

Measurement of the LHCb trigger efficiency for hadronic CEP data and search for X

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A little bit about LHCb

What is LHCb

-It's a detector system at p-p collision point focused CP violation on heavy quarks.

-Not as famous as ATLAS and CMS, but capable of very interesting physics.



A little bit about my supervisors

My supervisors

-Paula Collins

LHCb VELO group -Kazuyoshi Akiba

-Heinrich Schindler

My project

-To help testbeam time

-Analysis on “X” project

What is CEP?

CEP=Central Exclusive Production

P-P scattering produces a particle –NOT collision

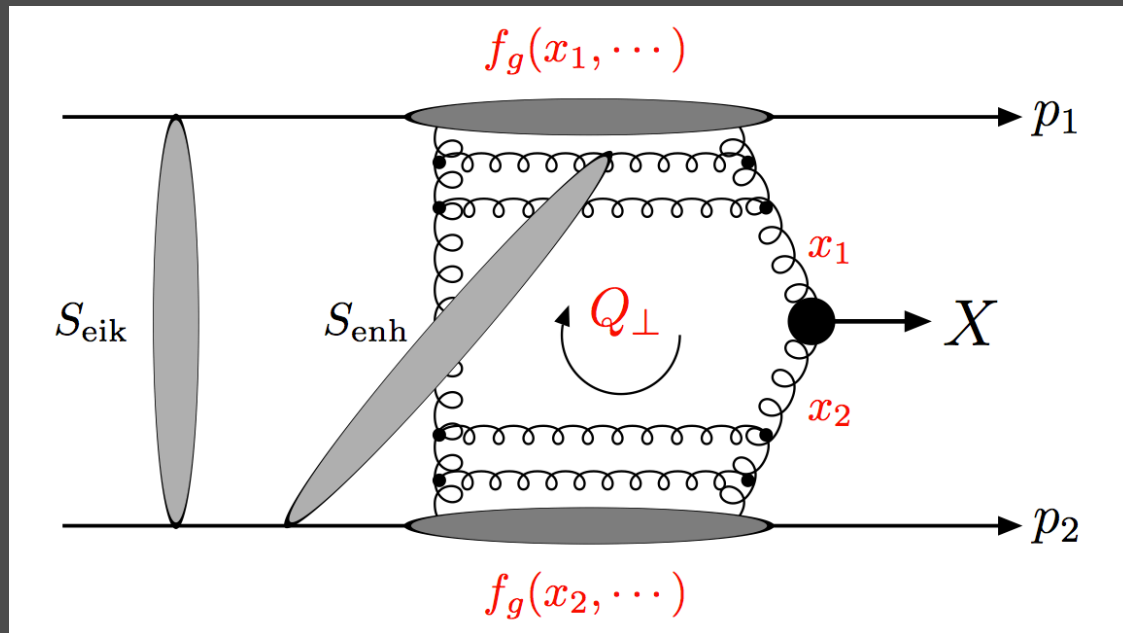


Image from [hep-ph:arXiv:1204:4803]

The Problem is ...

We have to modify the trigger to focus on CEP events,
Especially for D mesons.

-It was done during the Technical Stop.

My job is ...

-To measure the efficiency of new trigger

-To compare the new trigger with the previous one

The Key quantity is ...

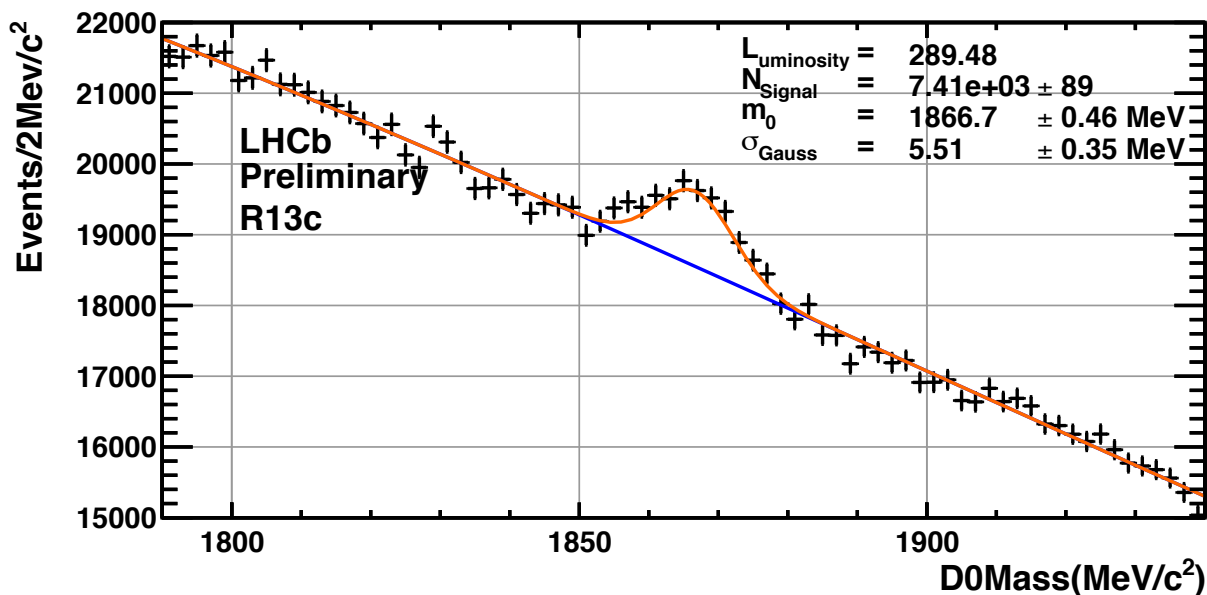
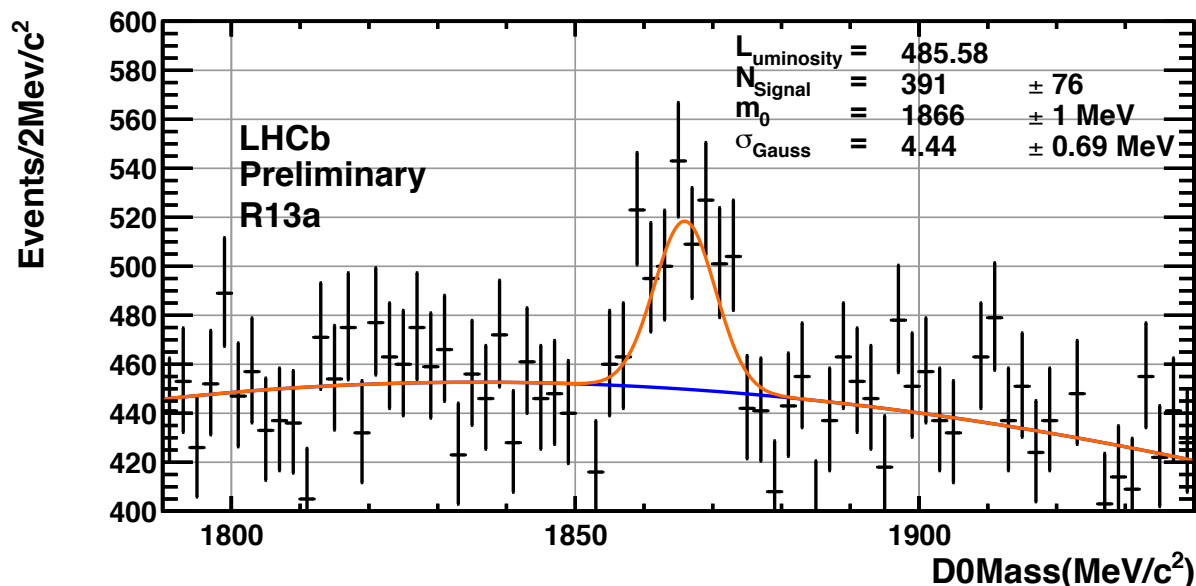
-The production rate of each particles

Rate= produced particles/integrated luminosity[pbarn^{-1}]

Test of New Trigger Do from CEP events

Compare production rate of D0 per picobarn⁻¹

Previous Trigger
 $0.805 \pm 0.157 / \text{pb}^{-1}$



Fit with Gauss
+ 1st Chebychev

New Trigger
 $25.6 \pm 0.31 / \text{pb}^{-1}$

Results in a table

		Normalized Production Rate to R13a	
R12 2011	D0	1.22 ±	0.164
	Dplus	1.49 ±	0.245
	Dstar	0.932 ±	0.082
	J/Psi	1.19 ±	0.004
	Phi2S	1.12 ±	0.031
		Normalized Rate	
R13 2012	D0	1.60 ±	0.589
	Dplus	1.47 ±	0.755
	Dstar	0.831 ±	0.271
		Normalized Rate	
R13a 2012	D0	1 ±	0.195
	Dplus	1 ±	0.267
	Dstar	1 ±	0.125
	J/Psi	1 ±	0.004
	Phi2S	1 ±	0.055
-----Technical Stop & Introduction of New Trigger-----			
		Normalized Rate	
R13c 2012 Data with New Trigger	D0	31.8 ±	0.39
	Dplus	33.6 ±	5.34
	Dstar	12.6 ±	0.61
	J/Psi	0.970 ±	0.005
	Phi2S	1.05 ±	0.063

← Relatively better results,
Probably because of RICH
calibration

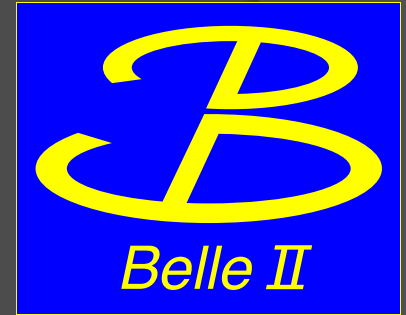
← Normalized to this data

← Huge effects on D mesons
← Muon channels stay the same

Search for $X(3872)$

What is $X(3872)$?

- It's a particle found at Belle in Japan first.
- It's now on $c\bar{c}$ section on PDG.



Nobody knows what “X” truly is.

Even quantum numbers are yet to be measured.

- Some predictions say it's a molecular state of DD .

How we search the particle?

- “Invariant Mass Spectroscopy” in CEP events
- Measuring the energy and momentum of daughter particles and reconstruct the invariant mass of the parental particle

Decay Mode of X

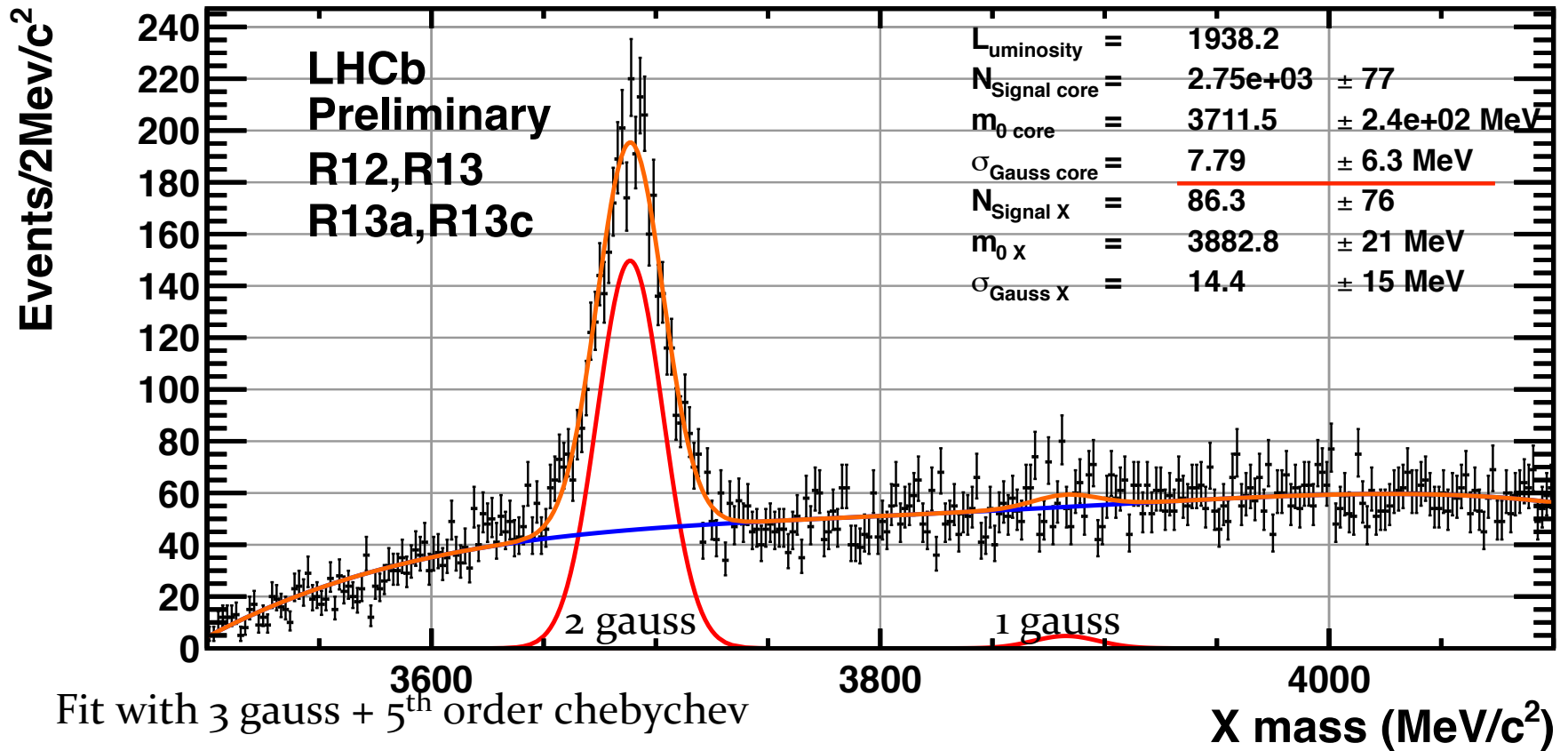
Check the PDG. –the bible of particle physicists

$X(3827) \rightarrow \pi^+ \pi^- J/\psi$ (>2.6%) ← Let's begin with this one
→ $\omega J/\psi$ (>1.9%)
→ ...other minor decays
→ ...

$J/\psi \rightarrow \mu^+ \mu^-$ (~5%) ← Let's begin with this
→ $e^+ e^-$ (~5%)

Let's take a look.

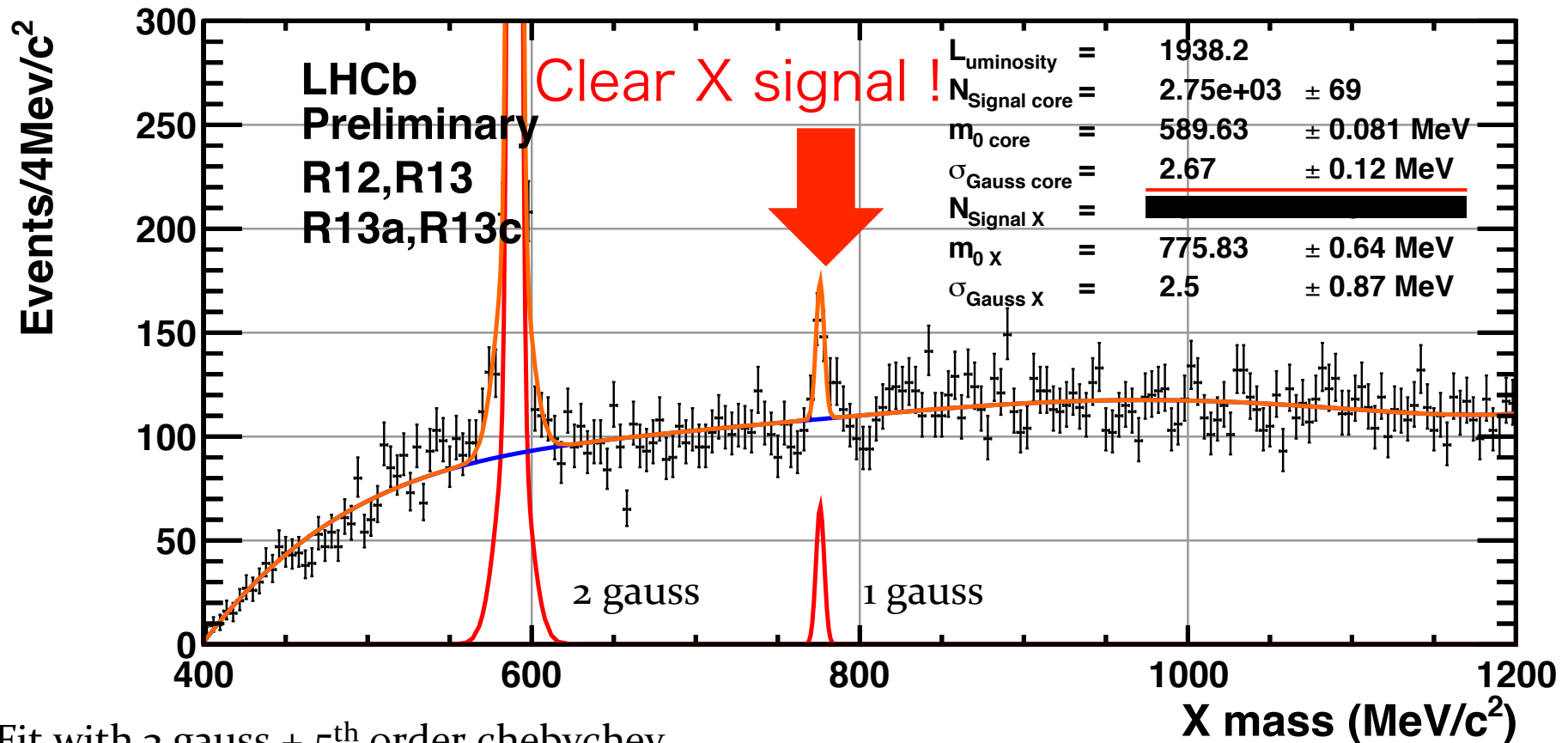
$X \rightarrow \pi^+ \pi^- J/\psi$ reconstructed data.



This is a peak from ψ' . (Width=7.79MeV)
-Perfect reference to optimize the fit&cut

Search for better cut conditions

- Using ψ' peak width as reference.
- The best results came from $M(J/\psi \pi^+ \pi^-) - M(J/\psi)$ with J/ψ Mass Constraint plot.
Width=2.67MeV



Thanks a lot to all of you!

