Heavy flavor properties of jets produced in p $\bar{p}$ interactions at $s^{1/2}$=1.8 TeV

A small step forward in resolving the long-standing discrepancy between the measured and predicted b-cross section at the Tevatron

P. Giromini
INFN/Frascati

Jets with heavy flavor

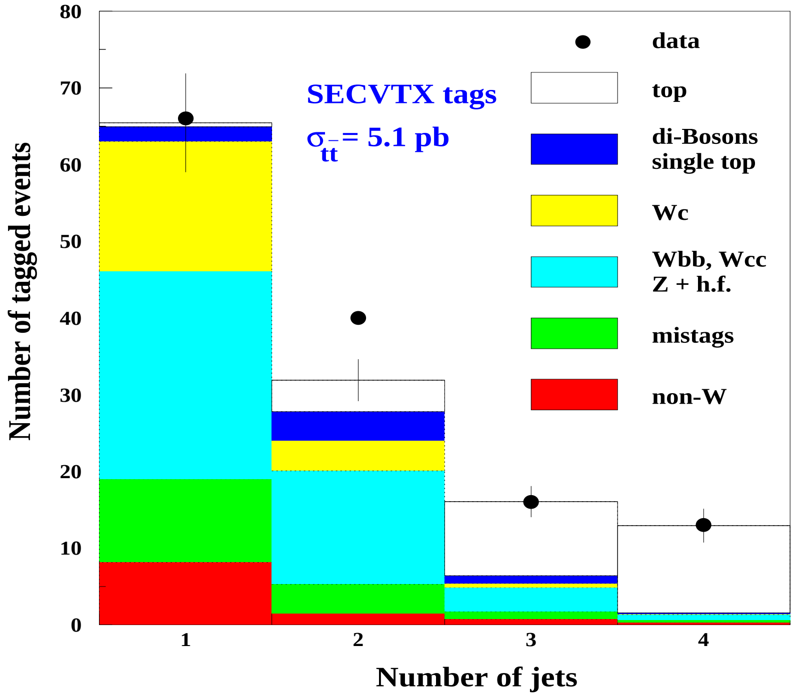
- Over several years CDF has been comparing the fraction of jets with heavy flavor (b and c quarks) to a simulation based upon the Herwig and CLEO (QQ) Monte Carlo generators
- Heavy flavor-identification :
-

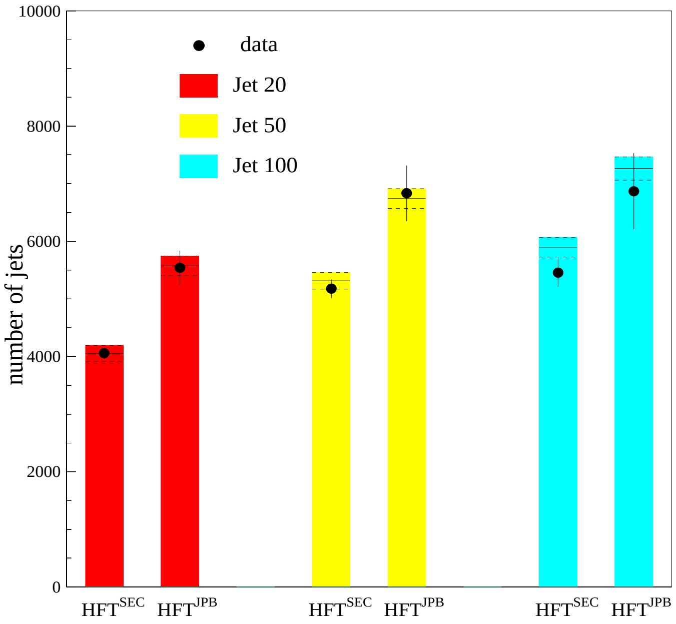
		Efficiency b quark	Efficiency c quark
✓ SECondary VerTeX	(SECVTX)	43%	9%
✓ Jet-ProBability	(JPB)	43%	30%

- Data sets : *W*+ jet events, generic-jet data (JET20, JET50, and JET 100), di-jet events with one jet containing a lepton (lepton-triggered sample)

Jets with heavy flavor

- We have used the lepton-triggered sample to calibrate the data-to-simulation scale factors for the SECVTX and JPB tagging algorithms
- We have used generic-jet data to tune the parton-level cross sections evaluated in Herwig





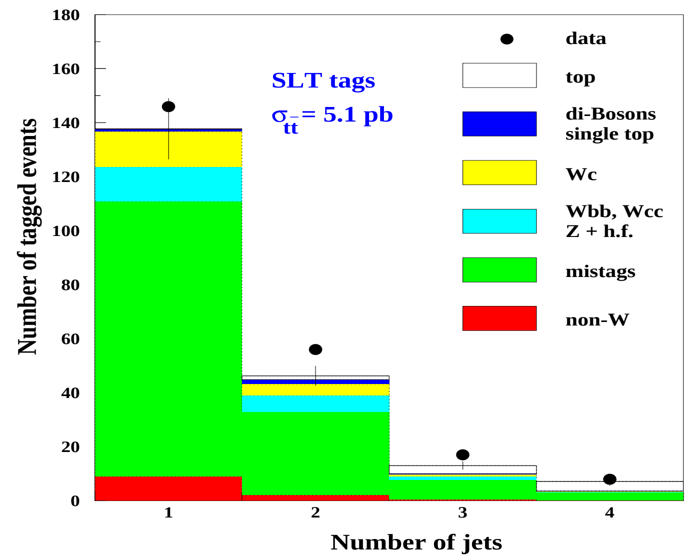
W+jet events
P~50%

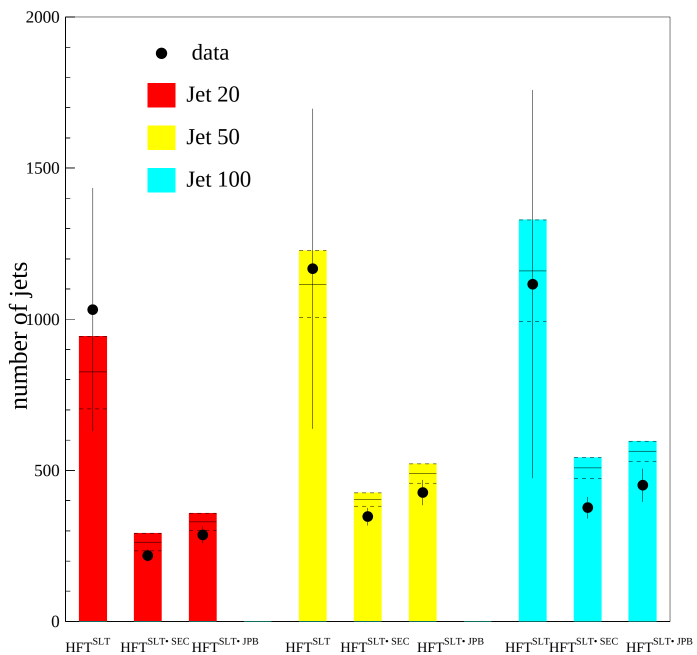
- PRD 64, 032002 (2001)

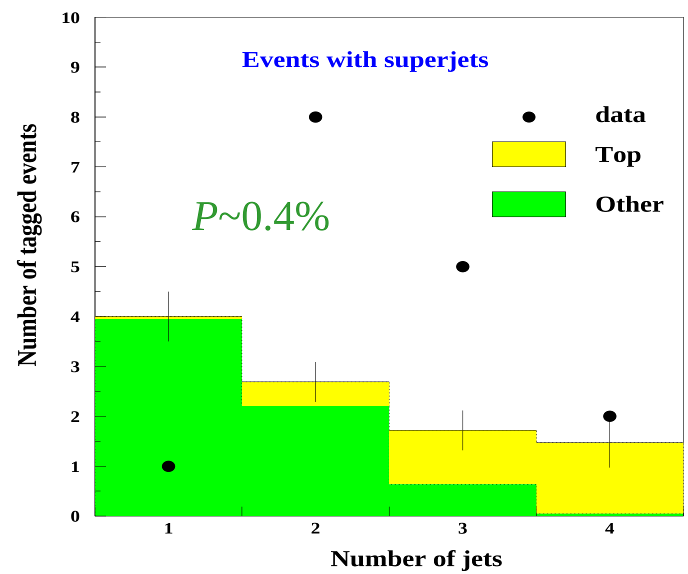
Jets with heavy flavor

- We also identify heavy flavors by searching jets for semileptonic decays (SoftLeptonTagging) efficiency 6.4 % (b) and 4.6% (c)
- PRD 65, 052007 (2002)

P~50%







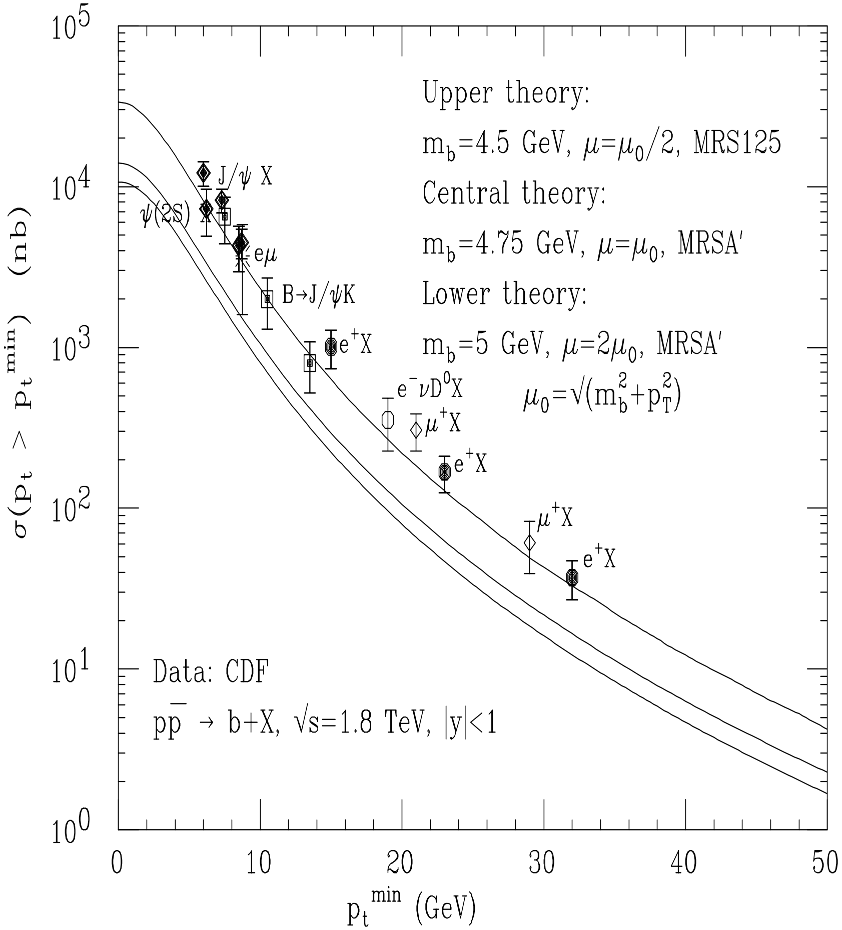
Anomalous W+ 2,3 jet events with a supertag

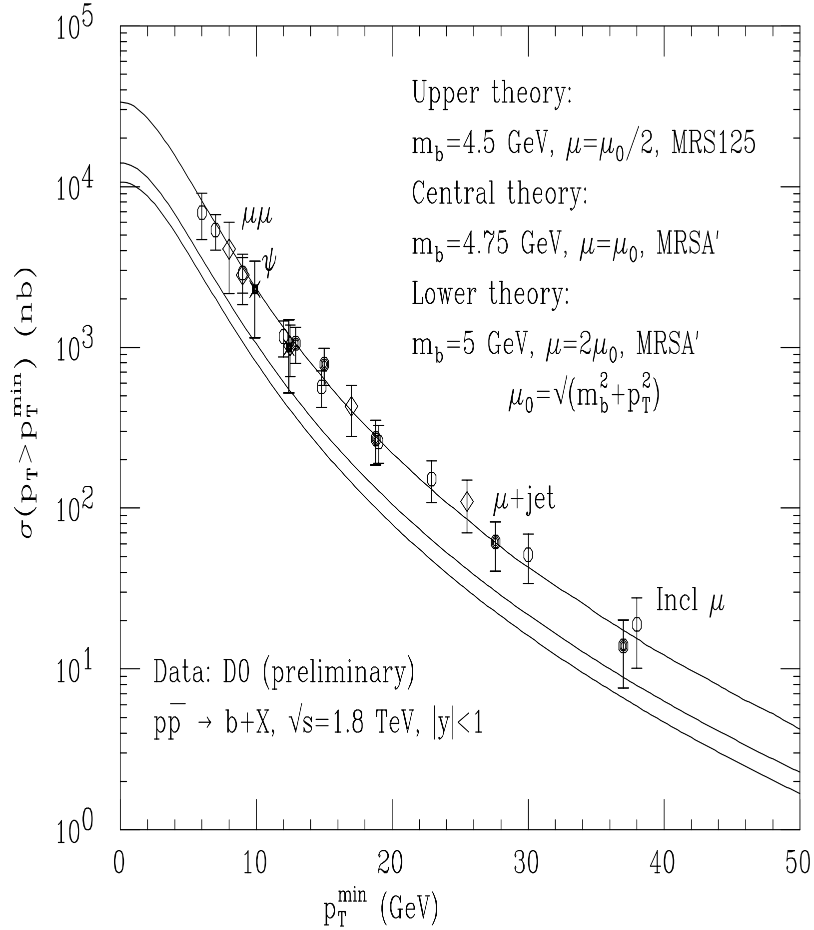
- The kinematics of these events has a 10^{-6} probability of being consistent with the SM simulation [PRD 64, 032004 (2002)]
- hep-ph/0109020 shows that the superjets can be modeled by postulating the existence of a low mass, strong interacting object which decays with a semileptonic branching ratio of the order of 1 and a lifetime of the order of 1 ps
- Since there are no limit to the existence of a charge –1/3 scalar quark with mass smaller than 7 GeV/c^2 [PRL 86, 1963 (2001)], the supersymmetric partner of the bottom quark is a potential candidate

Light sbottom (b_s)

- Lot of very recent buzz
- hep-ph/0007318 uses it to resolve the long-standing discrepancy between the measured and predicted value of *R* for $5 < s^{1/2} < 10$ GeV at $e^+ e^-$ colliders
- PRL 86, 4231 (2001) uses it in conjunction with a light gluino which decays to b b_s to explain the difference of a factor of 2 between the measured b-quark production cross section and the NLO prediction
- If light b_s existed, Run 1 has produced 10^9 pairs; why we did't see them ?

Inclusive b cross section

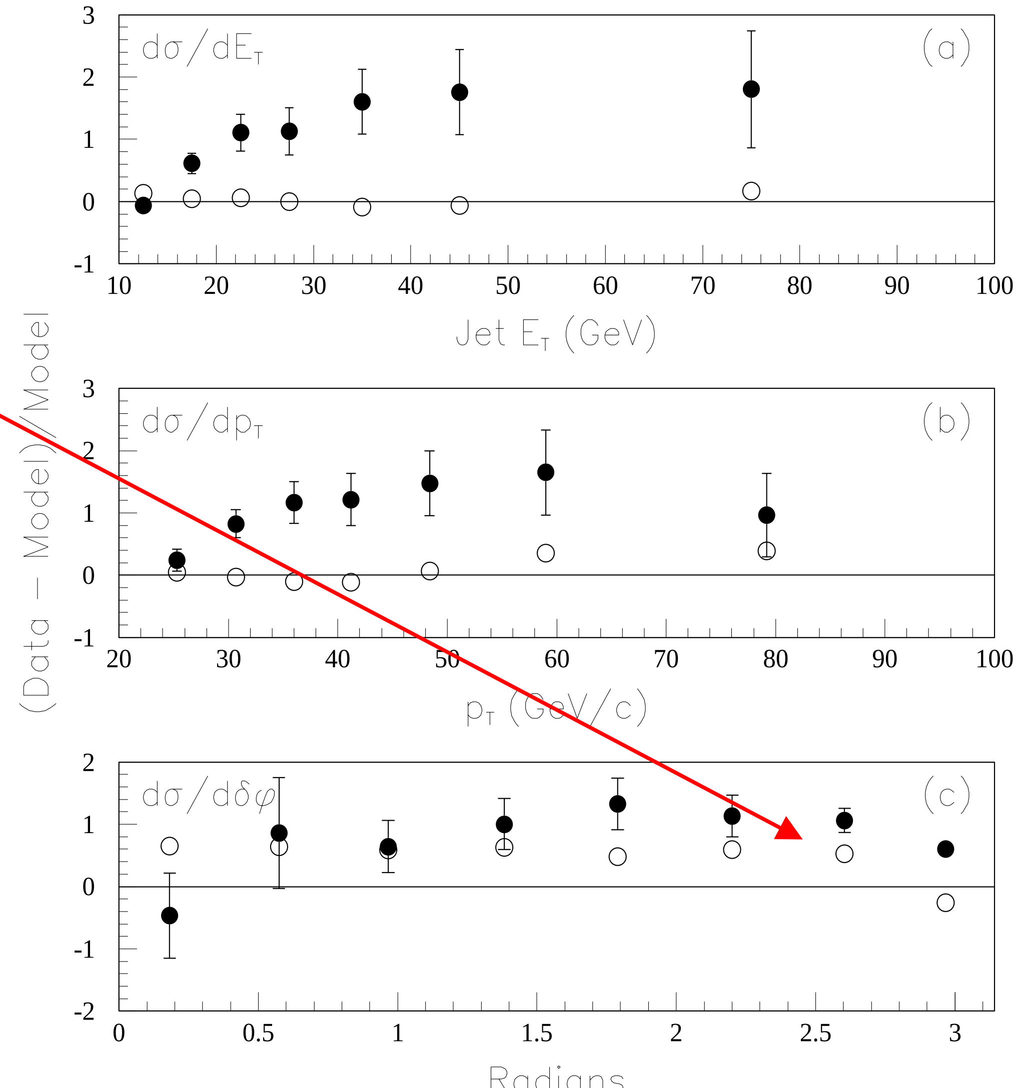




correlated μ+$\bar{b}$-jet cross section

σ_{bb}•BR

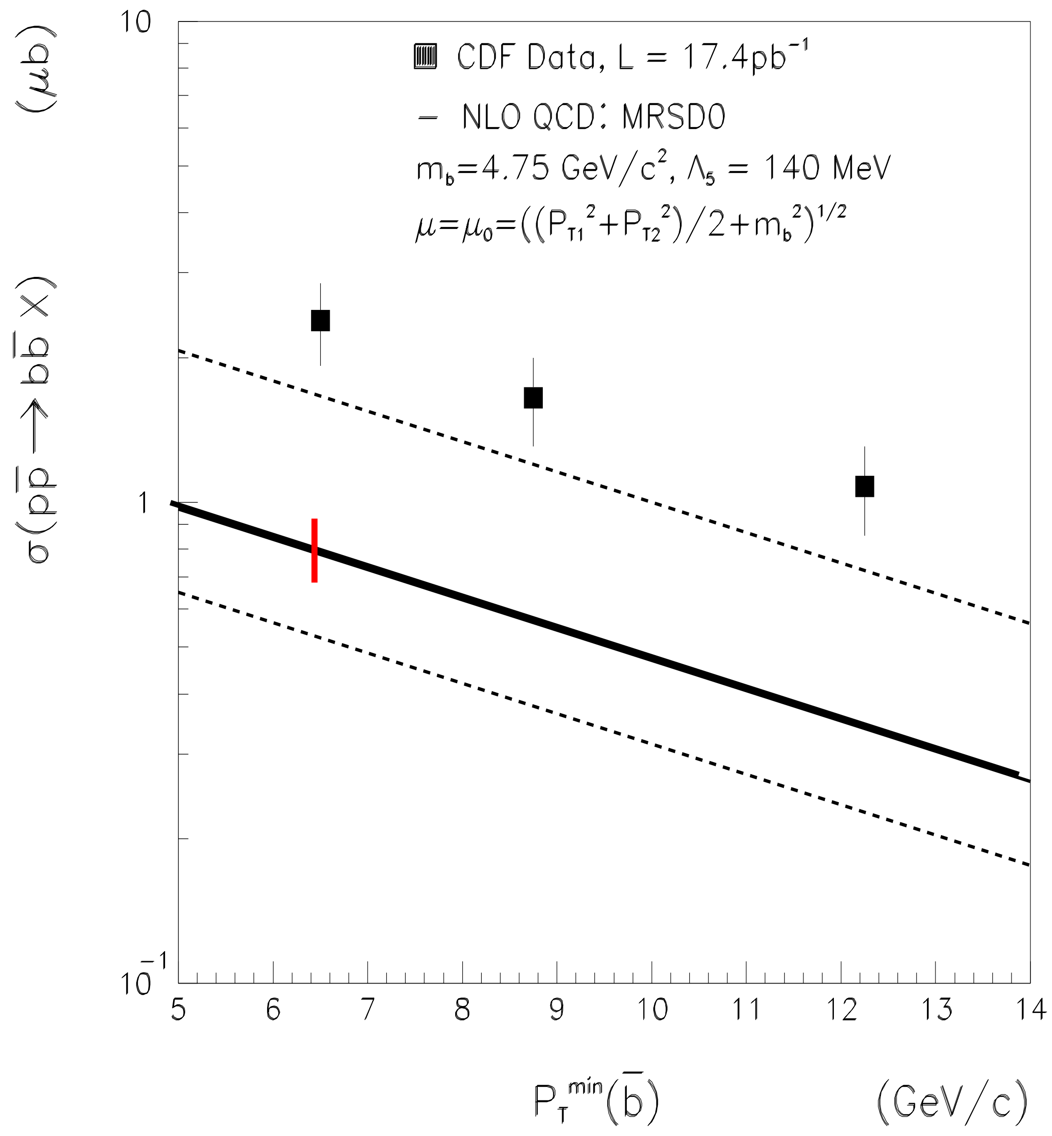
- PRD 53, 1051 (1996)
- Data are 1.5 times larger than the NLO calculation; however
  - ✓ The NLO cross section is not very sensitive to the scales μ
  - ✓ The NLO value is approximately equal to the Born value



$b\bar{b}$ correlations (dimuons)

$\sigma_{bb} \bullet BR^2$

- PRD 55, 2547 (1997)
- Data are 2.2 times larger than the NLO calculation
- DØ has a similar result
- The NLO cross section is not very sensitive to the scales μ (±20%)
- Born and NLO values are within a few percents



Strategy

- the NLO calculation of $p\bar{p} \rightarrow \bar{b}_s b_s$ predicts $\sigma = 19.2$ μb for a squark mass of 3.6 GeV/c^2 (Prospino MC generator program) .
- The $b\bar{b}$ production cross section at the Tevatron is $\sigma = 48.1$ μb (NLO)
- The $c\bar{c}$ production cross section at the Tevatron is $\sigma = 2748.5$ μb (NLO)
- The NLO calculations have a >50% uncertainty because of the renormalization scales μ

Strategy

- We have adjusted the heavy flavor production cross sections calculated by Herwig within the theoretical and experimental uncertainties to reproduce the rate of SECVTX and JPB tags observed in generic-jet data.
- In that study we have used jets with with uncorrected E_T>15 GeV and $|\eta|$<1.5; they correspond to partons with transverse energy approximately larger than 18 GeV
- For partons with transverse energy larger than 18 GeV, σ = 84 nb , σ = 298 nb , and σ = 487 nb (10% contamination)
- we could have easily tuned the Herwig generator to explain in terms of SM processes an additional 10% pair production of scalar quarks: σ^f = 382 nb , and σ^f = 487 nb

Strategy

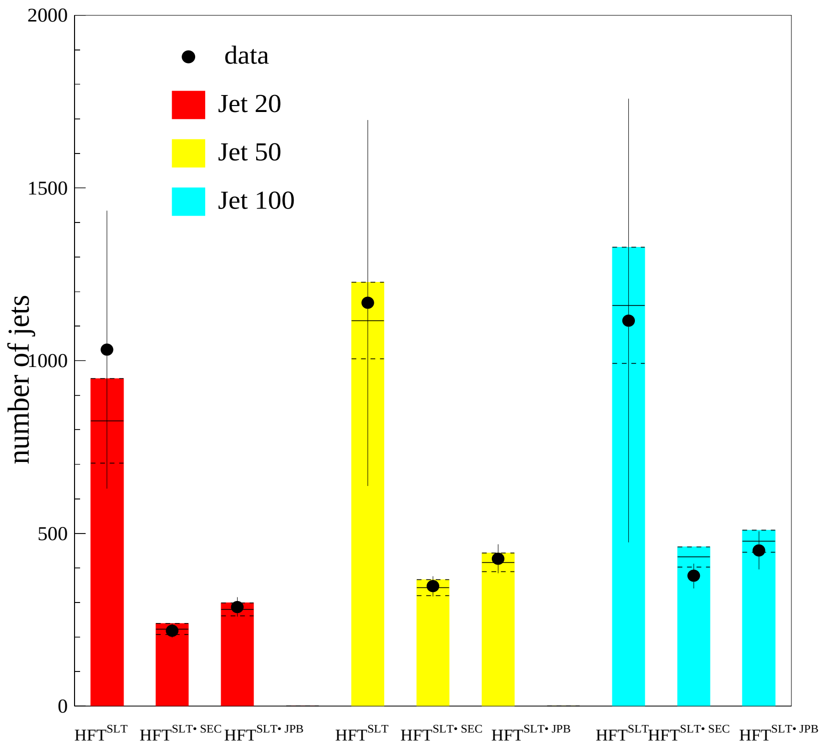
- What if there is a b_s quark with a 100% semileptonic branching ratio
- In b-quark decays, a lepton is produced in 37% of the cases
- In c-quark decays, a lepton is produced in 21% of the cases
- Use SECVTX and JPB tags to identify heavy flavors in the data and in the simulation.
- Tune the heavy flavor cross sections in the simulation to reproduce the rates of observed SECVTX and JPB tags (this renormalization removes the theoretical uncertainty on the cross sections).
- Compare data and simulation as a function of the number of jets containing a lepton

Strategy

	σ (nb)				b_s(%)	fitted QCD			σ/σ_{QCD}
	b	c	b_s	total		b	c	total	
generic jets renorm	298	487	84	869	10%	382	487	869	1
g. j. x BR	110	102	84	296	28%	141	102	243	1.2
g. j. x BR^2	41	22	84	147	57%	52	21	73	2
g .j. x BR renorm (or lep-trig. evts)	110	102	84	296	28%	194	102	296	1
lep-trig. evts. x BR	41	22	84	147	57%	72	21	93	1.5

- Generic-jet comparisons reported in PRD 64, 032002 (2001)

Strategy

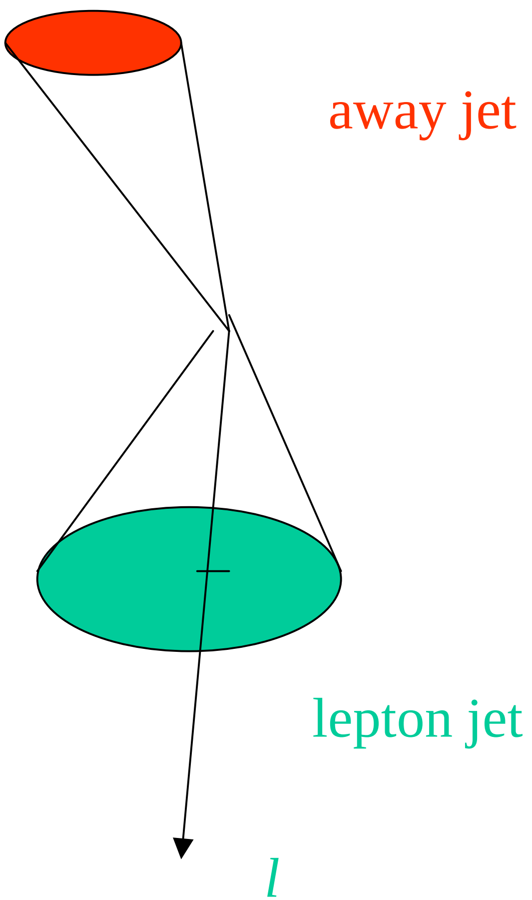


- Use generic-jet data to calibrate and cross-check the efficiency for finding SLT tags and supertags
- Efficiency for finding supertags

  empirically corrected by 15%
  PRD 65, 052007 (2002)

Lepton-triggered events

- Events with 2 or more jets with $E_T >$ 15 GeV and at least two SVX tracks (taggable,$|\eta|<1.5$)
- one electron with $E_T > 8$ GeV or one muon with $p_T > 8$ GeV/c contained in one of the jets
- Require $I > 0.1$
- Reject conversions
- Apply all lepton quality cuts used in the high-p_T lepton sample
- 68544 events with an electron jet and 14966 events with a muon jet



Strategy

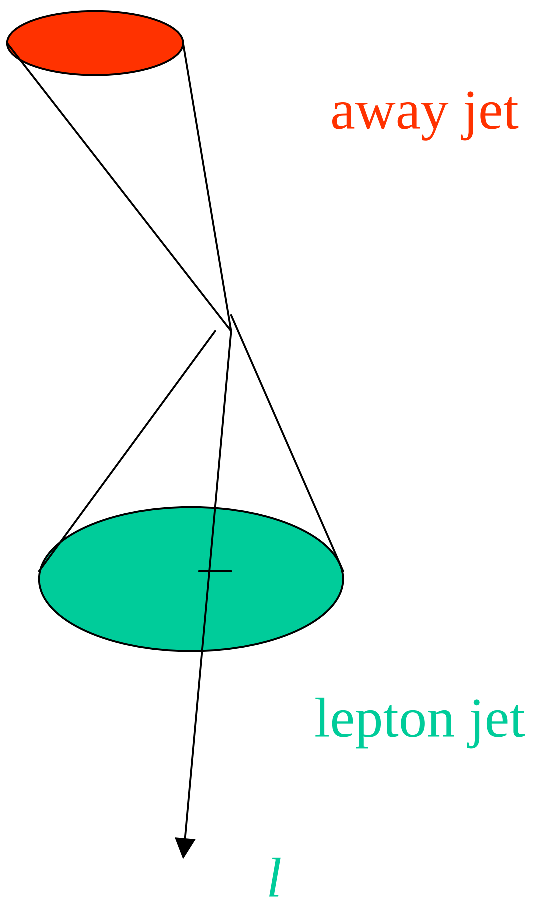
- Perform a detailed comparison between data and simulation using SECVTX, and JPB tags on both the lepton- and away-jets
- Differently from previous analyses, this study checks at the same time the cross section for producing at least 1 b with $|\eta|<1.5$ (imperfect NLO calculation), 1 b +1 $\bar{b}$ with $|\eta|<1.5$ (robust NLO calculation)
- Then we check the semileptonic branching ratio of heavy flavor hadrons by counting the number of a-jets with SLT tags in the data and in the simulation

Mistags and tagging efficiencies

- PRD 64, 032002 (2001) and PRD 65, 052007 (2002)
- Mistags (tags in a jet without heavy flavor) are evaluated with parametrized probability functions derived in generic-jet data. We estimate a 10% uncertainty.
- Since we use a parametrized simulation of the detector, we have measured the data-to simulation scale factor for the tagging efficiency of the SECVTX and JPB algorithms.These factors were determined with a 6% accuracy and implemented into the simulation.
- The SLT simulation uses efficiencies for each selection cut measured using data; we estimate a 10% uncertainty, which includes the uncertainty on the semileptonic branching ratio
- The simulated supertag efficiency is corrected for the data-to-simulation scale factor measured in generic-jet data: (85±5)%

Evaluation of the heavy flavor content of the data

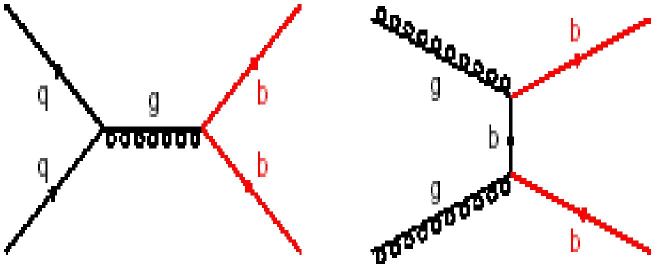
- Before tagging, approximately 50% of the lepton jets do not contain heavy flavor; they are mostly due to fake leptons
- Mistags in the lepton-jets and away jets are evaluated with a parametrized probability and removed
- The fraction (1-hf) of events in which the l-jet does not contain heavy flavor is not simulated. In these events, away-jets can have tags due to heavy flavor. Their rates are estimated using a parametrized probability of finding a tag due to heavy flavor in generic-jet data. Using a sample of *l*-jets containing electrons due to identified conversions, we estimate a 10% accuracy. It is a slight overestimate.



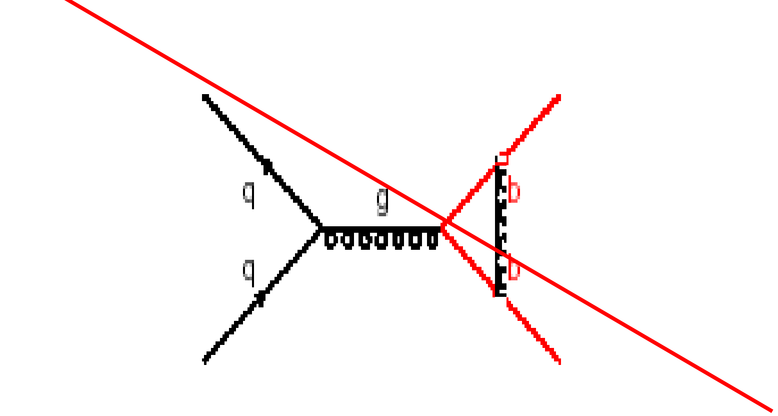
Simulation

- Use the Herwig generator program (option 1500, generic 2 → 2 hard scattering with p_T > 13 GeV/c)
- $b\bar{b}$ and $c\bar{c}$ production are generated through processes of order α^2 such as $q\bar{q} \to b\bar{b}$
- Processes of order α^3 are implemented through flavor excitation diagrams, such as $g\, b \to g\, b$, or gluon splitting, in which the process $g\, g \to g\, g$ is followed by $g \to b\bar{b}$
- Use MRS (G) PDF's
- The bottom and charmed hadrons are decayed with QQ (version 9_1)
- We select simulated events which contain hadrons with heavy flavor and at least one lepton with p_T > 8 GeV/c
- These events are passed through QFL, a parametrized simulation of the CDF detector and treated as real data
- We have simulated 27156 electron events (98.9 pb^{-1}) and 7267 muon events (55.1 pb^{-1}) with heavy flavor

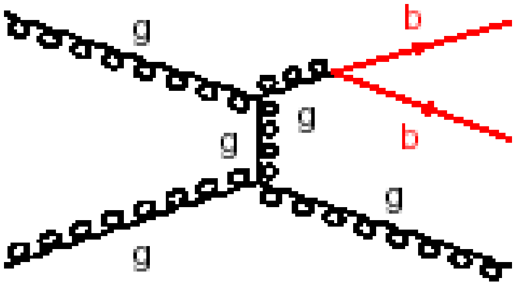
LO – Born term



NLO – Virtual Emission

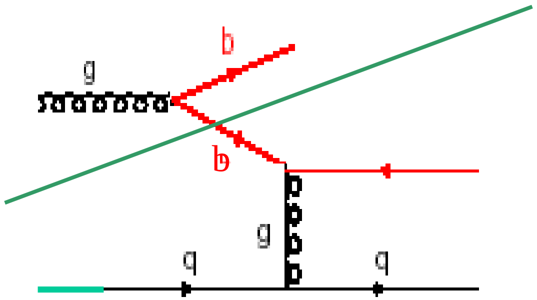


NLO – real emission



Gluon splitting

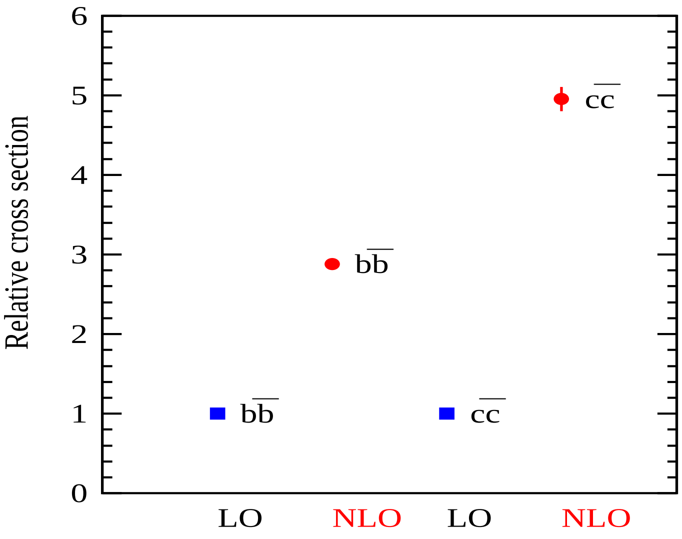
Parton shower

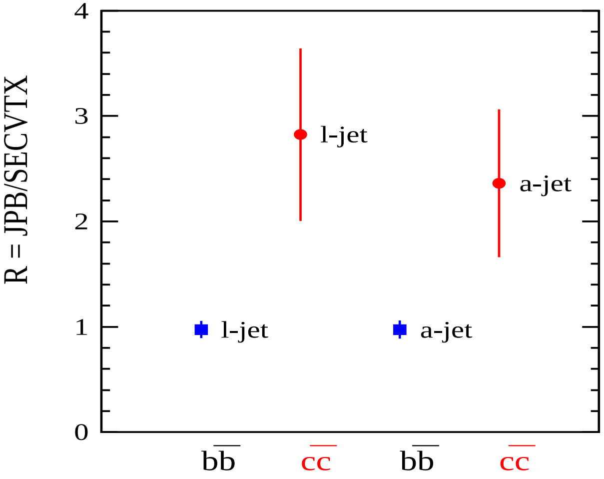


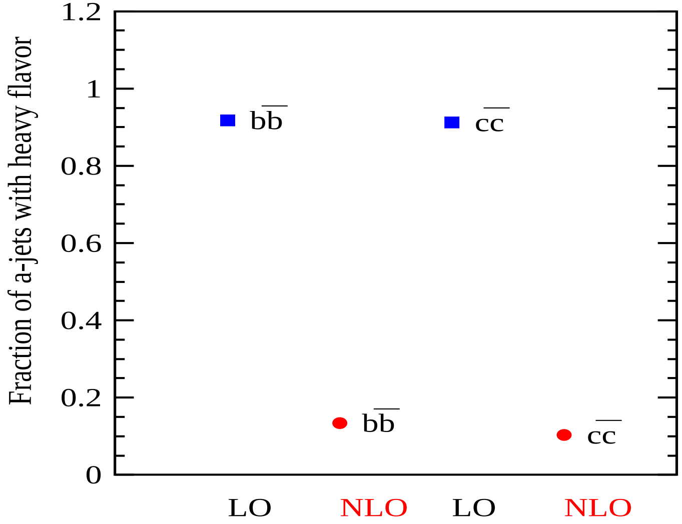
Flavor Excitation

Structure function

Tuning strategy







Fit of the simulation to the data

SECVTX	lepton side	
	away side	
	Both	
JPB	lepton side	
	away side	
	Both	→

Fit parameters	Constraints	Error
c dir norm	b dir/c dir ≈ 1	14%
b flav exc norm	b/c ≈0.5	28%
c flav exc norm		
b gluon split norm	1.40	0.19
c gluon split norm	1.35	0.36
Ke norm		
Kμ norm		
SECVTX scale factor, b	1.0	6%
SECVTX scale factor, c	1.0	28%
JPB scale factor	1.0	6%

- Use 6 fit parameters corresponding to the direct, flavor excitation and gluon splitting production cross sections evaluated by Herwig for b and c-quarks
- K_e and K_μ account for the luminosity and b-direct production
- The parameters bf, bg, c, cf, cg account for the remaining production cross sections, relative to the b-direct production

Data

	electron data			muon data		
tag type			P_{GQCD}			P_{GQCD}
N_{l-jet}	68544			14966		
N_{a-jet}	73335			16460		
T^{SEC}_{l-jet}	10115.3 ± 101.7	$(10221/105.7)$	0	3657 ± 60.8	$(3689/31.7)$	0
T^{JPB}_{l-jet}	11165.4 ± 115.8	$(11591/425.6)$	0	4068.6 ± 66.2	$(4204/135.4)$	0
T^{SEC}_{a-jet}	4353.3 ± 68.5	$(4494/140.7)$	1.56%	1054.6 ± 33.3	$(1094/39.4)$	1.67%
T^{JPB}_{a-jet}	5018.9 ± 98.9	$(5661/642.1)$	2.45%	1265.2 ± 41.1	$(1427/161.8)$	2.63%
DT^{SEC}	1375.2 ± 37.6	$(1405/29.8)$	0	452.6 ± 21.6	$(465/12.4)$	0
DT^{JPB}	1627.8 ± 43.7	$(1754/126.2)$	0	546.4 ± 25.1	$(600/53.6)$	0

Heavy flavors in the simulation are identified at generator level

electron simulation

tag type	b-dir	c-dir	b-f.exc	c-f.exc	b-gsp	c-gsp
HF_{l-jet}	5671	947	10779	2786	5263	1690
HF_{a-jet}	5848	977	11280	2913	6025	1877
h.f./light	5407/441	899/78	1605/9675	367/2546	707/5318	145/1732
HFT^{SEC}_{l-jet}	1867	52	3624	194	1732	147
HFT^{JPB}_{l-jet}	2392	163	4531	602	2106	356
HFT^{SEC}_{a-jet}	2093	91	480	68	222	15
HFT^{JPB}_{a-jet}	2622	203	584	136	276	58
$HFDT^{SEC}$	678	5	157	4	78	1
$HFDT^{JPB}$	1083	43	303	25	168	18

muon simulation

tag type	b-dir	c-dir	b-f.exc	c-f.exc	b-gsp	c-gsp
HF_{l-jet}	1285	298	2539	942	1455	747
HF_{a-jet}	1358	313	2705	994	1708	816
h.f./prompt	1206/152	278/35	422/2283	124/870	171/1537	48/768
HFT^{SEC}_{l-jet}	569	34	1131	83	652	92
HFT^{JPB}_{l-jet}	707	77	1386	229	830	202
HFT^{SEC}_{a-jet}	498	29	132	13	54	11
HFT^{JPB}_{a-jet}	627	62	173	34	60	21
$HFDT^{SEC}$	218	3	59	2	20	1
$HFDT^{JPB}$	347	12	105	7	50	6

Fit of the simulation to the data

- Use 6 fit parameters corresponding to the direct, flavor excitation and gluon splitting production cross sections evaluated by Herwig for b and c-quarks
- K_e and K_μ account for the luminosity and b-direct production
- The parameters bf, bg, c, cf, cg account for the remaining production cross sections, relative to the b-direct production
- The ratio of b to c direct production constrained to the default value (about 1) within 14%
- the ratio of b to c flavor excitation constrained to the default value (about 0.5) with a 28% uncertainty
- bg constrained to (1.4±0.19)
- cg constrained to (1.35±0.36)
- The tagging efficiencies are also fit parameters, and are constrained to their measured values within their uncertainties (6% for b-quarks, 28% for c-quarks)

Fit result

SECVTX scale factor	SF_b	0.97 ± 0.03
SECVTX scale factor	SF_c	0.94 ± 0.22
JPB scale factor	SF_{JPB}	1.01 ± 0.02
e norm.	K_e	1.02 ± 0.05
μ norm.	K_μ	1.08 ± 0.06
c dir. prod.	c	1.01 ± 0.10
b flav. exc.	bf	1.02 ± 0.12
c flav. exc.	cf	1.10 ± 0.29
$g \to b\bar{b}$	bg	1.40 ± 0.18
$g \to c\bar{c}$	cg	1.40 ± 0.34

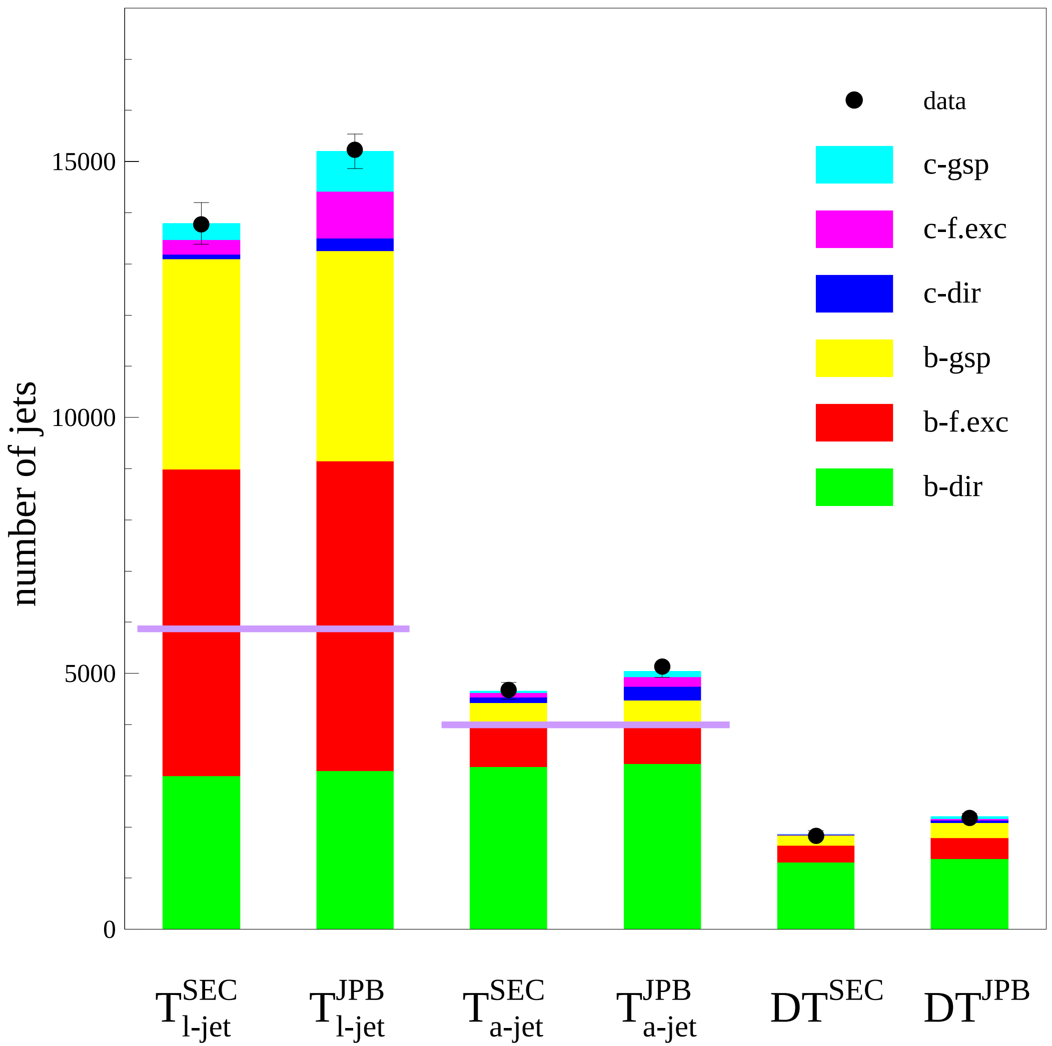
- χ^2/DOF=4.6/9

Fit result-parameter corr. coeff.

	SF_c	SF_{JPB}	K_e	c	bf	cf	bg	cg	K_μ
SF_b	-0.073	0.718	-0.747	0.054	0.346	0.297	-0.062	0.066	-0.715
SF_c		0.358	-0.238	-0.002	0.038	0.147	-0.071	0.086	-0.306
SF_{JPB}			-0.810	0.010	0.363	0.127	-0.009	-0.049	-0.802
K_e				-0.092	-0.641	-0.302	0.071	0.077	0.933
c					0.053	0.020	0.008	0.002	-0.098
bf						0.245	-0.680	-0.199	-0.526
cf							-0.321	-0.164	-0.274
bg								-0.029	-0.019
cg									-0.018

For

Fit result



- $F_{hf} = (45.3 \pm 1.9)\%$ for electrons
- $F_{hf} = (59.7 \pm 3.6)\%$ for muons

NLO and Herwig calculations

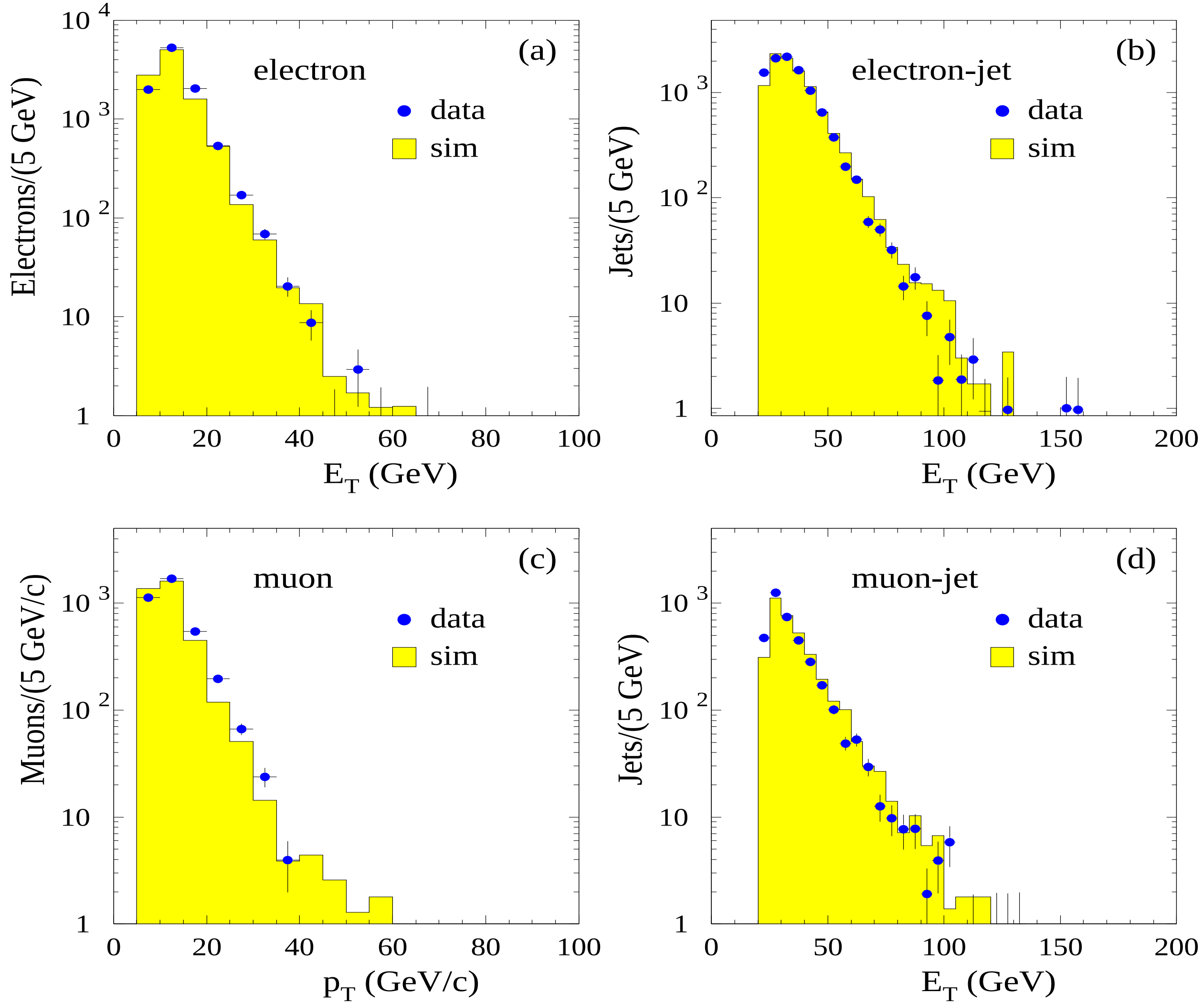
- Herwig ignores interference terms between the Born approximation and the NLO diagrams, and evaluates a gluon splitting+flavor excitation contribution which is a factor of 3 larger than the Born approximation.
- In the NLO calculation the contribution of the Born cross section and of the gluon splitting+flavor excitation are approximately equal using the renormalization scale μ; when using the scale the scale $\mu/2$,the NLO calculation gets closer to Herwig.
- The fact that the ratio between NLO and Born is about two and is not stable as a function of the renormalization scale is taken by the experts as an indication that NNLO corrections are important
- The relevance of the Herwig result, which models the data, is the indication that the effect of NNLO correction should be that of canceling the interference terms

NLO and Herwig calculations

- However, in this specific analysis we are interested in comparing rates of a-jet with heavy flavor (signaled by SLT or SECVTX tags) in events in which the l-jet has also heavy flavor
- These jet have $|\eta|<1$ and corresponds to partons with $E_T > 18$ GeV
- In this case Herwig evaluates that the gluon splitting+flavor excitation contribution are 40% of the Born contribution and not a factor of 3 higher
- For this type of kinematics, the ratio of the NLO to Born calculations is also of the order of 1.1-1.3. In addition, for this topology, the NLO calculation depends little on the choice of μ, and it appears to meet general criteria of robustness.

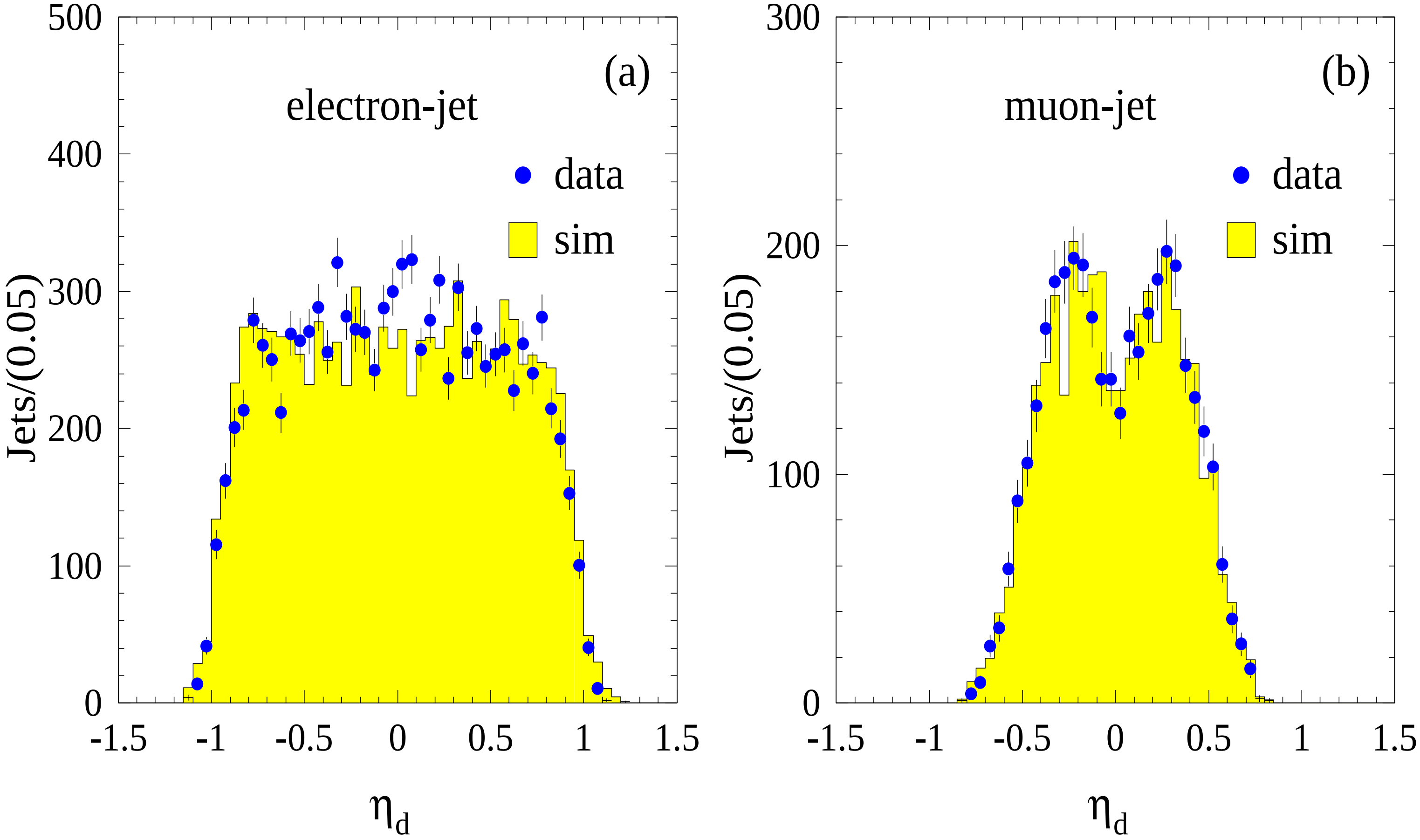
Kinematics

SECVTX tagged



Kinematics

SECVTX tagged

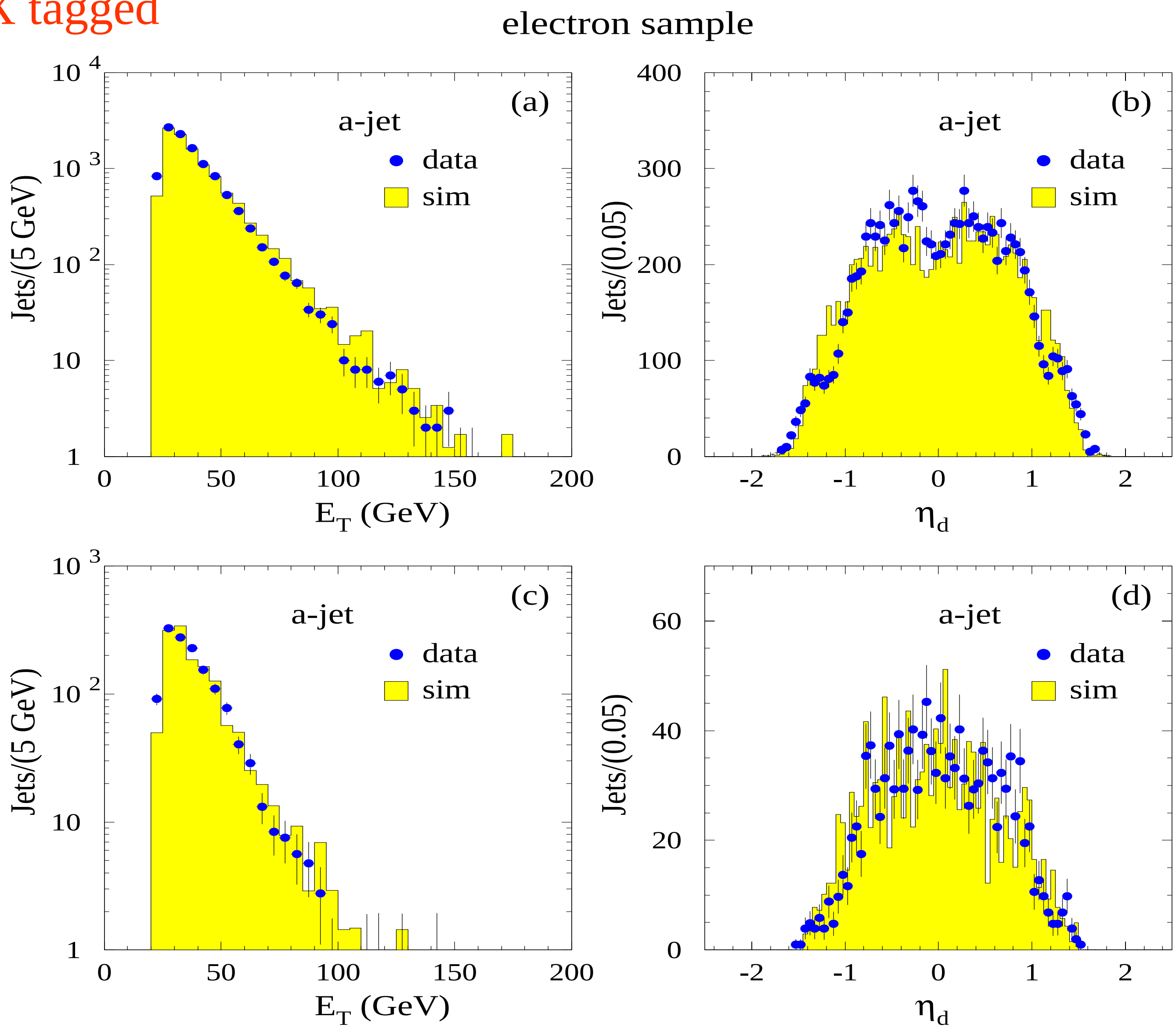


Kinematics

L -jet SECVTX tagged

A-jet

A-jet with SECVTX tags

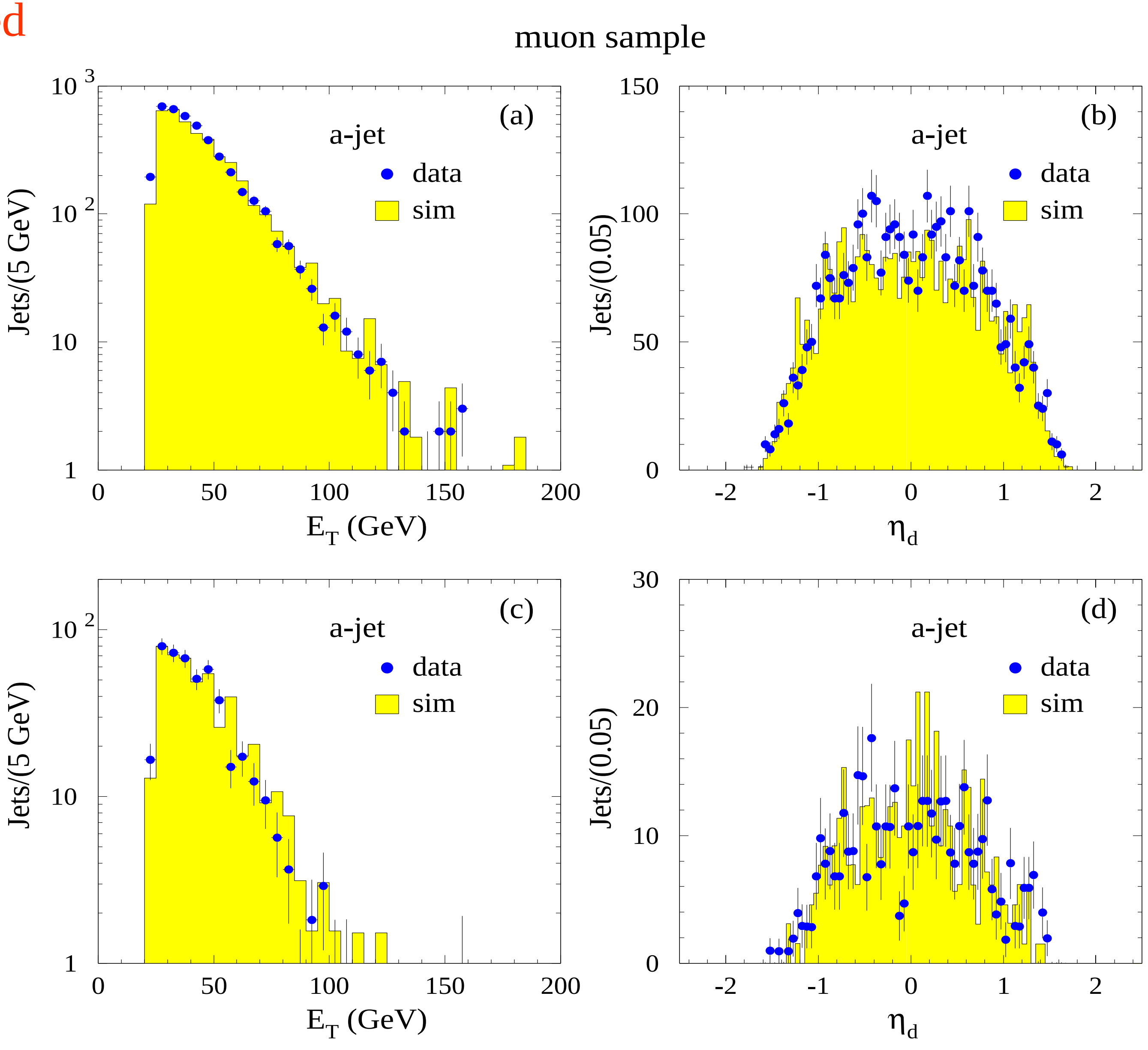


Kinematics

L -jet SECVTX tagged

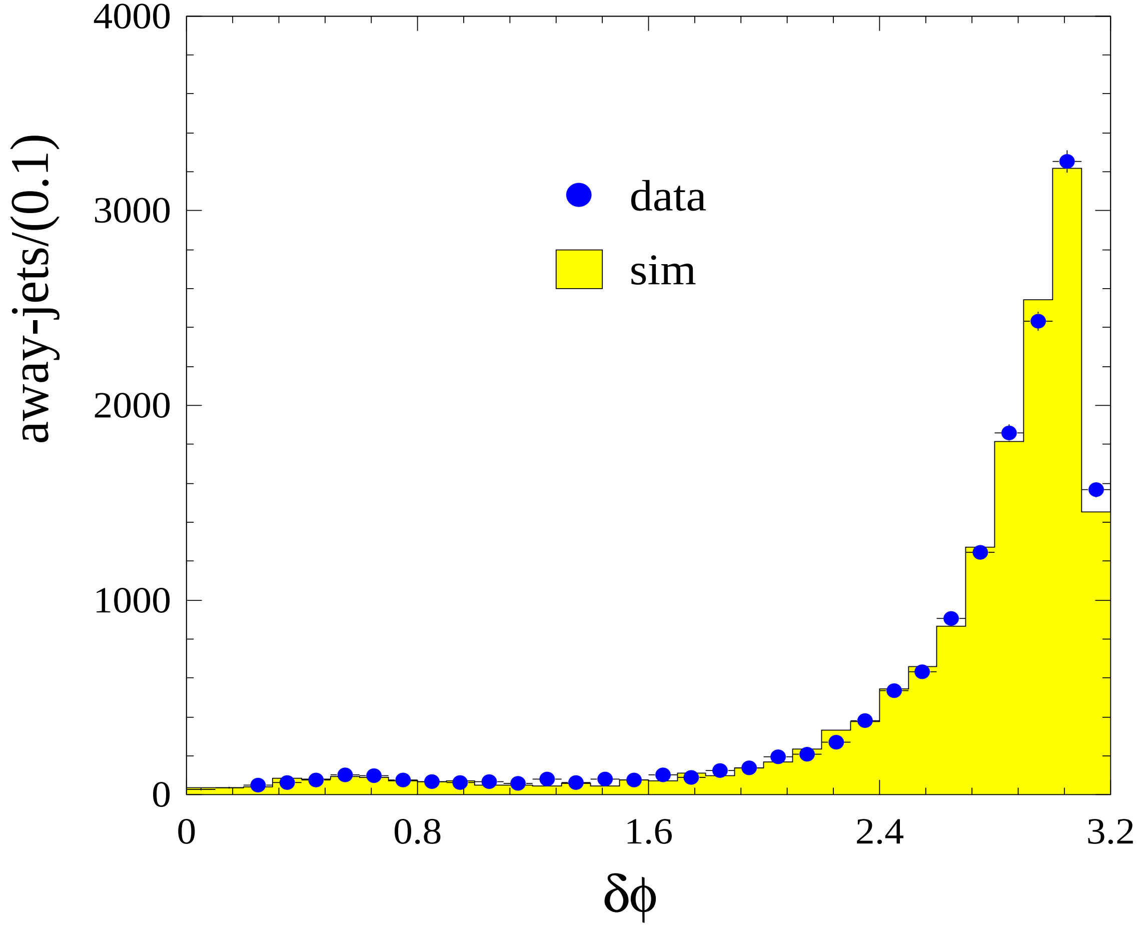
A-jet

A-jet with SECVTX tags



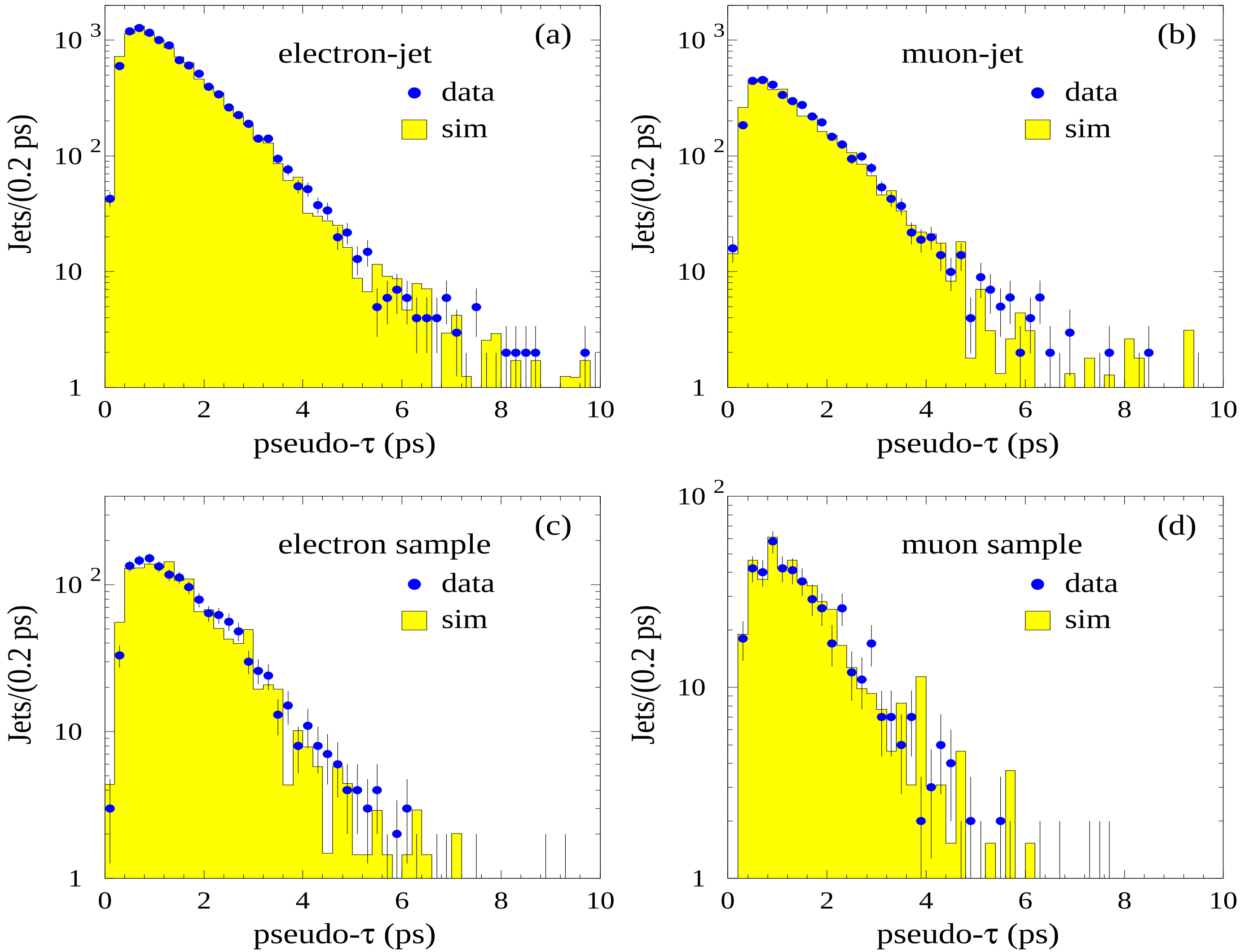
Kinematics

L -jet SECVTX tagged



Kinematics

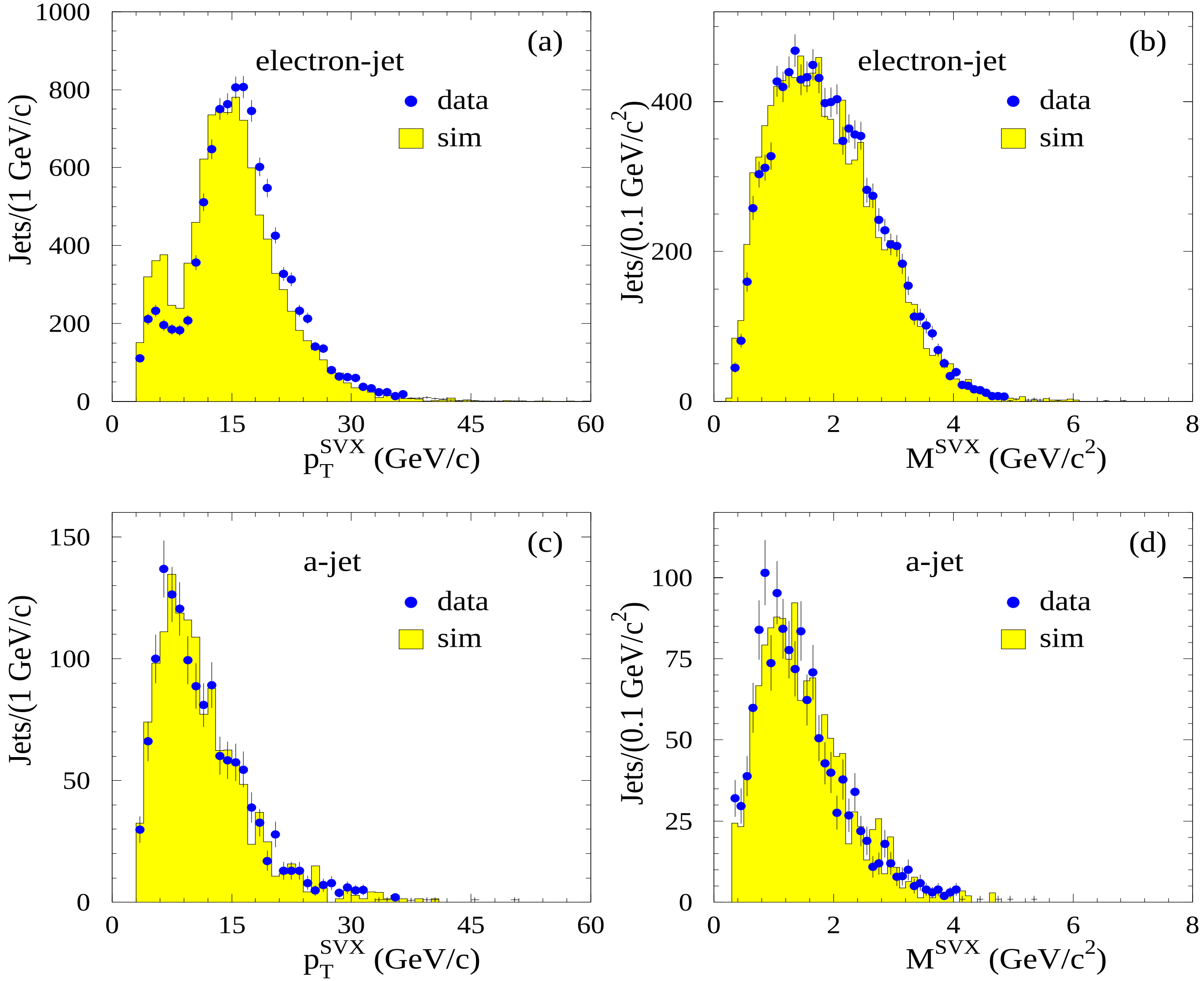
L -jet SECVTX tagged



A-jet with SECVTX tags

Kinematics

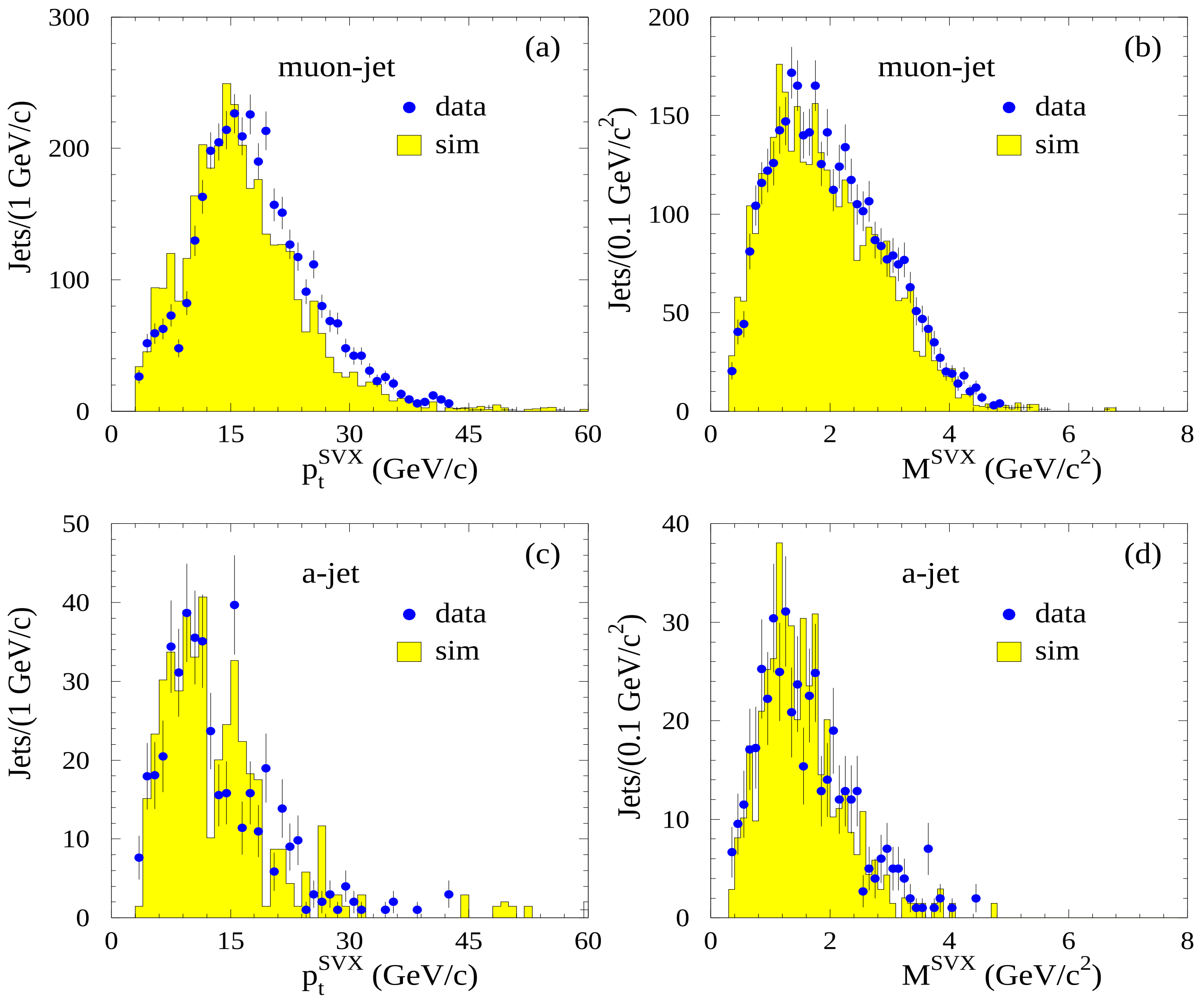
L -jet SECVTX tagged



A-jet with SECVTX tags

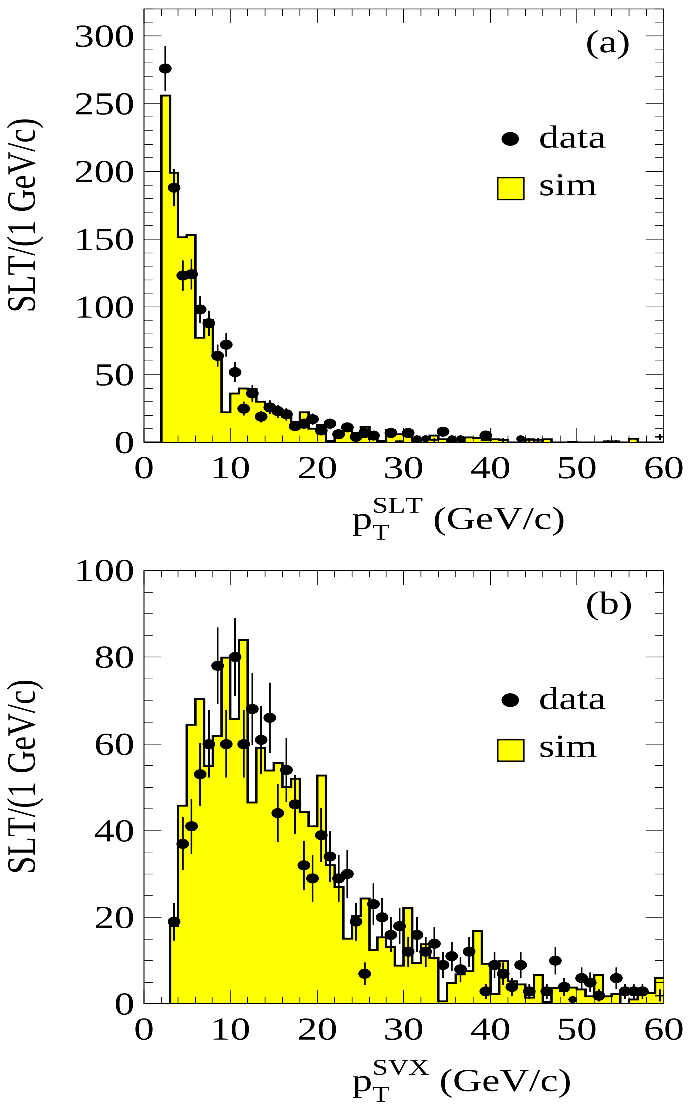
Kinematics

L -jet SECVTX tagged



A-jet with SECVTX tags

fragmentation in generic-jet data



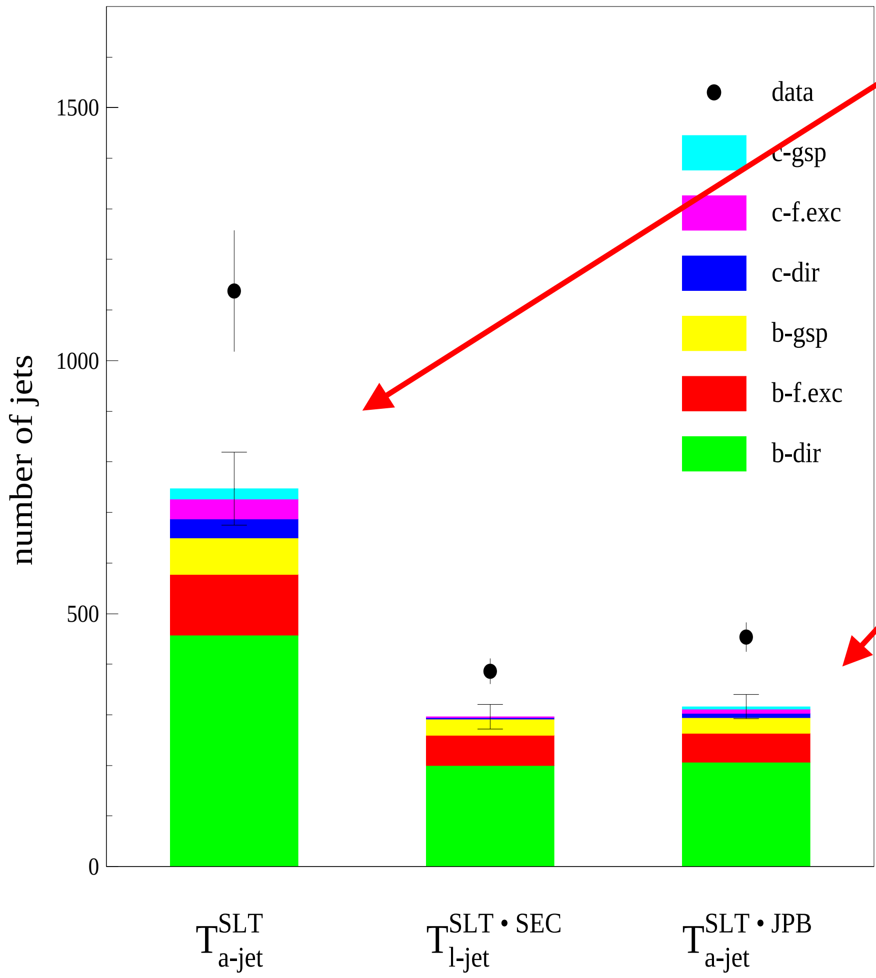
- 550,000 generic-jet events in the data and in the Herwig simulation (JET20, JET50, and JET100).
  - ✓ 1324 supertags in the data
  - ✓ 1342 simulated supertags

away-jets with SLT tags

tag type	electron data		P_{GQCD}	muon data		P_{GQCD}
T_{a-jet}^{SLT}	1063.8 ± 47.0	(2097/1033.2)	0.49%	308.6 ± 34.7	(562/253.4)	0.54%
$T_{a-jet}^{SLT \cdot SEC}$	356.3 ± 22.8	(444/87.7)	0.08%	69.3 ± 9.9	(92/22.7)	0.09%
$T_{a-jet}^{SLT \cdot JPB}$	401.3 ± 25.3	(513/111.7)	0.13%	112.3 ± 12.3	(143/30.7)	0.14%

	Electrons		Muons	
Tag type	Data	Simulation	Data	Simulation
HFT_{a-jet}^{SLT}	865.1 ± 114.8	597.6 ± 69.3	272.7 ± 34.9	149.3 ± 21.0
$HFT_{a-jet}^{SLT \cdot SEC}$	322.6 ± 23.3	242.4 ± 22.5	63.3 ± 9.9	53.8 ± 8.7
$HFT_{a-jet}^{SLT \cdot JPB}$	350.2 ± 26.3	251.5 ± 21.7	103.2 ± 12.4	65.0 ± 8.9

Comparison of a-jets with SLT tags in the data and the normalized simulation



SEEN 1137±140.0 (±51.0 STAT.)

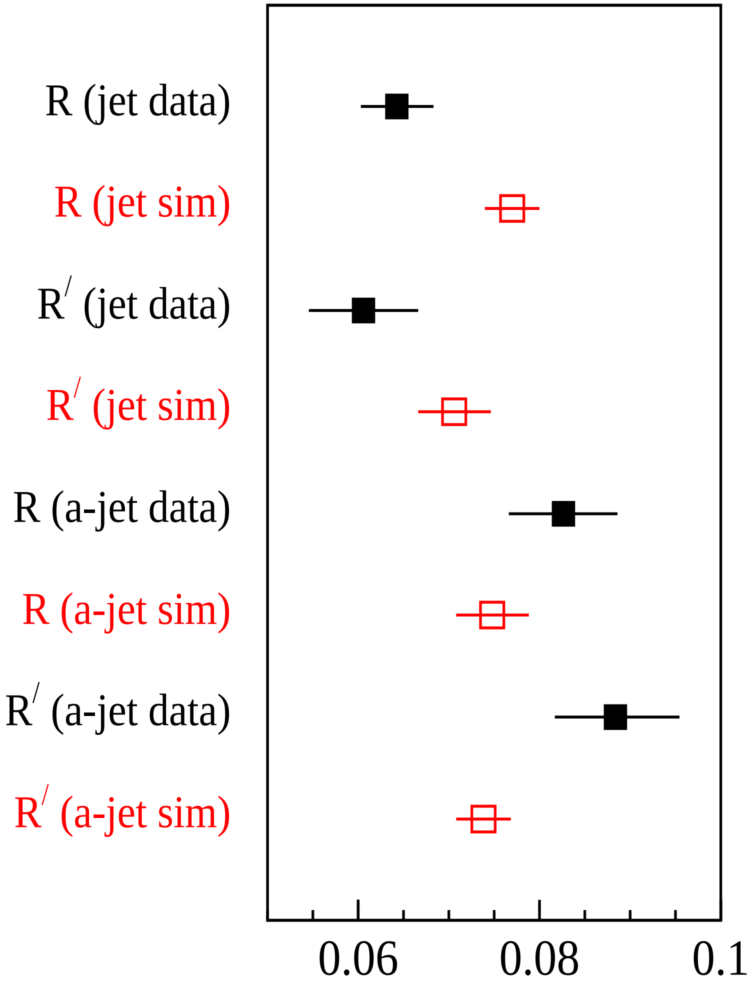
EXPECTED 746.9±75.0 (SYST)

SEEN 453±29.4 (±25 STAT.)

EXPECTED 316.5±25.4 (SYST)

(±15.8 SLT efficiency, ±20 fit)

Supertags


R (jet data)
R (jet sim)
R/ (jet data)
R/ (jet sim)
R (a-jet data)
R (a-jet sim)
R/ (a-jet data)
R/ (a-jet sim)
0.06
0.08
0.1

No dependence of the result from the fit normalization

- N_b and N_c are the numbers of predicted a-jets with bottom and charmed flavor
- $\varepsilon_b^{JPB}=0.43$, $\varepsilon_c^{JPB}=0.30$, $\varepsilon_b^{SLT}=0.064$, $\varepsilon_c^{SLT}=0.047$
- $\varepsilon_c^{JPB}/\varepsilon_b^{JPB} = \varepsilon_c^{SLT}/\varepsilon_b^{SLT}$
- $HFT^{SLT}(\text{a-jet}) = \varepsilon_b^{SLT}(N_b + \varepsilon_c^{SLT}/\varepsilon_b^{SLT}\, N_c)\, \varepsilon_b^{JPB}/\varepsilon_b^{JPB}$
  $= \varepsilon_b^{SLT}/\varepsilon_b^{JPB}\, HFT^{JPB}(\text{data})$
  $= \varepsilon_b^{SLT}/\varepsilon_b^{JPB}\,(5126.6\pm146.7) = 763\pm80$
- Independent of the heavy flavor composition of the fitted simulation

No dependence of the result from the fit normalization

- In other words
- Remove, e.g., the 14% constraint on c/b ratio for direct production
- Fool the fit to return a local minimum c=2.8±1.6
- HFT^{SLT}(a-jet) =597.6±69.3 → 603±66 (electrons)
- 149±21 → 156±21 (muons)

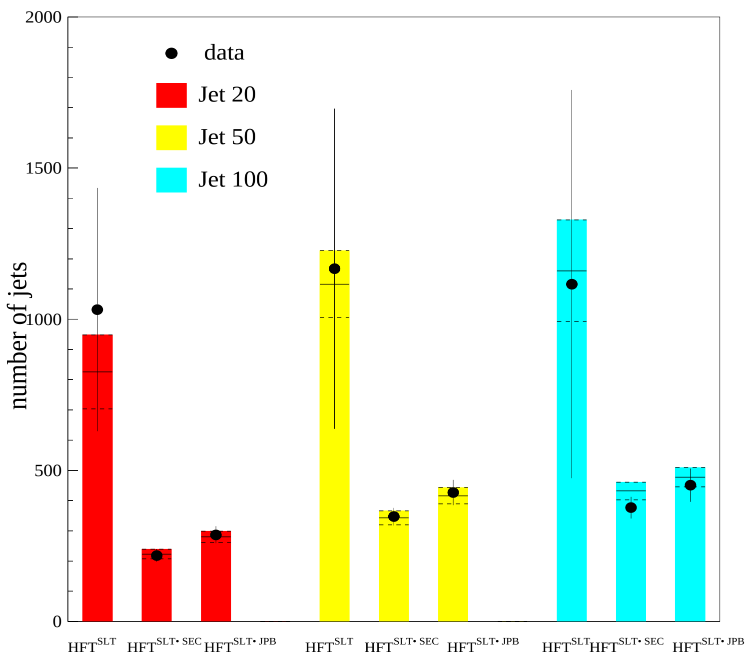
Systematics (away-jets with SLT tags)

- In events due to heavy flavor, there is an excess of 391 a-jets with a SLT tag with respect to the simulation (1137.8 observed and 746.9 expected), having removed 619.3 fake tags [the events in which the l-jet does not have heavy flavor contain 901.9±91 a-jet with SLT tags (74% fake+ 26% heavy flavor): slight overestimate].
- If one could increase the fake rate in events with heavy flavor by 60%, the excess would disappear. However, in generic-jet data, the fake rate is already 74% of the SLT tagging rate.
- Since fakes are approximately 74% of the SLT rate, the 10% uncertainty of the fake removal was evaluated by comparing observed rates of SLT tags to the parametrized prediction in all QCD samples. Most of the 10% comes from the fact that different QCD sample have slightly different heavy flavor purity

Systematics (wrong fake SLT tags ?)

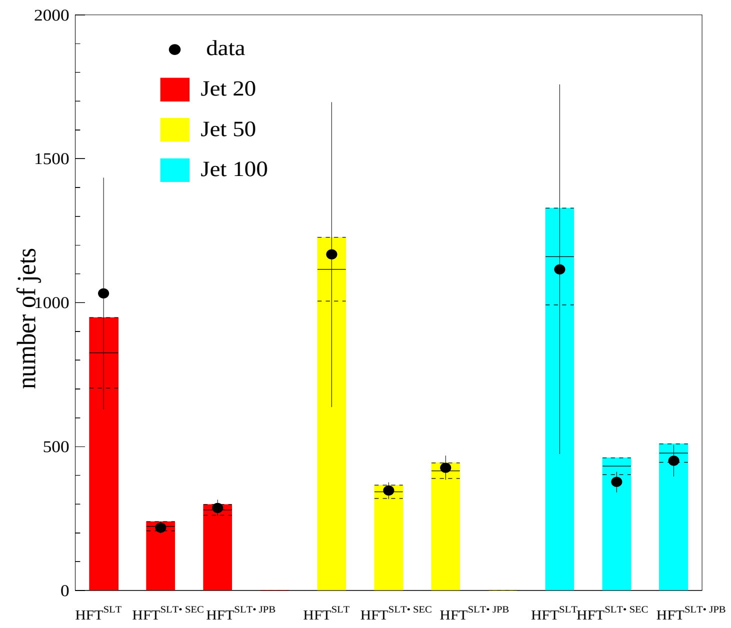
- The heavy flavor content of generic-jet data has been evaluated using SECVTX and JPB tags
- In generic-jet data the number of SLT tags due to heavy flavor is therefore known with a 13% error, mostly due to the 10% uncertainty of the SLT tagging efficiency
- Therefore the real uncertainty on the fake rate is no larger than 2.6%

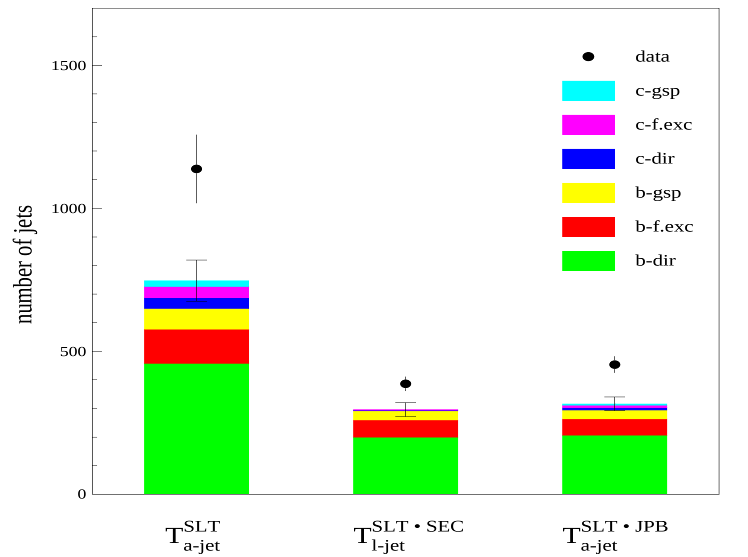
Data – simulated H.F. = 15783±423 fakes
Parametrized SLT fakes 15570



Systematics (wrong SLT efficiency ?)

- Away-jets in the inclusive lepton have a higher heavy flavor content (26%) than generic-jet data (13%) .
- Could the fake rate in jets with heavy flavor be anomalously large ? Could the SLT efficiency or the semileptonic branching ratio in the simulation be grossly wrong ?
- Jets with SECVTX or JPB tags in generic-jet data have a heavy flavor content ranging from 86% (JET 20) to 71% (JET 100) . The rate of SLT tags in these jets is not higher than in the simulation





Uncertainty of fake and h.f. SLT tags

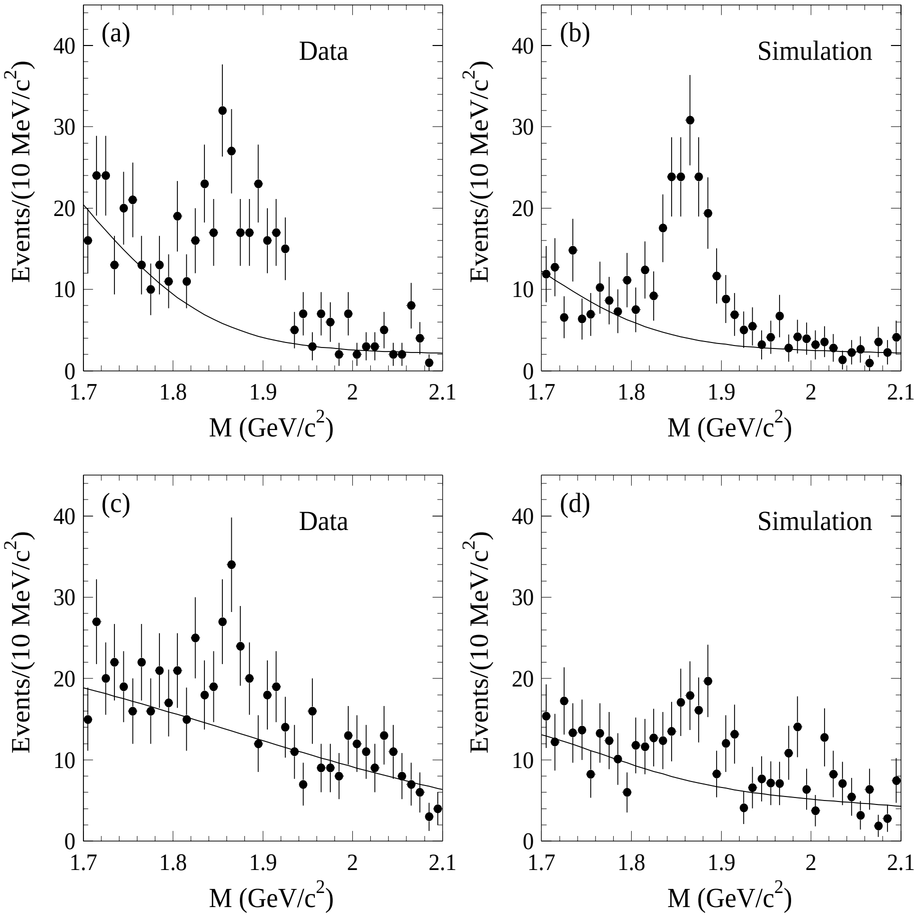
- Fit observed rates of SLT tags in generic jets with
  P_f x fakes +P_{hf} x h.f.
- The fit returns P_f =1.017±0.013 and P_{hf} =0.981±0.045, ρ =-.77
- Using this result the SLT expectation in away-jets is 1362±28 whereas 1757±104 are observed (3.8 σ)
- This discrepancy cannot come from obvious prediction deficiencies

	observed	pred. fakes.	pred. h.f.
SLT 's in g. jets	18885	15570±1557	3102 ±403
SLT's in g. jets with SECVTX	1451	999 ±60	508 ±51
SLT's in g. jets with JPB	2023	856 ±86	1175 ±71
SLT 's in a-jets (lep-trig.)	1757	619 ±62	747 ± 75

b-purity (cross-check)

- D^0 : 126.0 ± 15.5 in the data and 139.9 ± 15.0 in the simulation
- $D^{\pm}$: 73.7 ± 17.8 and 68.5 ± 14.1
- J/ψ: 90.8 ± 10.1 and 101.9 ± 11.4
- Ratio of the b-purity in the simulation to that in the data is 1.09 ± 0.11

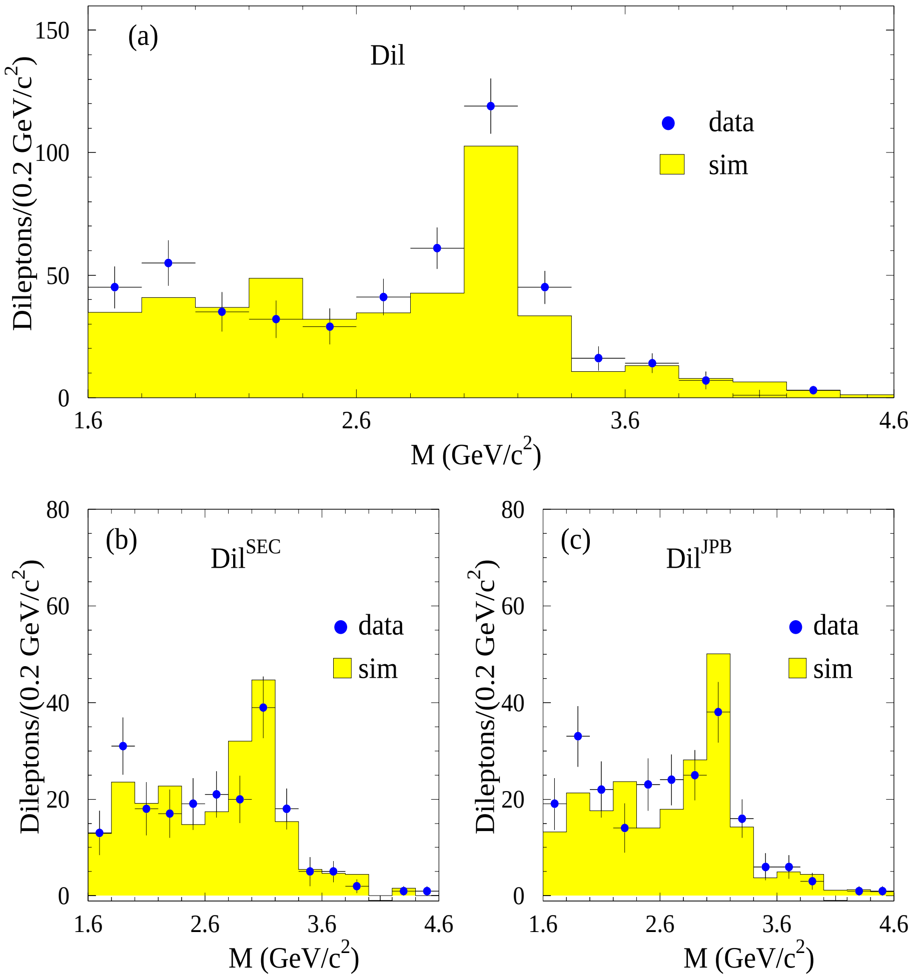
D^0



$D^{\pm}$

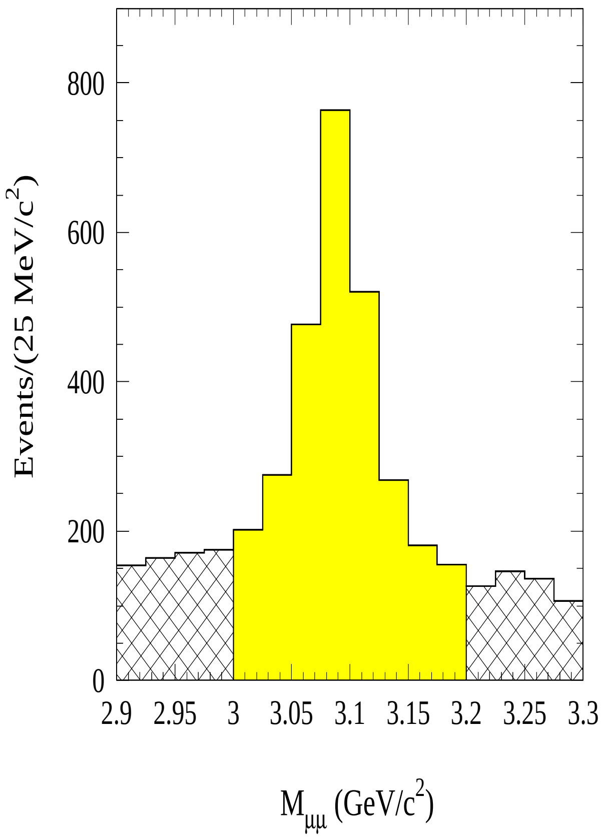
Same flavor OS-SS dileptons

- $2.6 < m_{ee} < 3.6$ GeV/c^2
- $2.9 < m_{\mu\mu} < 3.3$ GeV/c^2
- 259 ± 17.2 and 209.2 ± 23.7 (before tagging)
- 89.7 ± 10.5 and 100.5 ± 12.4 (SECVTX)
- 90.8 ± 10.1 and 101.9 ± 11.4 (JPB)



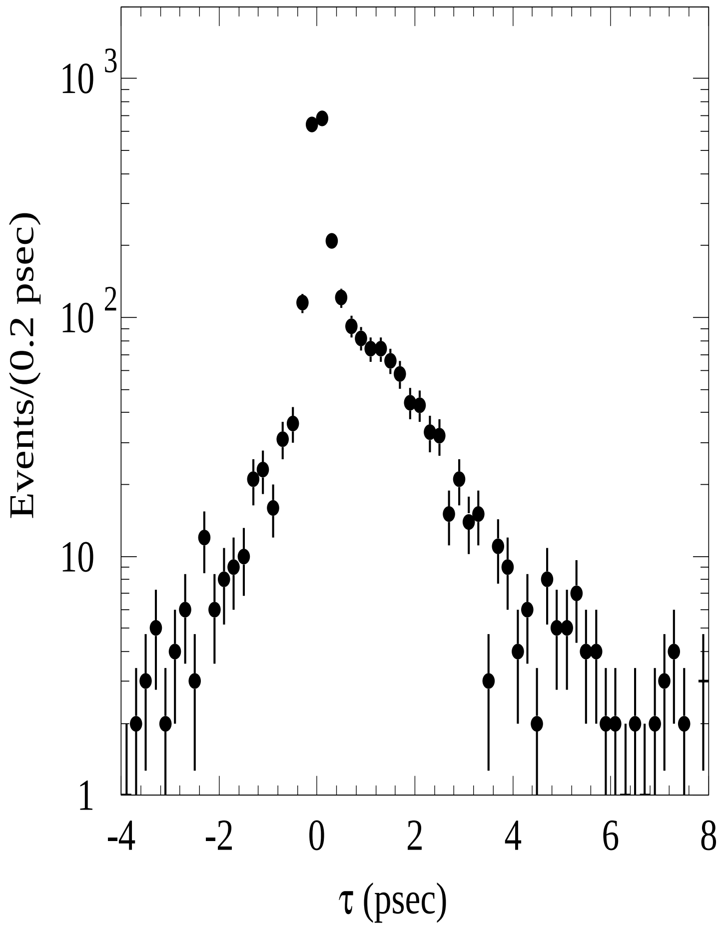
Cross check with J/ψ mesons from B-decays

- In generic-jet data we do not have any excess of jets with SLT tags or supertags
- We do observe an excess after enriching the b-purity of the QCD data by requiring a lepton-jet
- We study a sample of jets recoiling J/ψ mesons from B-decays. We use the same $J/\psi \rightarrow \mu\mu$ data set and selection used for the measurement of the J/ψ lifetime and fraction from B-decays
- 1163 J/ψ over a background of 1179 events estimated from the side-bands (SB)



J/ψ lifetime

- The number of J/ψ mesons from B-decays is $N_\psi = (\psi^+ - \psi^-) - (SB^+ - SB^-)$ =561, which is 48% of the initial sample
- In the 572 away-jets we find 48.0 ± 15.1SECVTX, 61.7 ± 17.3 JPB tags, and –9.4 ± 14.4 SLT tags
- In the simulation we expect 8.1 ± 1.1 SLT tags



Conclusions

- We have measured the heavy flavor content of the low p_T inclusive lepton sample by comparing rates of SECVTX and JPB tags in the data and the simulation
- We find good agreement between the data and the simulation tuned within the experimental and theoretical uncertainties
- We find a 50% excess of a-jets with SLT tags due to heavy flavor with respect to the simulation; the discrepancy is a 3 σ systematic effect due to the uncertainty of the SLT efficiency and background subtraction. However, comparisons of analogous tagging rates in generic-jet data and their simulation do not support any increase of the efficiency or background subtraction beyond the quoted systematic uncertainties

Conclusions

- A discrepancy of this kind and size is expected, and was the motivation for this study, if pairs of light scalar quarks with a 100% semileptonic branching ratio were produced at the Tevatron
- The data cannot exclude alternate explanations for this discrepancy
- Previously published measurements support the possibility, born out of the present work, that approximately 30% of the presumed semileptonic decays of heavy flavor hadrons produced at the Tevatron are due to unconventional sources

C/B X 2 (JET 20)

	b	c	total	data
SECVTX	2894	1158	4052	4058±92
JPB	2894	2679	5573	5542±295
SLT+SEC	170	53	223	220±20
SECVTX	2251	1801	4052	4058±92
JPB	2251	4105	6356	5542±295
SLT+SEC	132	83	215	220±20

R= 0.055 ⟶ 0.053 (96.3% and not 85%)