



Charm-Beauty Separation in D meson final states

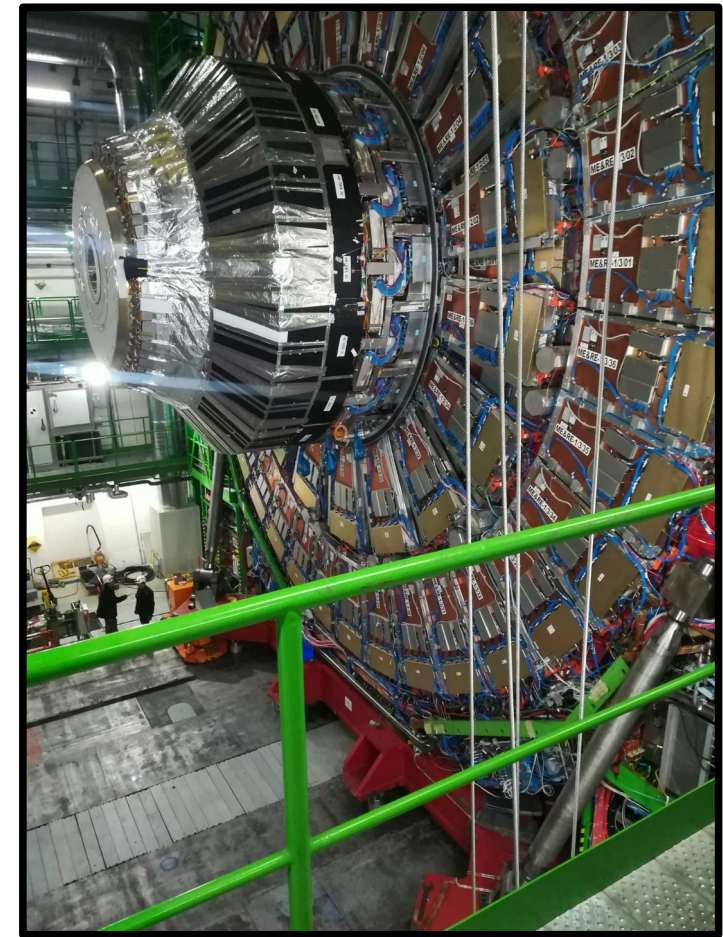
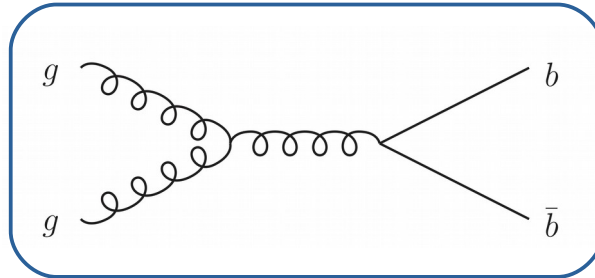
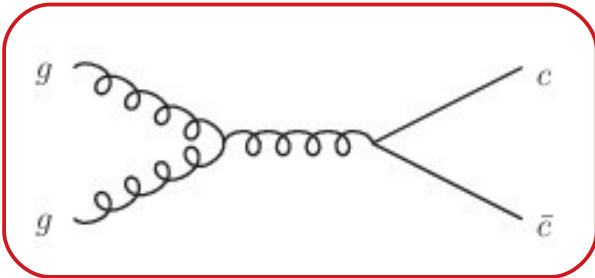


Josry Metwally - Hamburg, 06.12.2019



Reminder to my PhD project

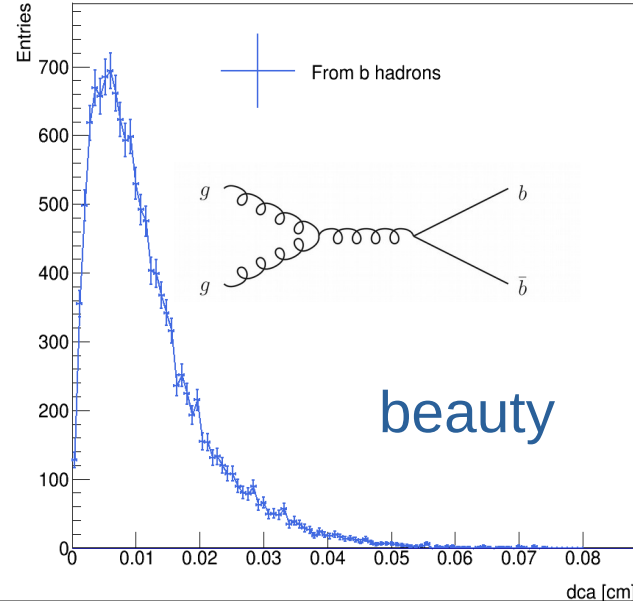
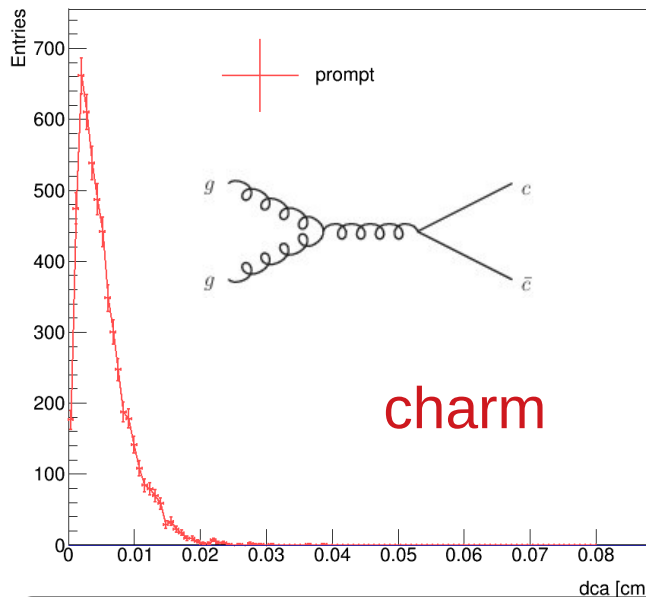
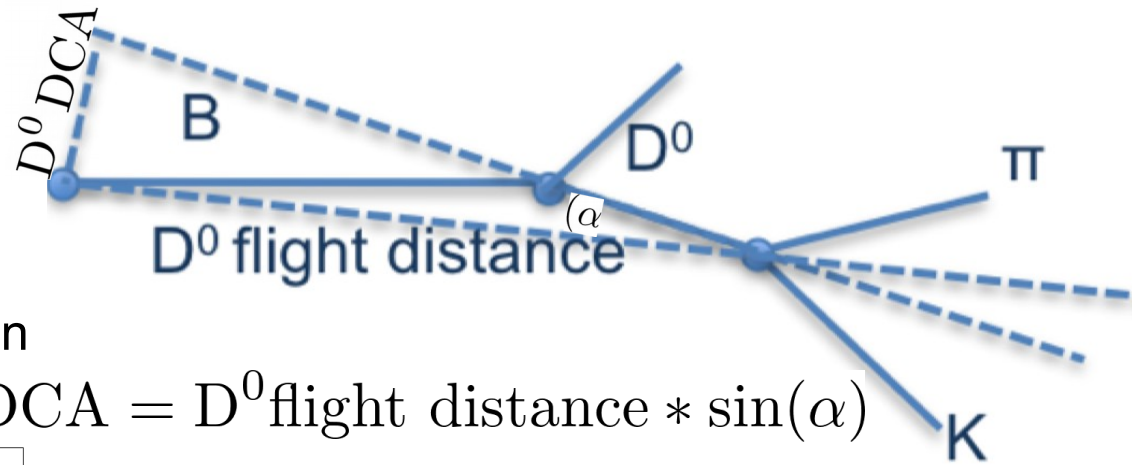
- Last months worked for the Alignment (got my EPRs)
- Measure total **beauty** cross sections at different center of mass energies 0.9, 2.76, 5, 7, 8, and 13 TeV, without theory extrapolation for the first time in →
- Measure cross sections in full phase space of D mesons **from b hadron decays** in small bins in p_T and $|Y|$ and integrate



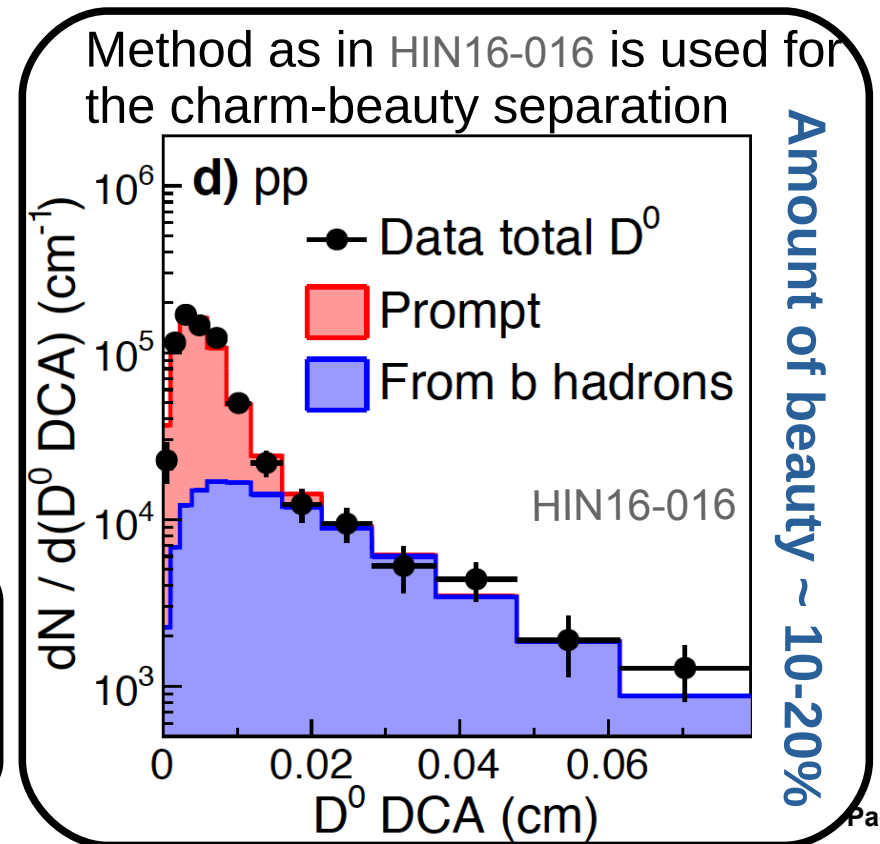
- **Challenge:** Separation of D mesons (**prompt** and **from b hadrons decays**) near the production threshold

Charm-Beauty Separation

- Trained with a MC (**prompt** and **non-prompt** D^0) how to distinguish statistical between **charm** and **beauty**
- Created Distance of Closest Approach (DCA) distribution



- Shapes are different and can be used to fit
- Used **MC15_PrmtD0pT0** & **MC15_NonPrD0pT0** (details in Backup)
- Trained with pseudodata (no background) → next slide



Charm-Beauty Separation

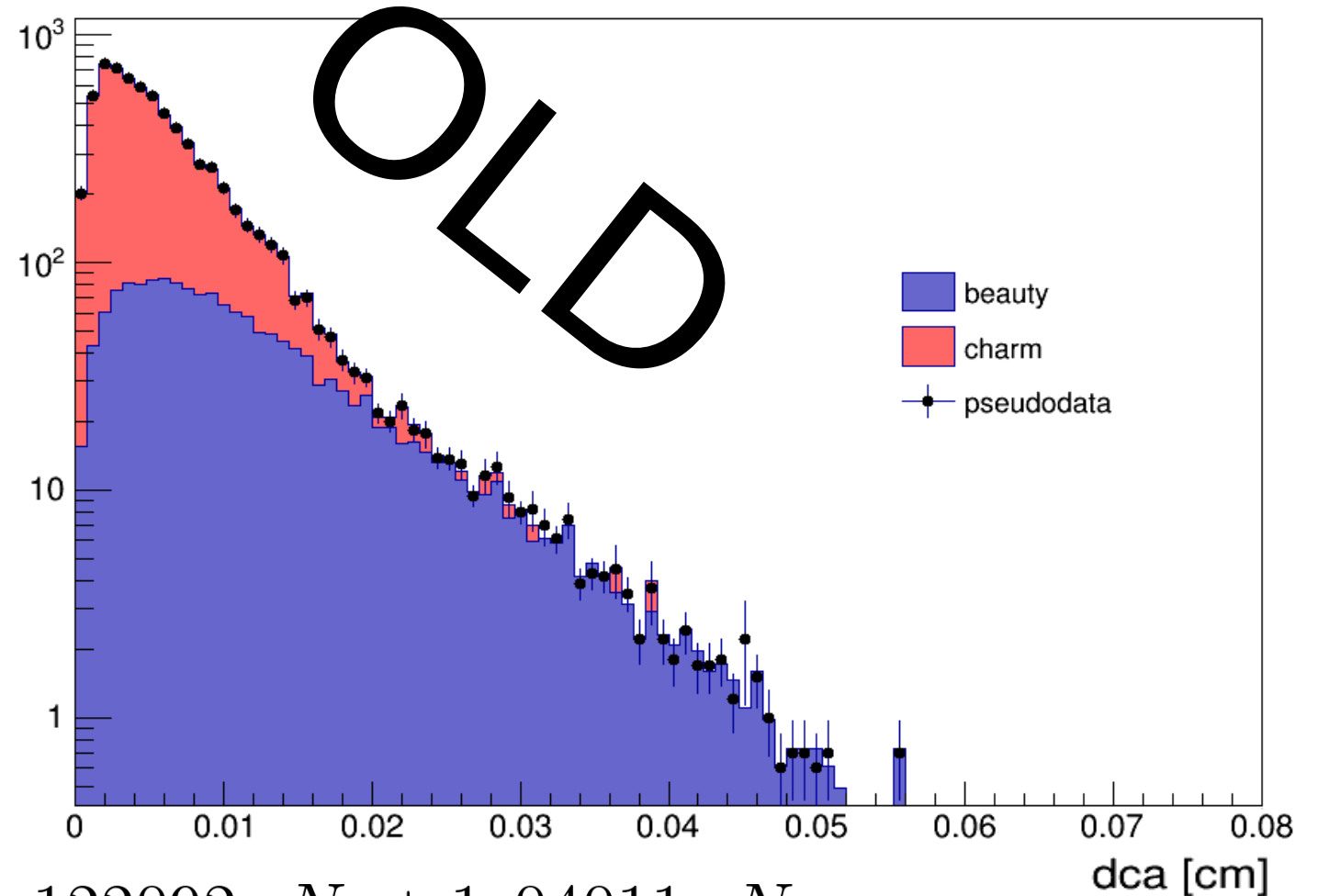
Past: Used *TFractionFitter* → different fractions (charm/beauty) can be extracted
It uses only 1 parameter (fraction) to fit

Train with pseudodata (MC):

- $frac_c \rightarrow 0,774705$
- $frac_b \rightarrow 0,225291$
- $N_c = 5335$
- $N_b = 13217$
- $N_{psd} = 7162,7$

$$N_{psd} = a_b \cdot N_b + a_c \cdot N_c = 0,122092 \cdot N_b + 1,04011 \cdot N_c$$

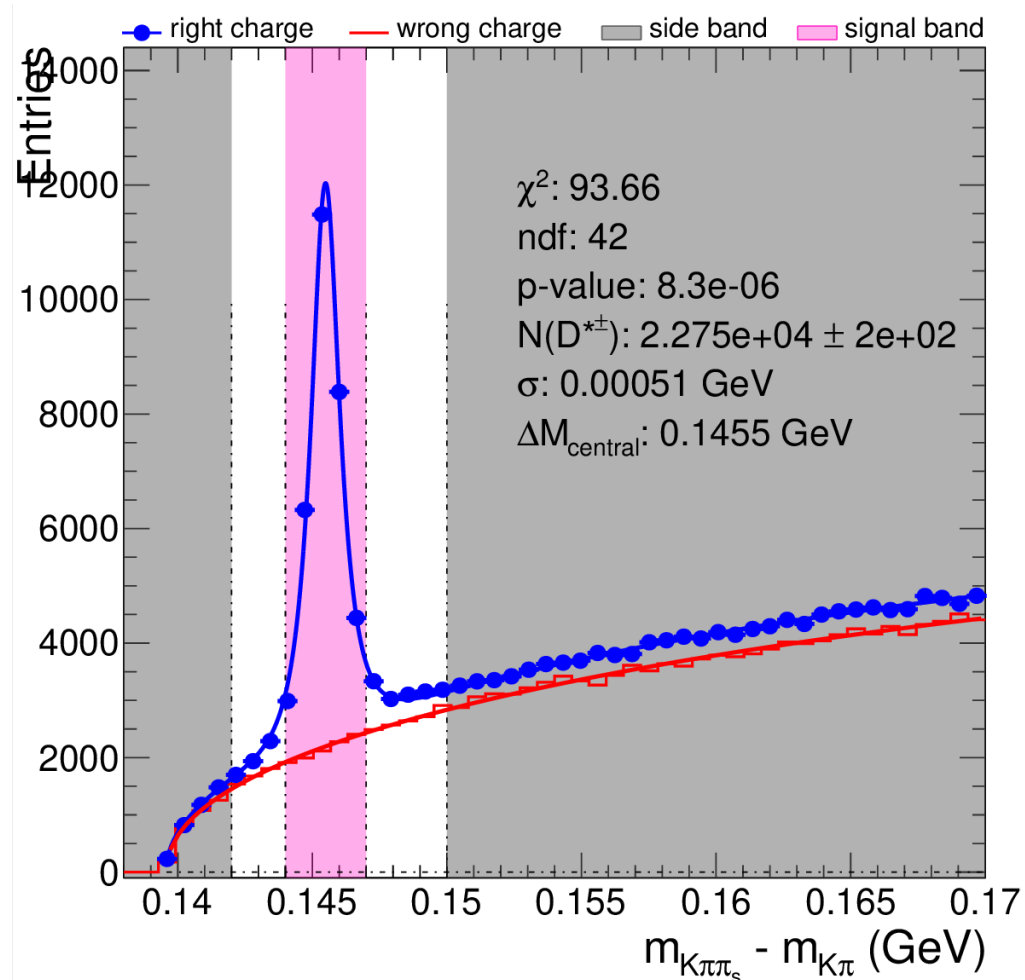
- The input contribution of beauty of 23% is **recovered** by the fit



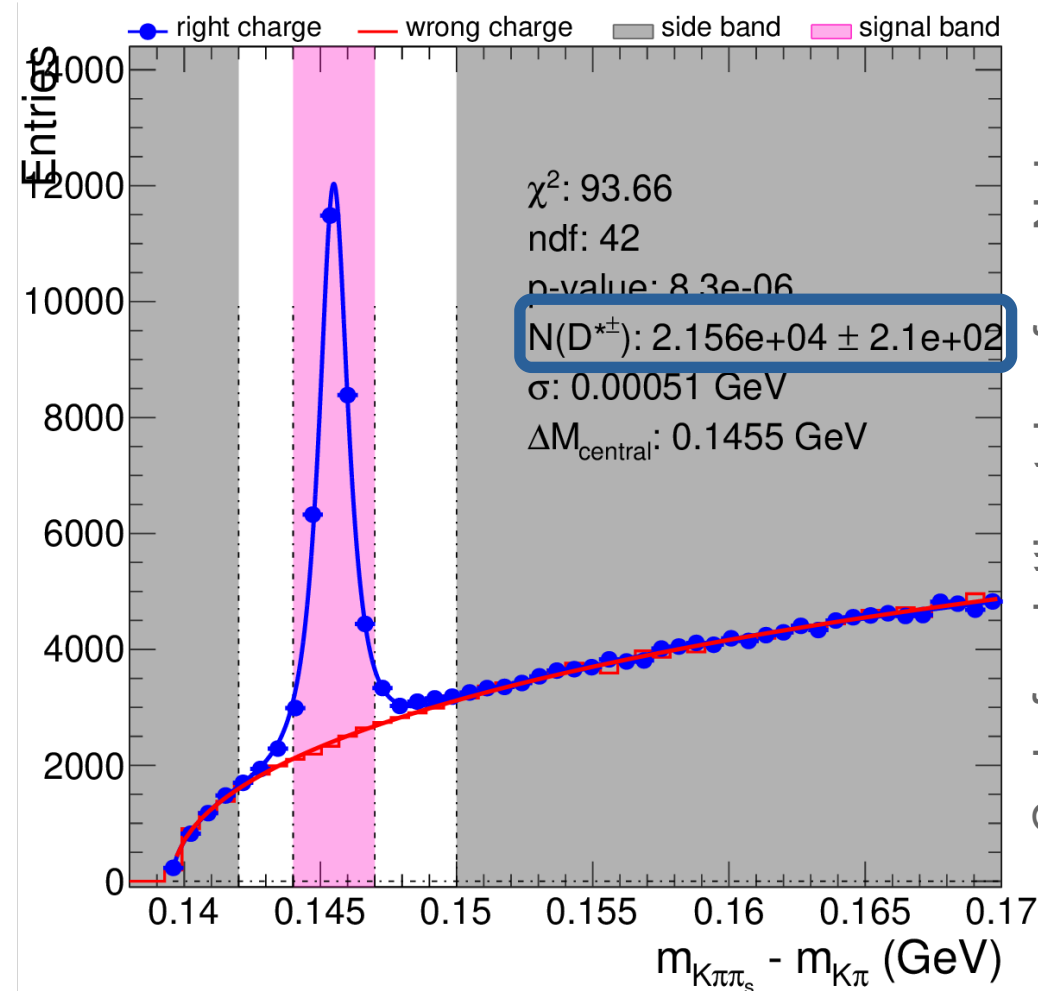
First touch on real data

- Now data and MC, not only MC
→ we have to take care about the background
- Measure $D^* \rightarrow D^0 \pi$
- The shown distributions have the cuts: $p_T > 3,5 \text{ GeV}, |Y| < 1$

Background subtraction



Code for plotting taken from Nuha



Code for plotting taken from Nuha

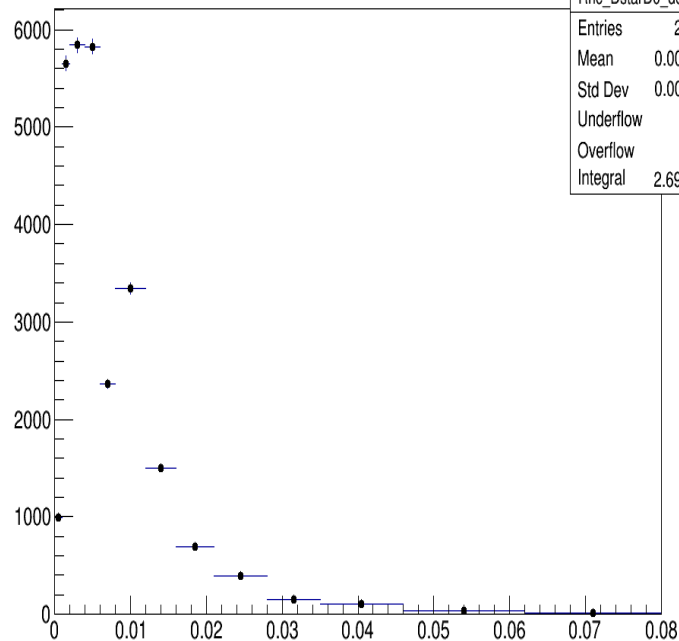
- Used 5 TeV 2015 Data
- We need to subtract the background in the signal region
- Normalize red to the blue (in grey area) leads to an scale factor of $SF = 1,09983$ in the signal region (pink)

The dca-data distributions

right sign

hc_DstarD0_dcahptr

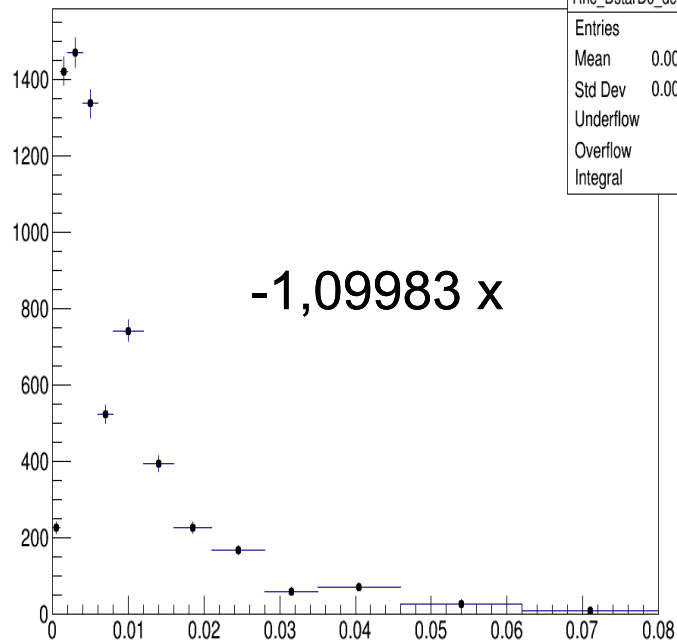
Rhc_DstarD0_dcahptr	
Entries	26902
Mean	0.005993
Std Dev	0.005809
Underflow	0
Overflow	1
Integral	2.69e+04



wrong sign

hc_DstarD0_dcahptw

Rhc_DstarD0_dcahptw	
Entries	6690
Mean	0.006808
Std Dev	0.007726
Underflow	0
Overflow	2
Integral	6688



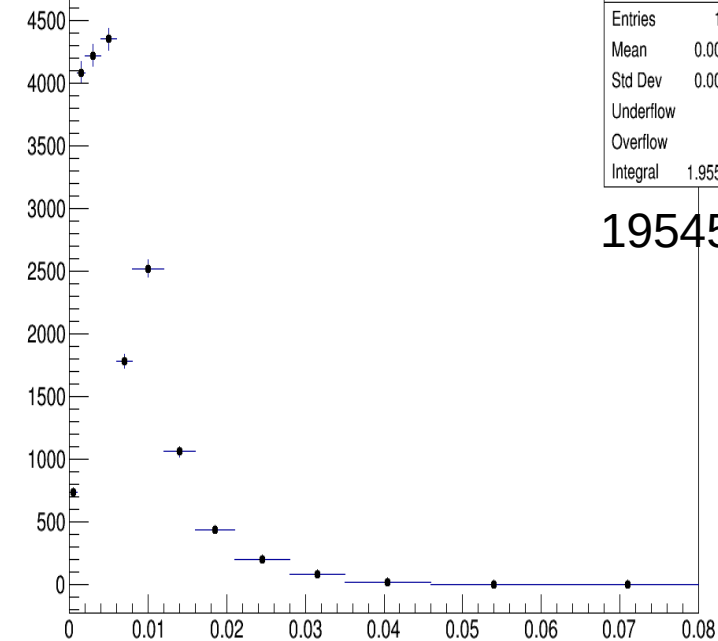
-1,09983 x

=

signal

dcahpt_r-w_data

dcahpt_r-w_data	
Entries	10918
Mean	0.005669
Std Dev	0.005038
Underflow	0
Overflow	-1.2
Integral	1.955e+04



19545.3

Charm-Beauty Separation

- **Now:** Fitting MC distribution to the data with Root function TFit using:
 $a \cdot \text{charm} + b \cdot \text{beauty} = \text{data}$

- Integral of input MC Charm is: $N_c = 4608$
 Fit parameter of Charm is: $a = 3.88432$
 Error of Fit parameter of Charm is: 0.04966

- Integral of input MC Beauty is: $N_b = 11797$
 Fit parameter of Beauty is: 0.128904
 Error of Fit parameter of Beauty is: 0.014046

→ Fraction of charm is 0,921694

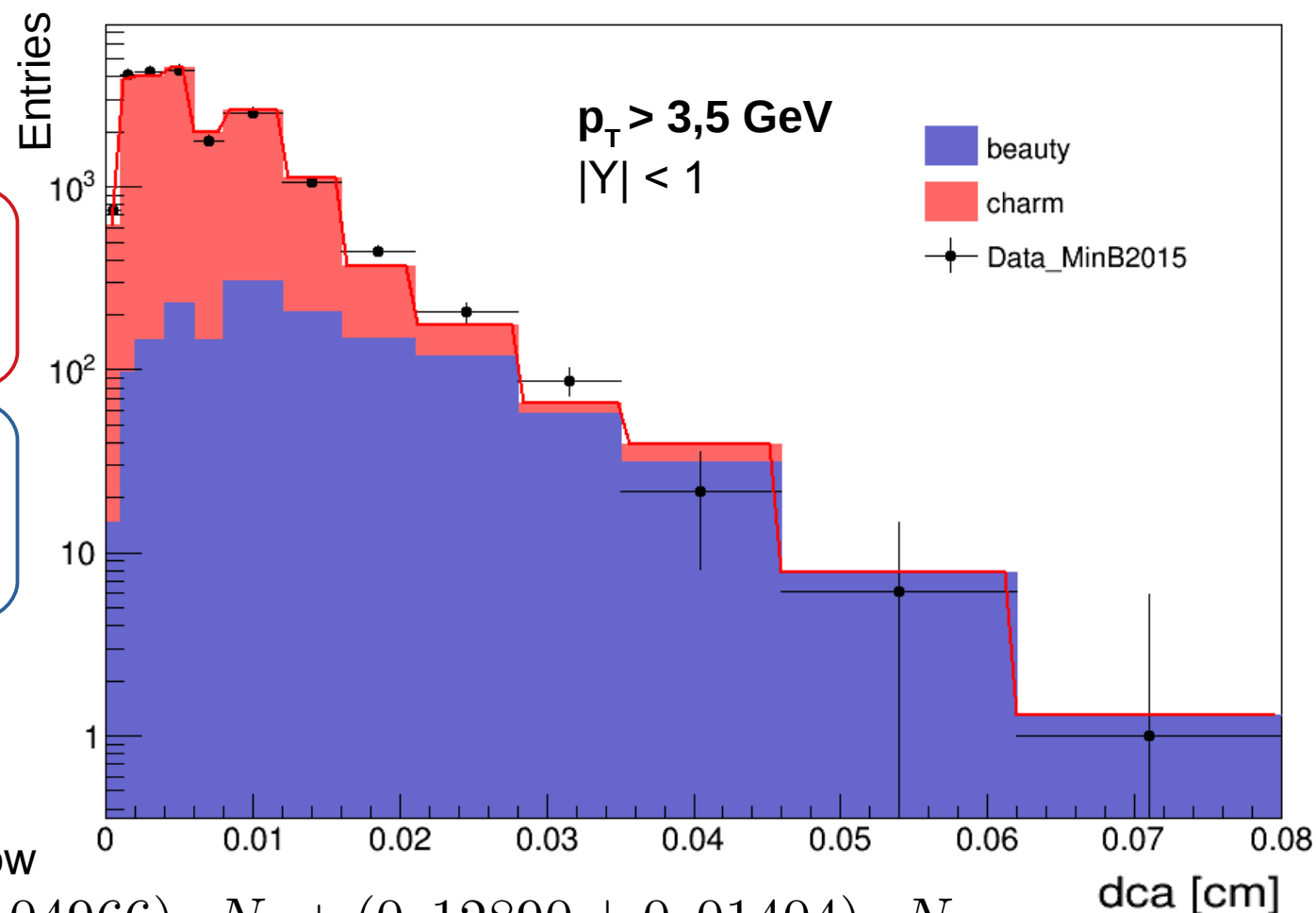
→ Fraction of beauty is 0,0783063

- Next time with our new charm/beauty MC already available but ntuples are not ready now

$$N_{data} = a \cdot N_c + b \cdot N_b = (3,88432 \pm 0,04966) \cdot N_c + (0,12890 \pm 0,01404) \cdot N_b$$

$$= a \cdot 4608 + b \cdot 11797 = (17899 \pm 229) + (1521 \pm 166) = 19419 \pm 281 \approx 19545$$

Used MC have a rapidity cut <1
 dca of beauty and charm in D^*D^0



charm-beauty separation is under control

**Thank you for
your attention**

Backup

- Trained with a MC (**prompt** and **non-prompt** D^0) how to distinguish statistical between **charm** and **beauty**
- Created Distance of Closest Approach (DCA) distribution (HIN16-016) , Used: MC15_PrmtD0pT0 and MC15_NonPrD0pT0
- **MC15_PrmtD0pT0**: /PrmtD0_pThat-0_pT-0_pp_5p02-Pythia8/HINppWinter16DR-75X_mcRun2_asymptotic_ppAt5TeV_v3-v1/AODSIM, 1347186 events
- **MC15_NonPrD0pT0**: /NonPrD0_pThat-0_pT-0_pp_5p02-Pythia8/HINppWinter16DR-75X_mcRun2_asymptotic_ppAt5TeV_v3-v1/AODSIM, 1942712 events
- Latest code: NanoAnalyzer.cc.Dimu3, NanoTrigger.cc.forinclude.RunBEG