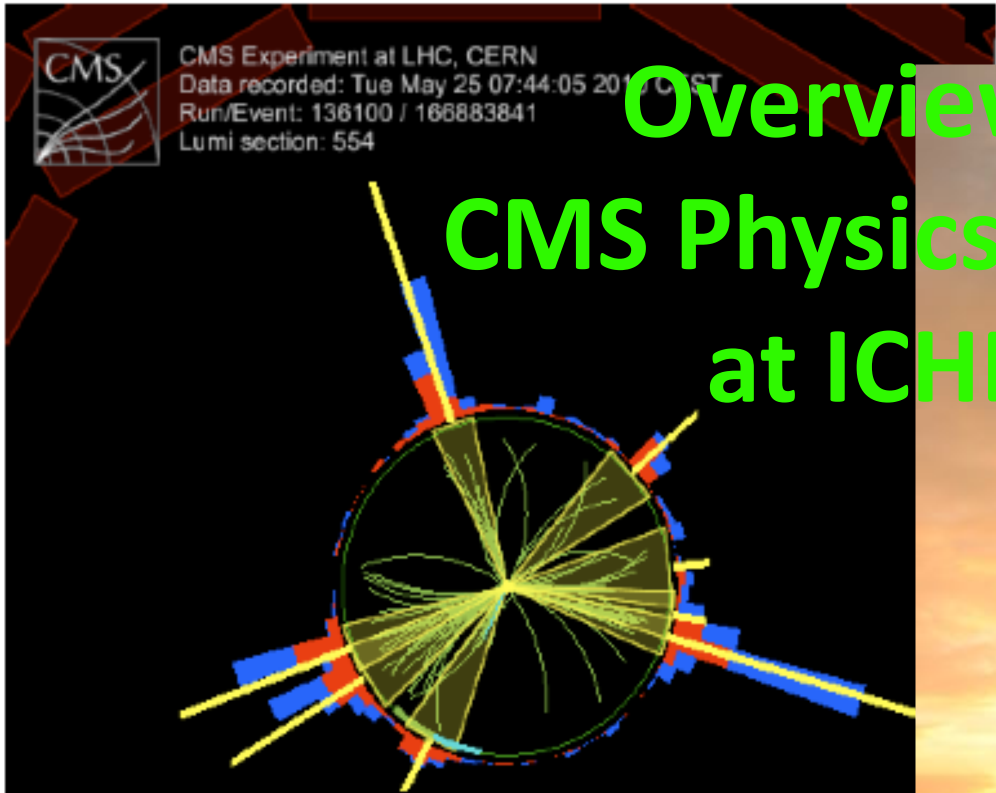
Overview of CMS Physics Results at ICHEP



Ilaria Segoni (CERN)
for the CMS collaboration

LHC Physics Day
Aug 6th 2010

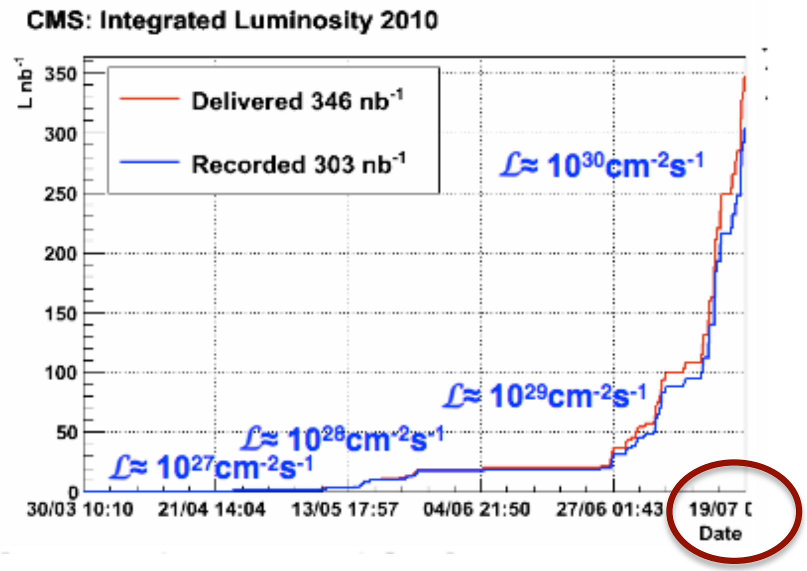
Outline

- Data Taking overview
- Soft QCD, Jet production cross sections
- Onia (bb-cc) Production
- W and Z physics
- Top
- Conclusions & Overview of Searches

More details in the CMS ICHEP Talks during the parallel sessions and CMS PAS'es:

http://cdsweb.cern.ch/collection/CMS%20Physics%20Analysis%20Summaries?ln=en&as=1

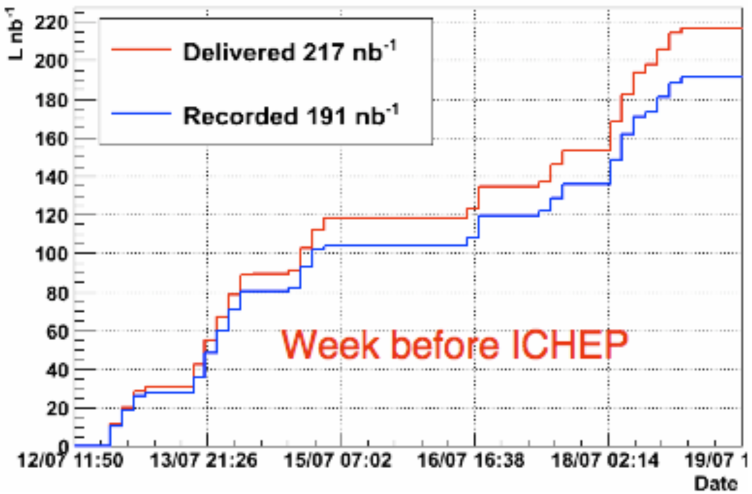
Data Taking up to ICHEP



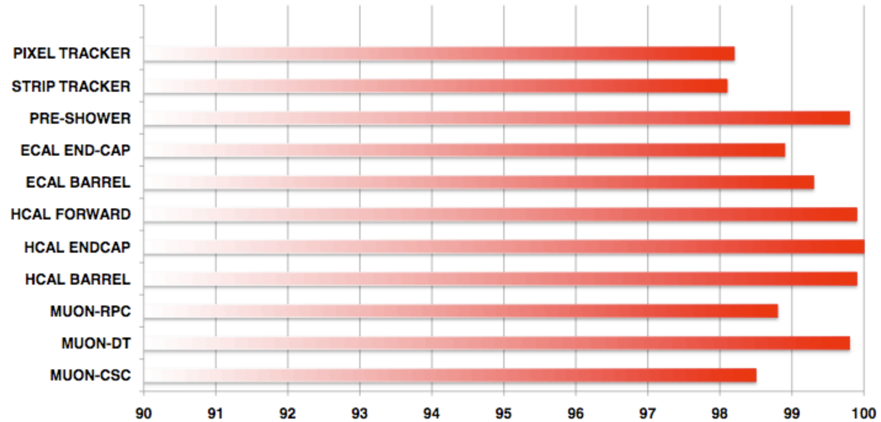
← After recording, runs and Luminosity Sections are validated to filter only highest quality data for physics analyses. By July 19th:

280nb^{-1} of good data with looser requirements (muon analyses) (254nb^{-1} of data validated with strictest requirements for blind usage in any analysis)

(Recorded Lumi = 743nb^{-1} as of Aug 4th)



SUBDETECTOR OPERATIONAL STATUS



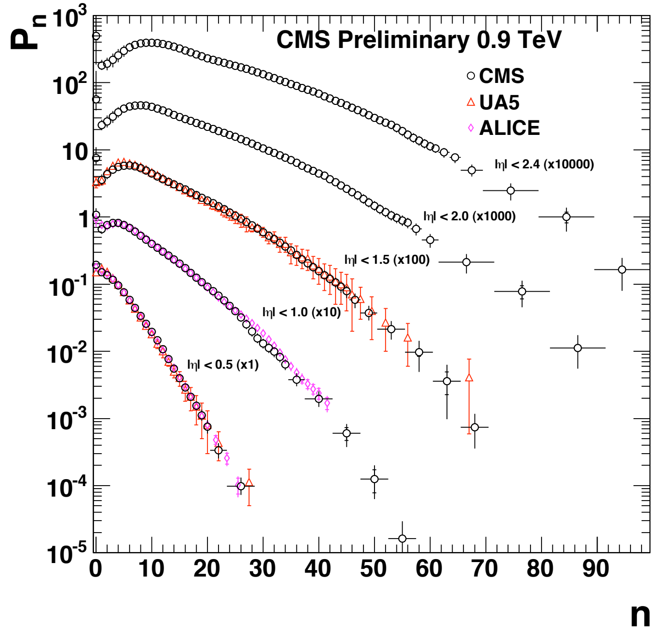
	MUON-CSC	MUON-DT	MUON-RPC	HCAL BARREL	HCAL ENDCAP	HCAL FORWARD	ECAL BARREL	ECAL END-CAP	PRE-SHOWER	STRIP TRACKER	PIXEL TRACKER	
Series1	98.5	99.8	98.8	99.9	100	99.9	99.3	98.9	99.8	98.1	98.2	

Soft QCD & Onia

Charged Particle Multiplicity

CMS PAS QCD-10-004

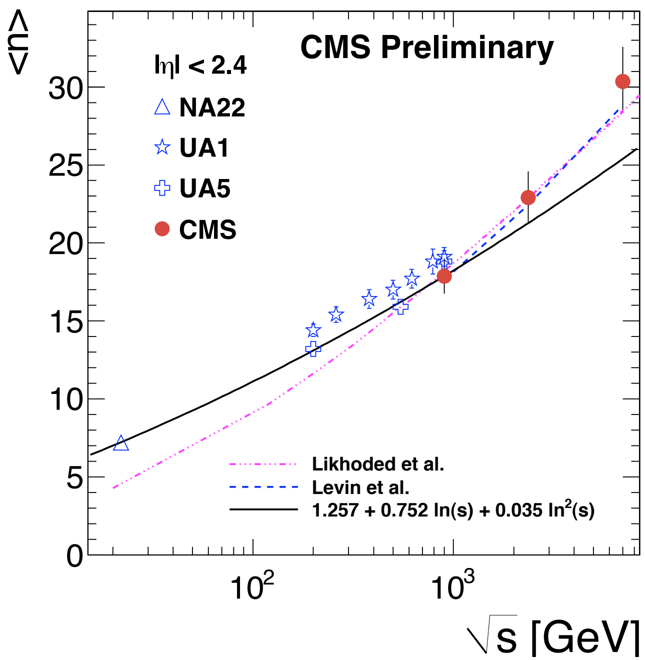
Measurement at 900GeV, 2.36TeV, 7TeV →scaling of particle multiplicity and $<P_T>$ vs sqrt(s) soft QCD test



- Selection optimized for NSD interactions
- Good tracking performance down to 100MeV

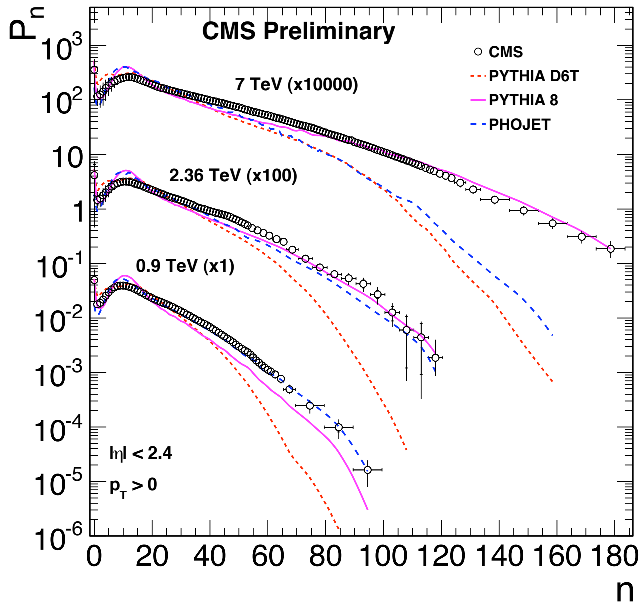
(results extrapolated to full P_T acceptance)

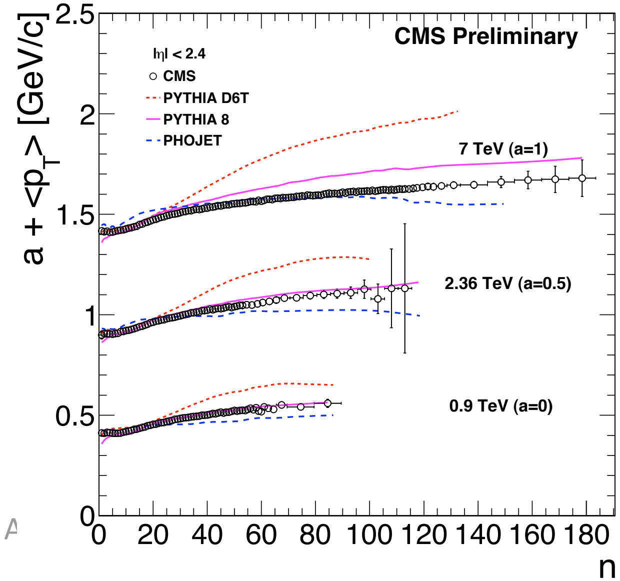
Systematics <10%. (40% in multiplicity region boundaries)



<n> measurements at 7TeV higher than extrapolations from lower energies

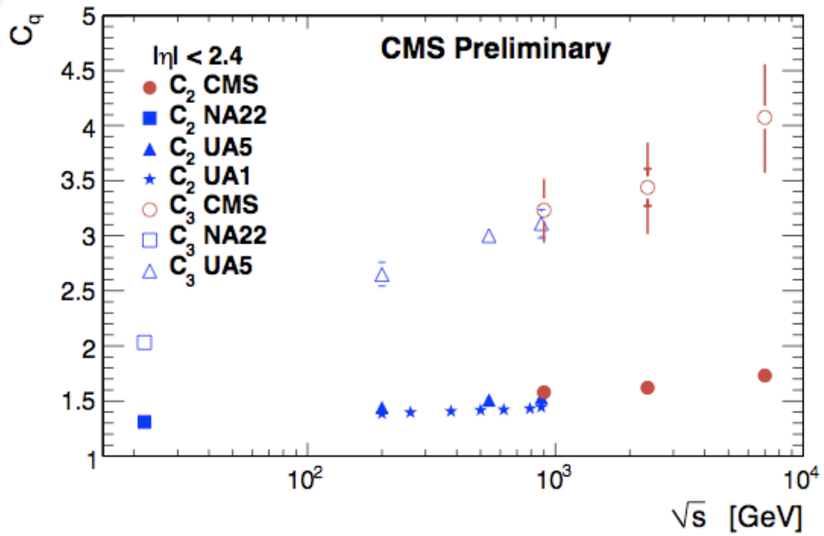
Charged Particle Multiplicity





Comparisons with Theory

Discrepancy with expectations, all simulations fail to reproduce particle multiplicity and average momentum in agreement with data at all sqrt(s)



Violation of KNO model confirmed (KNO: higher order momenta $C_q=\langle n^q\rangle/\langle n\rangle^q$ independent of sqrt(s))

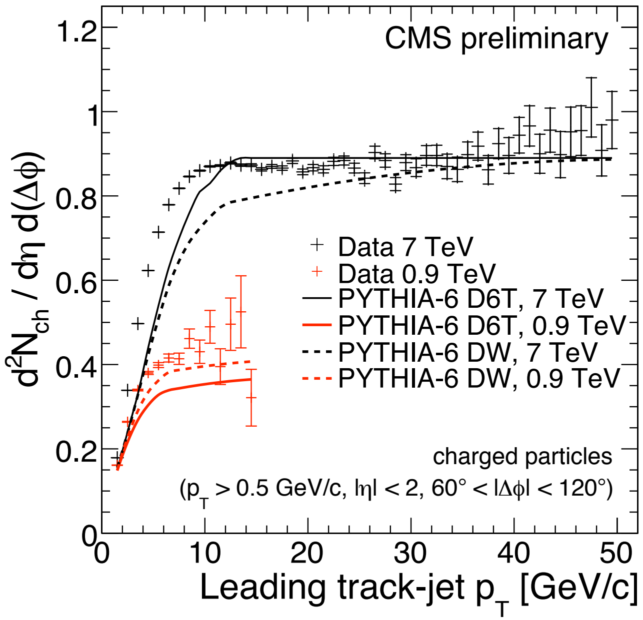
Underlying Event

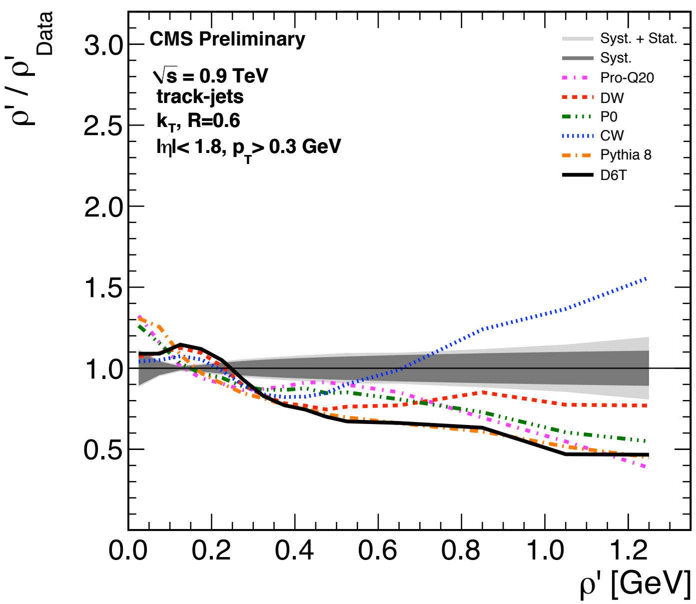
CMS PAS QCD-10-010/005

Average Track Multiplicity in Transverse region with respect to Jet P_T vs Leading Jet P:

New technique (A.Cacciari, G.P Salam and S.Sapeta JHEP, 04 (20010) 065) based on the median of Jet P_T/Jet Area ratio:

$$\rho' = \text{median}_{j \in \text{physical jets}} [\{\frac{P_{Tj}}{A_j}\}] \cdot C$$





Sensitivity to different PYTHIA Tuning of the UE Pattern of deviations Similar to results with Traditional (Track Multplicity) method

Underestimation of Track Multiplicity at Low leading Jet P_T in the predictions

Inclusive Jet $d\sigma/dP_T$

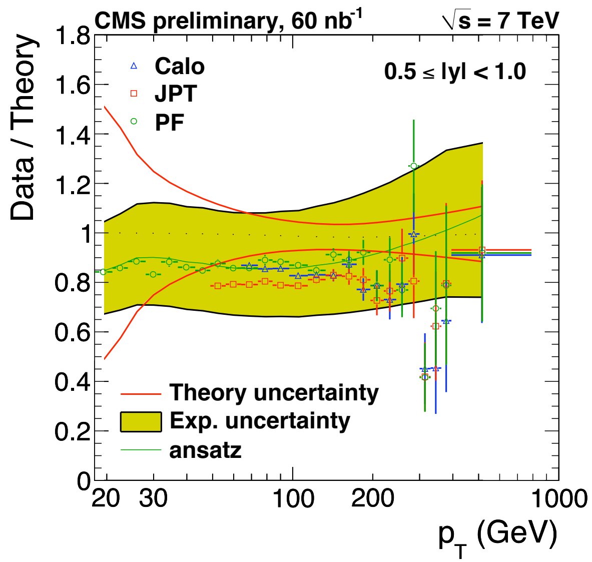
CMS PAS QCD-10-011

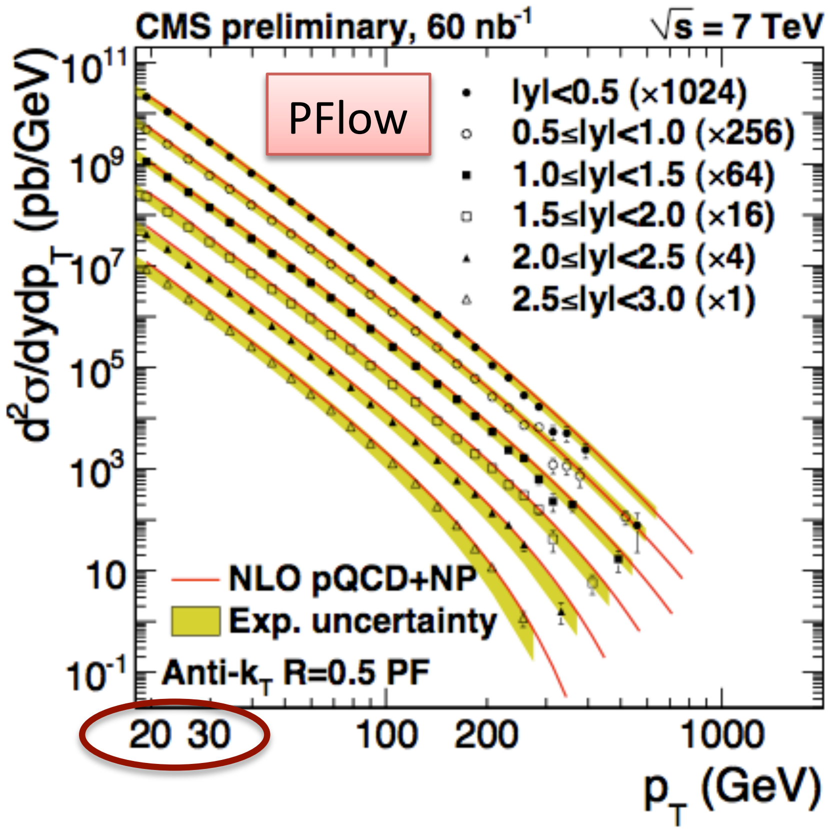
Int Lumi =60/nb
Jet E_T = 18GeV-100GeV

Theoretical uncertainty: non pert effects (Pythia-Herwig),
PDF's (different DPF's in CTEQ-6.6 Set),
Factorization/renormalization scale ($P_T/2$ and $2P_T$)

Exp uncertainty from Luminosity measurements (11%) and Jet Energy Scale (JES):
JES at 5%(10%) for Pflow and JPT (Calo)
+ 2% increase with raising $|\eta|$.
Jet Energy Resolution 10%

Conservative MC-based JES estimates with x-checks in data. E.g. agreement on response better than 1%(5%) in ECAL(HCAL)

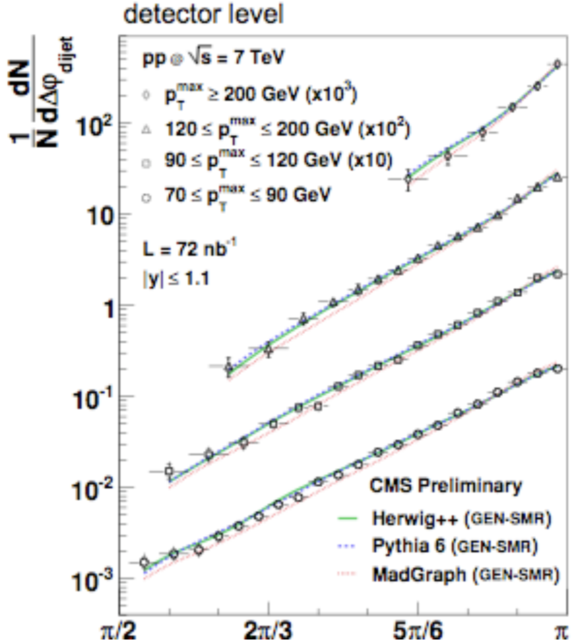




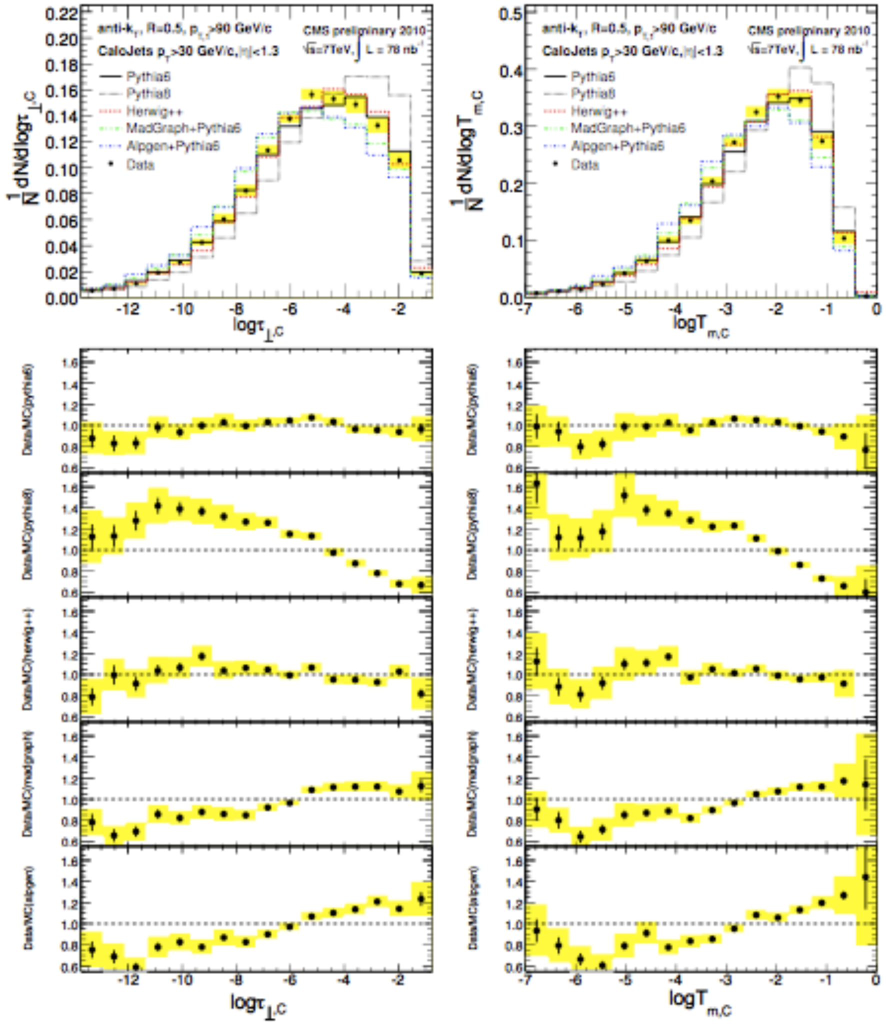
Results on Jets and Event Characterization for test of QCD calculations, models tuning

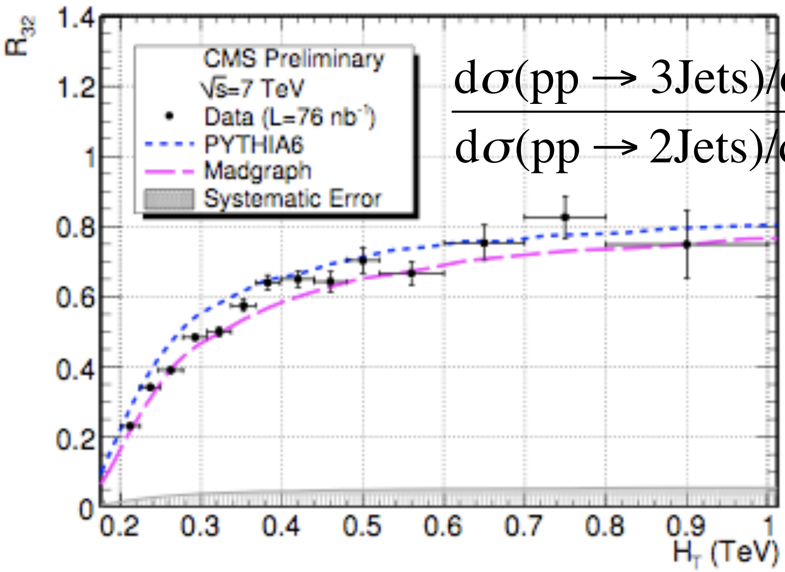
CMS PAS'es QCD-10-011/012/015

Dijet Azimuthal → decorrelation sensitive to higher order QCD (ISR)



Hadronic event shape already powerful, best agreement: PYTHIA D6T, HERWIG++





$$R_{32} = \frac{d\sigma(pp \to 3Jets)/dH_T}{d\sigma(pp \to 2Jets)/dH_T}$$

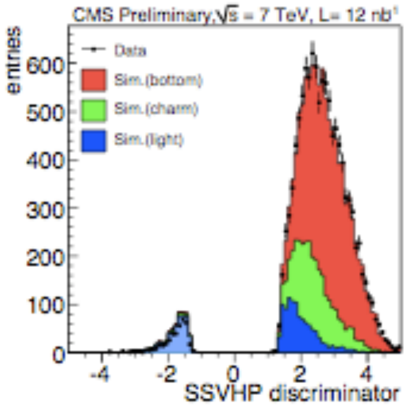
b Jets Production

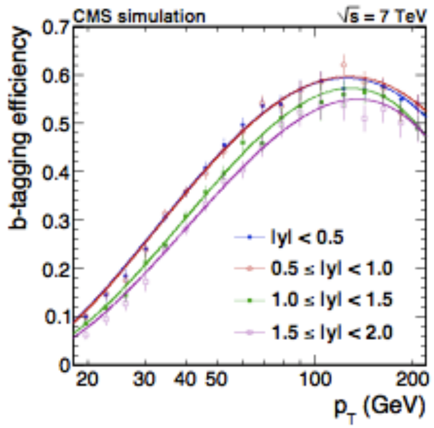
CMS PAS BPH-10-009

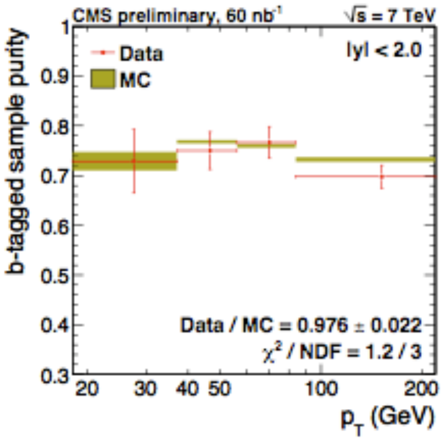
Bjets tagged by secondary VTX with at least 3 Tracks

- 3D Decay length significance used to reject charm

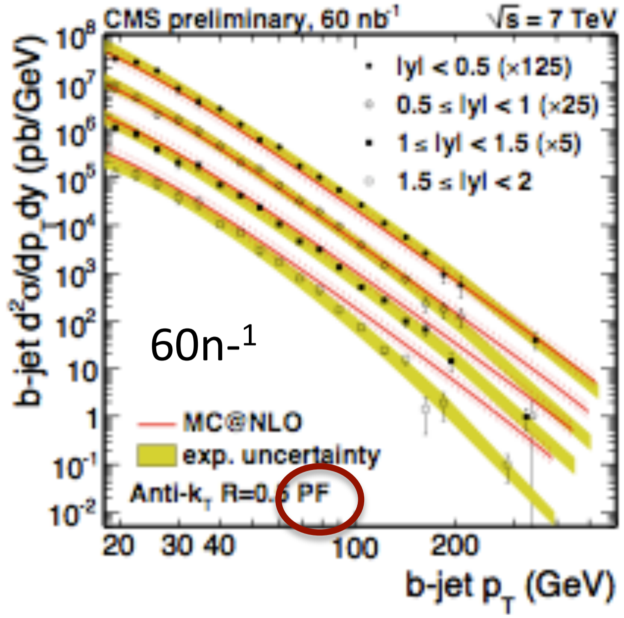
Tagging eff & mis-tagging rate from MC after validation with data driven methods ($P_T(\mu)^{rel}$, 2^{dn} VTX mass)

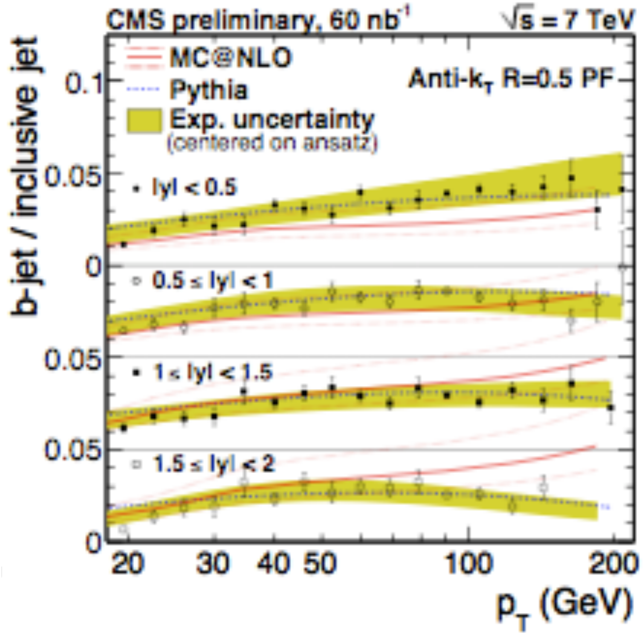






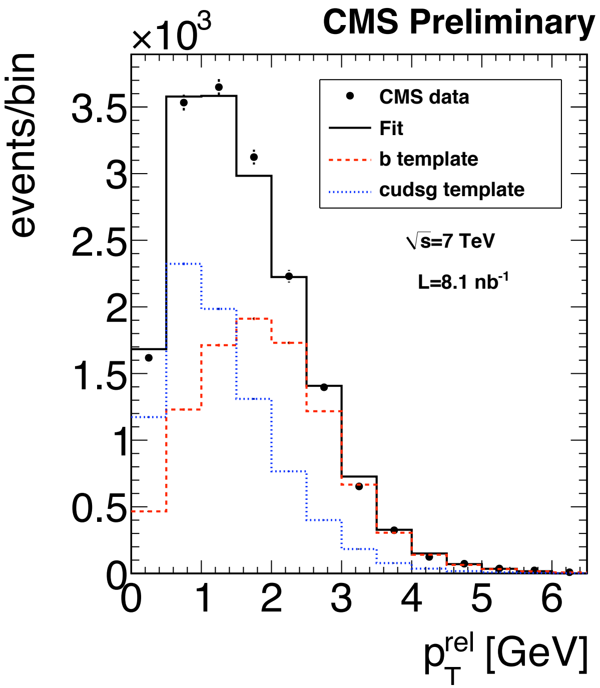
← Sample purity from template fit to secondary VTX invariant mass





b Production

CMS PAS BPH-10-007



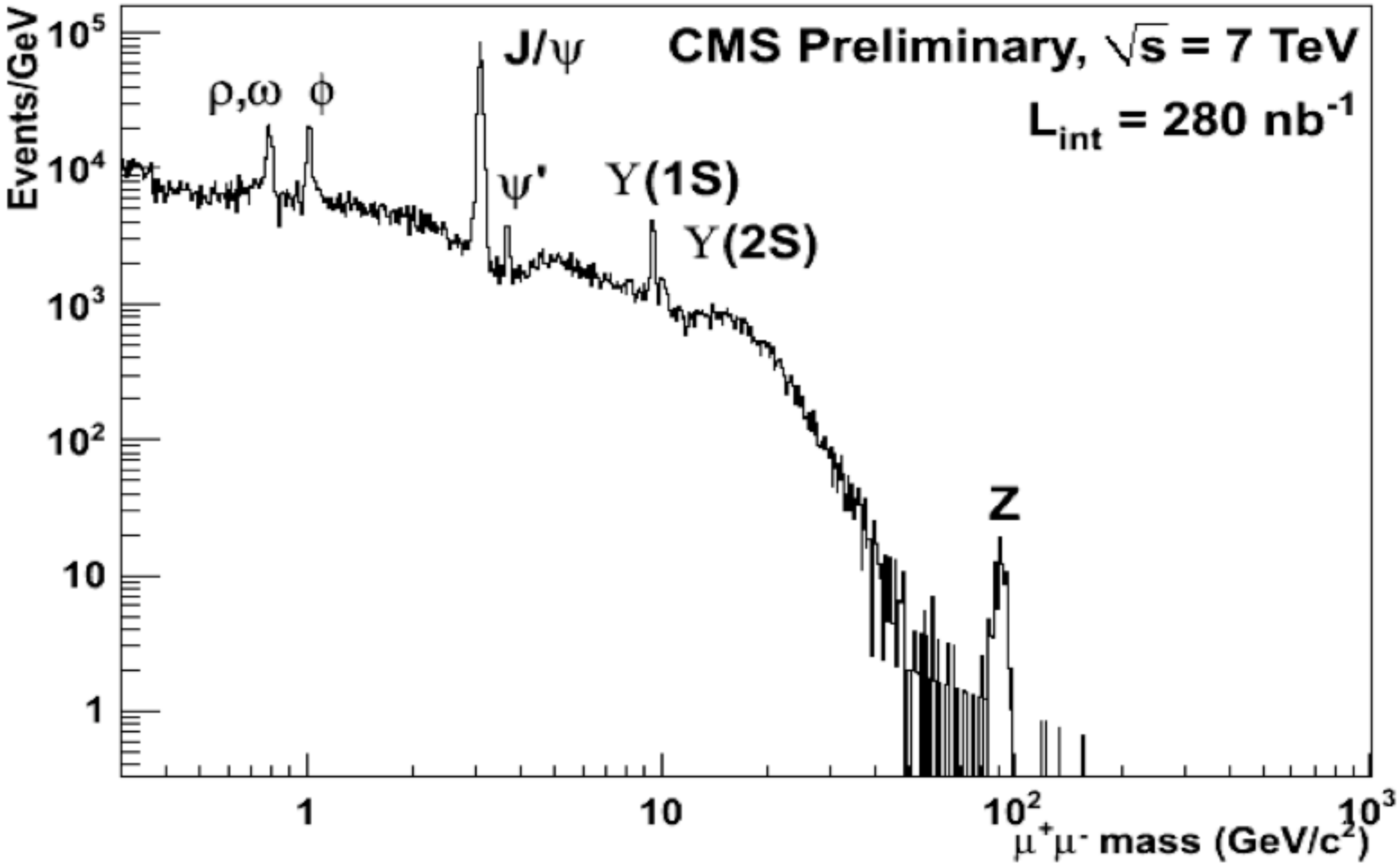
An alternative approach uses template fits to the distribution of $P_T(\mu)^{rel}$: P_T of muon relative to associated Jet axis (Anti-kT with R=0.5)

Template fit to $P_T(\mu)^{rel}$ to determine b events.

c and b templates from MC, light flavor template from hadronic events (passing muon kinematics but not ID selection). c and light templates combined in fit

σ = (1.48 ± 0.04(stat) ± 0.22(syst) ± 0.16(lumi)) μb.

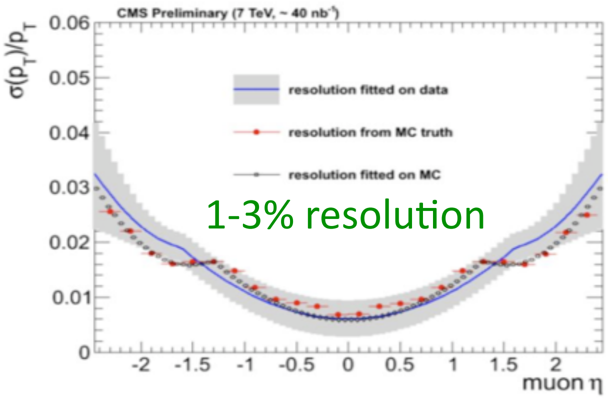
Di-muon Mass Spectrum

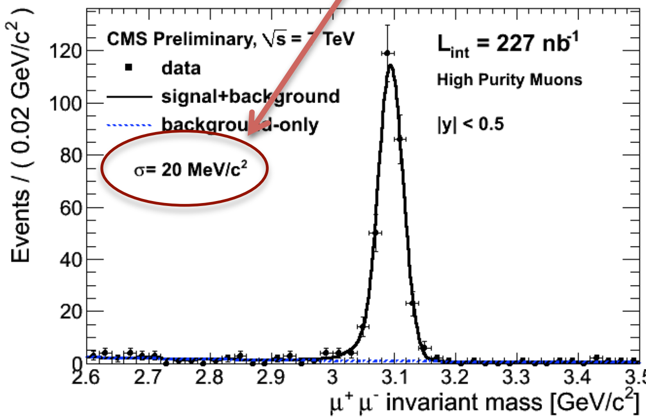


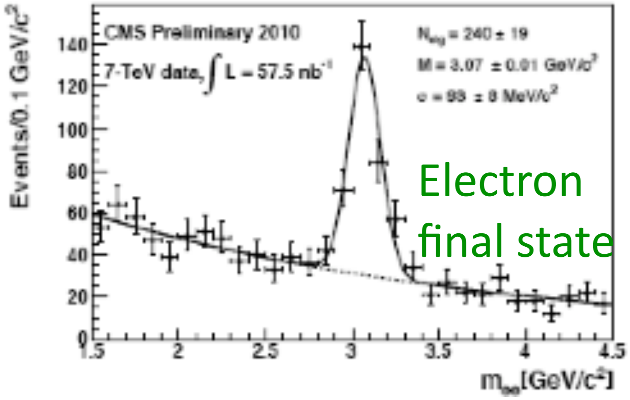
Onia: J/Ψ Inclusive Production

CMS PAS BPH-10-002

CMS working at design specs!





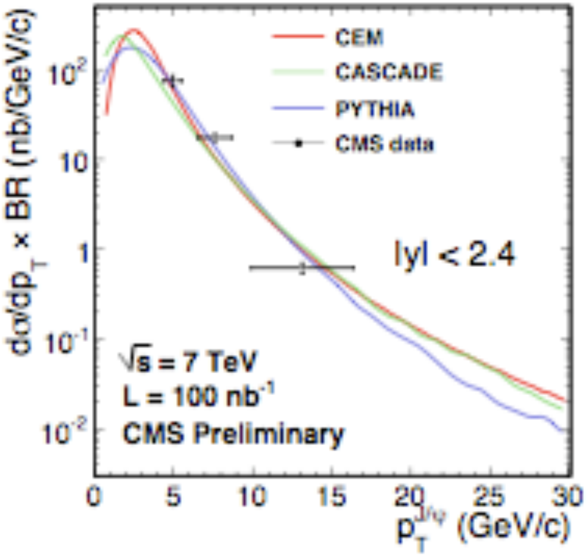


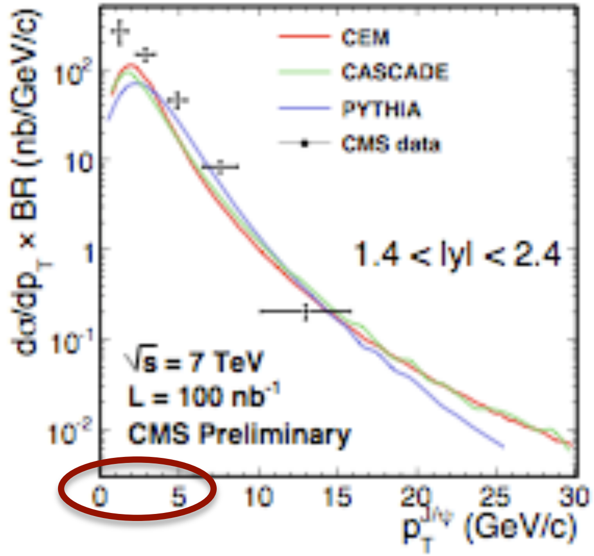
Direct/indirect quarkonia production Mechanisms. Direct production not fully understood

Results for 5 different polarization Scenarios (20%-30% effect)

Dedicated HLT path with very high efficiency (~50K J/Ψ per pb^{-1} up to E^{31} down to very Low P_T)

Largest Syst from Lumi & Muon Efficiency (Tag&Probe)

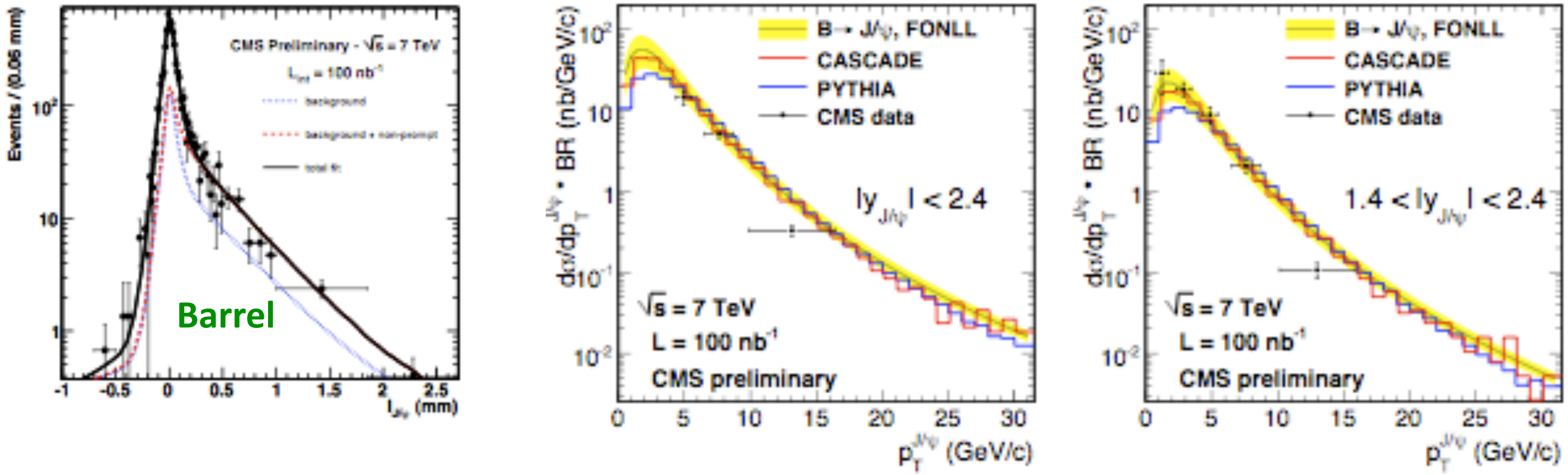




σ_{INCL} *BR= 289.1 ±16.7(stat)±60.1(syst) nb (P_T within 4-30GeV/c, |η|<2.4)

J/Ψ Production from B Decays

Unbinned ML fit to transverse decay length to disentangle from prompt production



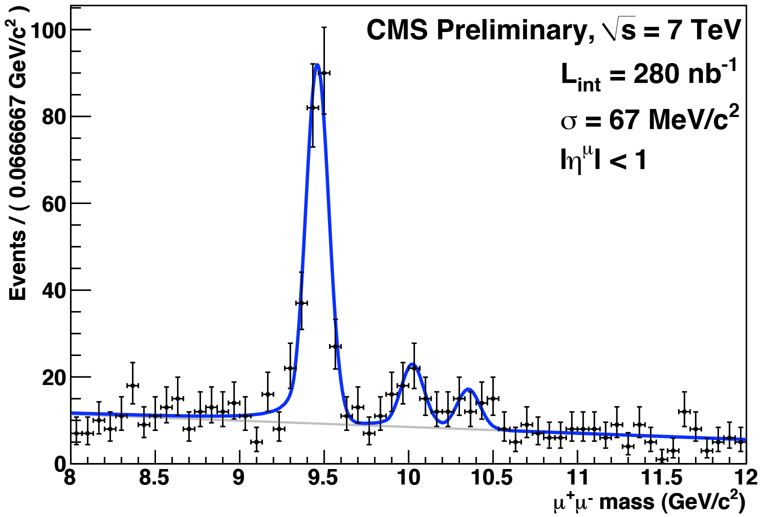
Polarization measured by BaBar at the Υ(4s) Taken into account in the systematics (from difference wrt EVTGEN prediction)

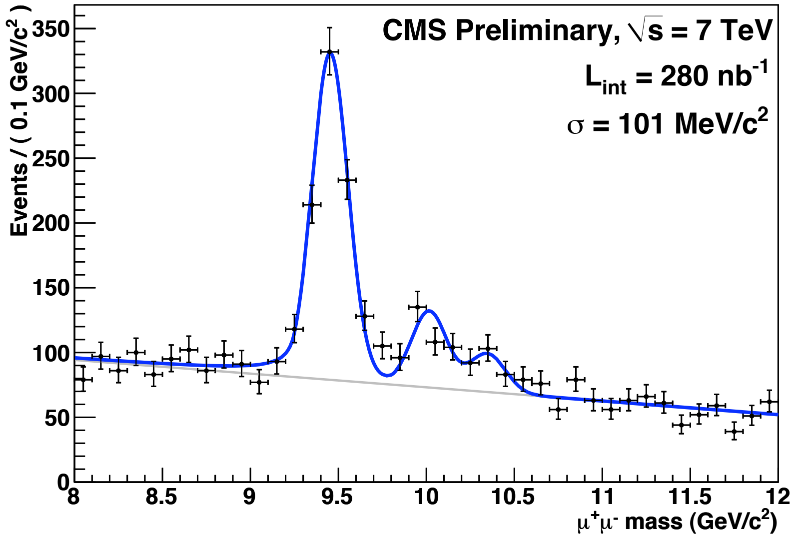
RESULTS on J/Ψ Production cross sections:

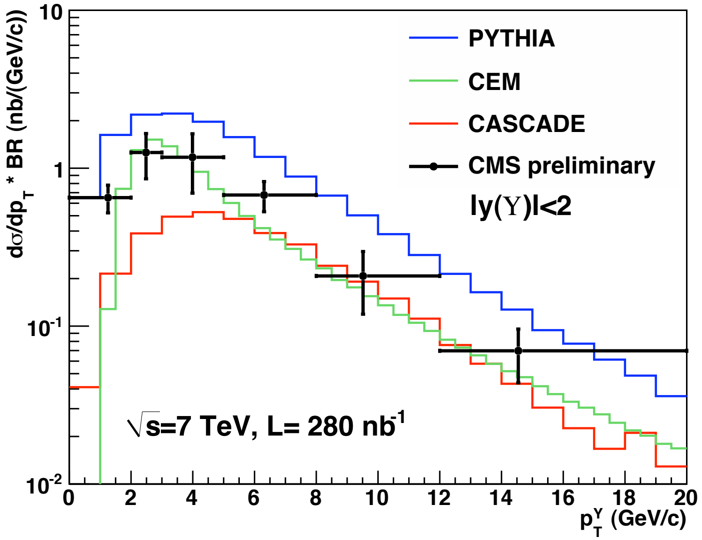
σ_{INCL} *BR= 289.1 ±16.7(stat)±60.1(syst) nb (P_T within 4-30GeV/c, |η|<2.4)

$\sigma_{NON\ PROMPT}$*BR= 56.1±5.5(stat)±7.2(syst) nb

Υ Production







Υ(1S) Inclusive cross section measurement and Υ(2S)+Υ(3S)/Υ(1S) ratio measurement:

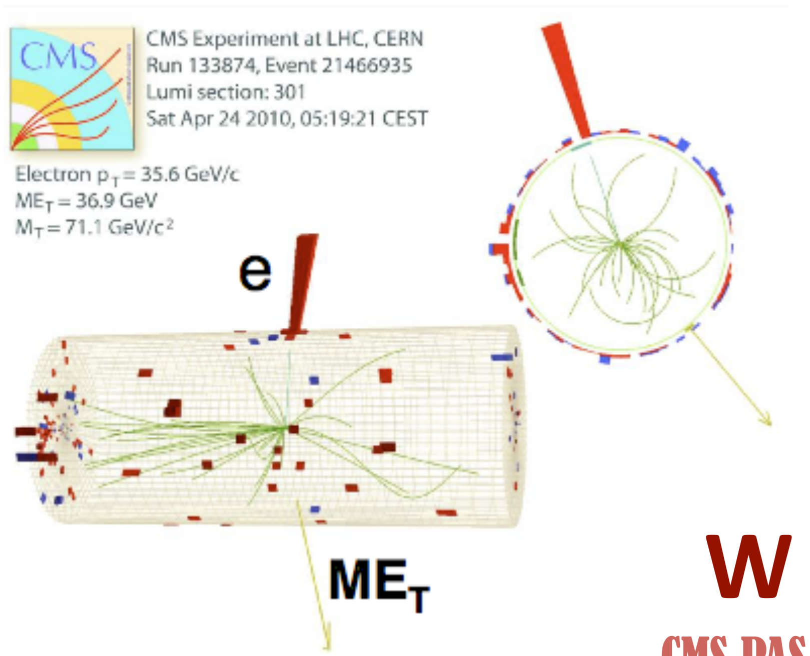
RESULTS:

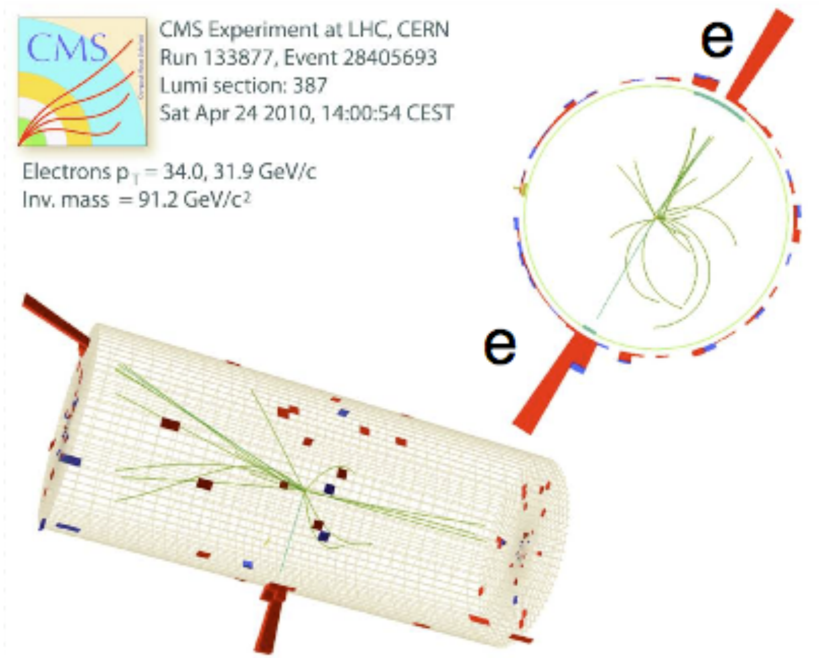
$\sigma(pp \rightarrow \Upsilon(1S)X) \cdot B(\Upsilon(1S) \rightarrow \mu\mu) = (8.3 \pm 0.5 \pm 0.9 \pm 1.0)$nb

$\sigma(pp\ \Upsilon(2S)X) + \sigma(pp\ \Upsilon(3S)X)] / \sigma(pp\ \Upsilon(1S)X) =$

$0.44 \pm 0.06 \pm 0.07$

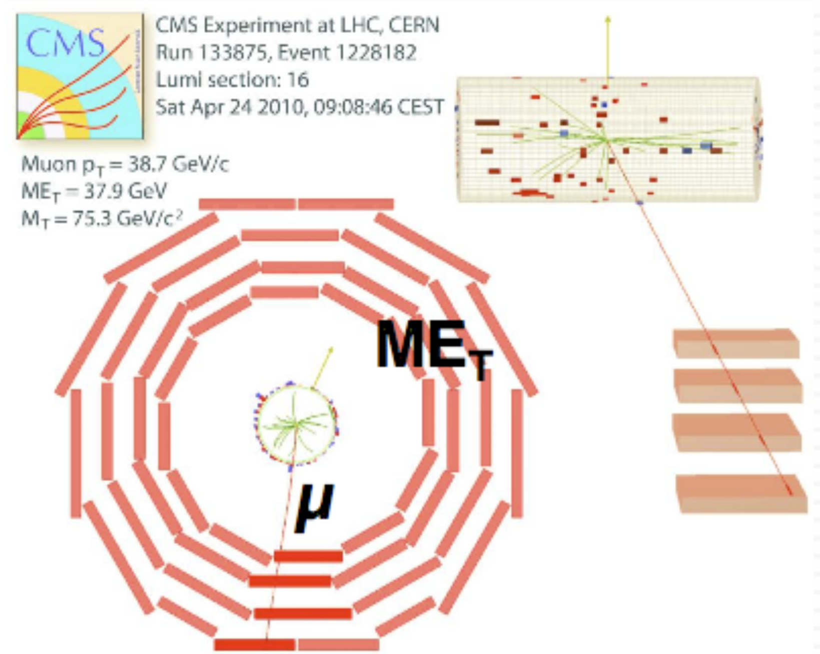
CMS PAS BPH-10-003

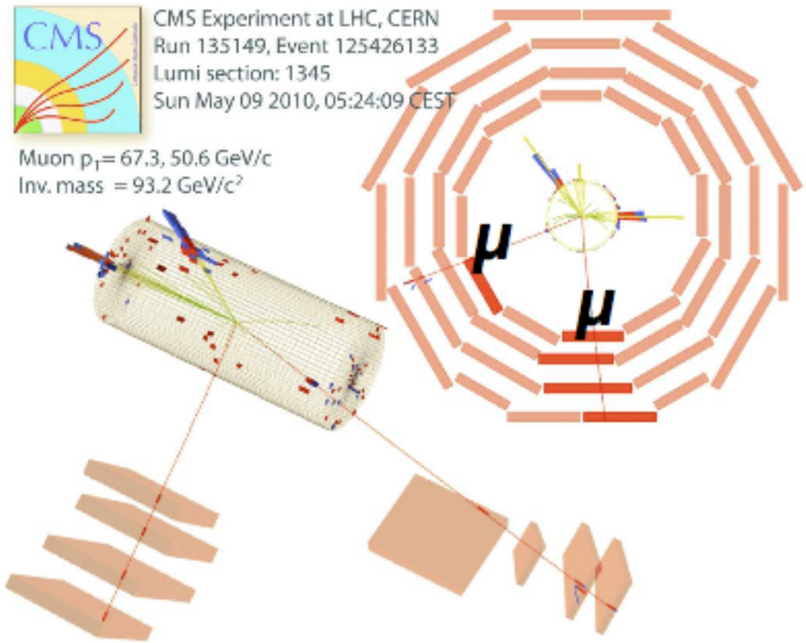




W and Z

CMS PAS EWK-10-002

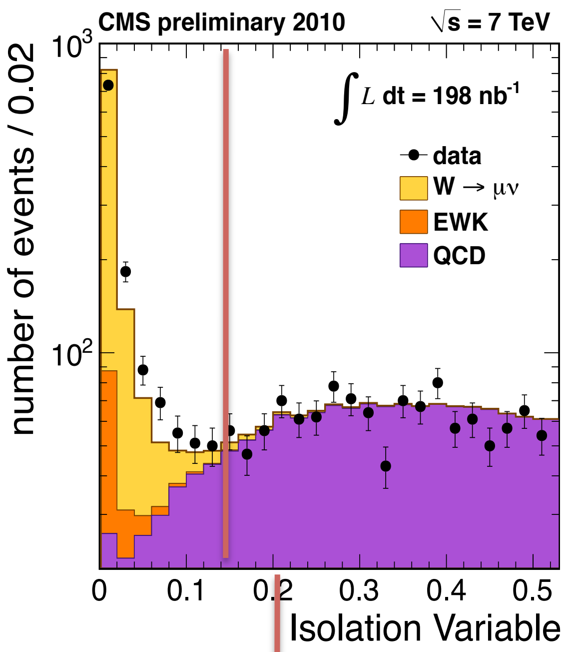




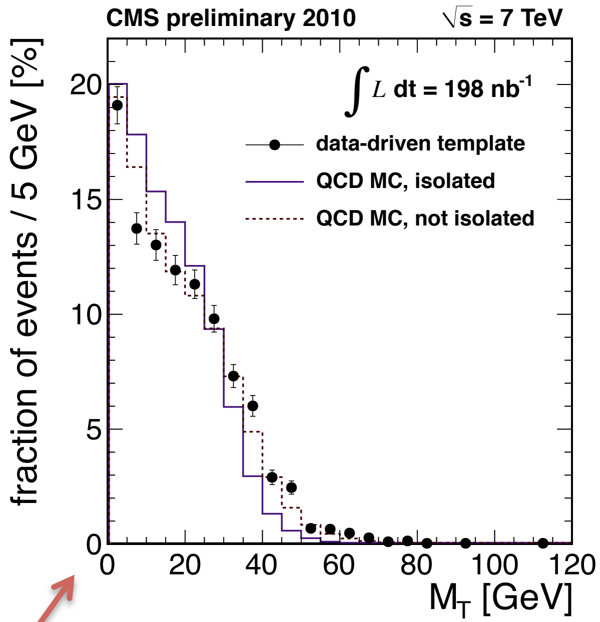
W and Z in μ channel

Selection: HLT:P_T>9GeV/c, |η|<2.1. W(μν)):P_T>20GeV/c, MuonID (tracker-muons chamber consistency, fit quality, punch through rejection), Drell-Yan rejection for W (veto on second Muon with P_T>10GeV)

$$\text{Combined Relative Isol} = \frac{\sum_{R<0.3} P_T^{Track} + \sum_{R<0.3} E_T^{ECAL} + \sum_{R<0.3} E_T^{HCAL}}{P_T^{Lepton}}$$



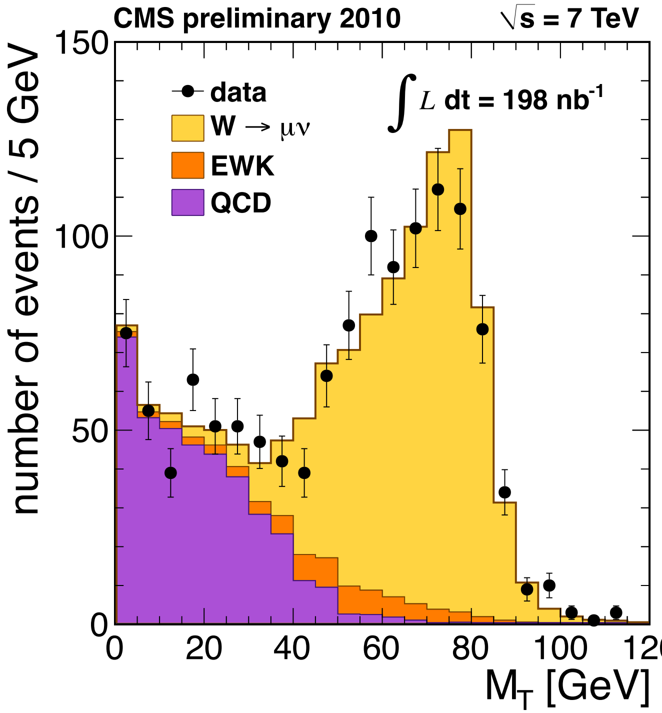
Inverted cut for QCD control sample

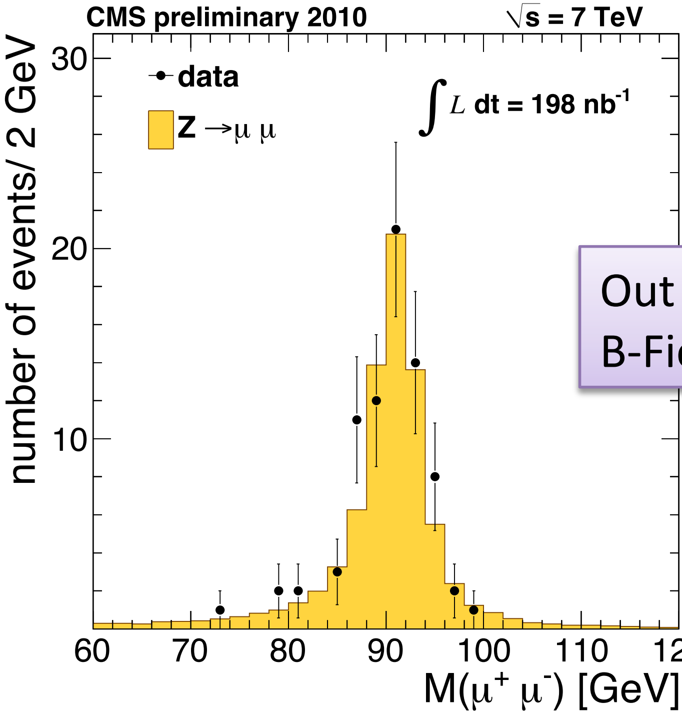


Z→μμ: looser ID for 2^{nd} P_T μ. Track-based only isolation.
Signal extraction: cut and count (bkg level 0.3%)

W Signal Extracted with binned ML (Signal, EWK BKG, QCD BKG). Shapes for EWK from MC with efficiency correction factor (0.98+-0.03), QCD from data control sample, systematic from two MC templates (3.5%)

W and Z in μ channel Signal extraction





Out of the box B-Field map!!

With Particle Flow algorithm excellent angular (and energy) resolution on MET allowing for unprecedentely seen separation of processes with and without real missing transverse energy

$\sigma(pp \rightarrow W + X) \times BF(W \rightarrow \mu\nu) = 9.14 \pm 0.33$ (stat.) nb

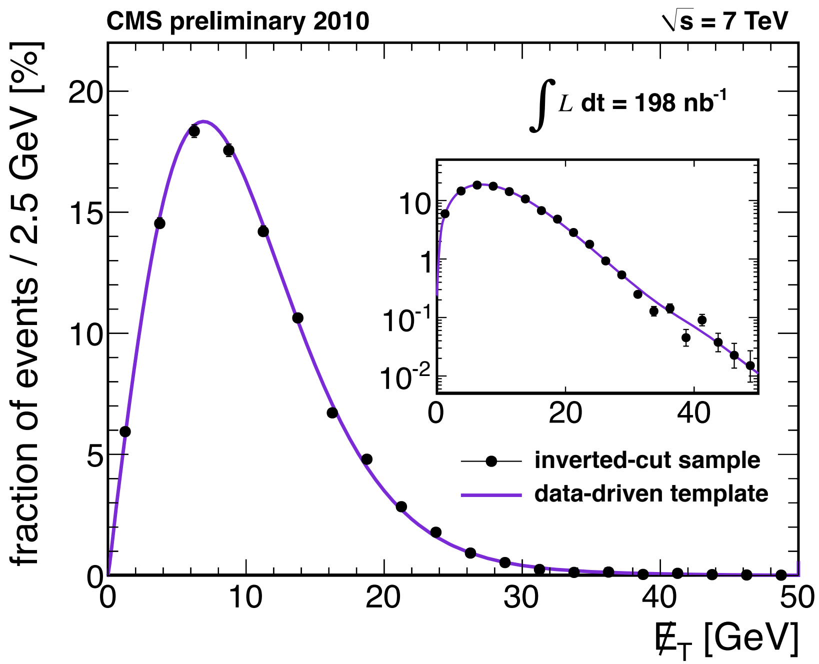
$\sigma(pp \rightarrow W^{+} + X \rightarrow \mu^{+}\nu + X) = 5.75 \pm 0.26$ (stat.) nb

$\sigma(pp \rightarrow W^{-} + X \rightarrow \mu^{-}\nu + X) = 3.39 \pm 0.15$ (stat.) nb

$\sigma(pp \rightarrow /(\gamma^{*} + X \rightarrow \mu^{+}\mu^{-} + X) = 0.881 \pm 0.104$(stat)nb

W and Z in e channel

Selection: HLT: ECAL cluster with E_T>15GeV. W(eν): E_T>20GeV, |η|<2.5+ EB-EE transition region exclusion Electron ID based on ECAl-Tracker measurements matching, EM Fraction, shower shape along η direction requirements. Conversion rejected with requirement on no missing hits in the first tracker layers. Isolation (ECAl+ HCAL+Track) to reject electrons from (heavy and light) hadron decays



Selection optimized for 75% efficiency on W and 90% for Z

Z signal extracted with cut&count
W Signal extracted with unbinned ML (Signal, EWK BKG, QCD BK)

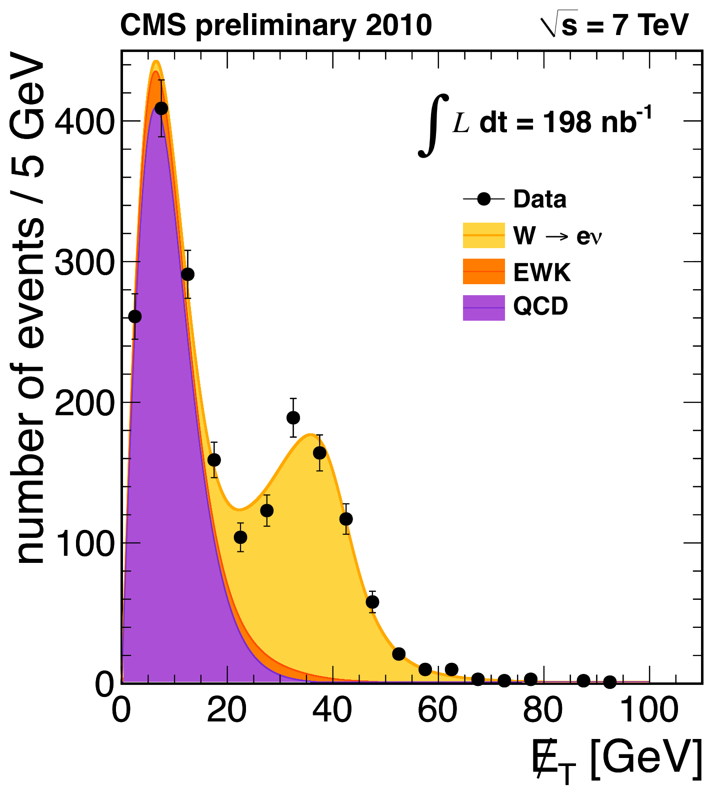
←QCD shape (modified Rayleigh):

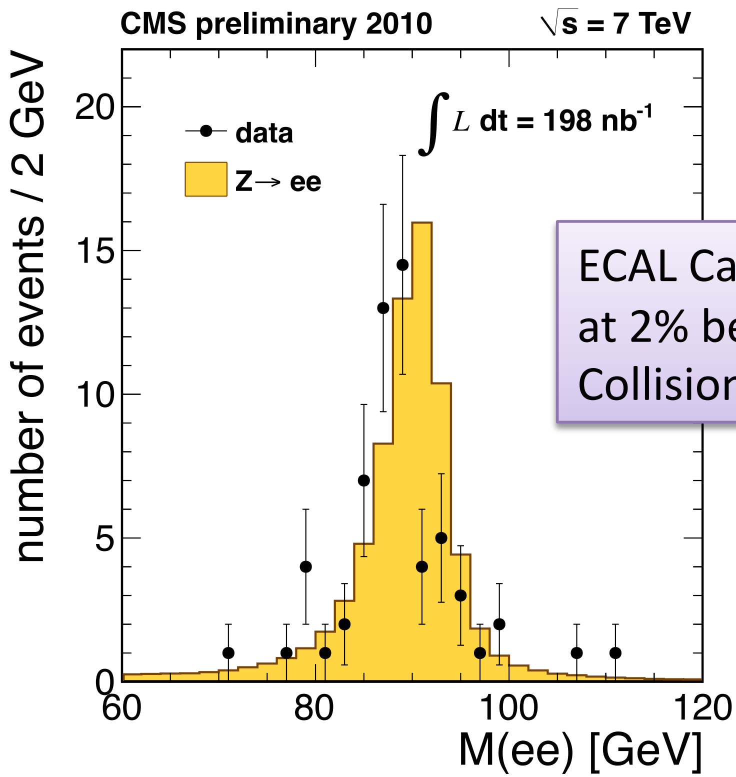
$x \exp(-x^2/2(\sigma_0 + \sigma_1 x)^2)$

σ_1 determined from control sample (floated in systematic studies (2.2%))

N_S, N_{QCD} and σ_0 free fit parameters

W and Z in e channel Signal extraction





ECAL Calibration at 2% before Collision data!

$\sigma(pp \rightarrow W + X) \times BF(W \rightarrow e\nu) = 9.34 \pm 0.36$ (stat.) nb

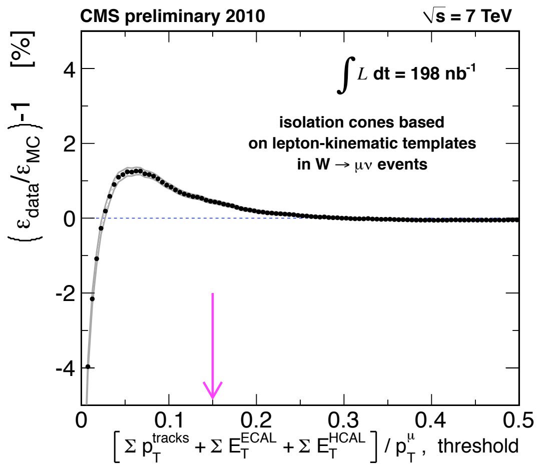
$\sigma(pp \rightarrow W^{+} + X \rightarrow e^{+}\nu + X) = 5.18 \pm 0.26$ (stat.) nb

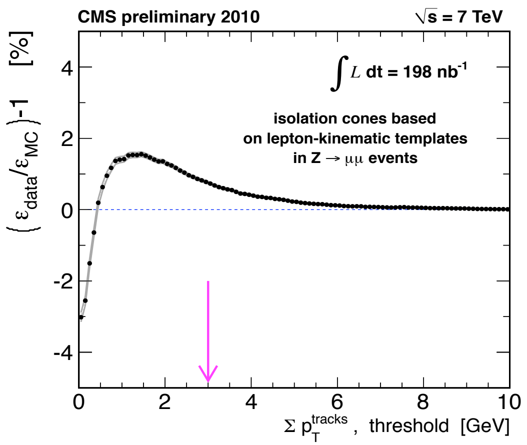
$\sigma(pp \rightarrow W^{-} + X \rightarrow e^{-}\nu + X) = 4.13 \pm 0.24$ (stat.) nb

$\sigma(pp \rightarrow /(\gamma^{*} + X \rightarrow e^{+}e^{-} + X) = 0.884 \pm 0.118$(stat)nb

Systematics on the Cross Sections

Efficiency correction factors (Muon channels)





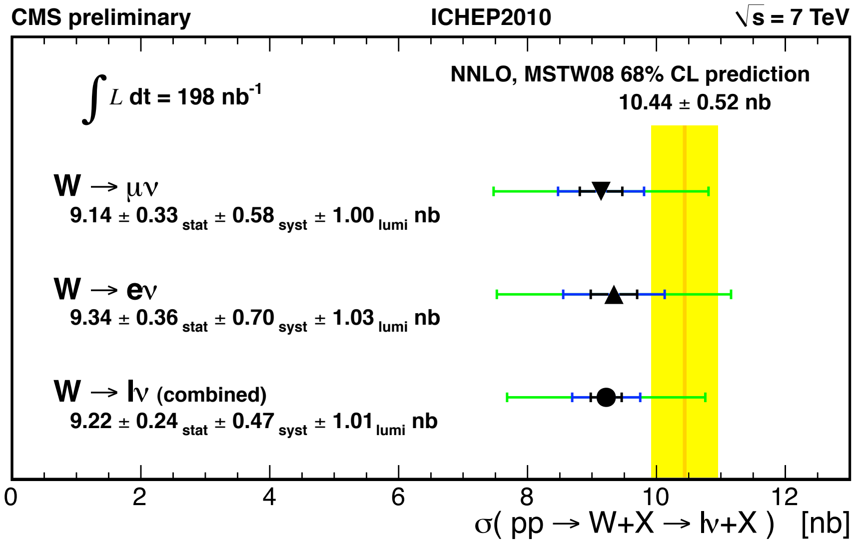
Muon Channels

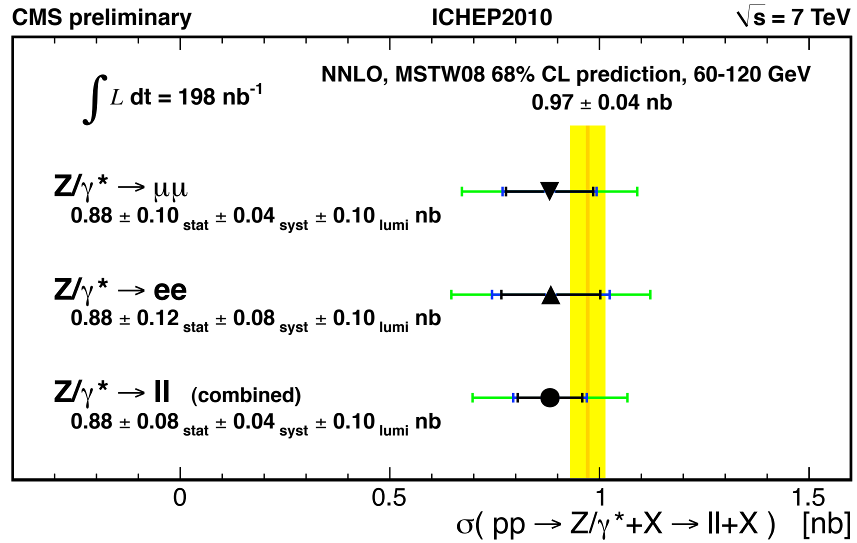
Source	W channel (%)	Z channel (%)
Muon reconstruction/identification	3.0	2.5
Trigger efficiency	3.2	0.7
Isolation efficiency	0.5	1.0
Muon momentum scale/resolution	1.0	0.5
$\not\!\!E_T$ scale/resolution	1.0	-
Background subtraction	3.5	-
PDF uncertainty in acceptance	2.0	2.0
Other theoretical uncertainties	1.4	1.6
TOTAL (without luminosity uncertainty)	6.3	3.8
Luminosity	11.0	11.0

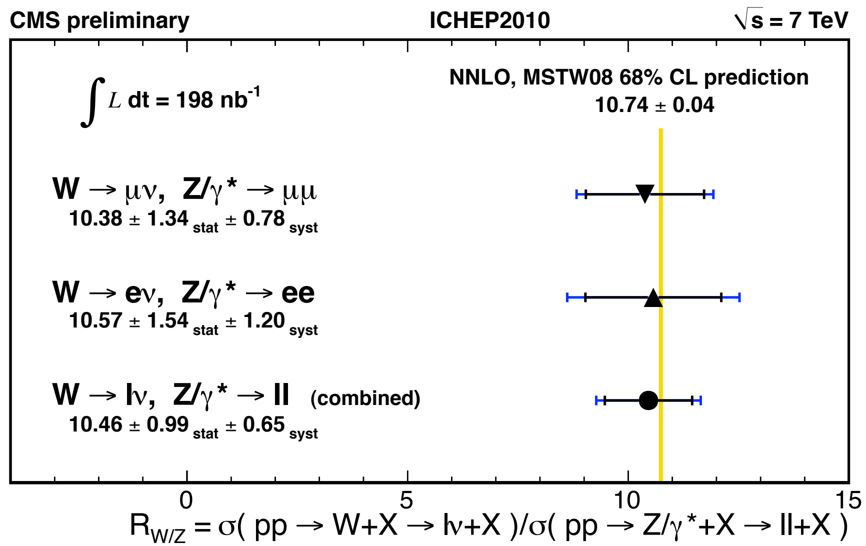
Electron Channels

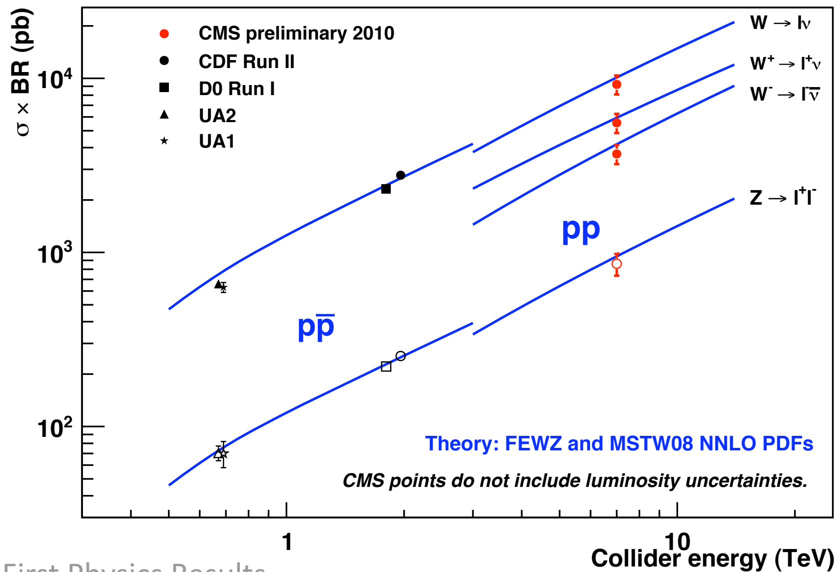
Source	W channel (%)	Z channel (%)
Electron reconstruction/identification	6.1	7.2
Trigger efficiency	0.6	-
Isolation efficiency	1.1	1.2
Electron momentum scale/resolution	2.7	-
$\not\!\!E_T$ scale/resolution	1.4	-
Background subtraction	2.2	-
PDF uncertainty in acceptance	2.0	2.0
Other theoretical uncertainties	1.3	1.3
TOTAL (without luminosity uncertainty)	7.7	7.7
Luminosity	11.0	11.0

W and Z Cross Sections

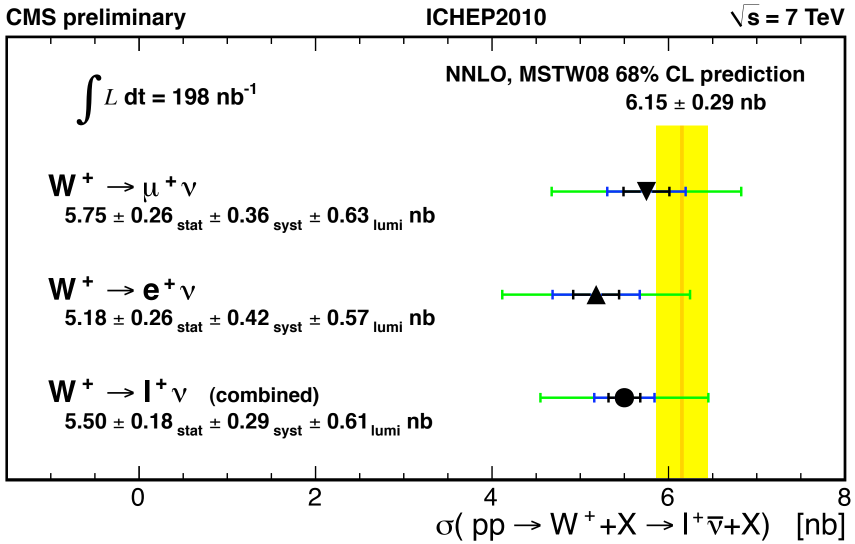


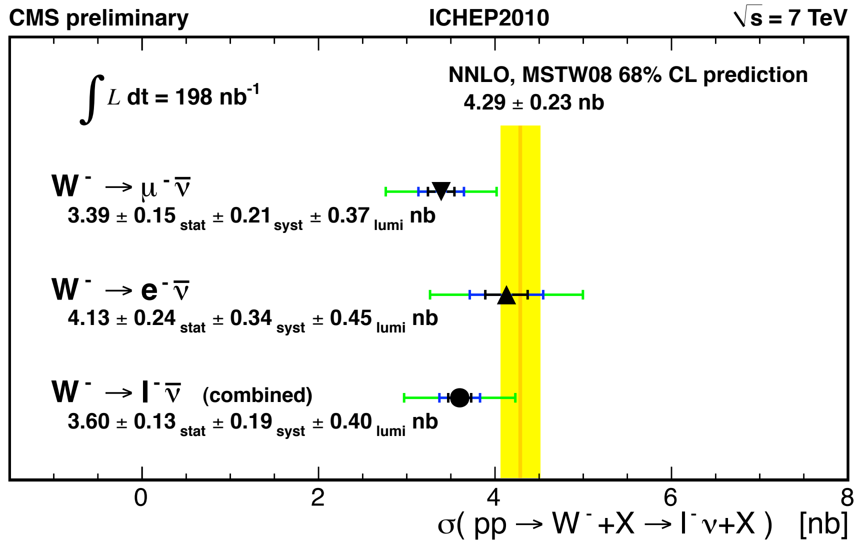


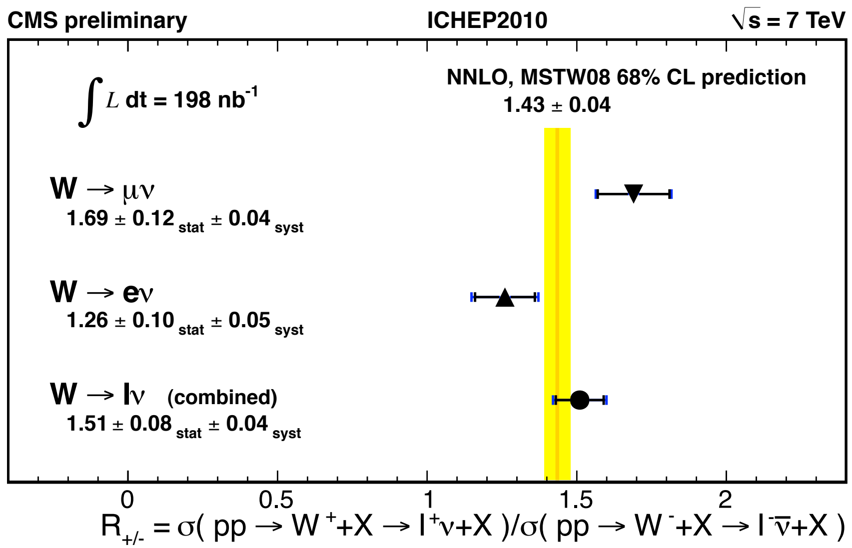




W⁺/W⁻ Cross Sections

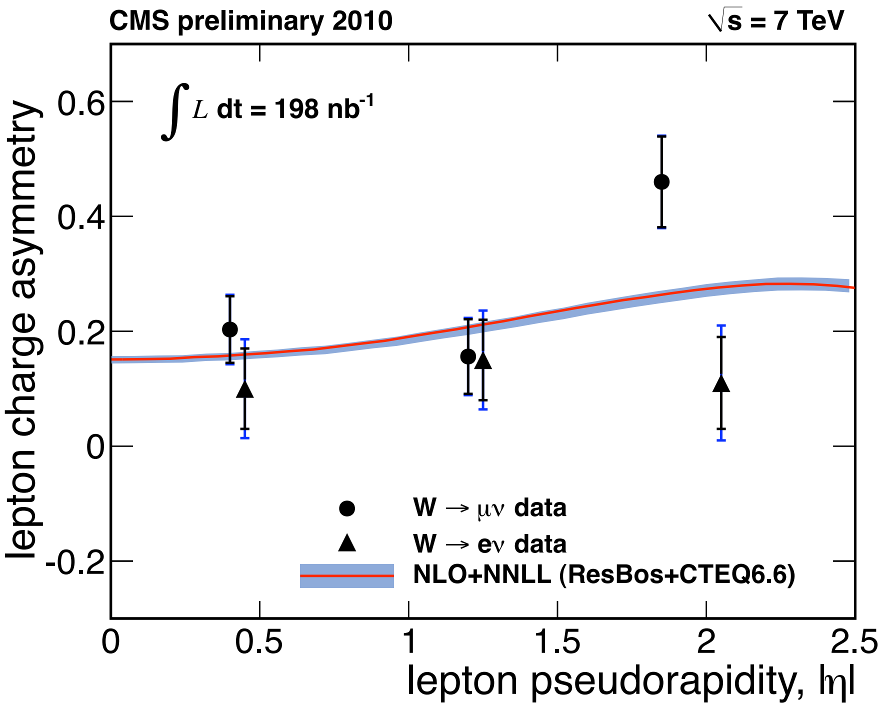


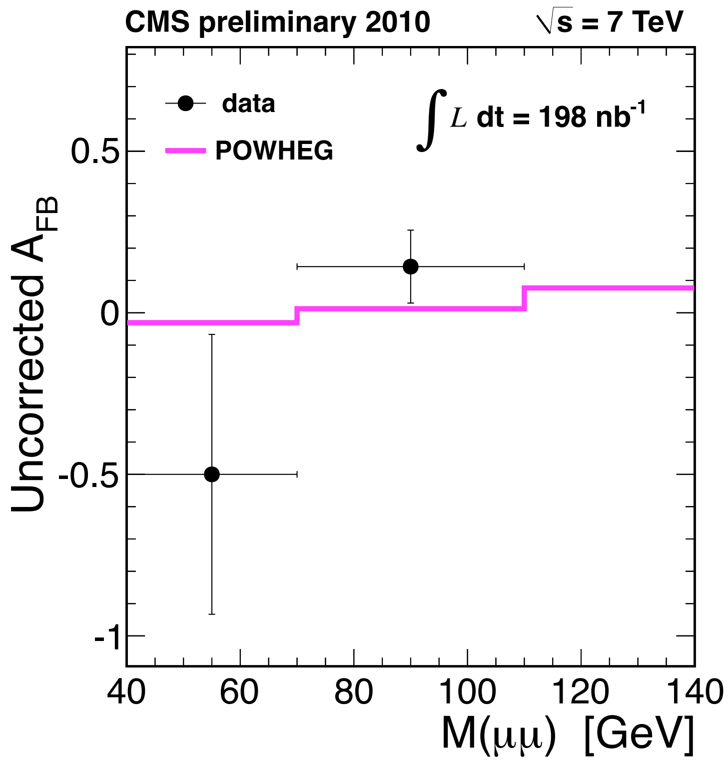




Differential Lepton Charge Asymmetry and Lepton Backward-Forward Asymmetry

$$A(\eta) = \frac{d\sigma^{(+)}/d\eta_l - d\sigma^{(-)}/d\eta_l}{d\sigma^{(+)}/d\eta_l + d\sigma^{(-)}/d\eta_l}$$





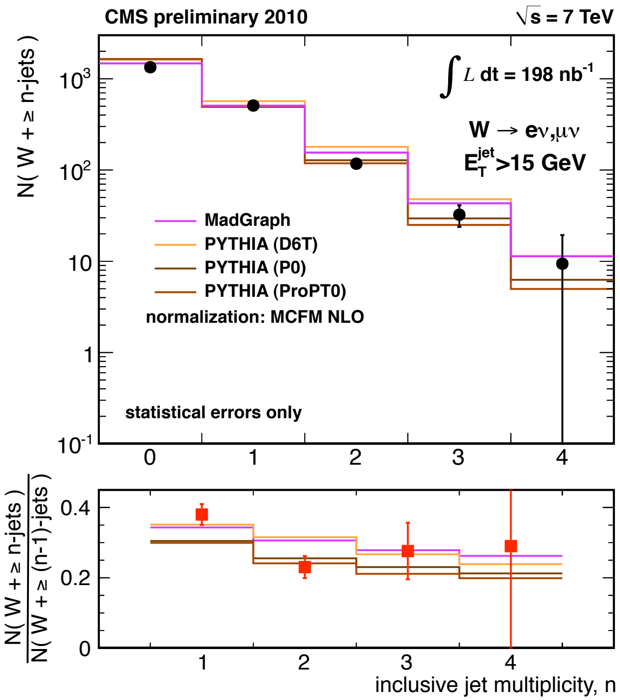
Asymmetry generated from different u/d content in proton ➔ Constraints on PDFs (expected from ~10/pb)

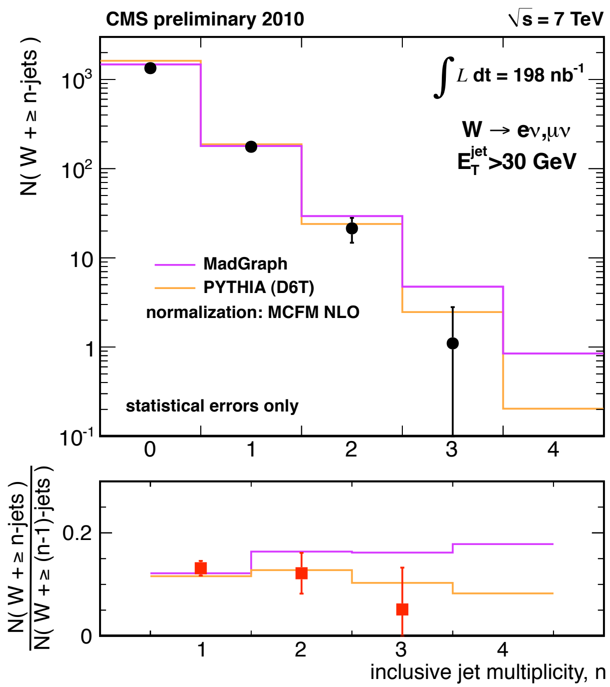
A_{FB}: from EWK coupling of LH/RH Leptons. If deviation from expected values is found could be evidence for new neutral gauge Boson in addition to Z/γ.

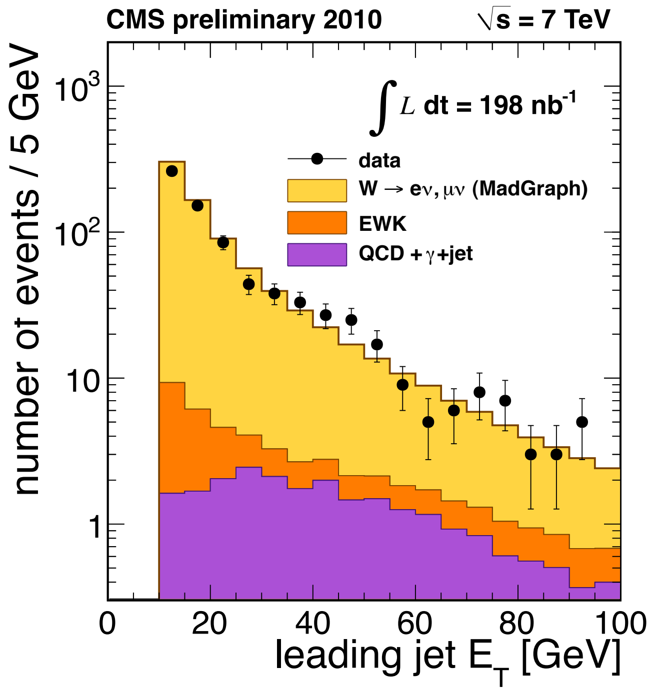
W(lν)+Jets

First study of V+Jets associated production at 7TeV

Event Rate vs Inclusive Jet Multiplicity (Pflow Jets) after QCD and EWK BKG (W,Z, top) subtraction from fit to the $M_T(W)$







Raw leading Jet E_T
(for WTMass>50GeV/c^2)

Systematics dominated by JES
(10%-20% for Jet E_T>30GeV)

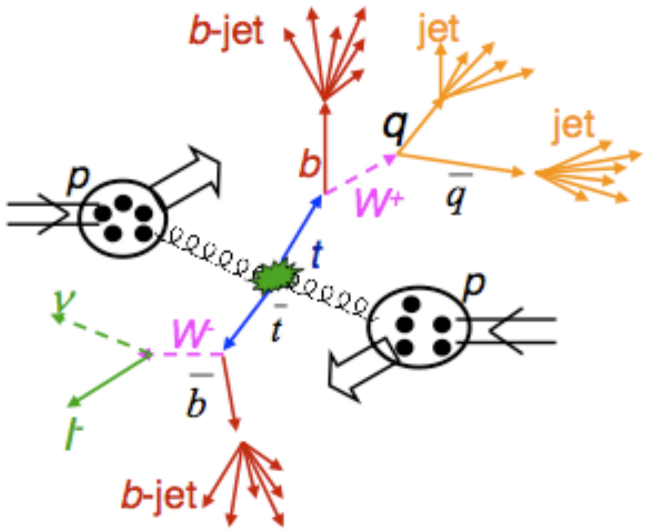
MC Predictions normalized to NLO MCFM cross sections

Top

ttbar Event Selection

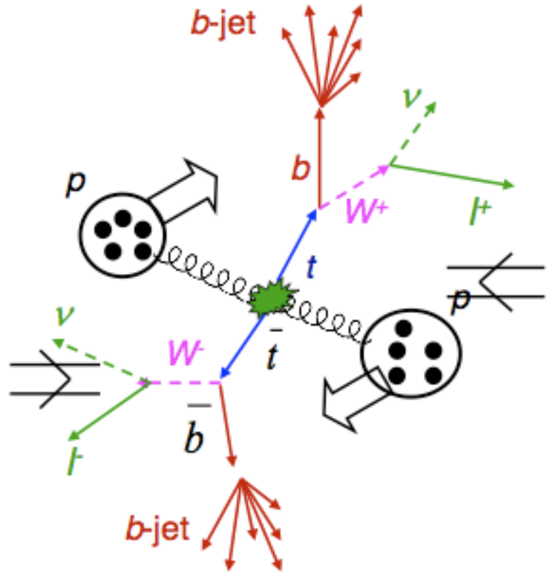
Lepton + Jets

HLT:$P_T(\mu)$>9GeV/c, P_T(e)>15GeV/c
Excalty One prompt isolated lepton
e: P_T>30GeV/c, $|\eta|$< 2.4
μ: P_T>20GeV/c, $|\eta|$< 2.1
Comb Rel Iso <10%(5%) for μ(e)
AKt5 Calorimeter Jets $|\eta|$<2.4, E_T>30GeV

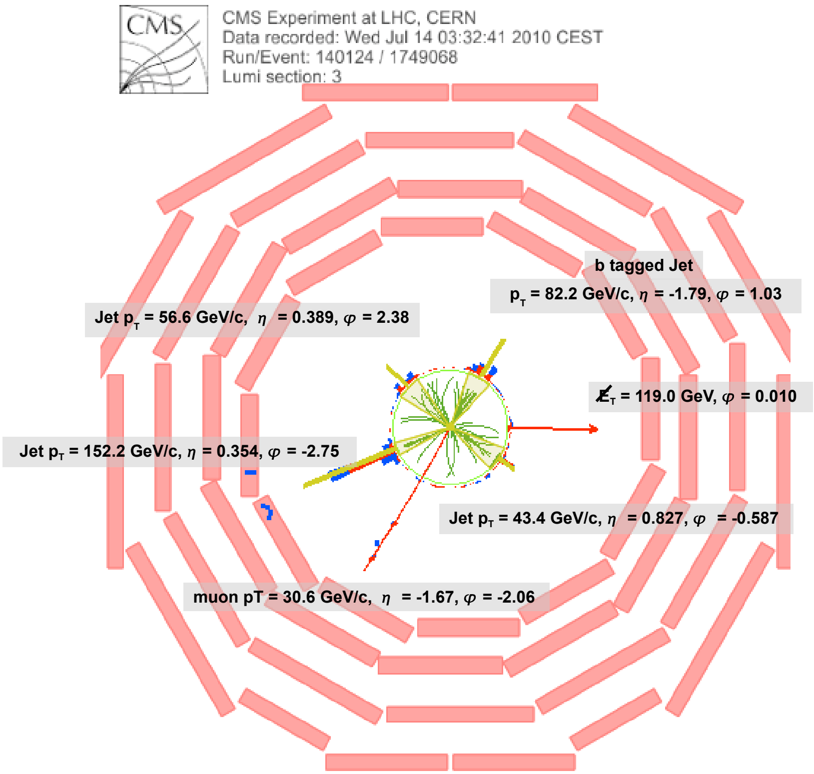


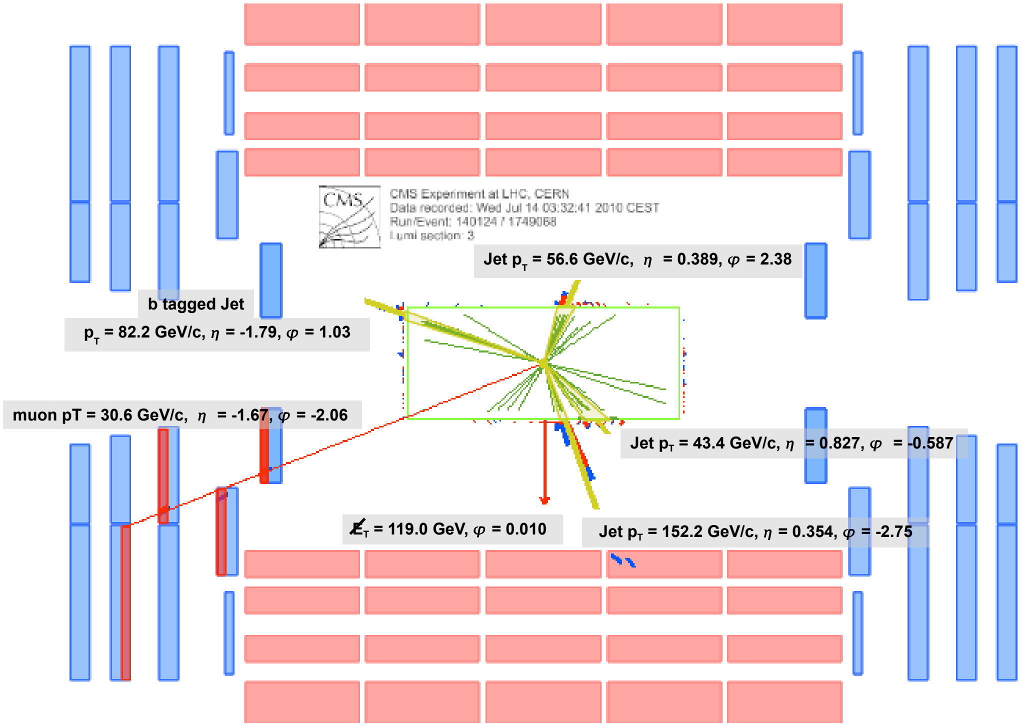
di-lepton

HLT:$P_T(\mu)$>9GeV/c, P_T(e)>15GeV/c
Excalty two prompt isolated Leptons P_T>20GeV/c
e: $|\eta|$< 2.4, μ: $|\eta|$< 2.5
Comb Rel Iso <15%
Track Corrected MET> 30(20) GeV for ee/$\mu\mu$ (eμ)
Z Boson veto in 76-106GeV/c^2
AKt5 JPT Jets $|\eta|$<2.4, E_T>30GeV



μ+Jets candidate

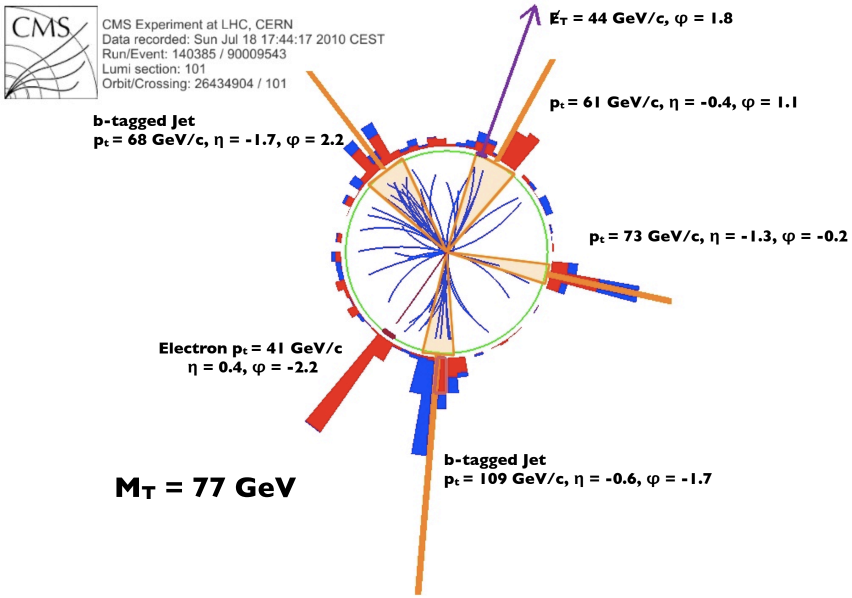


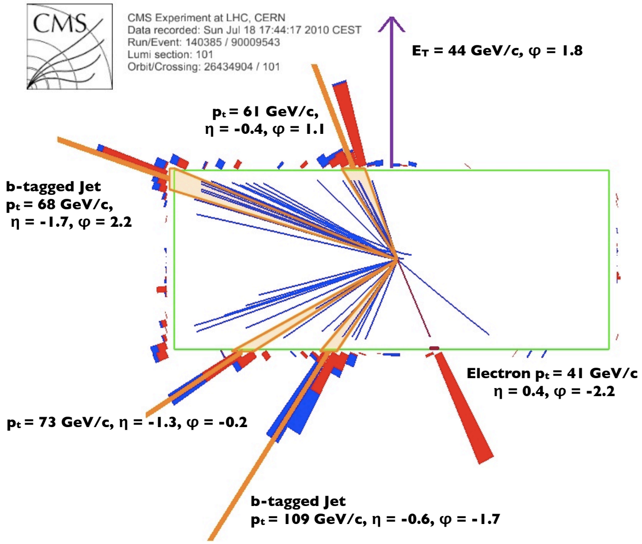


Four high P_T Jets, one with tight b-tagging
Di-jet mass (untagged jets): 104,105,151 GeV/c²

One high P_T Muon
Top mass~210GeV
M_T(W) = 104GeV/c2
MET>100GeV

e+Jets candidate

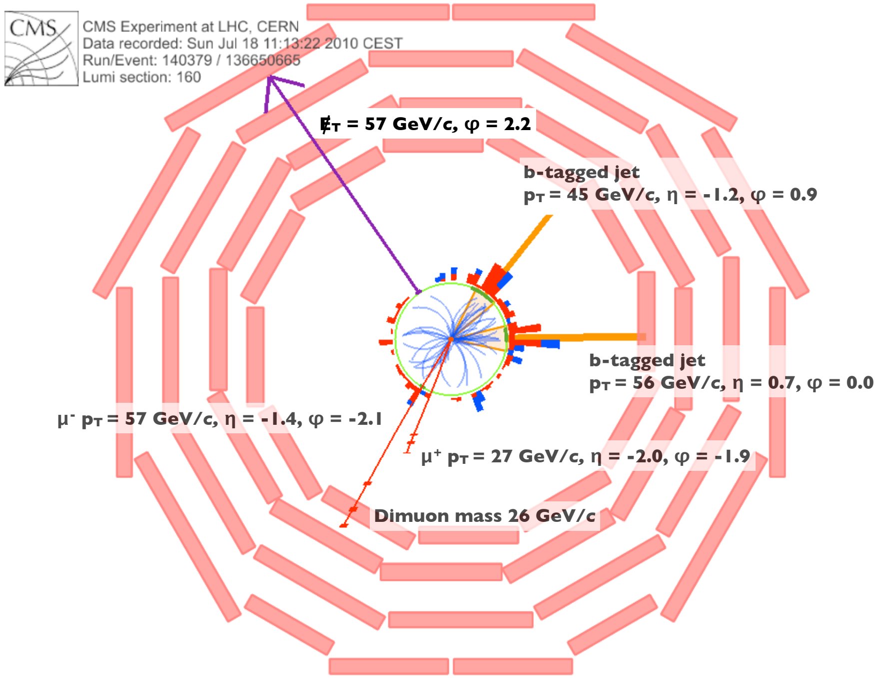


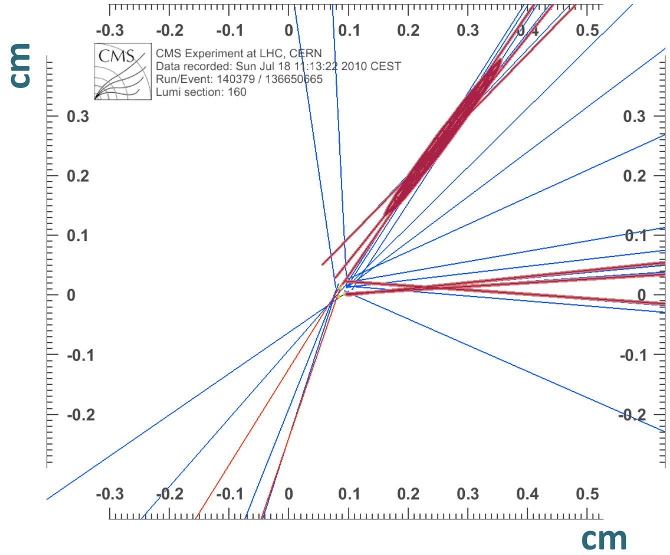


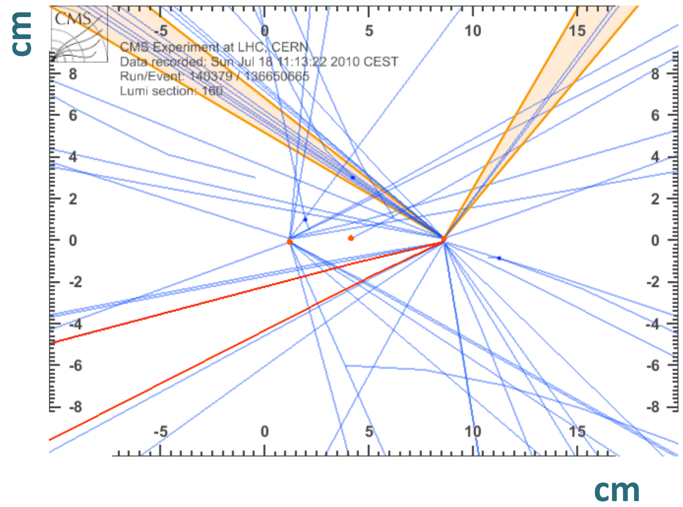
One high P_T electron
MET = 44GeV
M_T(W)= 77GeV/c^2
4HighPT Jets, 2 with good b-tagging

Mass of the two untagged Jets = 102 GeV/c
Three-Jet mass (2 combinations): 208, 332 GeV/c^2

μμ+Jets Candidate





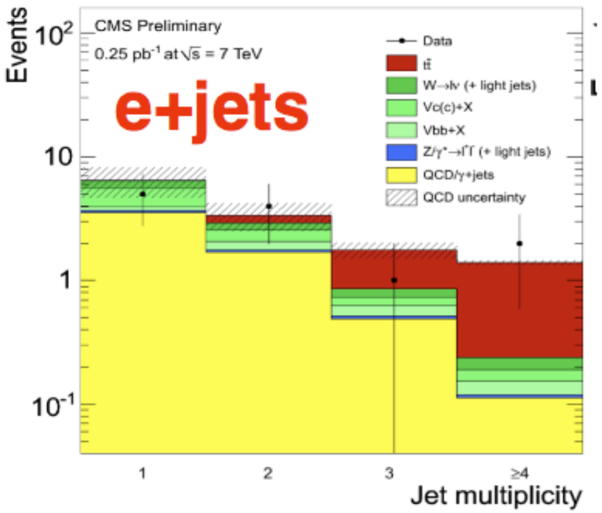


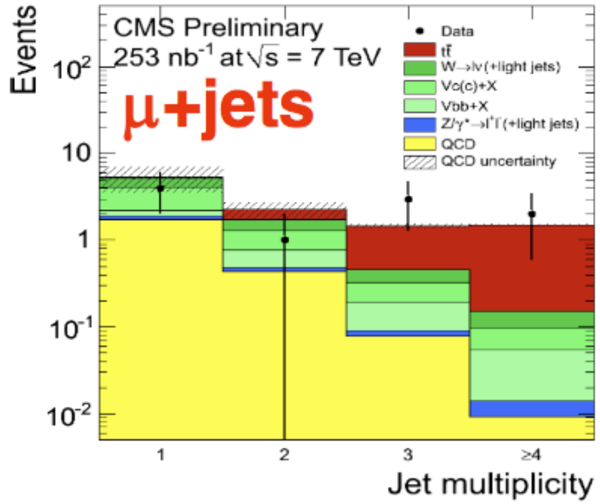
Two High P_T μ, opposite charge M(μμ) = 26 GeV/c^2
MET=57 GeV
Two High P_T Jets, both with b-tagging

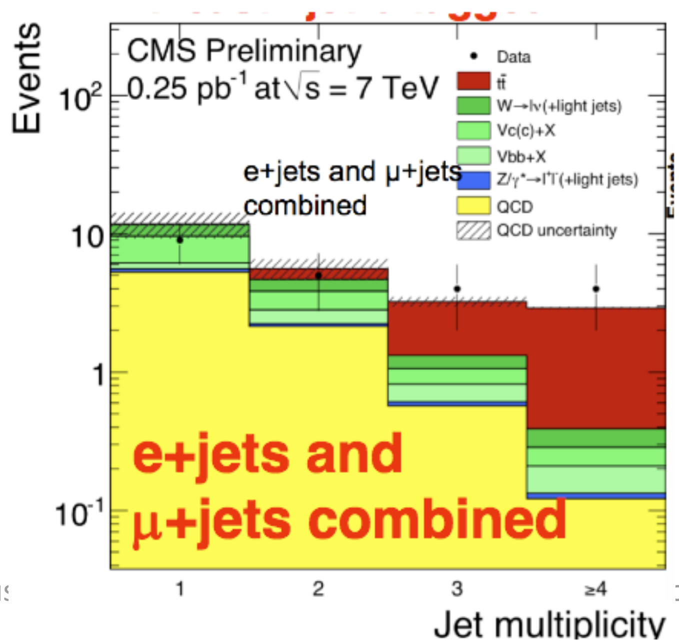
Multiple vertices event (pile up), Tracks associated To Jets and muons originating from same vertex!

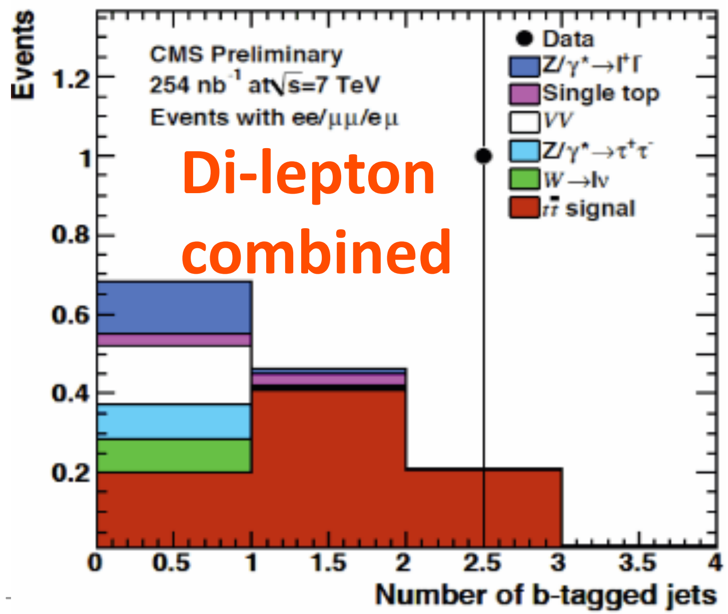
ttbar candidates in 254/nb

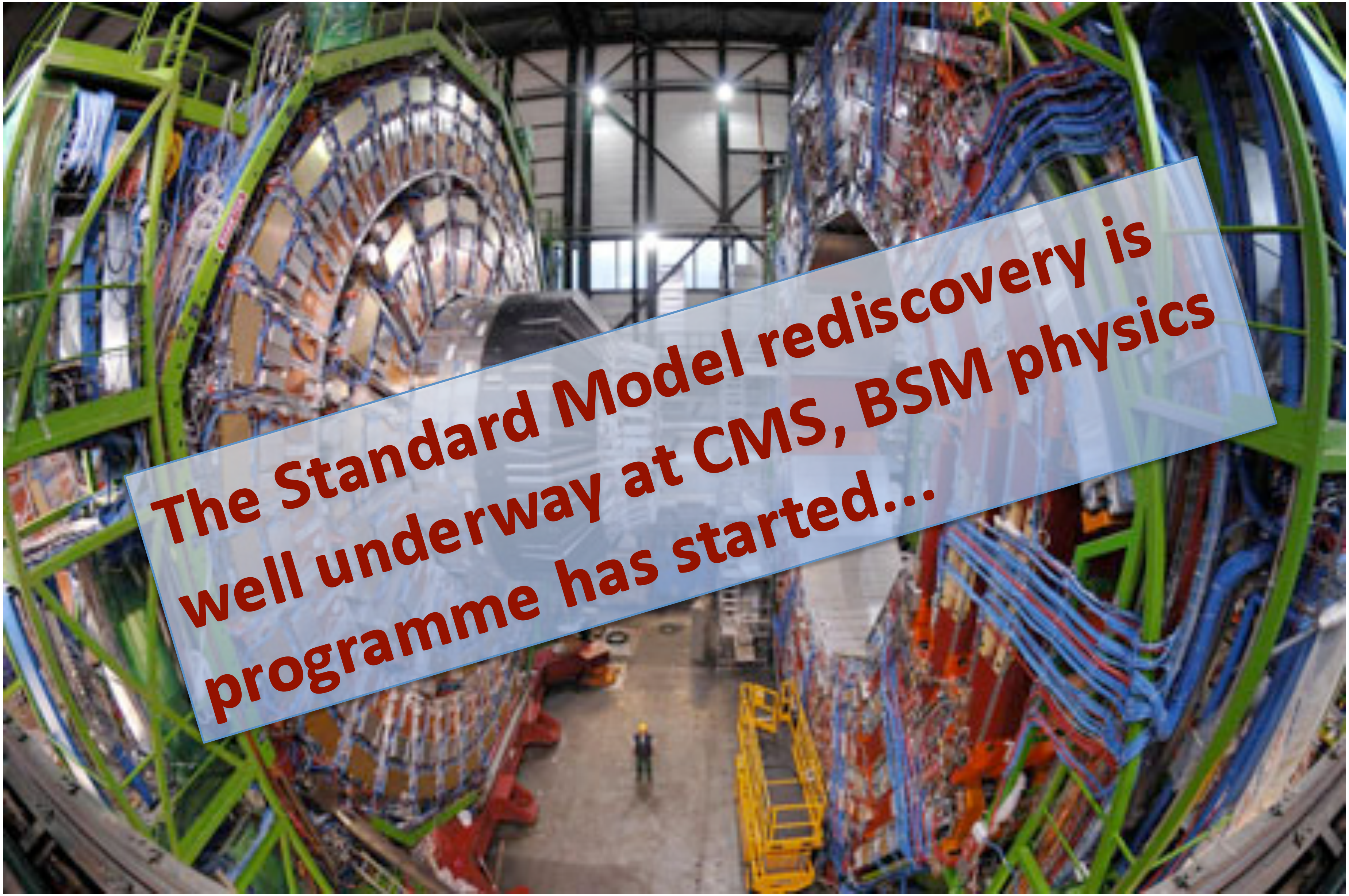
Raw rates requiring at least one secondary vertex b-tagged jet









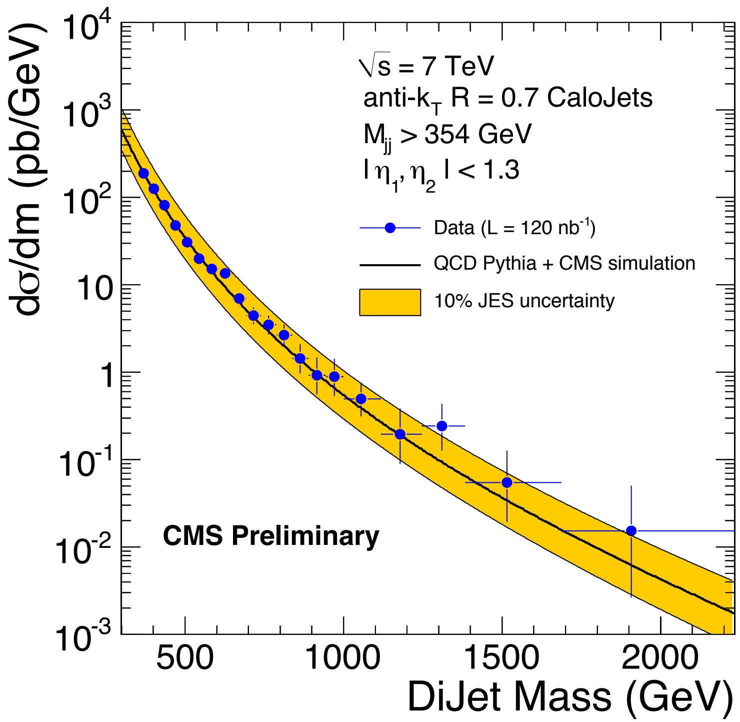

The Standard Model rediscovery is
well underway at CMS, BSM physics
programme has started…

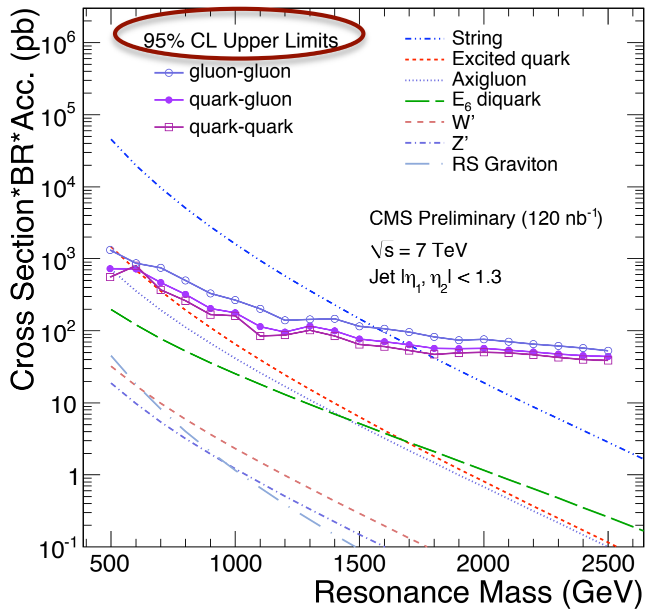
Searches for Di-Jet Resonances

CMS PAS EXO-10-001

Model Name	X	Color	J^P	$\Gamma/(2M)$	Final-state Partons
String	S	mixed	mixed	0.003-0.037	$q\bar{q}$, qq, gg and qg
Axigluon	A	Octet	1^+	0.05	$q\bar{q}$
Coloron	C	Octet	1^-	0.05	$q\bar{q}$
Excited Quark	q*	Triplet	$1/2^+$	0.02	qg
E_6 Diquark	D	Triplet	0^+	0.004	qq
RS Graviton	G	Singlet	2^+	0.01	$q\bar{q}$, gg
Heavy W	W'	Singlet	1^-	0.01	$q\bar{q}$
Heavy Z	Z'	Singlet	1^-	0.01	$q\bar{q}$

Properties of new particles expected to have significant BF for the decay into di-quark, di-gluons,quark-gluon





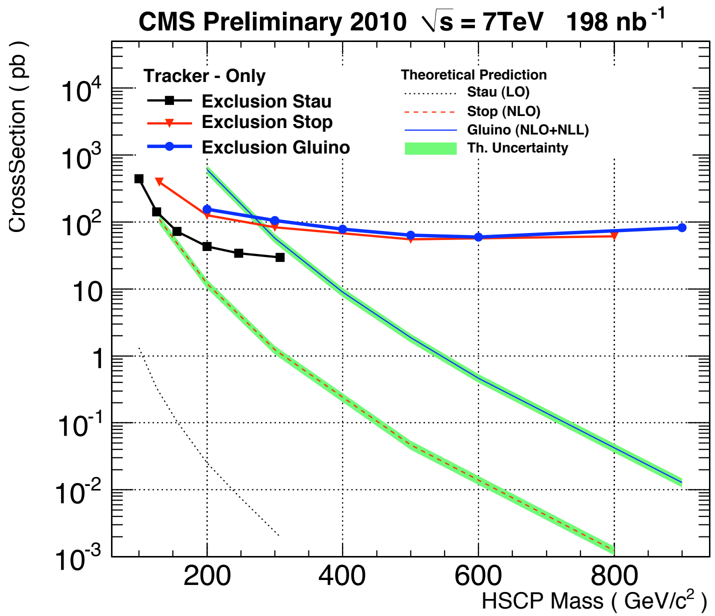
95% Exclusion limits: String resonances with mass<1.67TeV

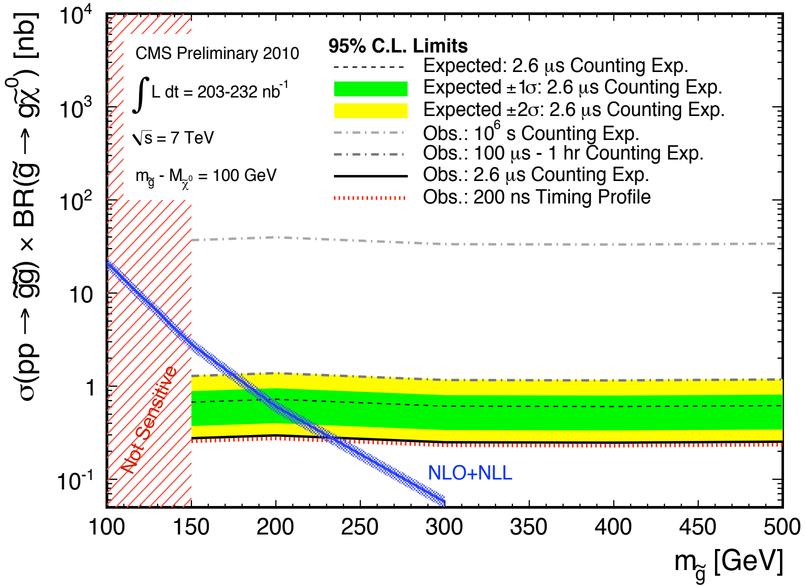
Searches for Heavy Stable Charged Particles (HSCP), stopped Gluinos

CMS PAS EXO-10-003/004

HSCP signature: large ionization energy loss rate (dE/dx) but still penetrating up to Muon chambers. Stopped gluinos: search for decay signature in non-beam gaps

Data from dedicated runs after physics-fills or from special Triggers in gaps between BX's

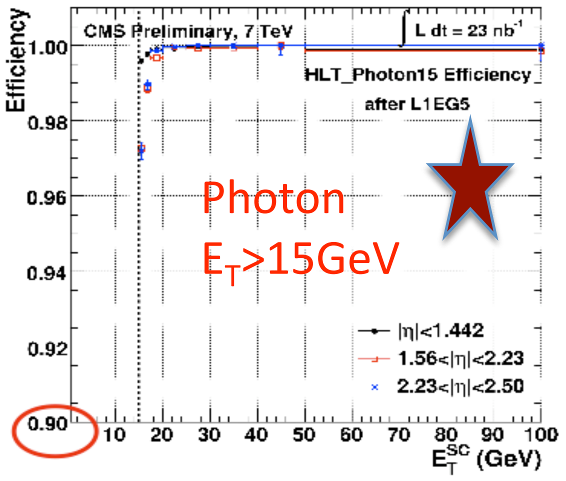


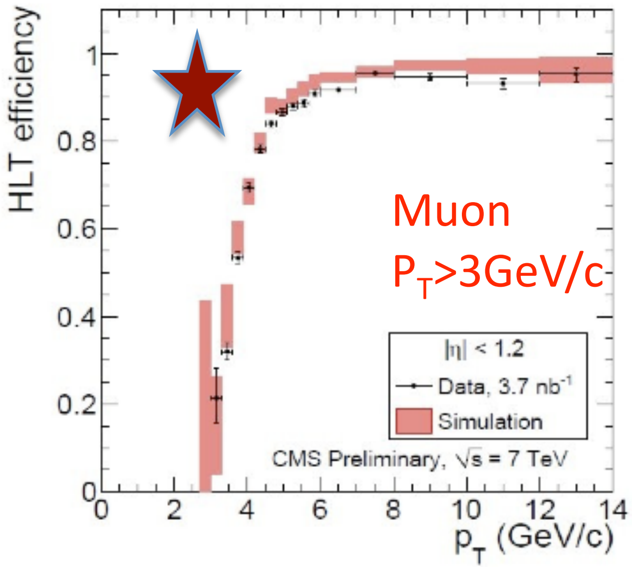


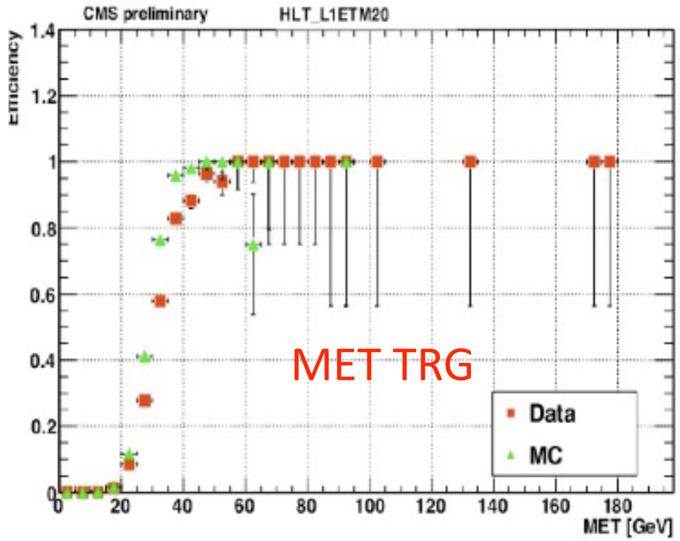
HSCP: 95% CL Lower Limit on stable gluino mass: 284GeV(271GeV) with(without) muon id.
Stopped Gluino: 95%CL exclusion m(gluino) <229GeV (t=200ns) and <225GeV (t=2.6ms)

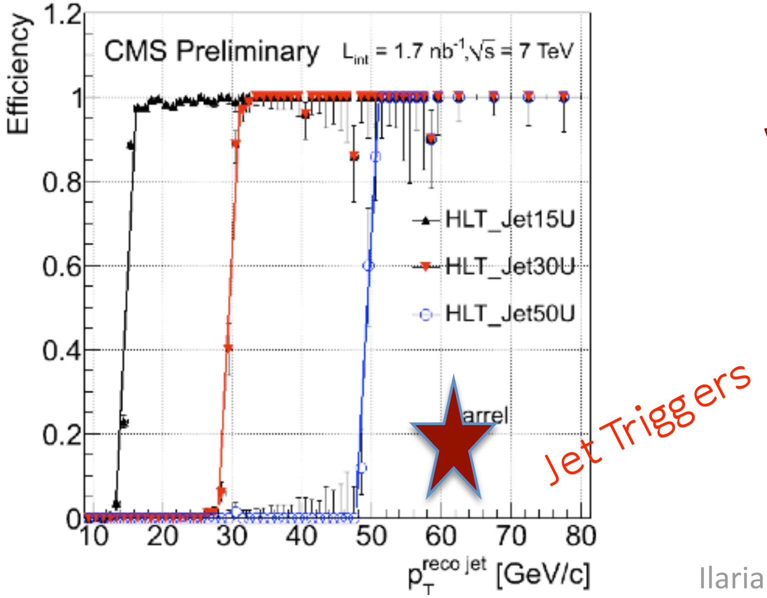
Back Up Slides

Trigger Performance









Very High Efficiency, Steep turn-on curves

→ most common triggers for shown results in addition to MinBias trigger (soft QCD) and Muon P_T>9GeV/c (EWK)

UE with JetPt/Area Median Method

Measurement at 900GeV

CMS PAS QCD-10-005

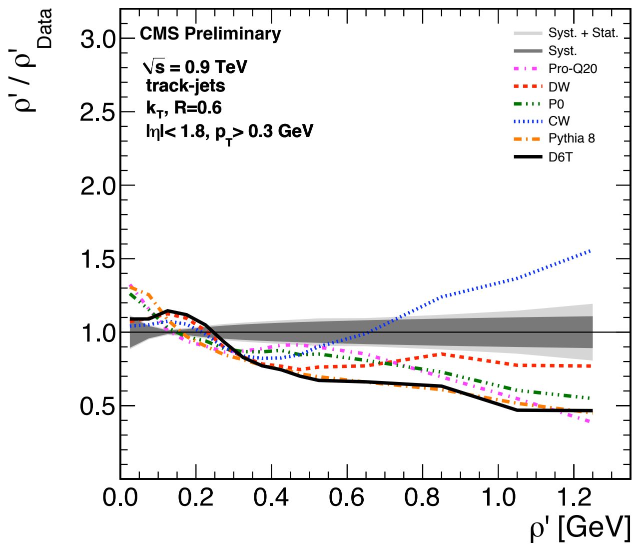
New technique (A.Cacciari, G.P Salam and S.Sapeta JHEP, 04 (20010) 065):

$$\rho' = \text{median}_{j \in \text{physical jets}} [\{\frac{P_{Tj}}{A_j}\}] \cdot C \qquad \left(C = \frac{\sum_{j \in \text{physical jets}} A_j}{A_{TOT}} \right)$$

C= estimate of occupancy (A_{TOT}= detector region)

Track Jets with K_T algo used(R=0.6), (grid of soft particles used to estimate Jet area)

Sensitivity to different PYTHIA Tuning of the UE
Pattern of deviations similar to results with traditional (Track Multplicity) method



Systematics from TRK material bdg/alignment, modeling of the recontruction (VTX, Tracks) and selection, TrackJet response

5

Jet performances

- **4 jet algorithms** with energy corrections from MC (+data cross-checks):
  - **Calorimeter Jets**
    → uncertainty on Jet Energy Scale 10%
  - **Jet-Plus-Tracks**
  - **Track Jets**
  - **Particle-Flow Jets**

    (Jet-Plus-Tracks, Track Jets, Particle-Flow Jets) → uncertainty on Jet Energy Scale 5%
  - η dependence of jet energy : 2% uncertainty, linearly increasing with η
  - Jet Energy Resolution 10% ($\sigma(p_T)$~10±1GeV for p_T~100GeV)
- anti-K_T algorithm with D=0.5 (or 0.7)
- jet quality cuts (100% eff. p_T>50)
- single jet trigger: L1 jet>6 GeV + HLT jet > 15 GeV (uncorrected)
- Rich set of measurements (next slides) → **jet commissioning and test pQCD**

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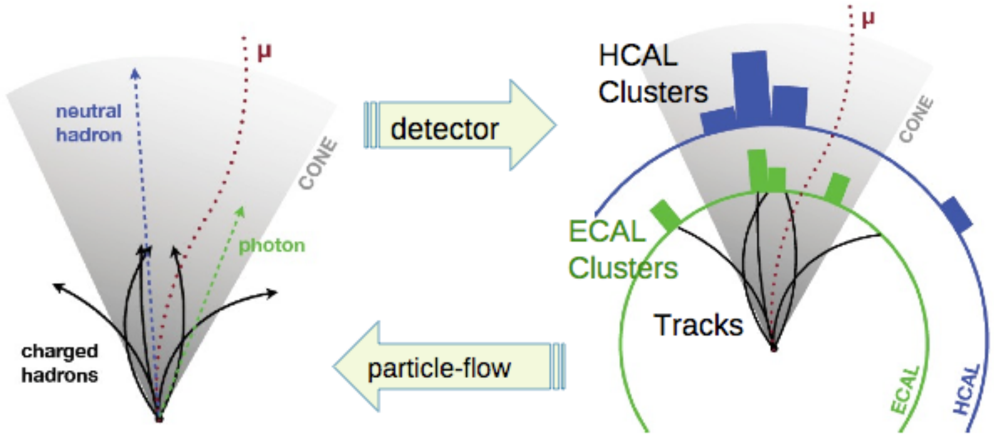
2Steps corrections;
•Relative in η
•Absolute response

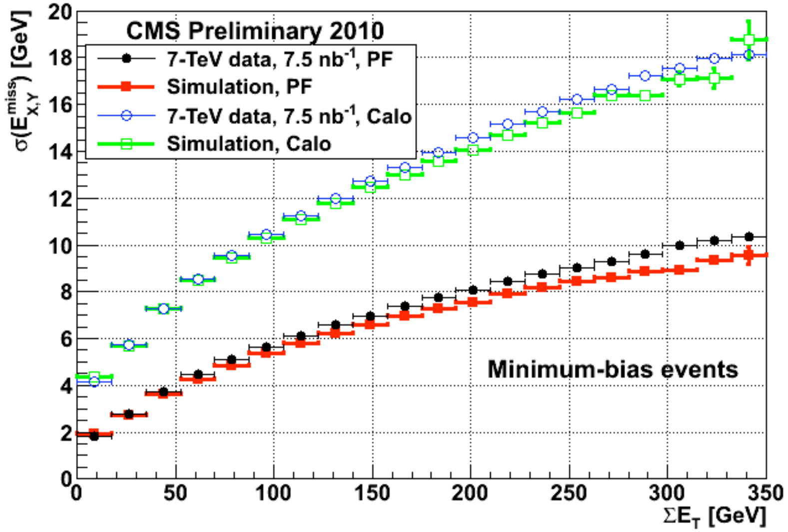
Track $\sigma(P_T)$ = 1% at 100GeV

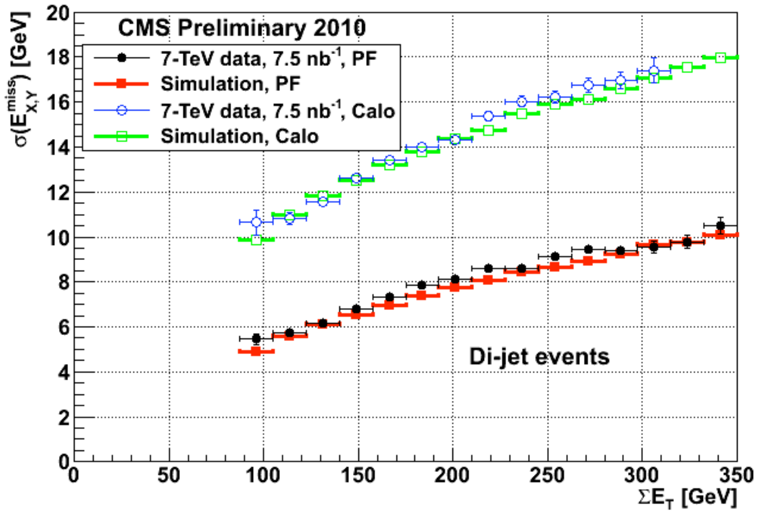
ECAL $\sigma(E_T)$=0.03/sqrt(E)

HCAL $\sigma(E_T)$=1/sqrt(E)

Particle Flow Jets





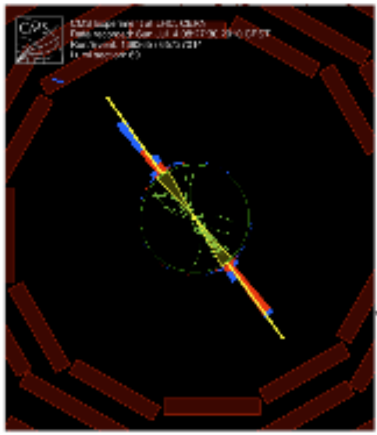


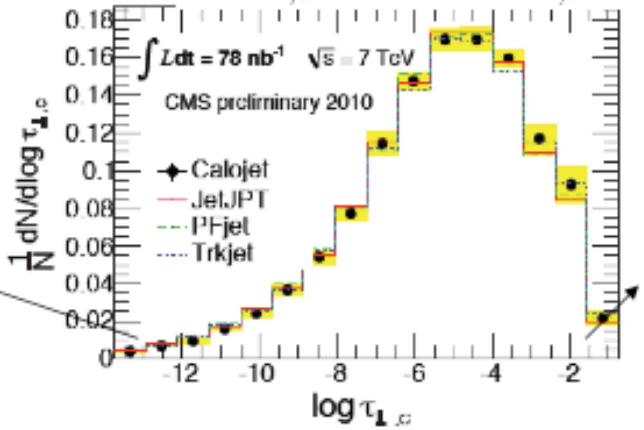
Hadronic Event Shape

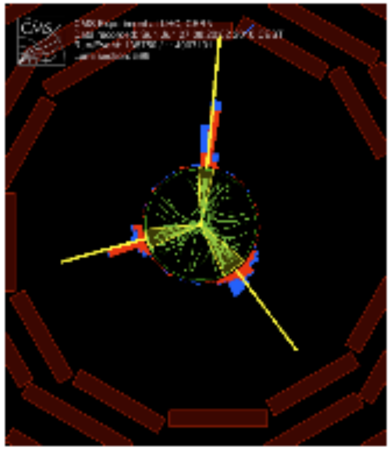
❑ **Central transverse thrust**

$$T_{\perp,\mathcal{C}} \equiv \max_{\vec{n}_T} \frac{\sum_{i\in\mathcal{C}} |\vec{p}_{\perp,i}\cdot\vec{n}_T|}{\sum_{i\in\mathcal{C}} p_{\perp,i}}$$

$$\log \tau_{\perp,\mathcal{C}} = \log(1 - T_{\perp,\mathcal{C}})$$

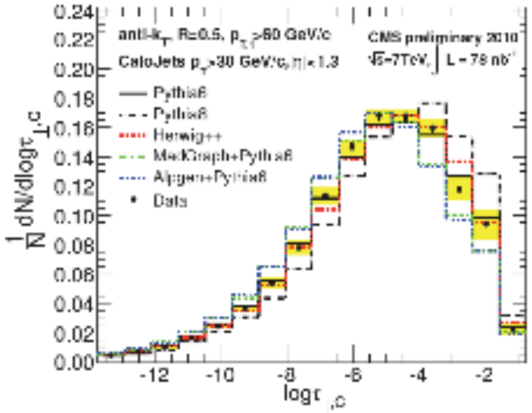






- **4 jet types** in very good agreement
- $p_T^{leading}$>60 GeV, $|\eta_{j1j2}|$<1.3, p_T>30 GeV, $|\eta|$<1.3,

  → **JES dominant syst**, JER and position resolution (±10%)



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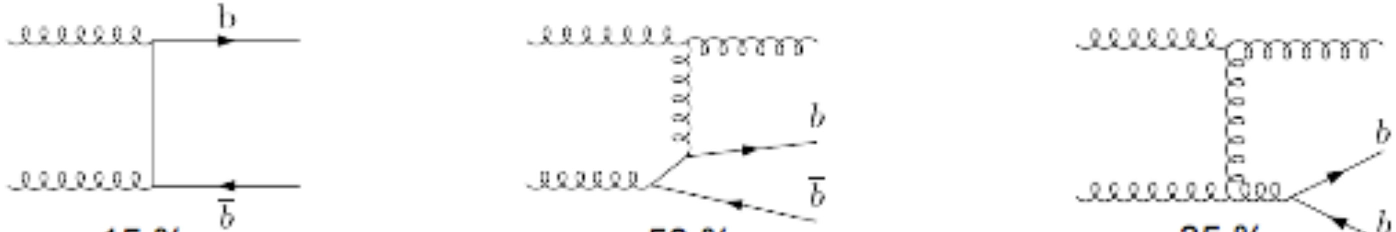
b production

- Understanding and testing b-quark production at 7 TeV

Flavor Creation **Flavor Excitation** **Gluon Splitting**



~15 % ~50 % ~35 % for p_T 20-100 GeV

- FEX, GS are higher order effects but dominate at LHC

With available statistics:

- measurement of inclusive b production cross section with 2 independent methods (next slides)

With more statistics:

- test the relative fractions of the different production processes
  - 3 muons angular correlation $BB_{bar} \rightarrow J/\psi + \mu + X$
  - pixel precision would allow multiple Secondary Vertices reconstruction

BTagging

Particle Flow Jets made with AKt5 clustering from 8-15/nb of data, JetPt>20-30GeV and Jet $|\eta|<2.4$

Results from three b-jet identification algorithms:

Track Counting (TC): at least N Tracks with significance of signed Impact Parameter above a threshold S (N=3 for high purity configuration)

Simple Secondary Vertex(SSV): at least one secondary VTX reconstructed (+ 2nd VTX having at least three tracks in the high purity configuration)

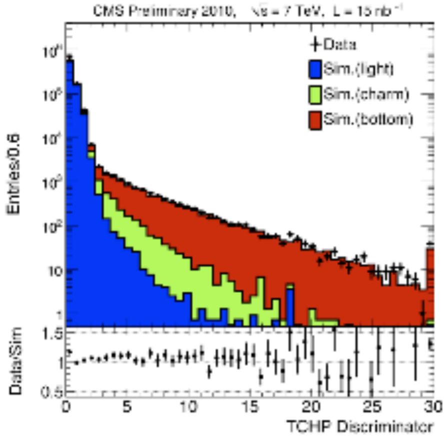
Jet Probability: assigns a probability that all tracks originate from the VTX based on significance of Impact parameter

Lepton base Tagging

Very good Data-MC agreement in discriminators distributions for all methods

CMS PAS BTV-10-001

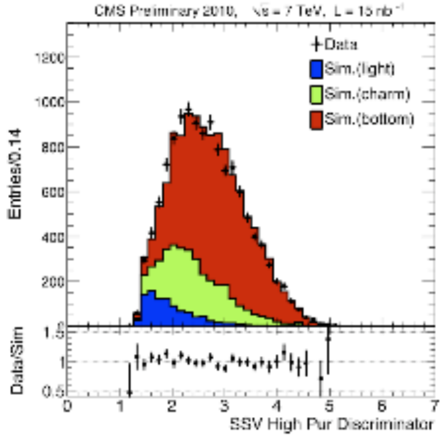
Data/MC comparison for Tagging Discriminators



Track Counting Algorithm

tags jets containing N tracks with Impact Parameter (IP) significance exceeding S

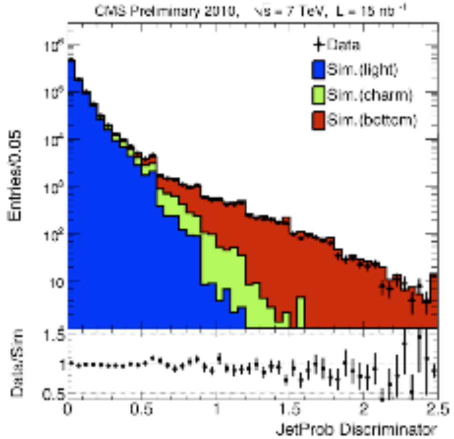
High Purity configuration: N=3



SSV Algorithm

tags jets according to the 3D flight distance significance of the reconstructed secondary vertex

High Purity configuration: Vertices with 3 or more tracks



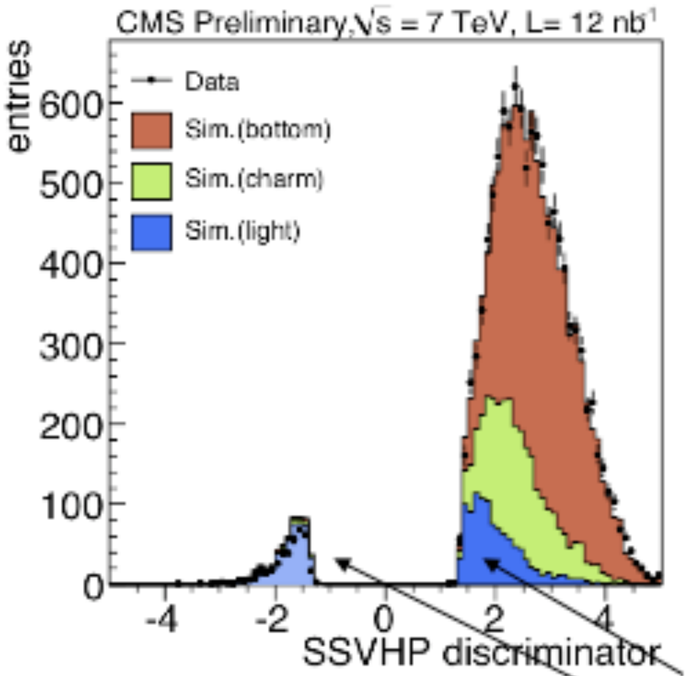
Jet Probability Algorithm

tags jets according to the probability of all the tracks in the jet to originate from the primary vertex, given their IP significances

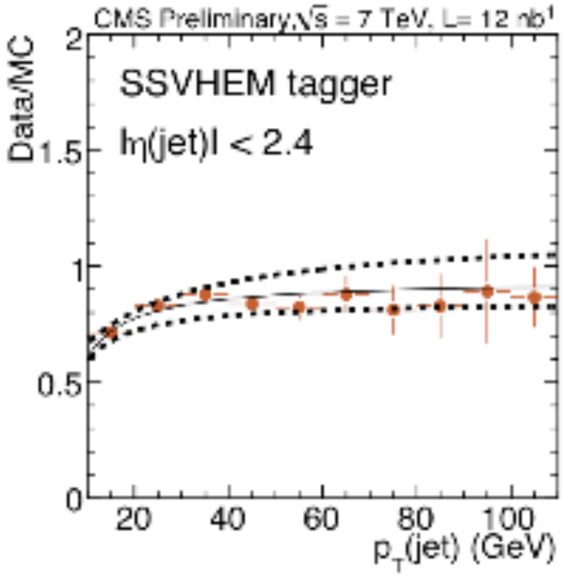
B-Tagging performance, cont'd

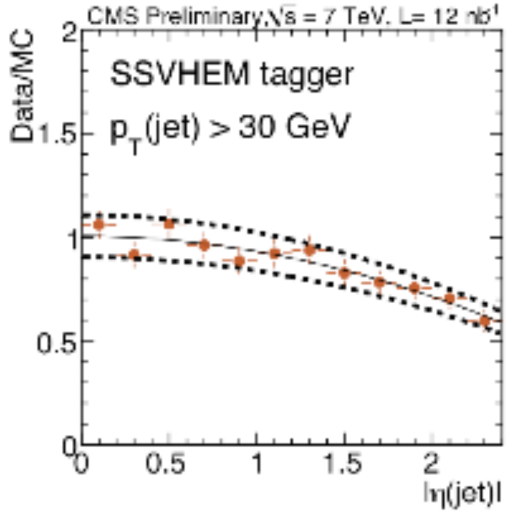
Efficiency evaluated using pre-tagged b-Jets using the soft lepton method (muon decay of b, requirements on muon pt relative to Jet axis based on MC template)

Tagger+Operating Point	ϵ_b^{data}	ϵ_b^{MC}	SF_b
SSVHPT	0.203 ± 0.015	0.207± 0.002	0.98± 0.08± 0.18
SSVHEM	0.405 ± 0.016	0.417± 0.003	0.97± 0.04± 0.19
SSVHET	0.127 ± 0.017	0.131± 0.002	0.97± 0.13± 0.21
TCHPL	0.404 ± 0.018	0.444± 0.003	0.91± 0.04± 0.19
TCHPM	0.303 ± 0.015	0.331± 0.003	0.92± 0.05± 0.19
TCHPT	0.233 ± 0.014	0.244± 0.002	0.95± 0.06± 0.19
TCHEL	0.562 ± 0.020	0.636± 0.003	0.88± 0.03± 0.19
TCHEM	0.455 ± 0.016	0.494± 0.003	0.92± 0.03± 0.20
TCHET	0.151 ± 0.015	0.150± 0.002	1.01± 0.10± 0.19



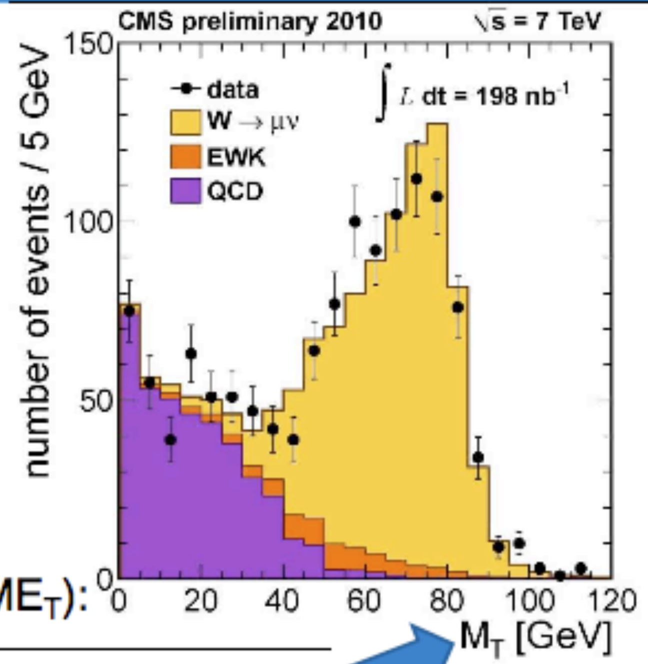
Mistag Rate based on negative Tags in data

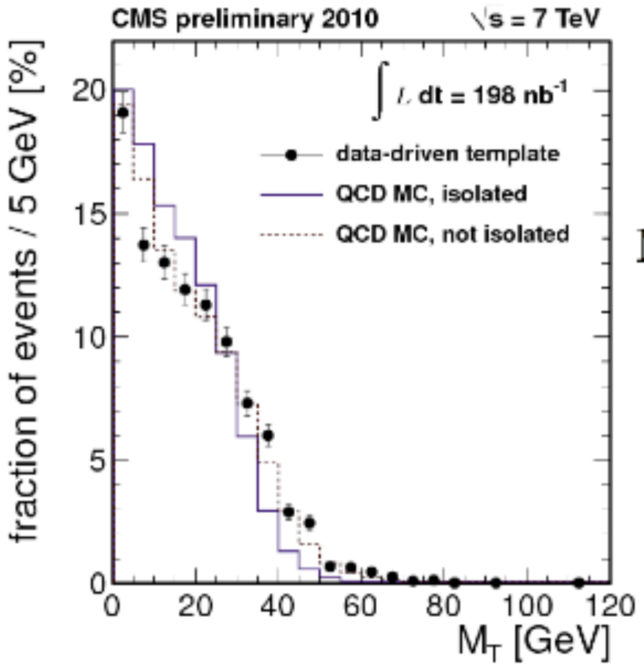




W→μν Selection

- Event triggered by Level1+HLT , $p_T > 9$ GeV
- **Selection Criteria** :
  - Muon $p_t > 20$ GeV, $|\eta| < 2.1$
  - Isolation $(\Sigma p_T(tk) + \Sigma E_T(had+em))/p_T < 15\%$
  - ME_T reconstructed using Pflow techniques
  - Drell Yan rejection (veto on events with a second muon of $p_T > 10$ GeV)





Transverse mass (μ, ME_T):

$$M_T = \sqrt{2p_T(\mu)\not{E}_T * (1 - \cos(\Delta\phi_{\mu,\not{E}_T}))}$$

- Main source of BG: QCD (b hadron decays)
- W Signal yield extracted through a Binned Likelihood fit to the MT distribution (Signal + QCD & EWK BGs)
- W Signal and EWK MT shapes modeled from MC
- QCD MT Shape extracted from data (isolation inversion)

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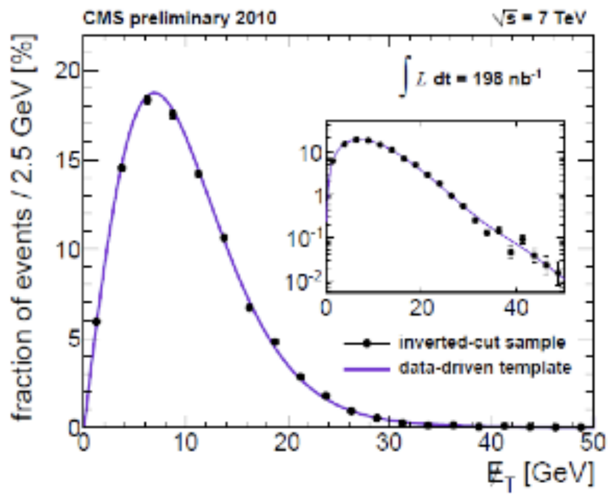
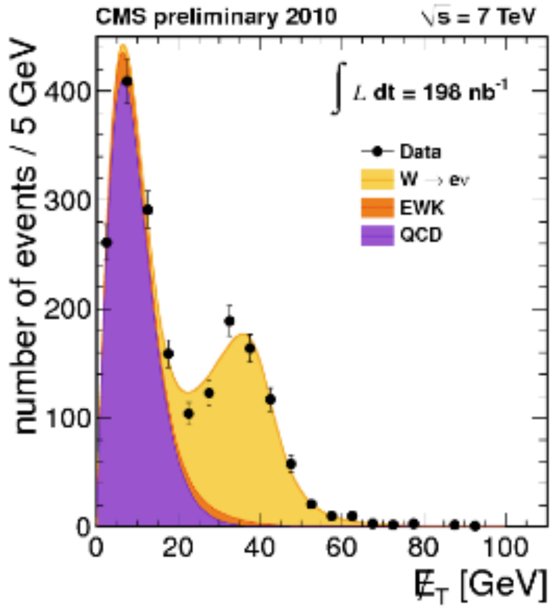
10 W→eν Selection

- Events triggered by Level1 (ECAL) + HLT (E_T>15 GeV)
- **Selection Criteria:**
  - Electron E_T> 20 GeV
  - $|\eta| < 1.4442$ (Barrel), $1.566 < |\eta| < 2.500$ (Endcap)
  - Isolation (independent cuts on track, em, had)
  - Drell Yan rejection (veto on events with a second electron of E_T>20 GeV)





- QCD BG dominated by fake electrons
- Unbinned Likelihood fit to the ME_T distribution
- W Signal and ElectroWeak ME_T shape well modeled from Monte Carlo
- QCD background is parameterized through a modified Rayleigh distribution with E_T dependent resolution

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