Energy dependence of total cross section of D*(2010) mesons on HERA colider

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- **Main goal** of this analysis is to measure energy dependence of D*(2010) mesons cross section production in electron-proton interaction for PHP.

- **Motivation**: it will be first investigation this results at HERA.

13 Jule 2012

Data samples, cuts

- **PHP selection:**

No good SINISTRA electron with E>5 GeV

and probability >0.9

$130 \text{ GeV} < W_{her} < 285 \text{ GeV}$

$100 \text{ GeV} < W_{mer} < 235 \text{ Gev}$

$85 \text{ GeV} < W_{ler} < 205 \text{ GeV}$

- **Trigger cuts:**

HFLO1 (charm hadrons in photoproduction)

HFMO1 (D* meson selection)

- **D* selection:**

$|\eta(D^*)| < 1.6$

$|\eta(K,\pi,\pi_s)| < 1.7$

$1.9 \text{ GeV} < Pt(D^*) < 20 \text{ GeV}$

$Pt(K,\pi) > 0.4 \text{ GeV}$

$Pt(\pi_s) > 0.12 \text{ GeV}$

$Pt/Et > 0.12$

$1{,}83 \text{ GeV} < m(D0) < 1.90 \text{ GeV}$

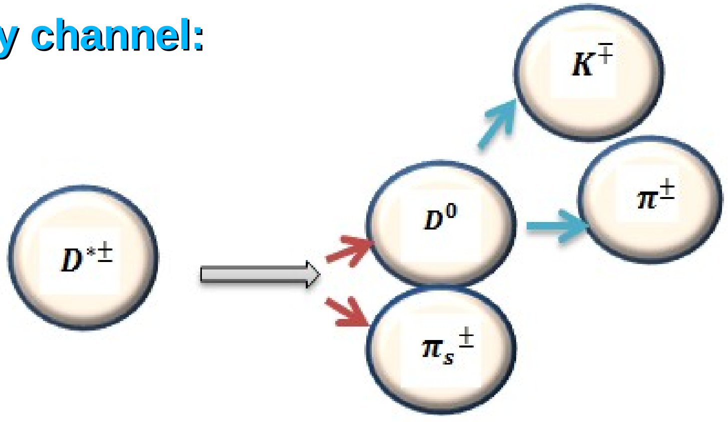
Data:

2006/07p Common Ntuples (v06a)-HER

Common Ntuples (v06a) - MER,LER

MC: 2006/07p Pythia Inclusive Charm in Photoproduction Monte Carlo Sample (v06b) - HER
2006/07p Pythia Inclusive Charm in Photoproduction Monte Carlo Sample with D filter (v05b) - MER,LER

decay channel:

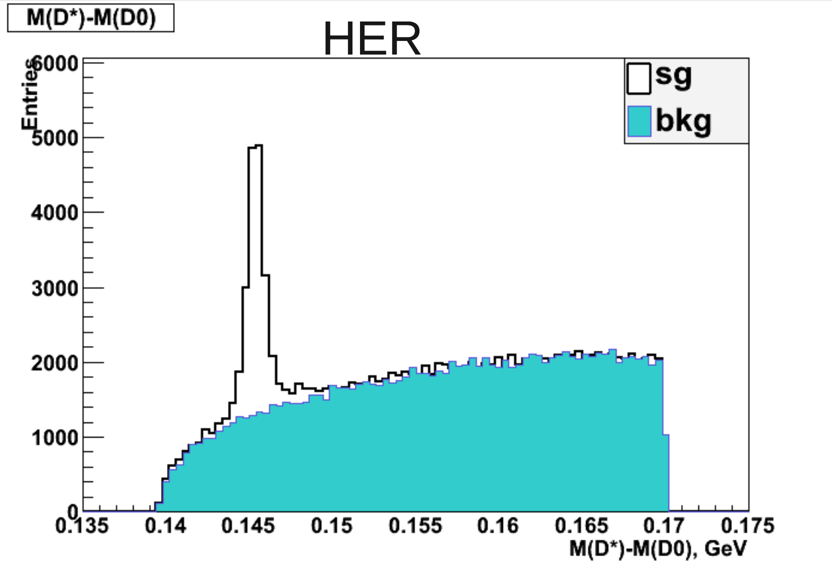


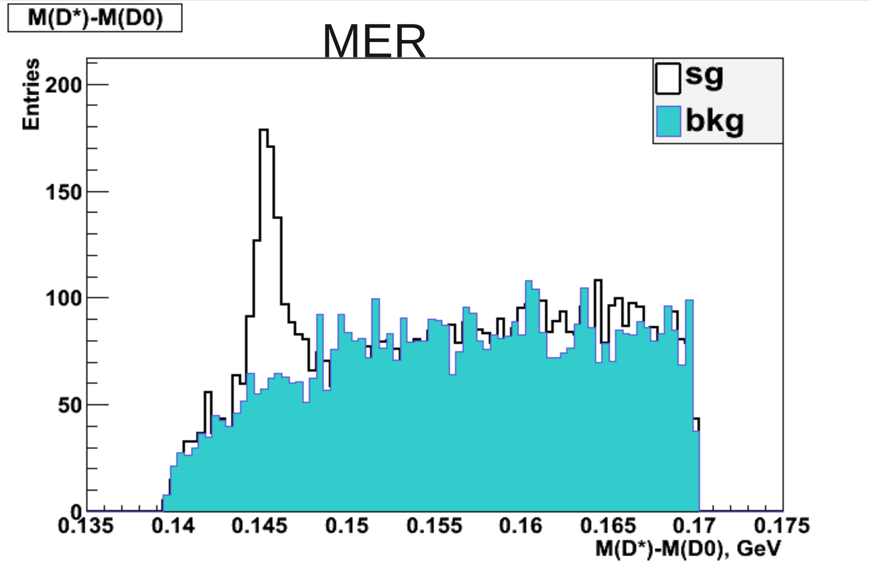
HER -high energy run 920 GeV

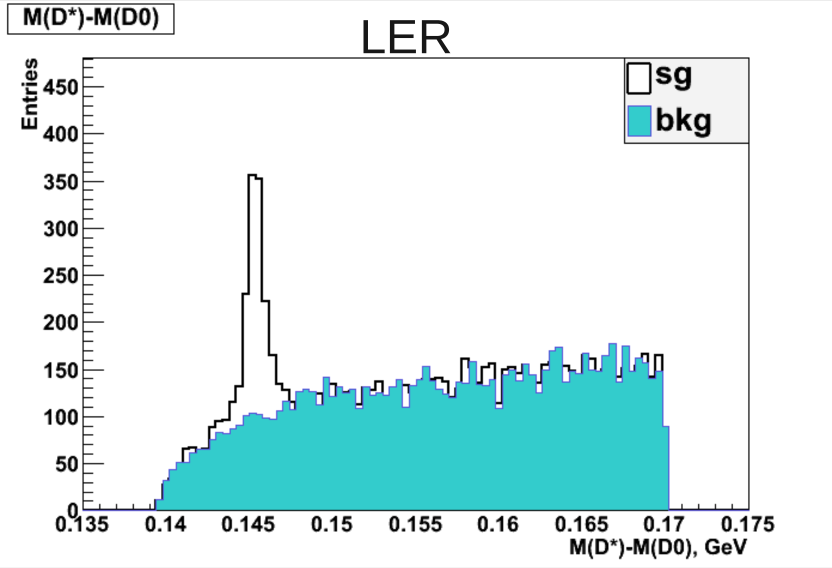
MER-middle energy run 575 GeV

LER-low energy run 460 GeV

Mass distribution and the number of D*mesons





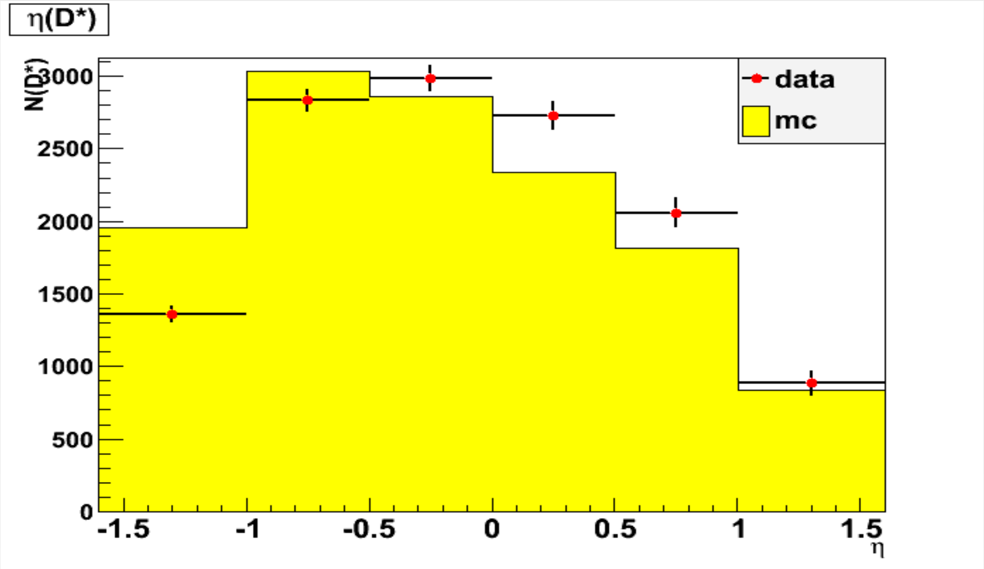


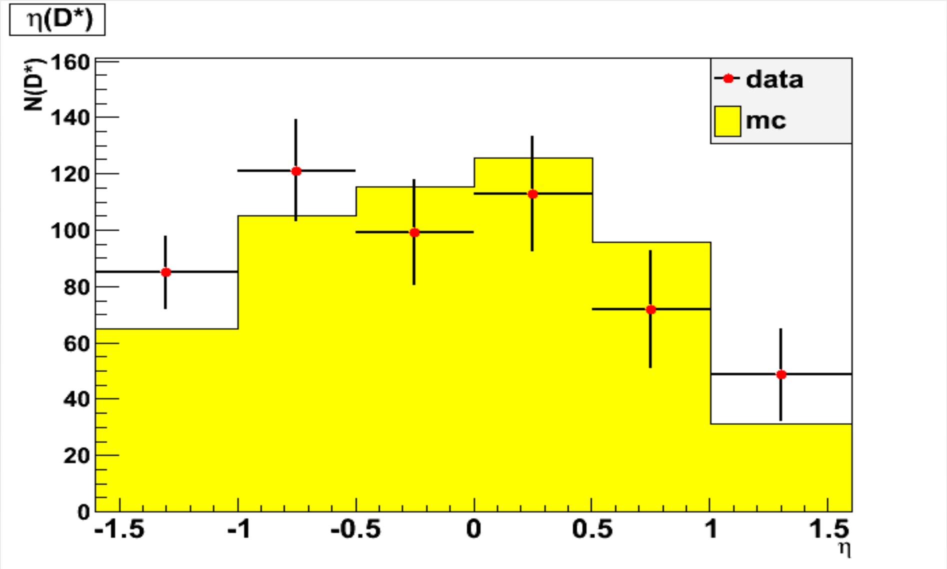
- Wrong-charge background subtraction metod

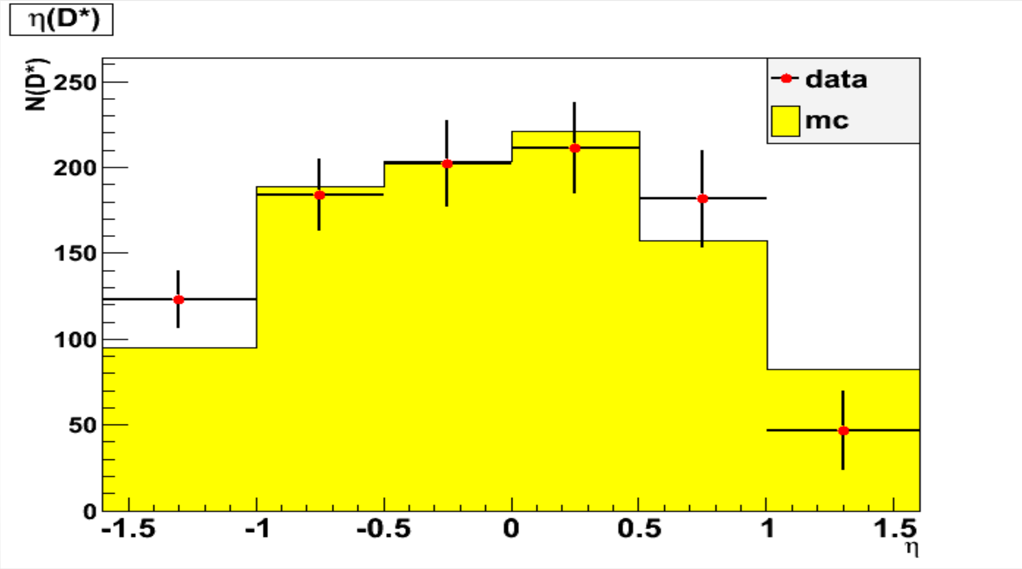
Table 1 : Number of D* mesons

N (D*)	DATA	MC
HER	12850 +- 212	13783 +- 140
MER	538 +- 44	417+- 23
LER	948 +- 58	461 +- 24

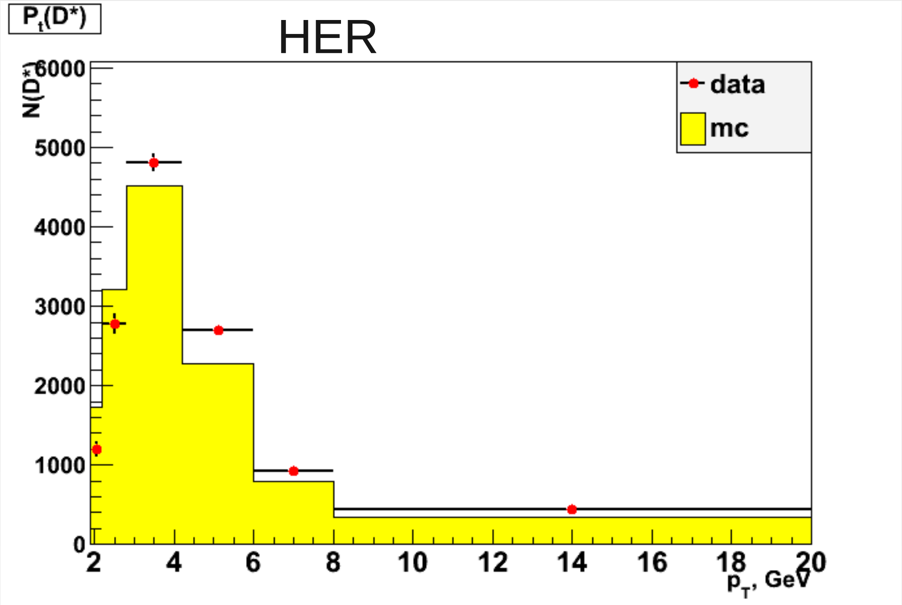
Control plots in η(D*) bins

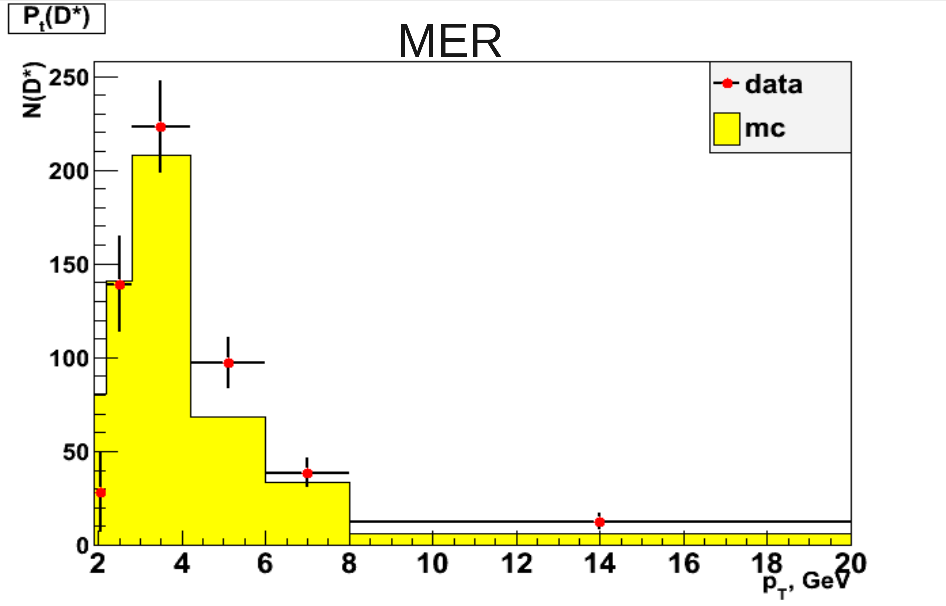


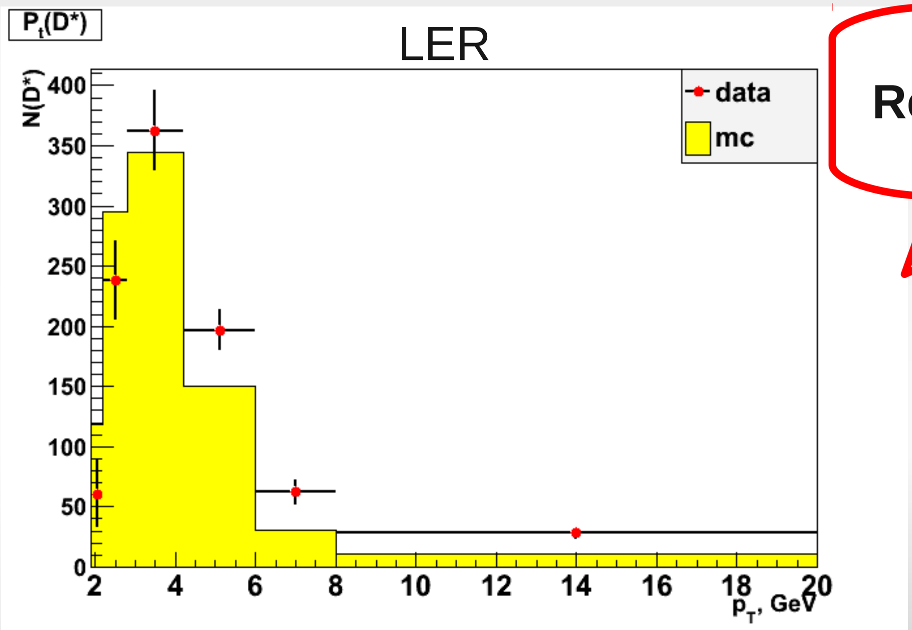




Control plots in pT(D*) bins







Reasonable agreement

Mass distribution and the number of D*mesons for v06a and v07a versions

Data: v07a & v06a

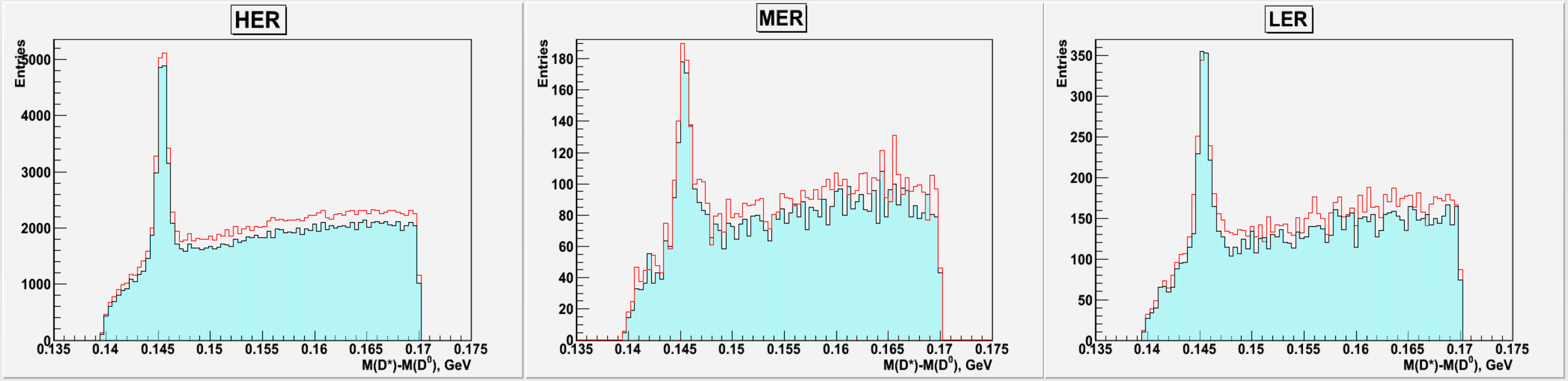


Table 1 : Number of D* mesons

N (D*)	**v06a**	**v07b**
HER	12850 +- 212	13513 +- 221
MER	538 +- 44	562 +- 46
LER	948 +- 58	953 +- 61

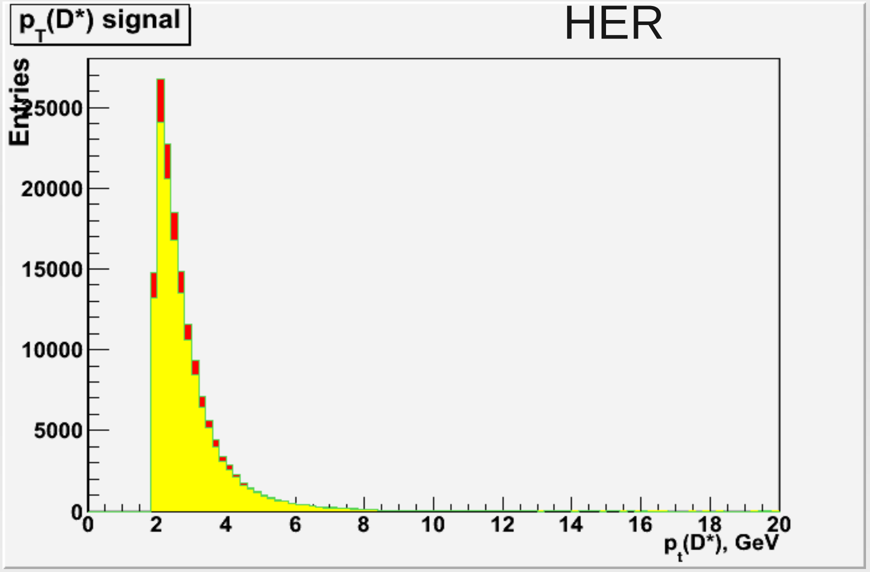
🟦 - v06a

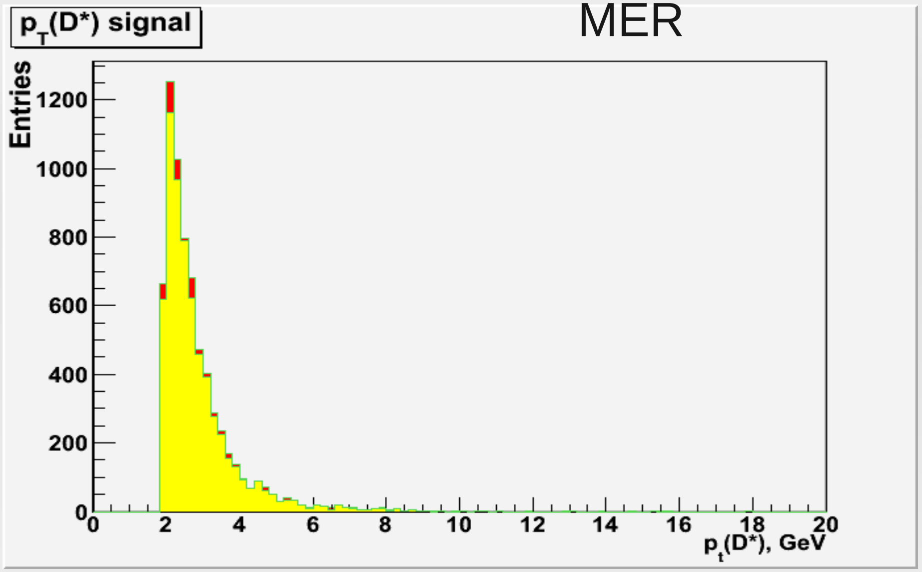
— - v07a

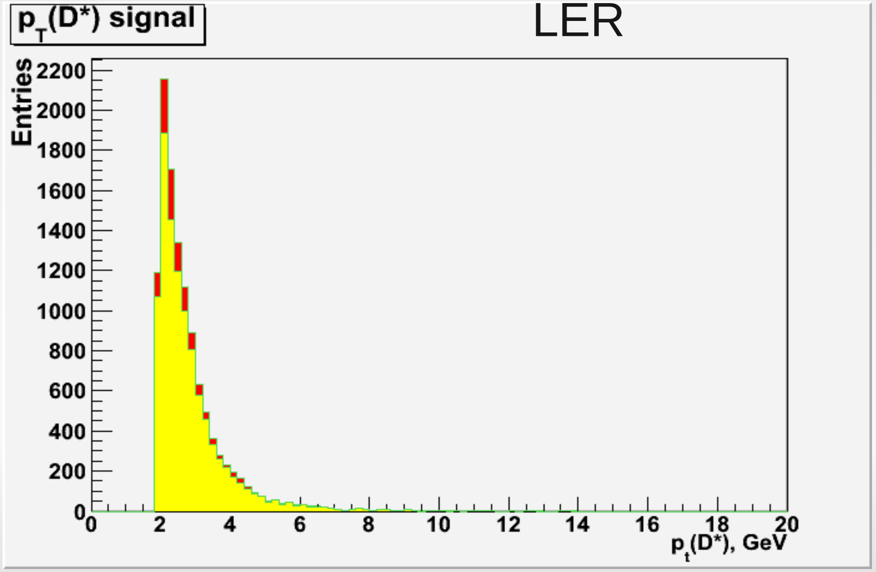
New version Common Ntuple has larger statistics : ≈ **4 %** for MER
≈ **0.5 %** for LER ;
≈ **5%** for HER;

Distributions of kinematic variables

Pt(D*)



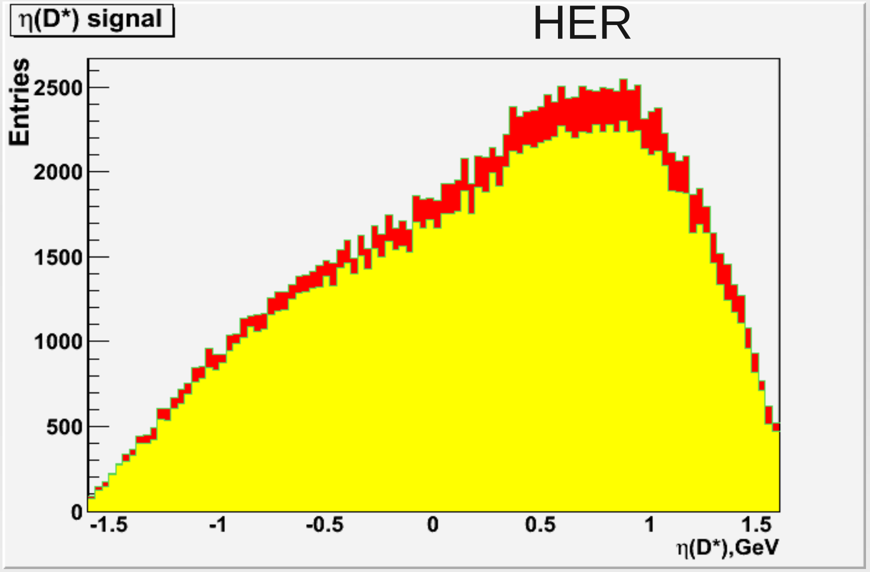


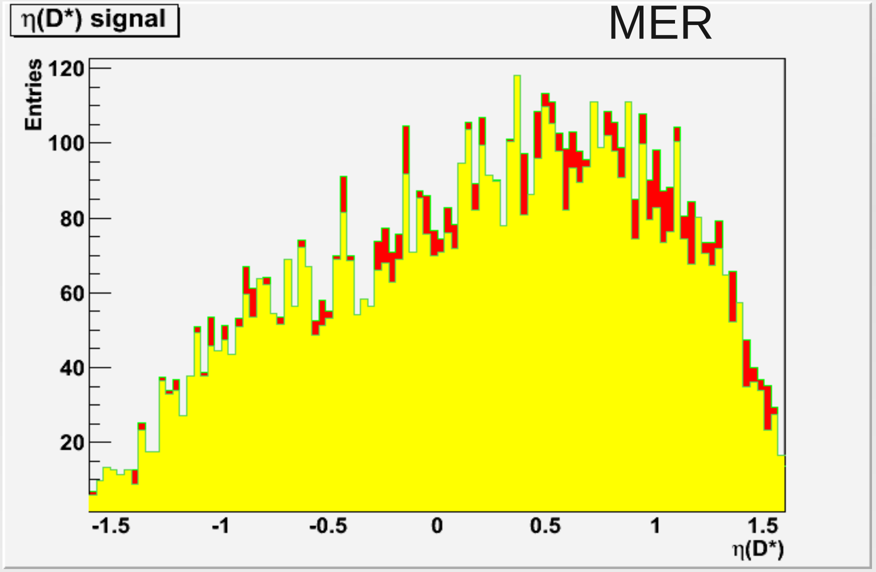


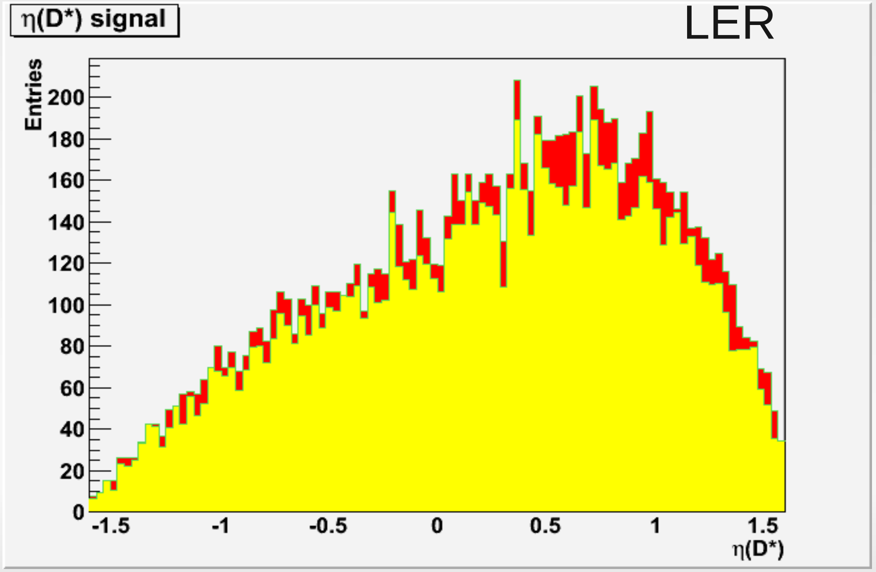
Red — v07a
Yellow - v06a

Distributions of kinematic variables

$\eta(D^*)$







Red — v07a
Yellow - v06a

NEW D meson MC for MER and LER

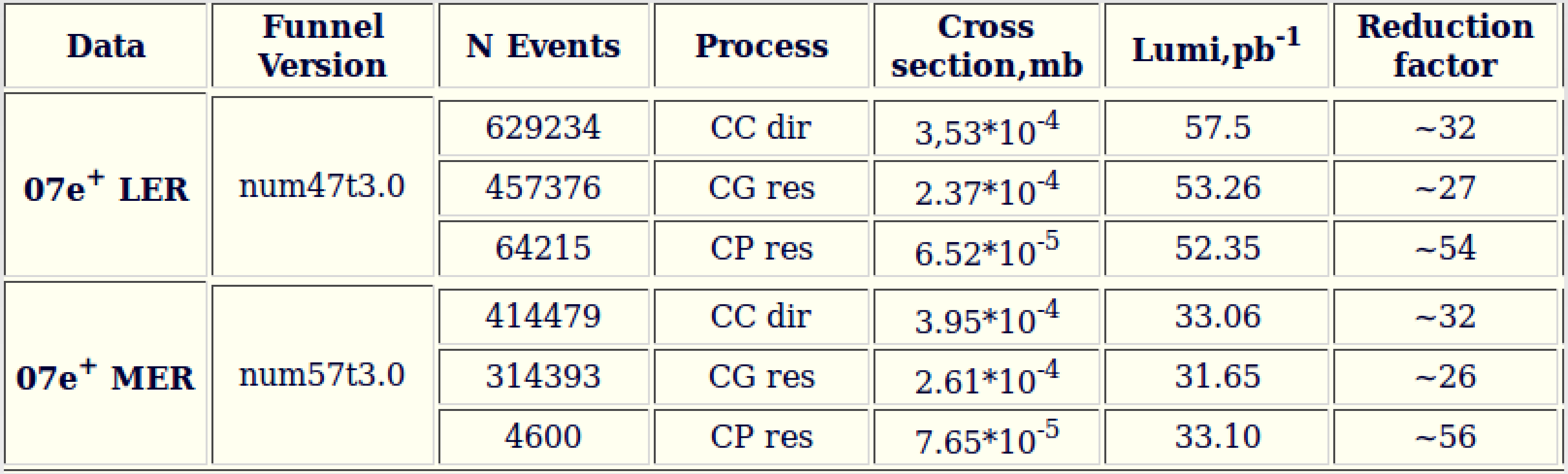
- new MC for MER and LER with luminosity 4 x DATA.

- the MC-Samples were generated with PYTHIA v6.221 ;
- c and b production, full range of Q2;
- selection: D mesons in 8 decay modes and backgrounds;

setup the AMADEUS and PYTHIA → prepered control cards with resolved and direct processes for beauty and charm production → generated .log files for necessary luminosity. → checked output files with Orange → the files sended to funnel.

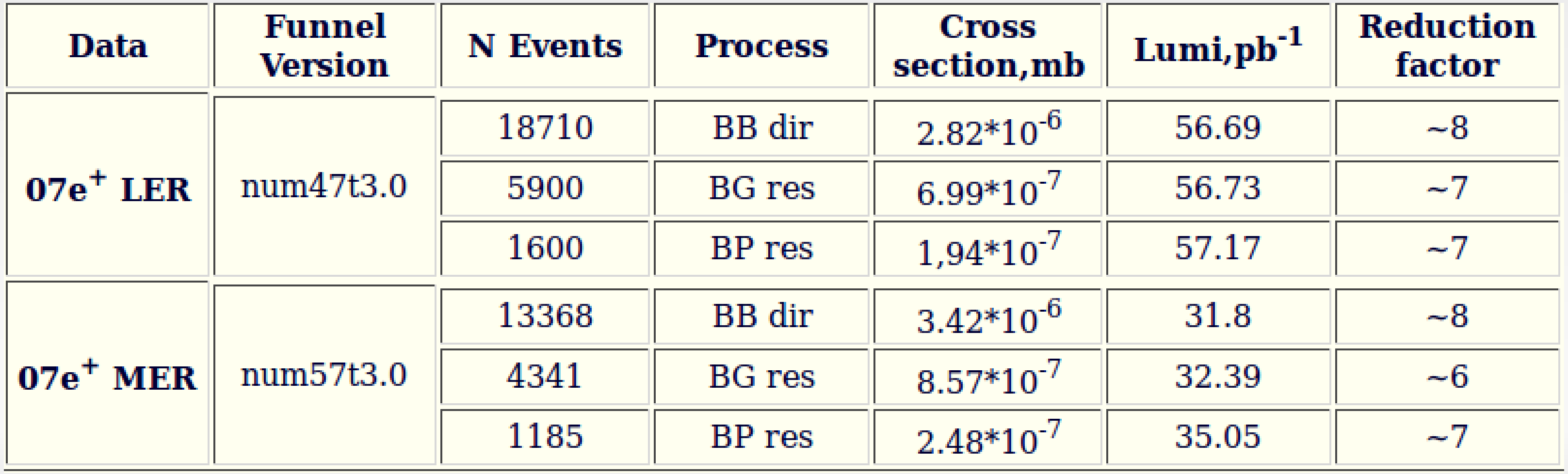
General D meson MC for MER and LER

Charm production



Data	Funnel Version	N Events	Process	Cross section,mb	Lumi,pb^{-1}	Reduction factor
07e$^+$ LER	num47t3.0	629234	CC dir	3,53*10^{-4}	57.5	~32
		457376	CG res	2.37*10^{-4}	53.26	~27
		64215	CP res	6.52*10^{-5}	52.35	~54
07e$^+$ MER	num57t3.0	414479	CC dir	3.95*10^{-4}	33.06	~32
		314393	CG res	2.61*10^{-4}	31.65	~26
		4600	CP res	7.65*10^{-5}	33.10	~56

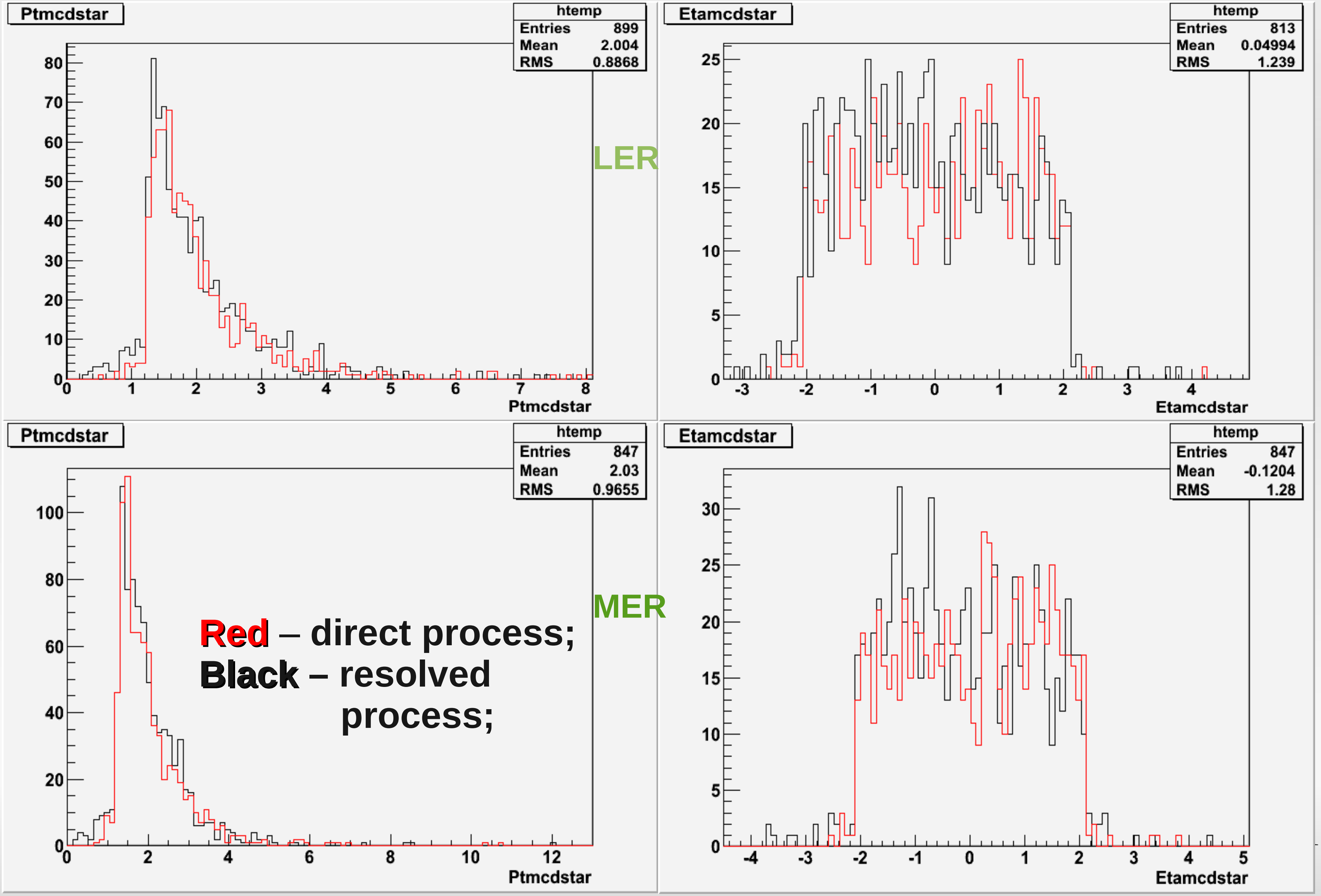
Beauty production



Data	Funnel Version	N Events	Process	Cross section,mb	Lumi,pb^{-1}	Reduction factor
07e$^+$ LER	num47t3.0	18710	BB dir	2.82*10^{-6}	56.69	~8
		5900	BG res	6.99*10^{-7}	56.73	~7
		1600	BP res	1,94*10^{-7}	57.17	~7
07e$^+$ MER	num57t3.0	13368	BB dir	3.42*10^{-6}	31.8	~8
		4341	BG res	8.57*10^{-7}	32.39	~6
		1185	BP res	2.48*10^{-7}	35.05	~7

All together it makes 1177035 Events for LER, 1062159 Events for MER

Distributions for MCDSTAR block parametrs (LER)



LER

MER

Red – direct process;
Black – resolved process;

Acceptance and total cross section

$$\alpha = \frac{N_{reco}(D^*)}{N_{gen}(D^*)};$$

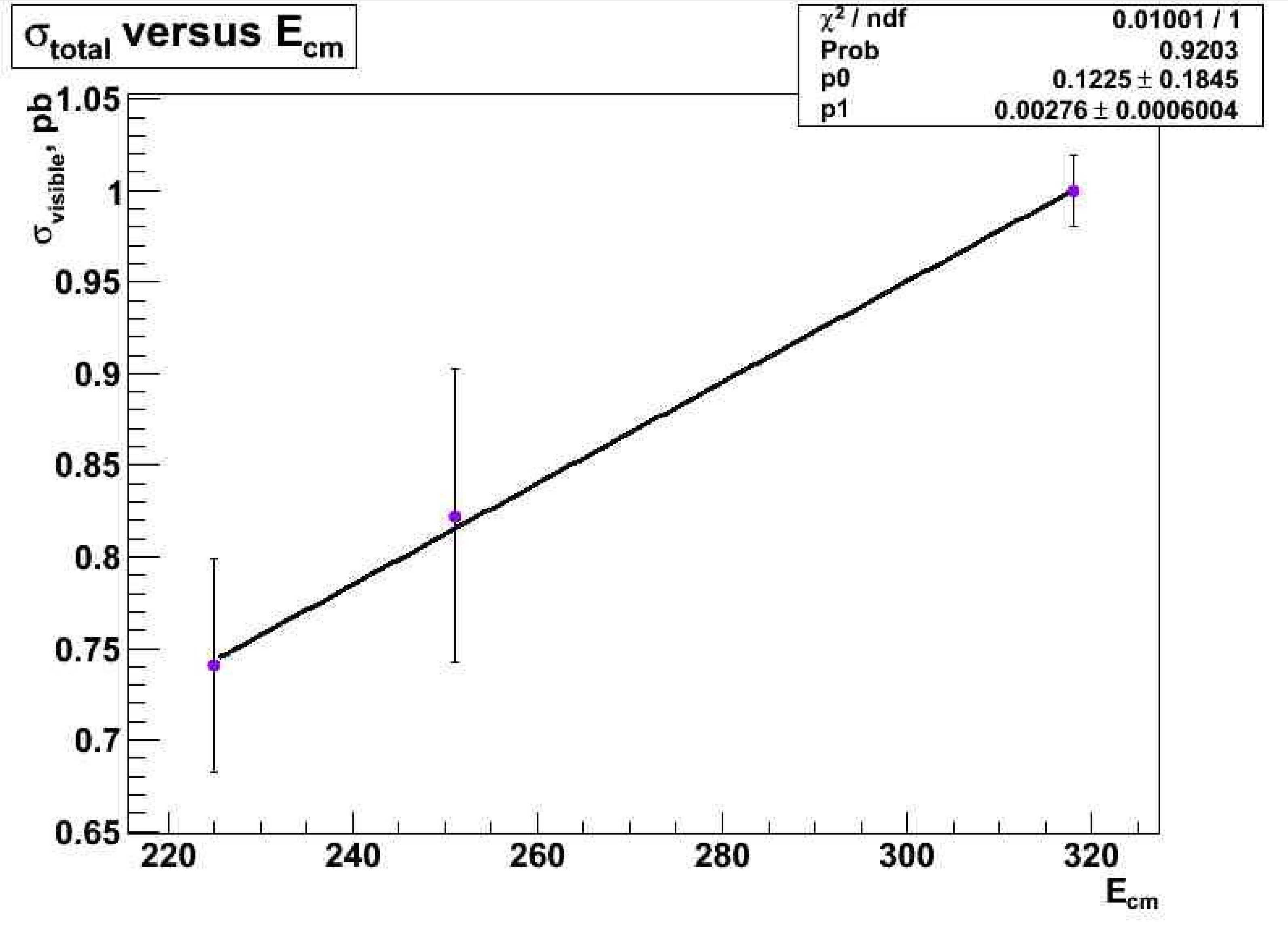
$$\sigma_{total}(D^*) = \frac{N_{reco}^{data}(D}{L\cdot Br\cdot\alpha} \;;$$

L - luminosity; α- acceptance; Br $= 0.026$ - branching ratio;
$N(D^*)$ - the number of reconstructed D^* mesons;

Table 2. Acceptance and total cross section

E_p	$N(D^*)MC_{reco}$	$N(D^*)MC_{true}$	α	$\sigma_{total}(D^*), pb$
LER	461±24	3922	0.117 ±0.006	23536 ±1923
MER	417±22	4091	0.102 ±0.005	26127 ±2612
HER	13783 ±136	129278	0.107 ±0.001	31773 ±616

Energy dependence of total cross section ratio



Summary

- **In this analysis was study energy dependence of total cross section ratio**:
- it can cancel systematic errors

- Acceptance and ratio of cross section calculated for different energy (HER, MER, LER) and energy dependence of cross section ratio builded
- The comparison of data with MC showed some discrepancies between data and Monte .
- Compared new version Common Ntuples v07a with v06a for HER, MER, LER:
  - the distributions of ΔM(D*-D0) and distributions of kinematic variables Pt(D*), η(D*) for MER, LER,HER;
  - calculated the number of D* mesons for v06a and v07a;

So, the distributions are similary. New version Common Ntuple has a litlle improve.

- Was preapered a new samples D mesons Monte Carlo for MER and LER with lumi 4xDATA. The samples was send to funnel queue.

- Theoretical calculation with FMNAR has been done.
- This results presented on Heavy Flavour Meeting

Next steps

1. Check and work with new MC (when MC will be ready)

- to calculate acceptance and total cross section;

2. Studying for trigger chains.
3. Ratio of cross section to measure.

4. Comparing the results with theoretical predictions — FMNAR.