Современные исследования в ЛВЭ ОЭФВЭ

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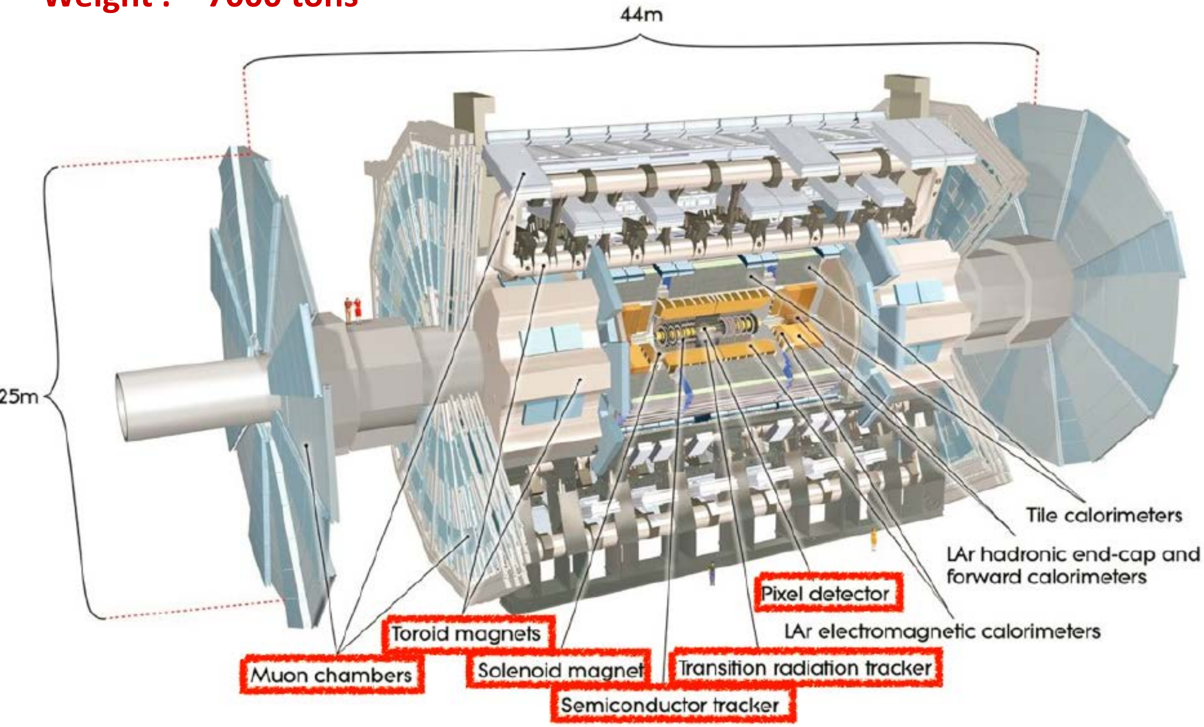
Июнь 14[ое], 2013, Москва, НИИЯФ МГУ

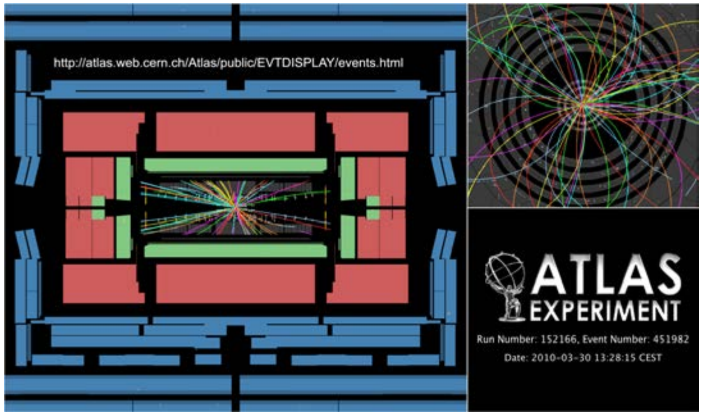
11 сотрудников / 7 на научных должностях

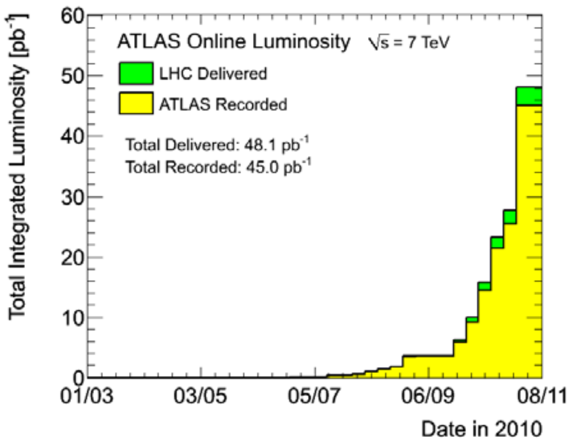
- **эксперимент D0@FNAL (участвовал 1 сотрудник)**
- **эксперимент SELEX@FNAL (участвовало 3-ое сотрудников)**
- **феноменология фоторождения η-мезонов (2)**
- **эксперимент ZEUS@HERA (3)**
- **эксперимент ATLAS@LHC (3, 2 соавтора открытия бозона Хиггса)**
- **эксперимент @ILC (пока 1, CALICE)**

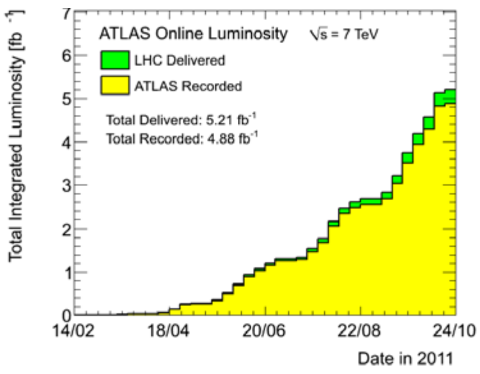
ATLAS @ LHC

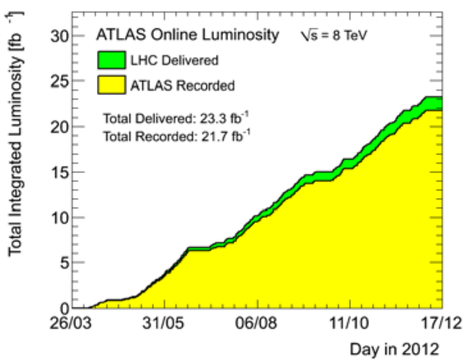
Weight : ~ 7000 tons











used for B and D meson measurements

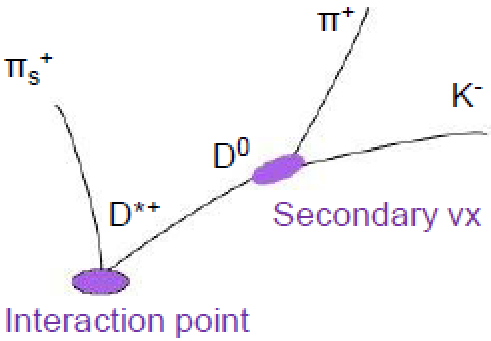
Peak Lumi: 7.73×10^{33} cm^{-2} s^{-1}

Измерение инклюзивного рождения *D* и *B* адронов в эксперименте ATLAS

Inclusive $D^{*\pm}$, $D^{\pm}$ and $D_s^{\pm}$ cross sections (3 notes released)

$B \to D^{*+} \mu^- X$ cross sections (Nucl. Phys. B 864 (2012), 341)

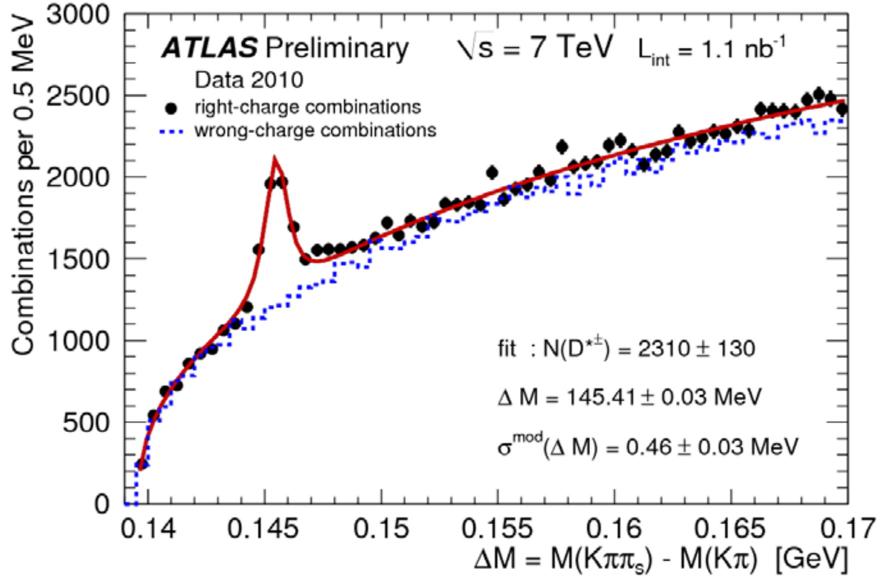
Reconstruction of *D*-mesons already feasible with first ATLAS data due to
- large cross-section values
- clean *D*-meson signatures
- precise ATLAS tracking and vertexing



Muons are well identified and can be used for triggering

Important to measure production of *D* and *B* mesons
- to evaluate and calibrate tracking performance
- to compare production in pp and heavy ion collisions
- to test theoretical calculations
- to verify $m_{c/b}$ values and proton structure functions
- to realistically estimate c/b contributions to backgrounds for New Physics

$D^{*+} \rightarrow D^0\pi^+ \rightarrow (K^-\pi^+)\pi^+$ (+c.c.) reconstruction



Kinematic range:

$p_T(D^{*\pm}) > 3.5\,\mathrm{GeV},\ |\eta(D^{*\pm})| < 2.1$

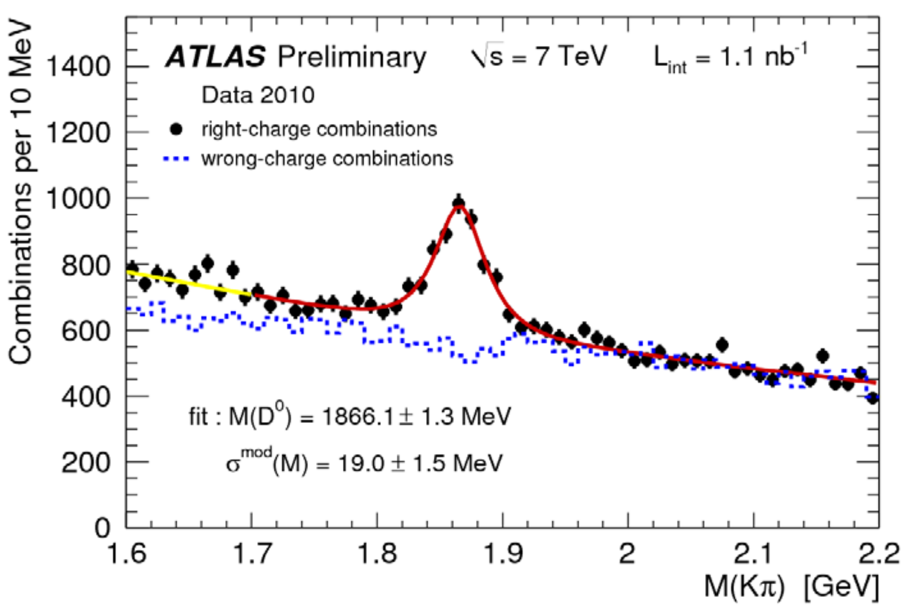
$p_T(D^{*\pm})/\sum E_T > 0.02$ $\Longleftarrow$ hard fragmentation

$L_{XY}(D^0) > 0$ $\Longleftarrow$ $c\tau(D^0) = 123\,\mu\mathrm{m}$

$p_T(K,\pi) > 1\,\mathrm{GeV},\ p_T(\pi_s) > 0.25\,\mathrm{GeV}$

$\Longleftarrow$ $1.82 < M(D^0) < 1.91$ GeV
wider (due to resolution)
for $p_T(D^{*\pm}) > 12$ GeV or $|\eta(D^{*\pm})| > 1.3$

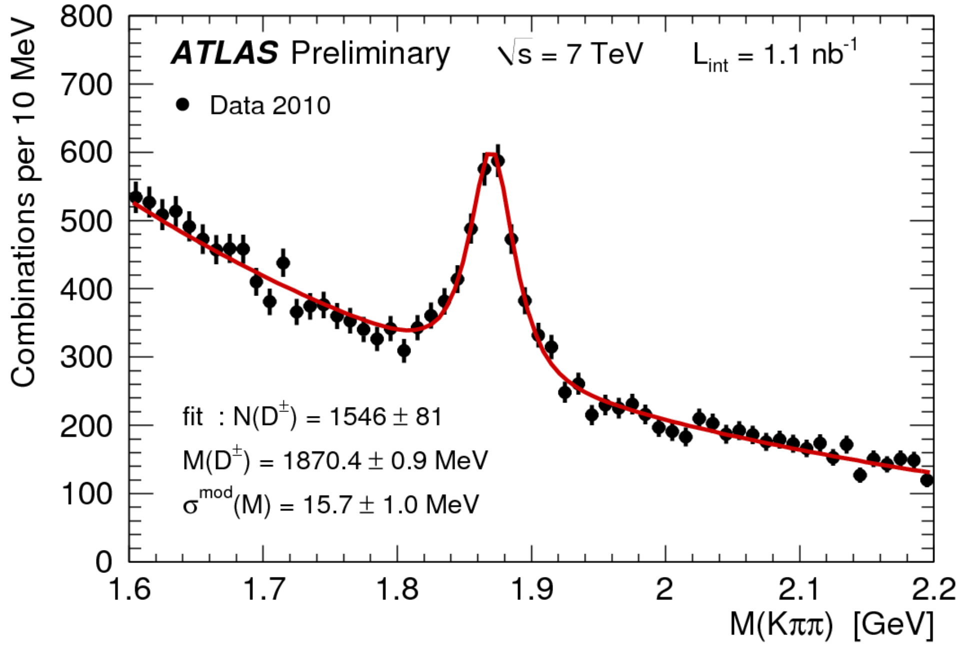
Wrong-charge combinations: $(K^+\pi^+)\pi_s^-$ (+ c.c.)



$\Longleftarrow$ $144 < M(K\pi\pi) - M(K\pi) < 147\,\mathrm{MeV}$

Fitted masses and widths consistent with MC and PDG mass values

$D^+ \to K^- \pi^+ \pi^+$ (+c.c.) reconstruction



Kinematic range:

$p_T(D^\pm) > 3.5$ GeV and $|\eta(D^\pm)| < 2.1$

$L_{xy}(D^\pm) > 1.2$ mm $c\tau(D^\pm) = 312$ µm

$p_T(K) > 1$ GeV

$p_T(\pi) > 0.8$ GeV, (one with $p_T > 1$ GeV)

$p_T(D^\pm)$ / event $\Sigma E_T > 0.02$

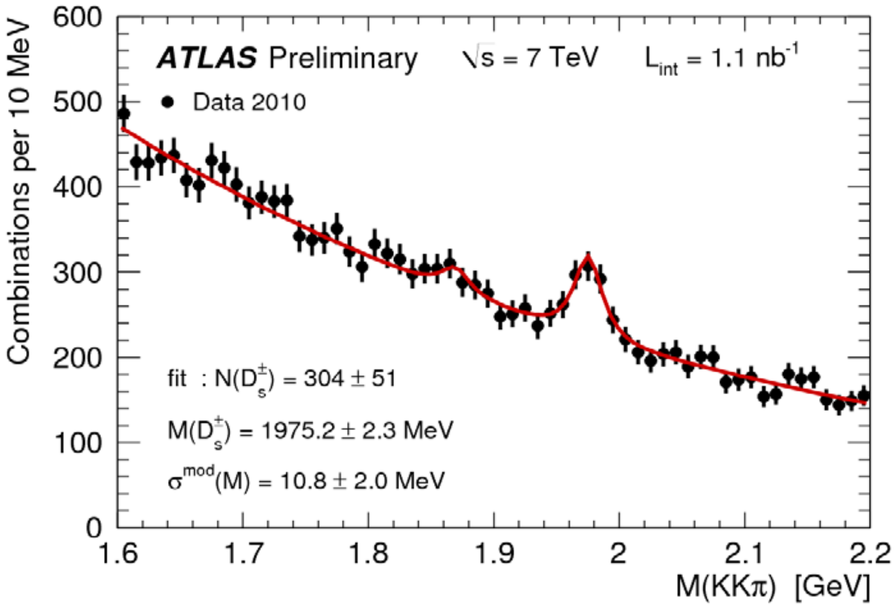
suppression of $D^{*\pm}$ and $D_s^+ \to \phi\,\pi^+ \to (K^-\,K^+)\,\pi^+$ (+c.c.) reflections:

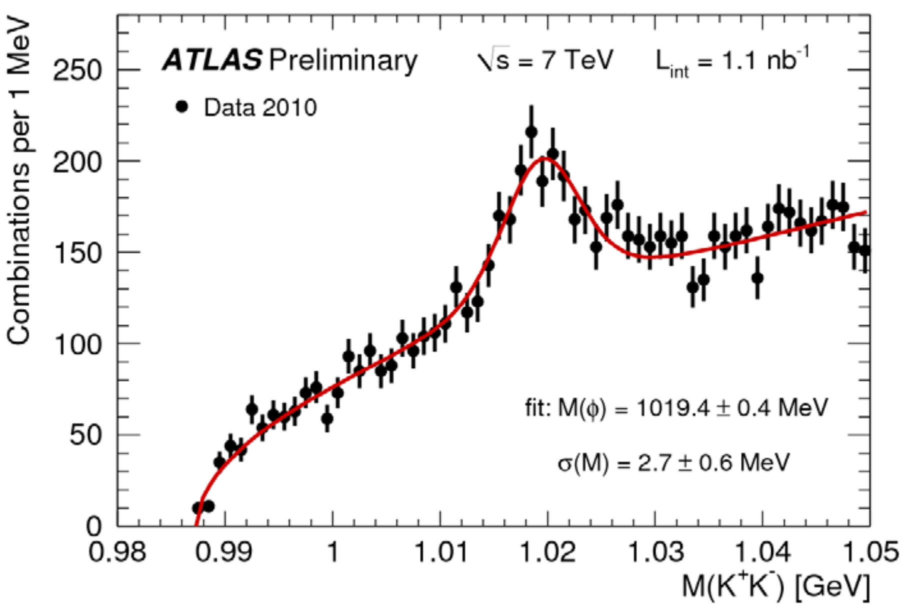
remove $\Delta M_{1,2} < 150\,\mathrm{MeV}$ and $|M(K^\pm,\text{"}K^\mp\text{"}) - M(\phi)_{\mathrm{PDG}}| < 8\,\mathrm{MeV}$

$\cos\theta^*(K) > -0.8$ (angle between $\vec{p}(K)$ in $D^\pm$ rest frame and $\vec{p}(D^\pm)$ in the lab)

Fitted mass and width consistent
with MC and PDG mass value

$D_s^+ \to \phi\pi^+ \to (K^-K^+)\pi^+$ (+c.c.) reconstruction





Kinematic range:

$p_T(D_s^\pm) > 3.5$ GeV and $|\eta(D_s^\pm)| < 2.1$

$L_{xy}(D_s^\pm) > 0.4$ mm $c\tau(D_s^\pm) = 150$ µm

$p_T(K) > 0.7$ GeV, $p_T(\pi) > 0.8$ GeV

$p_T(D_s^\pm)$ / event $\Sigma E_T > 0.02$

⟸ $|M(K^+K^-) - M(\phi_{PDG})| < 6$ MeV

$\cos\theta^*(\pi) < 0.4$
($\angle$ between $\vec{p}(\pi)$ in $D_s^\pm$ r.f. and $\vec{p}(D_s^\pm)$ in the lab)

$|\cos\theta'(K)|^3 > 0.2$
($\angle$ between $\vec{p}(K)$ and $\vec{p}(\pi)$ in K^+K^- r.f.)

⟸ $1.93 < M(KK\pi) < 2.01$ GeV

Fitted masses and widths consistent with MC and PDG mass values

Visible (integrated) cross sections

$p_T(D^{(*)}) > 3.5$ GeV and $|\eta(D^{(*)})| < 2.1$

ATLAS measurement :

$$\sigma^{vis}(D^{*\pm}) = 285 \pm 16(\text{stat.})^{+32}_{-27}(\text{syst.}) \pm 31(\text{lum.}) \pm 4(\text{br.})\,\mu\text{b}$$

$$\sigma^{vis}(D^{\pm}) = 238 \pm 13(\text{stat.})^{+35}_{-23}(\text{syst.}) \pm 26(\text{lum.}) \pm 10(\text{br.})\,\mu\text{b}$$

$$\sigma^{vis}(D_s^{\pm}) = 168 \pm 34(\text{stat.})^{+27}_{-25}(\text{syst.}) \pm 18(\text{lum.}) \pm 10(\text{br.})\,\mu\text{b}$$

POWHEG-PYTHIA :

$$\sigma(D^{*\pm}) = 153^{+169}_{-80}(\text{scale})^{+13}_{-15}(m_Q)^{+24}_{-21}(\text{PDF})^{+20}_{-16}(\text{hadr.})\,\mu\text{b}$$

$$\sigma(D^{\pm}) = 132^{+137}_{-65}(\text{scale})^{+11}_{-10}(m_Q)^{+20}_{-18}(\text{PDF})^{+21}_{-11}(\text{hadr.})\,\mu\text{b}$$

$$\sigma(D_s^{\pm}) = 59^{+57}_{-28}(\text{scale})^{+4}_{-6}(m_Q)^{+9}_{-8}(\text{PDF})^{+7}_{-8}(\text{hadr.})\,\mu\text{b}$$

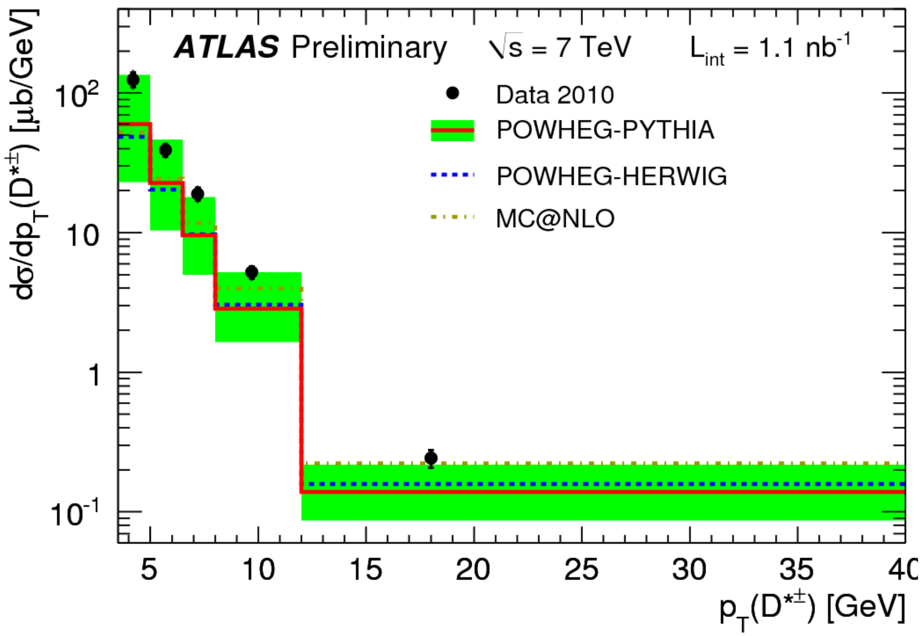
The corresponding POWHEG-HERWIG predictions are $\sigma(D^{*\pm}) = 135\,\mu\text{b}$, $\sigma(D^{\pm}) = 121\,\mu\text{b}$ and $\sigma(D_s^{\pm}) = 50\,\mu\text{b}$, while MC@NLO predicts $\sigma(D^{*\pm}) = 155\,\mu\text{b}$, $\sigma(D^{\pm}) = 138\,\mu\text{b}$ and $\sigma(D_s^{\pm}) = 57\,\mu\text{b}$.

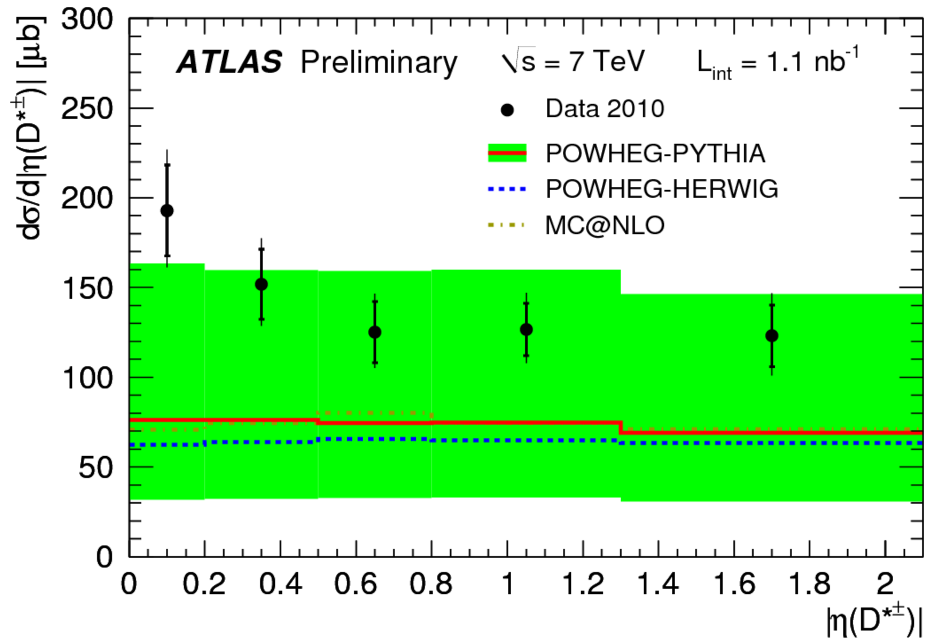
Binning for $D^{*\pm}$ and $D^{\pm}$ diff. x-sections

p_T : 3.5 - 5.0 - 6.5 - 8.0 - 12. - 40.

$|\eta|$: 0.0 - 0.2 - 0.5 - 0.8 - 1.3 - 2.1

D*± differential cross sections

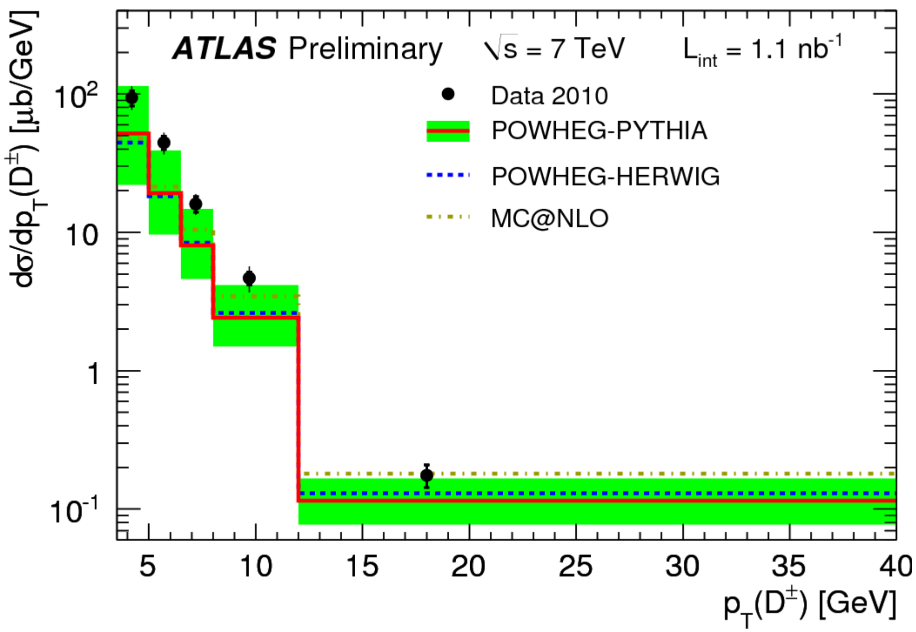


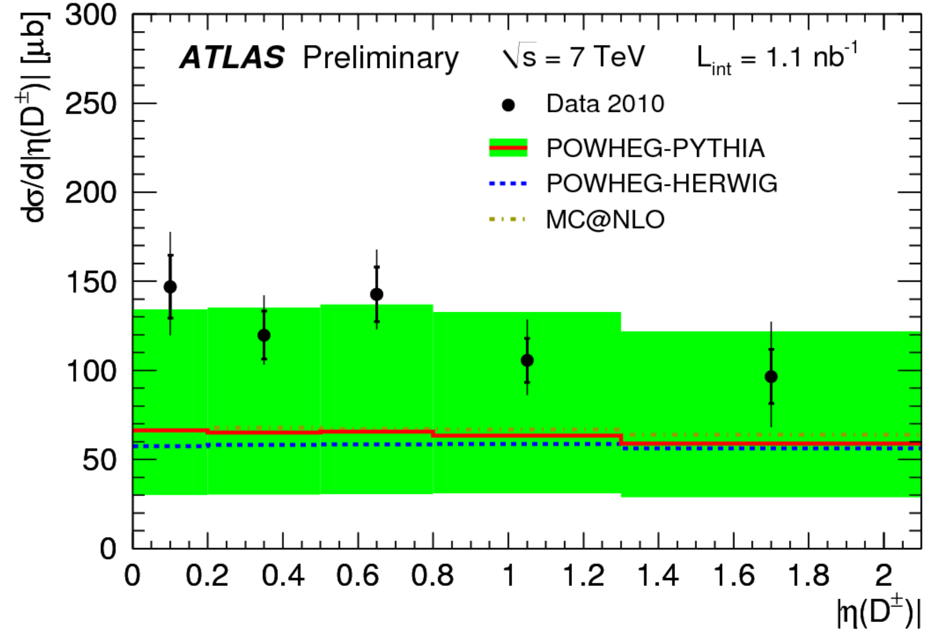


- Data within the range of the theoretical uncertainties
- Data inner error bars show statistical uncertainty, outer error bars show statistical and systematic uncertainties added in quadrature
- Largest contribution to theoretical uncertainty from renormalisation and factorisation scale uncertainties. Smaller sources of uncertainty due to m_Q, PDF and hadronisation

Detailed study of high-p_T range would be interesting

$D^{\pm}$ differential cross sections





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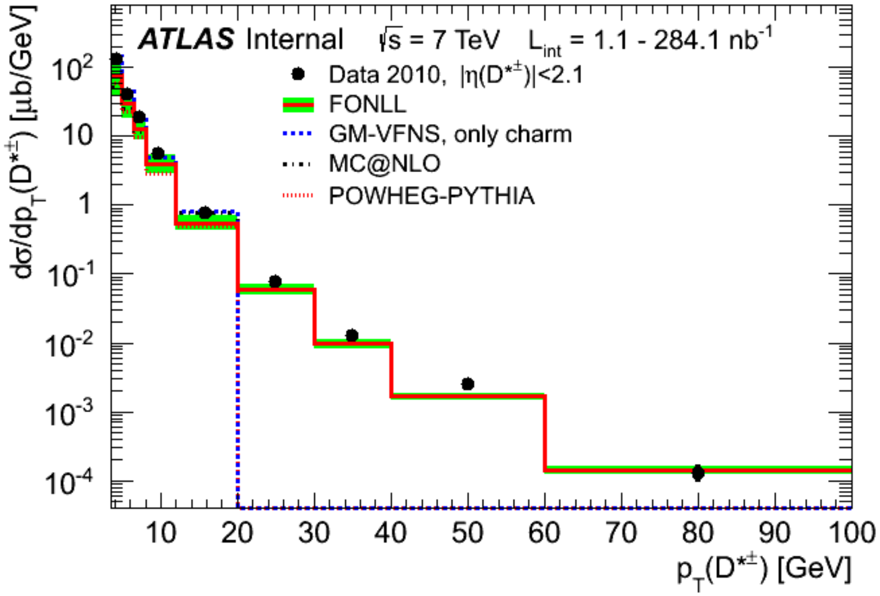
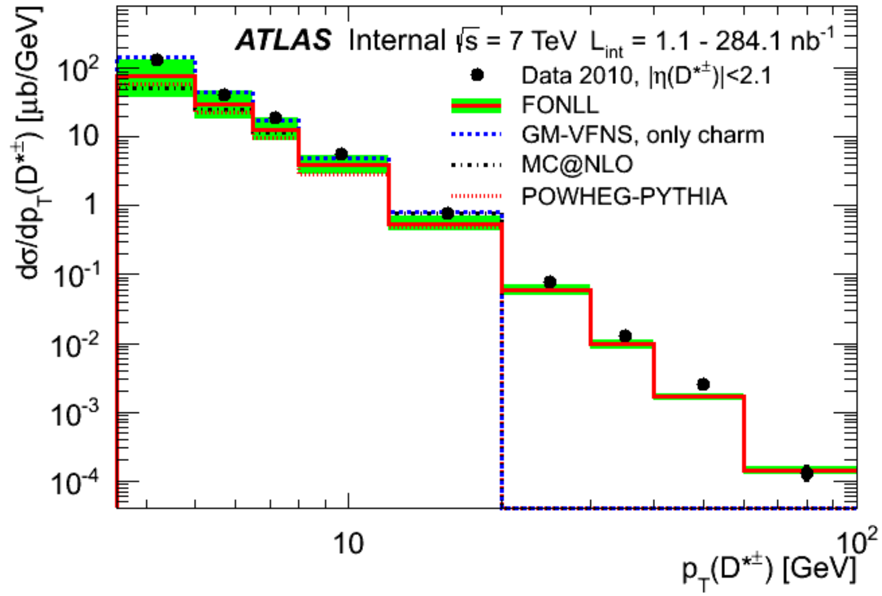
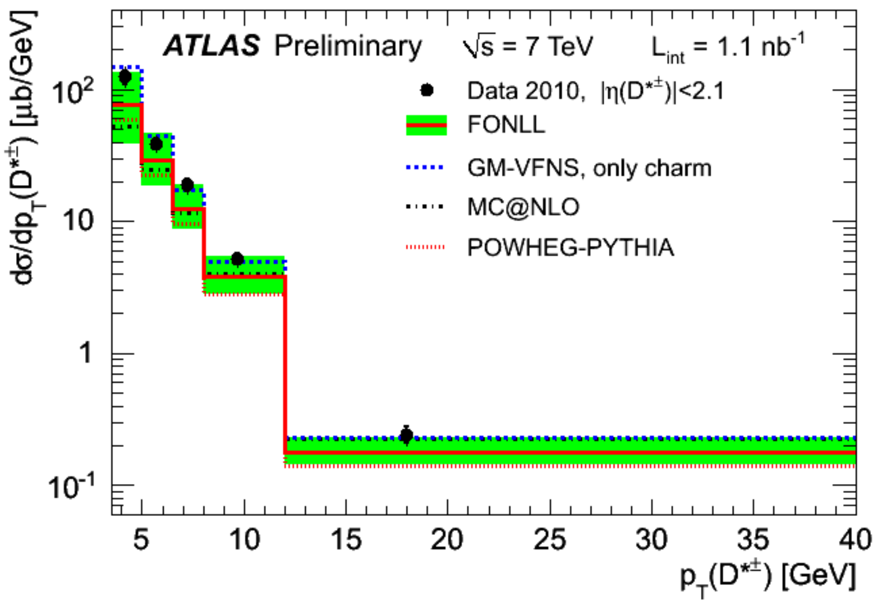
Detailed study of high-p_T range would be interesting

$D^{*\pm}$ differential x-sections vs $p_T(D^{*\pm})$

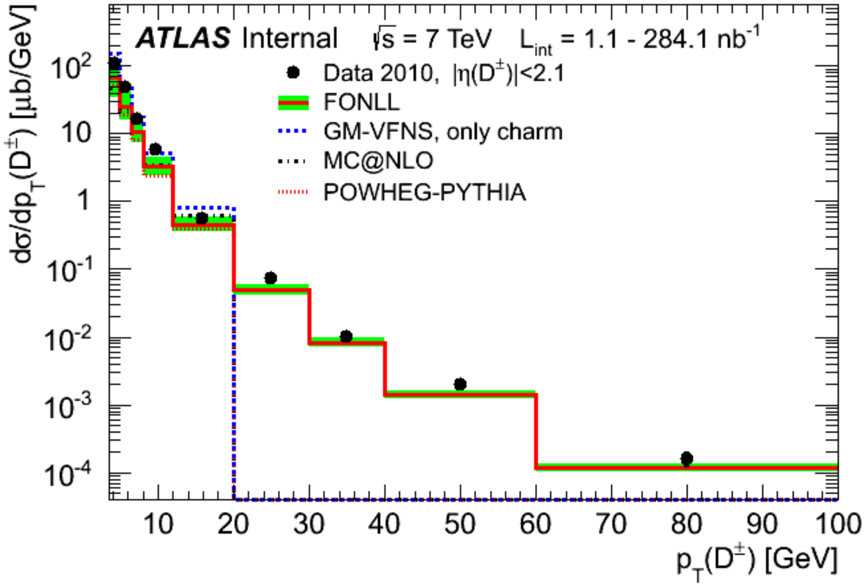


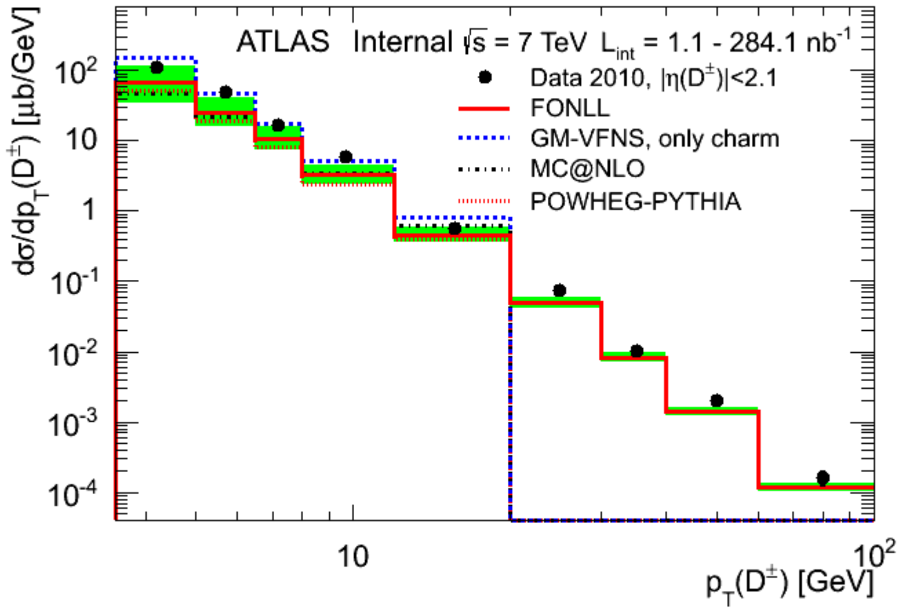


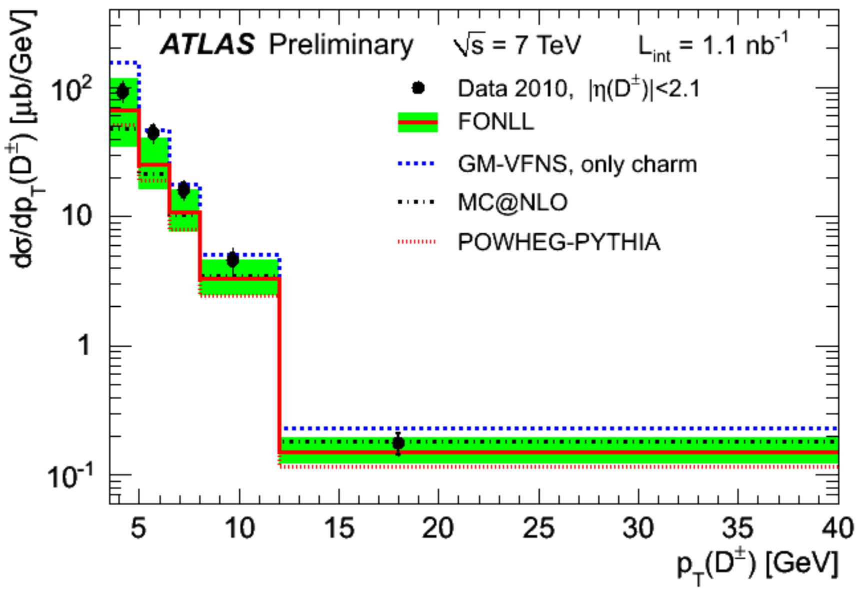


FONLL predictions updated using http://www.lpthe.jussieu.fr/~cacciari/fonll/fonllform.html modified by Matteo Cacciari on our request

$D^{\pm}$ differential x-sections vs $p_T(D^{\pm})$







FONLL predictions updated using
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modified by Matteo Cacciari on our request

Charm Fragmentation Ratios

Extrapolation with NLO QCD:

$$\sigma_{c\bar{c}}^{tot}(D^{*\pm}) = 3.36 \pm 0.19(\text{stat.})^{+0.38}_{-0.32}(\text{syst.}) \pm 0.40(\text{lum.}) \pm 0.05(\text{br.})^{+1.76}_{-0.82}(\text{extr.})\,\text{mb},$$

$$\sigma_{c\bar{c}}^{tot}(D^{\pm}) = 3.10 \pm 0.17(\text{stat.})^{+0.46}_{-0.30}(\text{syst.}) \pm 0.34(\text{lum.}) \pm 0.13(\text{br.})^{+1.70}_{-0.89}(\text{extr.})\,\text{mb},$$

$$\sigma_{c\bar{c}}^{tot}(D_s^{\pm}) = 1.90 \pm 0.38(\text{stat.})^{+0.30}_{-0.28}(\text{syst.}) \pm 0.21(\text{lum.}) \pm 0.11(\text{br.})^{+1.23}_{-0.55}(\text{extr.})\,\text{mb},$$

strangeness suppression factor:

$$\gamma_{s/d} = 0.35 \pm 0.07(\text{stat.})^{+0.03}_{-0.04}(\text{syst.}) \pm 0.03(\text{br.})^{+0.04}_{-0.03}(\text{extr.})$$

fraction of $D^{(*)\pm}$ mesons produced in vector state:

$$P_{\text{v}} = 0.63 \pm 0.03(\text{stat.})^{+0.02}_{-0.03}(\text{syst.}) \pm 0.02(\text{br.})^{+0.04}_{-0.02}(\text{extr.})$$

agree with the LEP results (charm fragm. universality):

$$\gamma_{s/d}^{\text{LEP}} = \frac{f(c \to D_s^+)}{f(c \to D^+) + f(c \to D^{*+}) \cdot \mathscr{B}_{D^{*+} \to D^0\pi^+}} = 0.23 \pm 0.02(\text{stat.} \oplus \text{syst.}) \pm 0.02(\text{br.})$$

$$P_{\text{v}}^{\text{LEP}} = \frac{f(c \to D^{*+})}{f(c \to D^+) + f(c \to D^{*+}) \cdot \mathscr{B}_{D^{*+} \to D^0\pi^+}} = 0.62 \pm 0.02(\text{stat.} \oplus \text{syst.}) \pm 0.02(\text{br.})$$

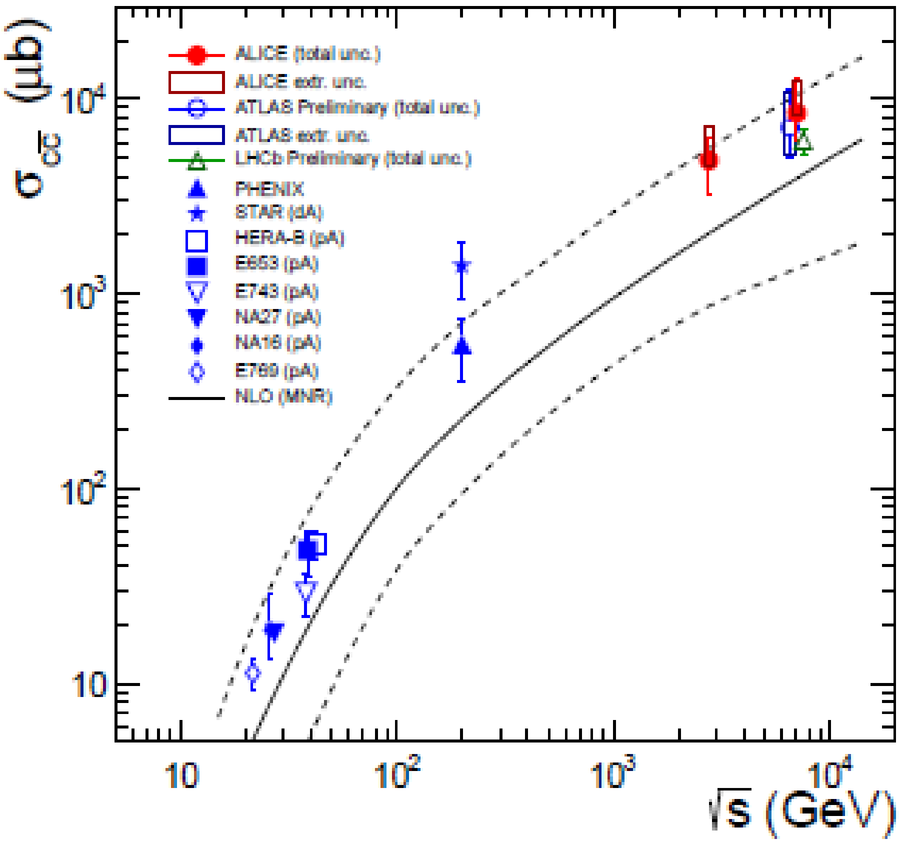
Total charm cross section

ATLAS-CONF-2011-017 :

Extrapolation with NLO QCD:

$$\sigma_{c\bar{c}}^{tot} = 7.13 \pm 0.28(\text{stat.})^{+0.90}_{-0.66}(\text{syst.}) \pm 0.78(\text{lum.})^{+3.82}_{-1.90}(\text{extr.})\,\text{mb}$$

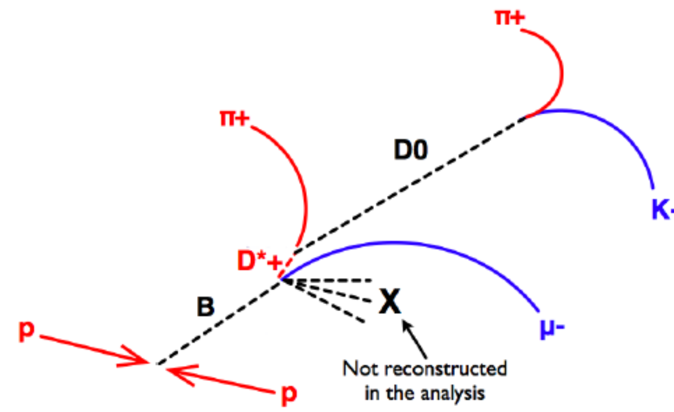
ALICE Coll., JHEP 07 (2012) 191



LHC measurements of the total charm production cross section agree

$B \to D^{*+}\mu^- X$ measurement at 7 TeV

$$\frac{d\sigma(pp \to H_b X \to D^* \mu X')}{dp_T(D^* \mu)} = \frac{f_b N^{D^* \mu}}{2 \epsilon \mathscr{B} \mathscr{L} \Delta p_T}$$

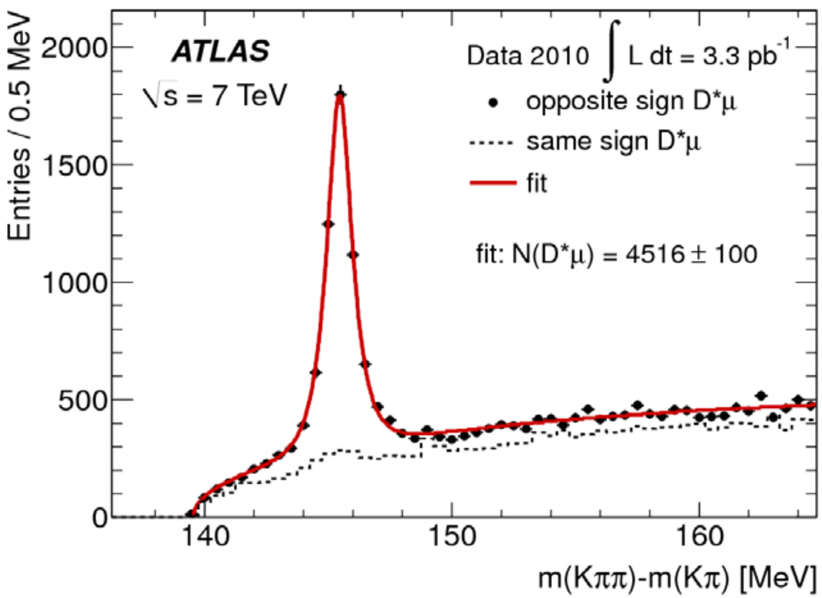


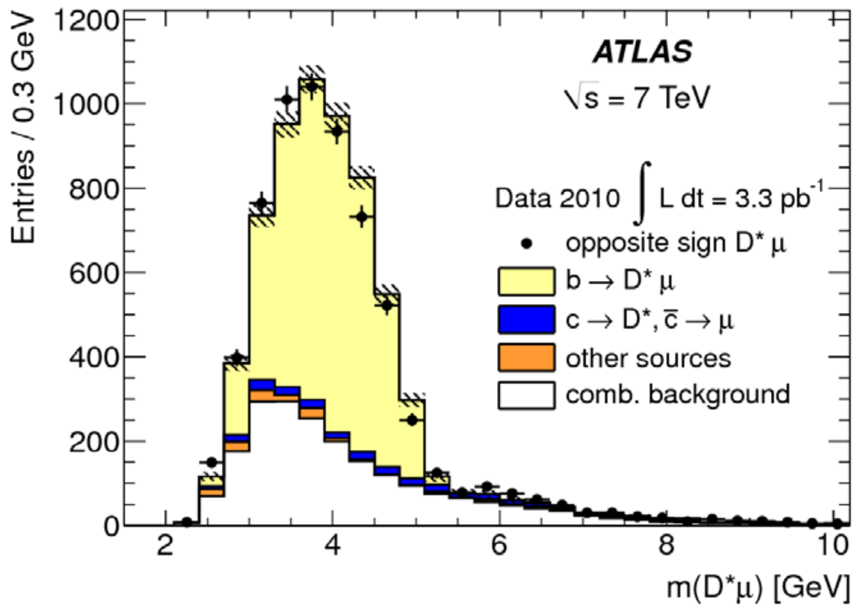
- $N^{D^* \mu}$: number of reconstructed $D^* \mu$ pairs
- f_b: fraction of $D^* \mu$ candidates from a single b decay (MC)
- ϵ: reconstruction, trigger and selection efficiency (MC + data-driven for trigger)
- $\mathscr{L}$: integrated luminosity of the collected data sample
- $\mathscr{B}$ = total branching ratio $\mathscr{B}(D^* \to D^0 \pi) \cdot \mathscr{B}(D^0 \to K\pi)$
- factor 2: $N^{D^* \mu}$ counts both $D^{*+}\mu^-$ and $D^{*-}\mu^+$
- Δp_T: bin width

$$\frac{d\sigma(pp \to H_b X \to D^* \mu X')}{dp_T(H_b)}$$ ← Unfolding with NLO MC

$$\frac{d\sigma(pp \to H_b X)}{dp_T(H_b)}$$ ← Decay acceptance with NLO MC and branching (PDG)

$B \to D^{*+} \mu^- X$ integrated cross section





$b \to D^* \mu X$: $93.2 \pm 0.3\%$

$c \to D^* X, \bar{c} \to \mu Y$: $3.8 \pm 0.2\%$

$b \to D^* \tau X (\tau \to \mu Y)$: $1.5 \pm 0.1\%$

$b \to D^* D X (D \to \mu Y)$: $0.9 \pm 0.1\%$

$b \to D^* X, \bar{b} \to \mu Y$ and D^* + fake muon: $0.6 \pm 0.1\%$

$2.5\ \text{GeV} < M(D^* \mu) < 5.4\ \text{GeV}$

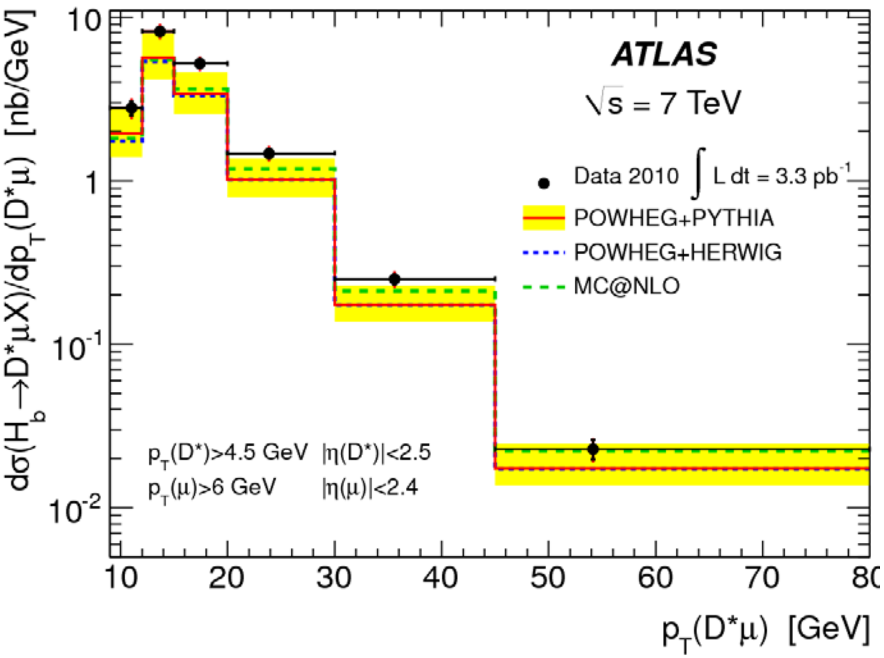
$p_T(D^*) > 4.5\ \text{GeV},\ p_T(\mu) > 6\ \text{GeV},\ |\eta(D^*)| < 2.5,\ |\eta(\mu)| < 2.4$

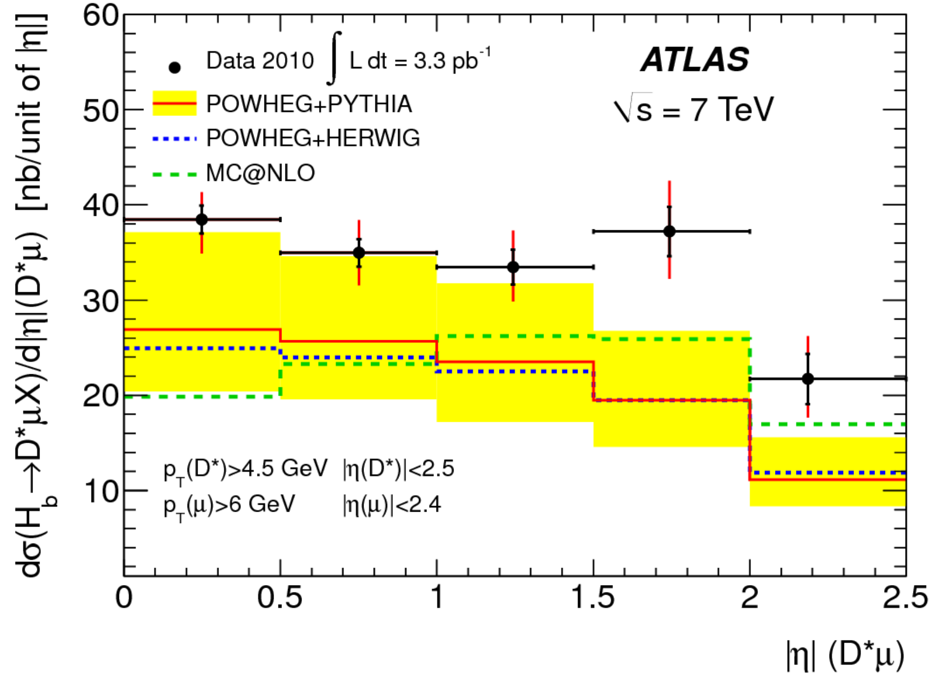
data: $\sigma(H_b \to D^* \mu X) = 78.7 \pm 2.0(stat) \pm 7.3(syst) \pm 1.2(\mathscr{B}) \pm 2.7(\mathscr{L})$ nb

PowhegPythia: $\sigma(H_b \to D^* \mu X) = 53^{+18}_{-11}(scale)^{+3}_{-3}(m_b)^{+3}_{-3}(PDF)^{+6}_{-5}(hadr)$ nb

POWHEG+HERWIG prediction is 51 nb, while MC@NLO predicts 56 nb

$d\sigma(H_b \to D^* \mu X)/dp_T(|\eta|)(D^* \mu)$ differential cross sections





NLO+LL QCD predictions are below the data

consistent within large theoretical uncertainties

Bayesian iterative unfolding (with NLO MC) from $D^*\mu$ bins to H_b bins →

Total beauty cross section

Extrapolation with NLO QCD (factor $11^{+2.6}_{-1.6}$):

$$\sigma(pp \to H_b)_{extrap} = 360 \pm 9(stat) \pm 34(syst) \pm 25(\mathscr{B}) \pm 12(\mathscr{L})^{+77}_{-69}(accept. \oplus extrap.)\ \mu b$$

LHCb (Phys. Lett. B694 (2010) 209), extrapolated from $2 < \eta < 6$: $(H_b \to D^0 \mu X)$

$$\sigma(pp \to b\bar{b}X) = 284 \pm 20|_{stat} \pm 49|_{syst}\ \mu b$$

LHCb (Eur.Phys.J. C71 (2011) 1645), extrapolated from $2.0 < y < 4.5$ $(H_b \to J/\psi X)$

$$\sigma(pp \to b\bar{b}X) = 288 \pm 4|_{stat} \pm 48|_{syst}\ \mu b$$

ALICE (hep-ex/1205.5880), extrapolated from $p_T > 1.3$ GeV, $|y| < 0.9$ $(H_b \to J/\psi X)$

$$\sigma(pp \to b\bar{b}X) = 244 \pm 64|_{stat}\ {}^{+50}_{-59}|_{syst}\ {}^{+7}_{-6}|_{extrap}\ \mu b$$

Measurements agree within experimental uncertainties

Полученные результаты:

- Results on inclusive $D^{*\pm}$, $D^{\pm}$ and $D_s^{\pm}$ production cross sections and $B \to D^{*+} \mu^- X$ cross sections at 7 TeV have been confronted with NLO+LL/NLL predictions
- Predictions are below the data although agree within large theoretical uncertainties
- Extrapolated total charm and beauty production cross sections at 7 TeV agree with other measurements at LHC

Планируемые измерения (есть задел):

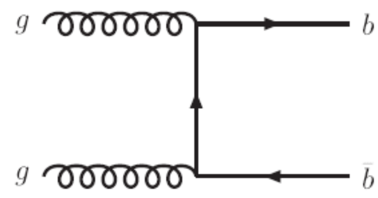
- $B_c \to J/\psi\ D^{(*)}_{(s)}$, $B_c \to \mu^+\mu^-\ D^{(*)}_{(s)}$
- Дважды и трижды тяжёлые барионы
- Ассоциированное рождение калибровочных бозонов и тяжёлых кварков
- Рождение двух и более пар тяжёлых кварков

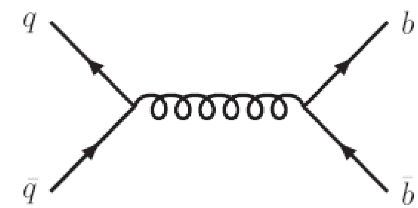
Back-up Slides

Predictions and expected cross sections

Monte Carlo with LO matrix elements and LL parton showering (PYTHIA)

- flavor creation ($gg \longrightarrow Q\bar{Q}$, $q\bar{q} \longrightarrow Q\bar{Q}$)
- flavor excitation ($gQ \longrightarrow gQ$, $qQ \longrightarrow qQ$)
- gluon splitting ($gg \longrightarrow Q\bar{Q}$)





NLO+LL (matched) public codes:

MC@NLO 3.41 $\Longrightarrow$ HERWIG
POWHEG-hvq 1.01 $\Longrightarrow$ HERWIG, PYTHIA
and for PDFs: LHAPDF 5.8.1

On request : FONLL (NLO+NLL)
GM-VFNS (general-mass - variable flavour number scheme)

Expected : MC@NLO+PYTHIA, NNLO ?

MC@NLO, CTEQ6.6, $m_b = 4.75\,\mathrm{GeV}$, $m_c = 1.5\,\mathrm{GeV}$, $\mu_r = \mu_f = m_T = \sqrt{m_Q^2 + p_T^2}$

$\sqrt{s}$ dependence:

$\sqrt{s}[TeV]$	$\sigma_{b\bar{b}}[mb]$	$\sigma_{c\bar{c}}[mb]$
0.9	0.0225	0.891
2.36	0.757	1.95
7.0	0.243	4.40
10.	0.345	5.68
14.	0.475	7.18

Theor. Uncertainties are large

Comparison with NLO+PS predictions

POWHEG-PYTHIA, POWHEG-HERWIG and MC@NLO

ATLAS-CONF-2011-017

Hadronisation : HERWIG cluster model or Bowler modification of Lund symmetric fragmentation function

Fragmentation fractions set to LEP data :

	LEP data	
	stat.$\oplus$syst.	br.
$f(c \to D^{*+})$	0.235 ± 0.007	± 0.003
$f(c \to D^{+})$	0.222 ± 0.010	± 0.009
$f(c \to D_s^{+})$	0.087 ± 0.009	± 0.005
$f(b \to D^{*\pm})$	0.175 ± 0.020	± 0.001
$f(b \to D^{\pm})$	0.227 ± 0.016	± 0.010
$f(b \to D_s^{\pm})$	0.140 ± 0.016	± 0.008

Theoretical uncertainties :

- Scale uncertainty: The uncertainty was determined by varying the renormalisation and factorisation scales independently to $\mu/2$ and 2μ, with the additional constraint $0.5 < \mu_r/\mu_f < 2$, and selecting the largest positive and negative variations
- m_Q uncertainty: Vary the charm and bottom quark masses independently by 0.2 GeV and 0.25 GeV respectively. Total m_Q uncertainty obtained by adding the positive and negative cross-section variations in quadrature
- PDF uncertainty: Determined using the CTEQ6.6 PDF error eigenvectors. Total PDF uncertainty obtained by adding positive and negative cross-section variations in quadrature
- Hadronisation uncertainty: Sum in quadrature of corresponding fragmentation fraction and fragmentation function uncertainties. The latter is determined using POWHEG-PYTHIA and the Peterson fragmentation function, with extreme choices of the fragmentation parameter

Comparison with FONLL and GM-VFNS predictions

ATL-PHYS-PUB-2011-011

FONLL predictions from M.Cacciari et al.

matched NLO+NLL calculations (developed from “massive” NLO)

use own fragmentation function fits but

the same (LEP) fragmentation fractions (f(c→D), f(b→D))

expected to predict larger and less uncertain x-sections w.r.t. POWHEG/MC@NLO

GM-VFNS predictions from B.Kniehl et al.

developed from “massless” NLO

use own fragmentation function fits and own fragmentation fractions (f(c→D))

only charm component (10-15% due to beauty contribution missed)

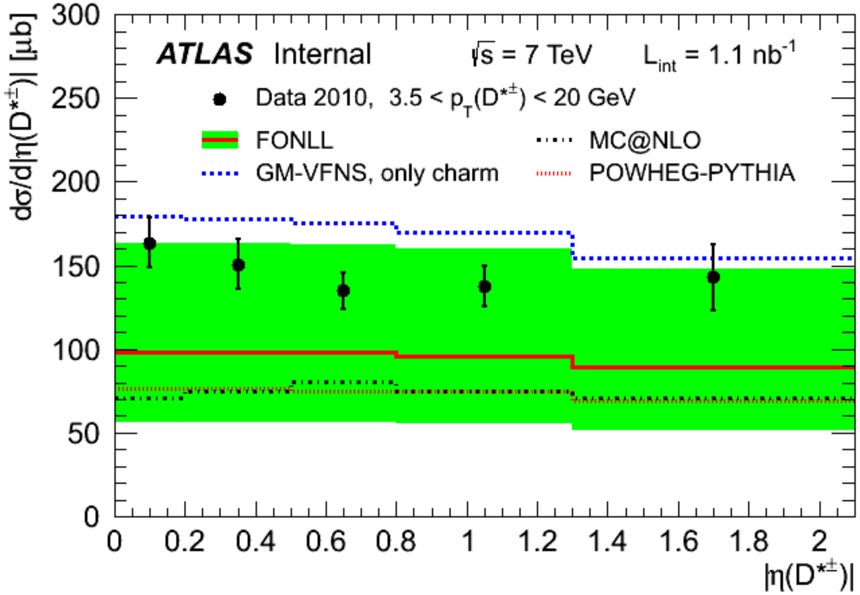
use y rather η (up to ~4% difference in the last η bin)

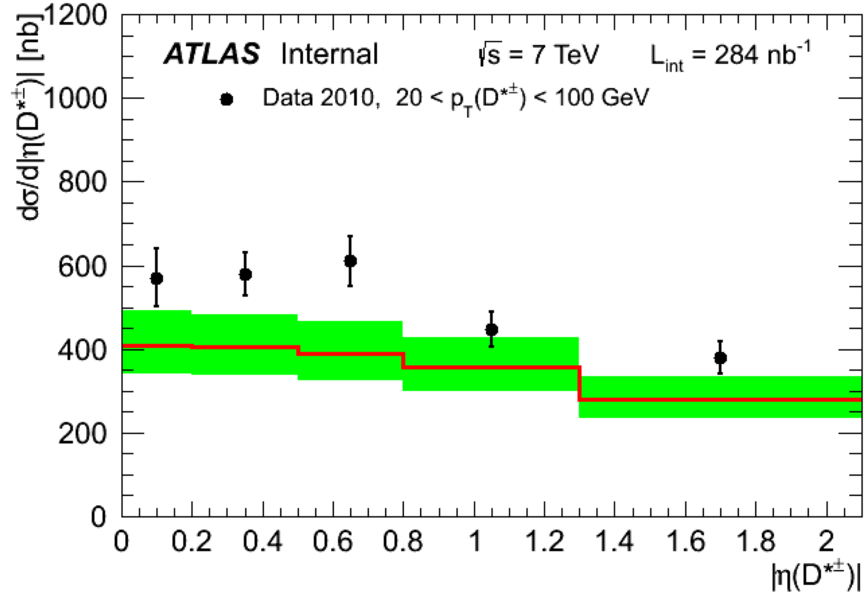
only scale uncertainties (dominant)

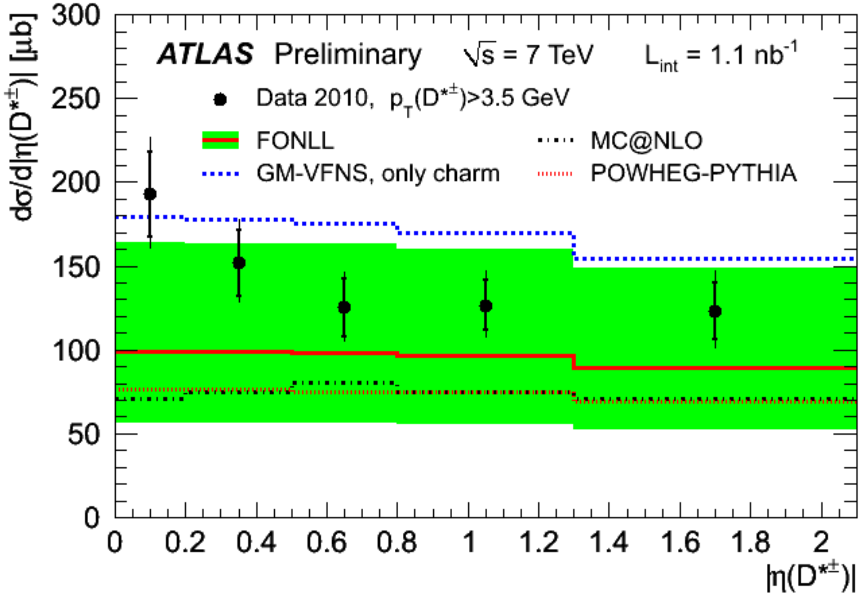
expected to predict …

Ideally, FONNL and GM-VFNS predictions should be close to each other

$D^{*\pm}$ differential x-sections vs $\eta(D^{*\pm})$

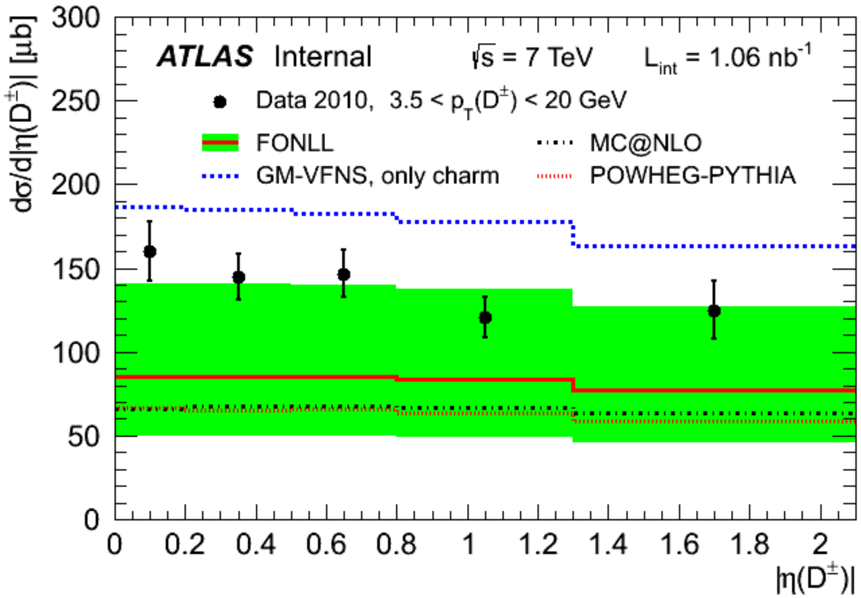


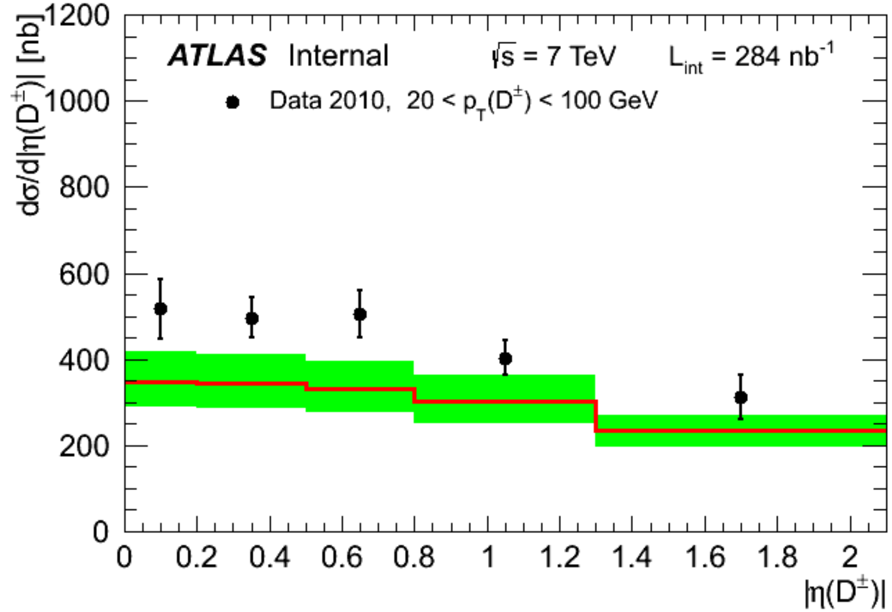


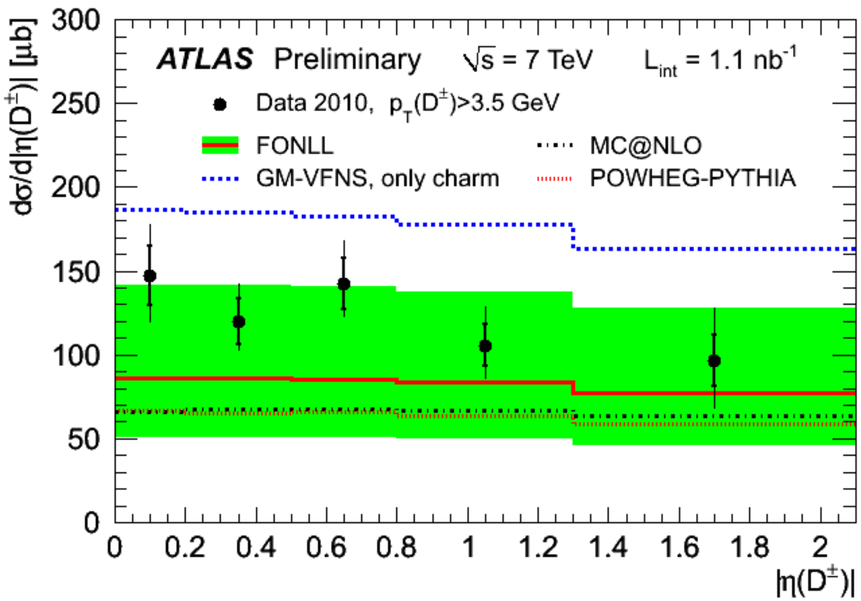


FONLL predictions updated using http://www.lpthe.jussieu.fr/~cacciari/fonll/fonllform.html modified by Matteo Cacciari on our request

$D^{\pm}$ differential x-sections vs $\eta(D^{\pm})$

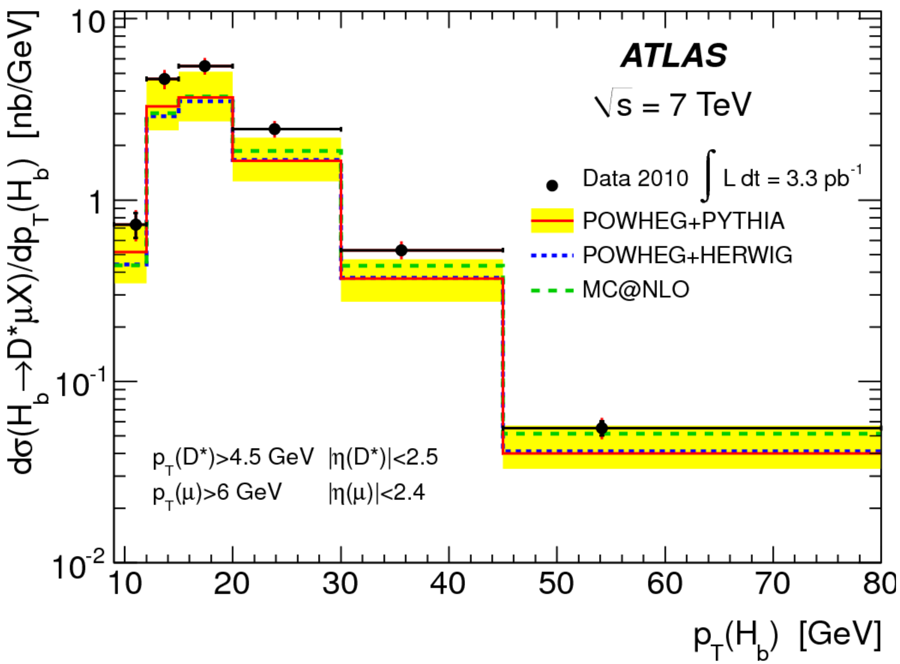


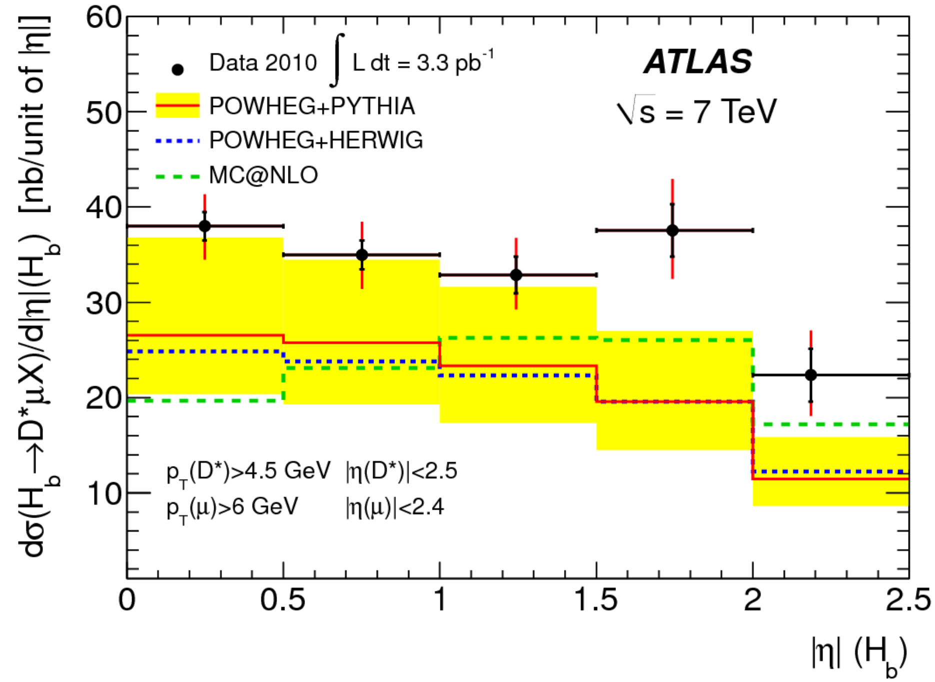




FONLL predictions updated using http://www.lpthe.jussieu.fr/~cacciari/fonll/fonllform.html modified by Matteo Cacciari on our request

$d\sigma(H_b \to D^* \mu X)/dp_T(|\eta|)(H_b)$ differential cross sections





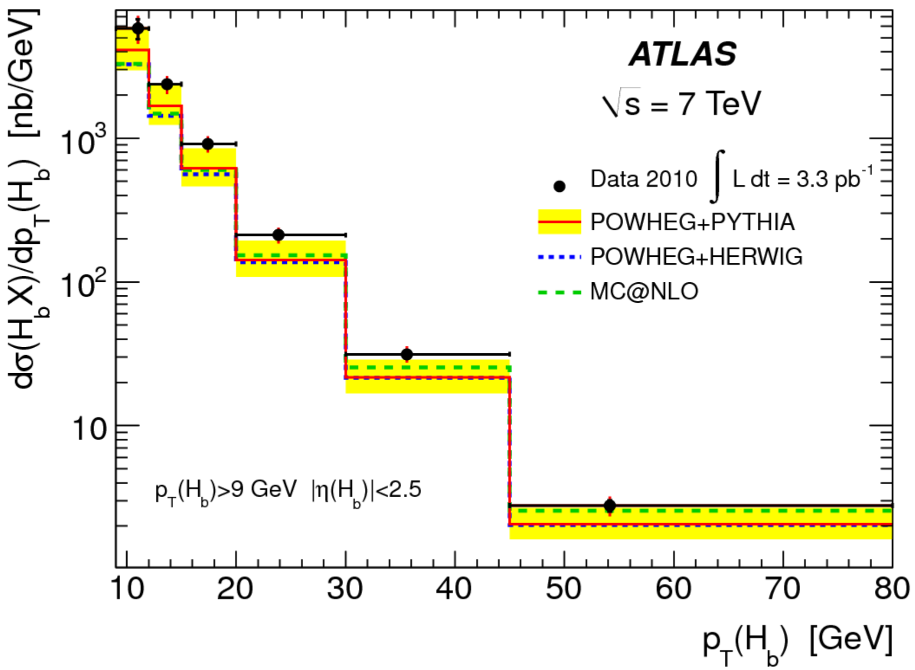
NLO+LL QCD predictions are below the data

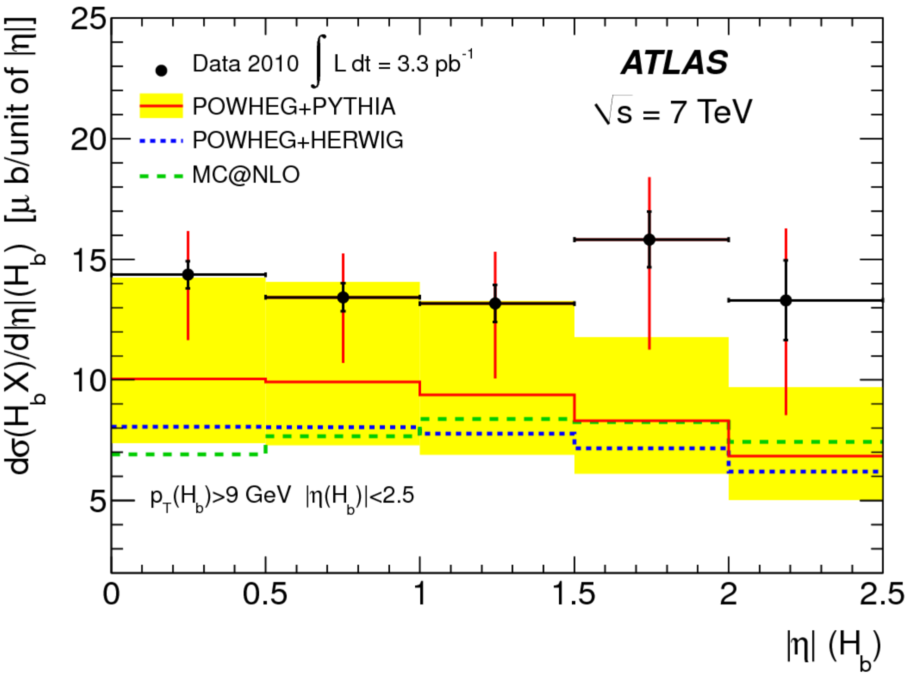
consistent within large theoretical uncertainties

Branching (PDG) and decays acceptance correction (with NLO MC)

for $H_b \to D^* \mu$ decay →

$d\sigma(H_b)/dp_T(|\eta|)(H_b)$ differential cross sections





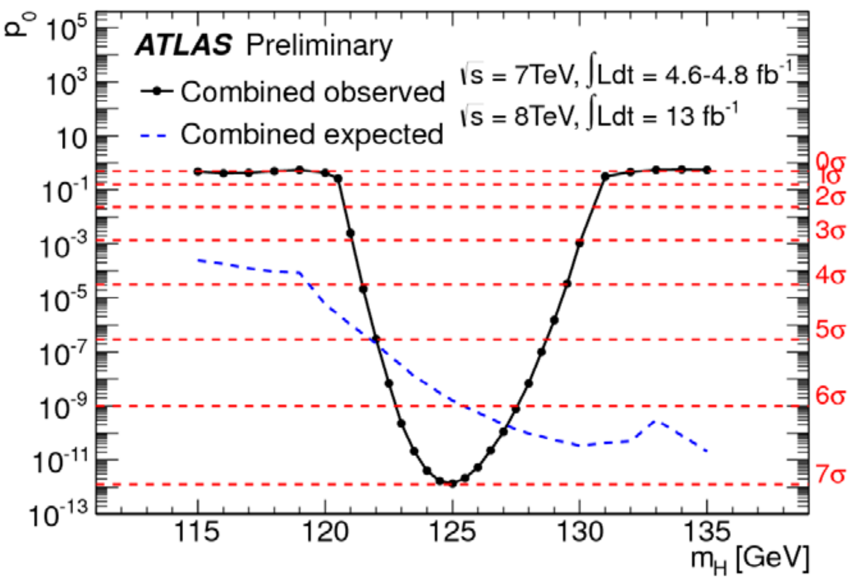
Systematic uncertainties are larger due to theoretical uncertainties of NLO MC used for the acceptance correction (α)

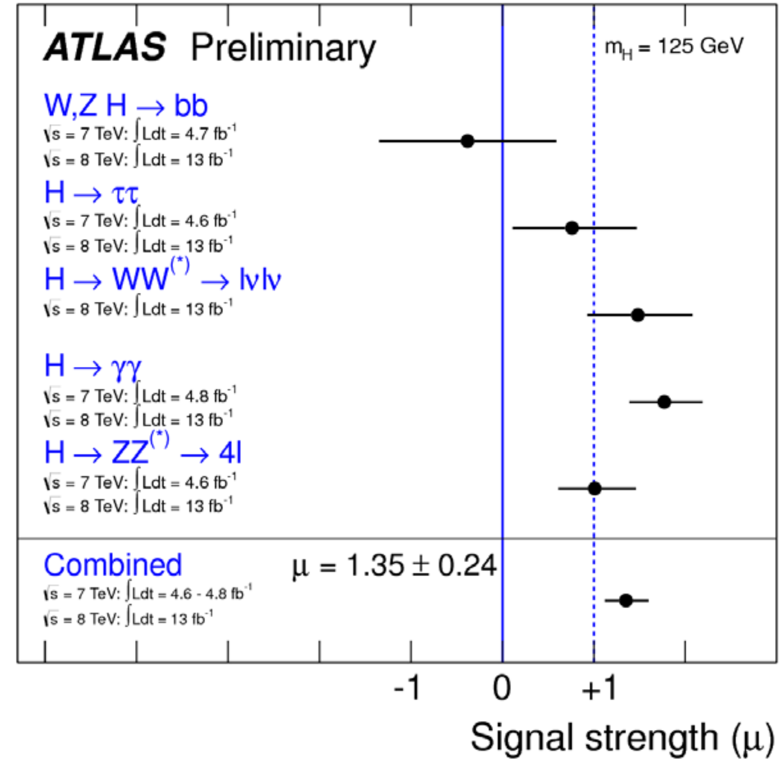
$p_T(H_b) > 9$ GeV and $|\eta(H_b)| < 2.5$

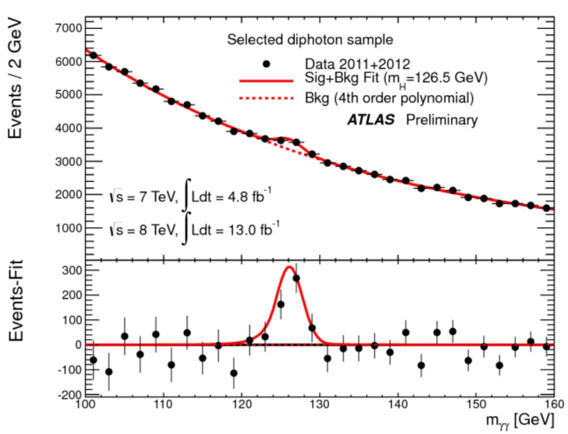
Integrated values:

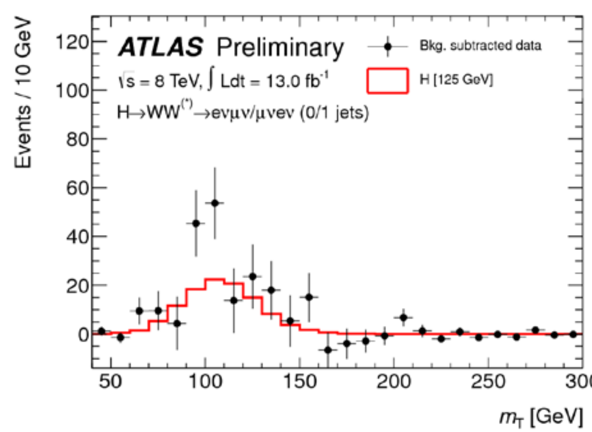
data: $\sigma(H_bX) = 32.7 \pm 0.8(stat) \pm 3.1(syst)^{+2.1}_{-5.6}(\alpha) \pm 2.3(\mathscr{B}) \pm 1.1(\mathscr{L})\,\mu b$

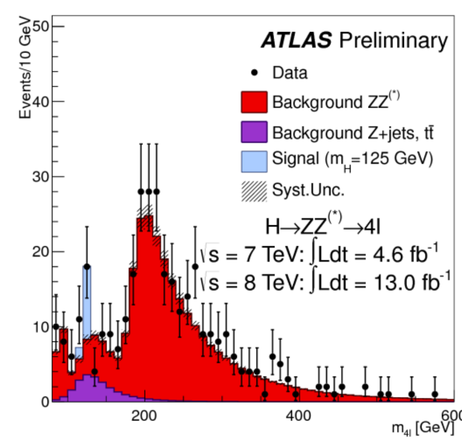
PowhegPythia: $\sigma(H_bX) = 22.2^{+8.9}_{-5.4}(scale)^{+2.1}_{-1.9}(m_b)^{+2.2}_{-2.1}(PDF)^{+1.6}_{-1.5}(hadr)\,\mu b$


ATLAS Preliminary
Combined observed
Combined expected
√s = 7TeV, ∫Ldt = 4.6-4.8 fb⁻¹
√s = 8TeV, ∫Ldt = 13 fb⁻¹
p0
0σ
1σ
2σ
3σ
4σ
5σ
6σ
7σ
mH [GeV]


ATLAS Preliminary
mH = 125 GeV
W,Z H → bb
√s = 7 TeV: ∫Ldt = 4.7 fb⁻¹
√s = 8 TeV: ∫Ldt = 13 fb⁻¹
H → ττ
√s = 7 TeV: ∫Ldt = 4.6 fb⁻¹
√s = 8 TeV: ∫Ldt = 13 fb⁻¹
H → WW(*) → lνlν
√s = 8 TeV: ∫Ldt = 13 fb⁻¹
H → γγ
√s = 7 TeV: ∫Ldt = 4.8 fb⁻¹
√s = 8 TeV: ∫Ldt = 13 fb⁻¹
H → ZZ(*) → 4l
√s = 7 TeV: ∫Ldt = 4.6 fb⁻¹
√s = 8 TeV: ∫Ldt = 13 fb⁻¹
Combined
μ = 1.35 ± 0.24
√s = 7 TeV: ∫Ldt = 4.6 - 4.8 fb⁻¹
√s = 8 TeV: ∫Ldt = 13 fb⁻¹
Signal strength (μ)


Selected diphoton sample
Data 2011+2012
Sig+Bkg Fit (mH=126.5 GeV)
Bkg (4th order polynomial)
ATLAS Preliminary
√s = 7 TeV, ∫Ldt = 4.8 fb⁻¹
√s = 8 TeV, ∫Ldt = 13.0 fb⁻¹
Events / 2 GeV
Events-Fit
mγγ [GeV]


ATLAS Preliminary
√s = 8 TeV, ∫ Ldt = 13.0 fb⁻¹
H→WW(*)→eνμν/μνeν (0/1 jets)
Bkg. subtracted data
H [125 GeV]
Events / 10 GeV
mT [GeV]


ATLAS Preliminary
Data
Background ZZ(*)
Background Z+jets, tt̄
Signal (mH=125 GeV)
Syst.Unc.
H→ZZ(*)→4l
√s = 7 TeV: ∫Ldt = 4.6 fb⁻¹
√s = 8 TeV: ∫Ldt = 13.0 fb⁻¹
Events/10 GeV
m4l [GeV]