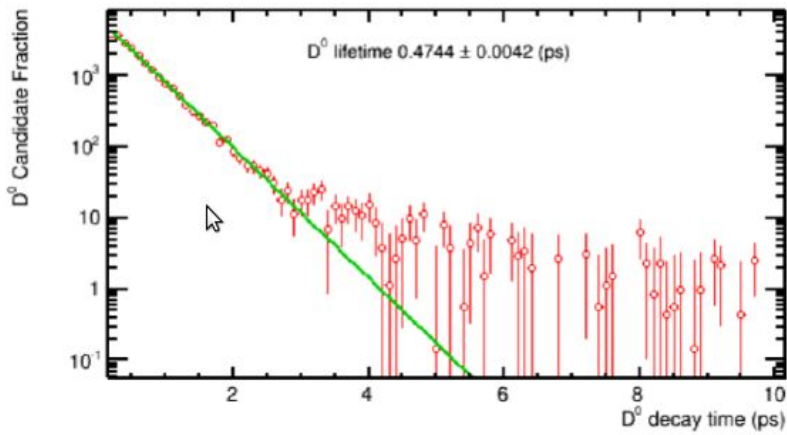


Exercise 2: Measure the lifetime of D0

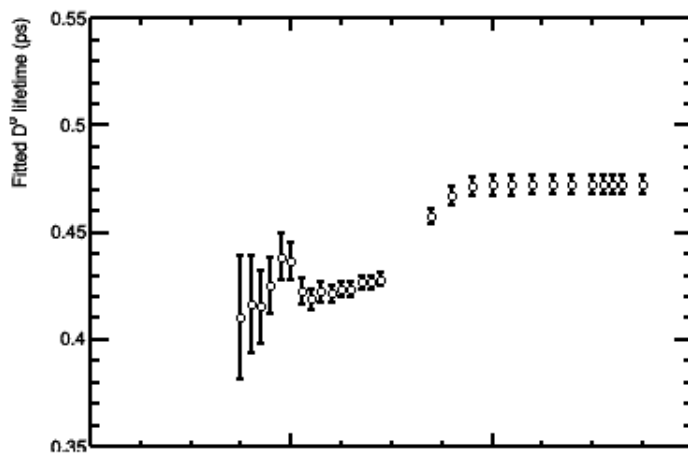
2.1 The central value for D0 mass 1866.6, the standard deviations 7.7
A Gaussian distribution contains 99.7% of its events within three standard deviations of the mean, so this "three σ " region around the mean is usually the definition of the signal region.

The range (1843.5, 1869.7) 1,5p

2.2 The value and the fit of the lifetime 0,5p

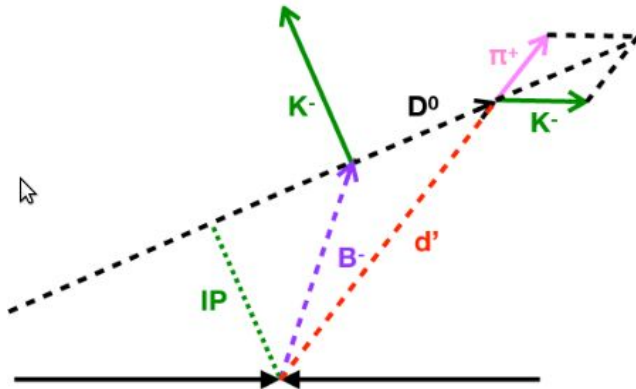


2.3 The plot with two levels 1 p



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2.4 Hypothesis of another signal coming from another particle with finite smaller lifetime. In this case the B^0 mesons. Explaining the possibility of an intermediate decay **1 p**



2.5 The working region for nominal value, of the D^0 lifetime, should be a plateau or a minimum. The uncertainty of the lifetime by variations around the nominal value should be comparable with the statistical uncertainty for the nominal value. **1 p**

2.6 For the IP variable the nominal value should be on the lower plateau in the range $(-1.7, -1.1)$

1,5p

2.7 The measurements for the D^0 TAU variable with values similar with the ones below **1 p**

	D0 TAU	t (lifetime)	error (statistical)
1	0,15	0,4268	0,003
2	0,2	0,4212	0,003
3	0,25	0,4195	0,0032
4	0,3	0,4159	0,0032
...	0,35	0,416	0,0034
	0,4	0,4122	0,0036

2.8 The measurements for the D^0 PT variable with values similar with the ones below **1 p**

	D0 PT	t (lifetime)	error (statistical)
1	2,5	0,4122	0,0036
2	3	0,4109	0,0041
3	3,5	0,4056	0,0045
4	4	0,3983	0,005
...	4,5	0,4015	0,0061

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2.9 The quotation of the D0 lifetime and the ranges studied before for D0 IP, D0 TAU and D0 PT

0,5 p

Exercise 3: Systematic errors

3.1 Identify the availability of four variables for which the study can be made, D0 IP, D0 TAU, D0 PT and D0 Mass. For each variable it is repeated the same study of finding the uncertainty associated with choosing the allowed range and the working point.

For the value of the uncertainty use a formula similar to the one below

Let x_0 = nominal point

$$s_{IP} = \sqrt{((x_1 - x_0)^2 + (x_2 - x_0)^2 + \dots + (x_n - x_0)^2)/n}$$

$s_{D0\ IP} =$ **1,6 p**

$s_{D0\ TAU} =$ **1,6 p**

$s_{D0\ PT} =$ **1,6 p**

$s_{D0\ M} =$ **1,6 p**

3.2 The quotation of the D0 lifetime with (1) statistical uncertainty, (2) systematic uncertainty for D0 IP (3) D0 TAU (4) D0 PT (5) D0 M **1 p**

3.3 Order the uncertainty sources and comment on them **1 p**
