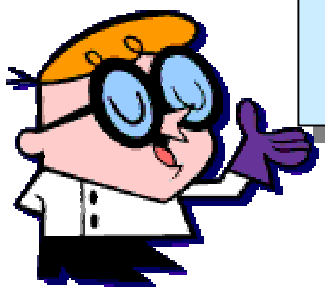
$t\bar{t}$ Produktion im e+jets Kanal

Zerfallsignatur & Vorselektion
Topologische Variablen & Wahrscheinlichkeit
Ergebnisse im e+jets Kanal
Ergebnisse der Dilepton-Analysen
Kombinierte Ergebnisse



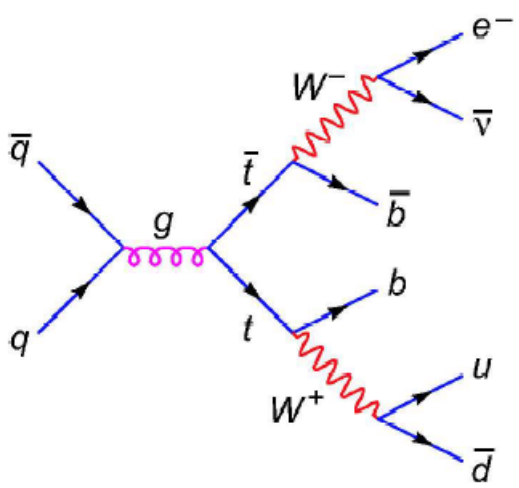
Marc-André Pleier
University of Rochester
pleier@fnal.gov

&

Stefan Anderson, Freya Blekman, Tobias Golling, Aurelio Juste, Joe Kozminski,
Jessica Leveque, Prolay Mal, Rob McCroskey, Arnulf Quadt, Lisa Shabalina, Marcel Vreeswijk,…

DPG Frühjahrstagung, 30.03.2004

Zerfalls-Signatur & "weiche" Vorselektion



<u>"weiche" Vorselektion:</u>

Primärvertex: mind. 3 Spuren, $|z| < 60$ cm,
Δz (PV,e) < 1 cm

→ Elektron in $|\eta| < 1.1$ mit rek. Spur, $p_T > 20$ GeV/c

→ $\not{E}_T > 20$ GeV

≥ 4 Jets mit $|\eta| < 2.5$,
$p_T > 15$ GeV/c

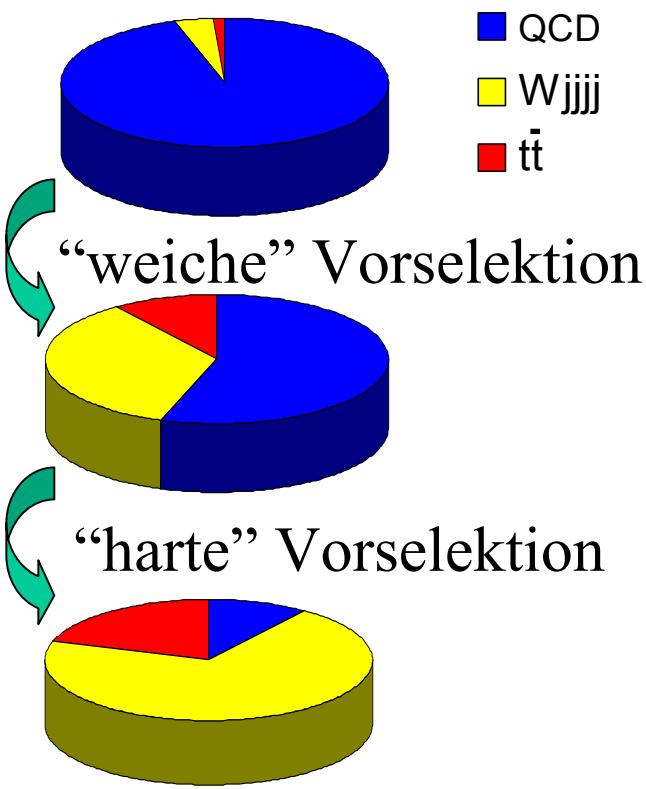
<u>Orthogonalität zu anderen Analysen:</u>
Veto gegen μ tag,
zweites Elektron

<u>Hauptuntergrund:</u>

- Multijet-Ereignisse mit misrekonstr. $\not{E}_T$,e ("QCD")
- W+ ≥ 4 Jets (ISR) -Ereignisse

Datensatz und Vorselektion

Datensatz: ≈ 5.7 M Ereignisse, 141 pb^{-1}

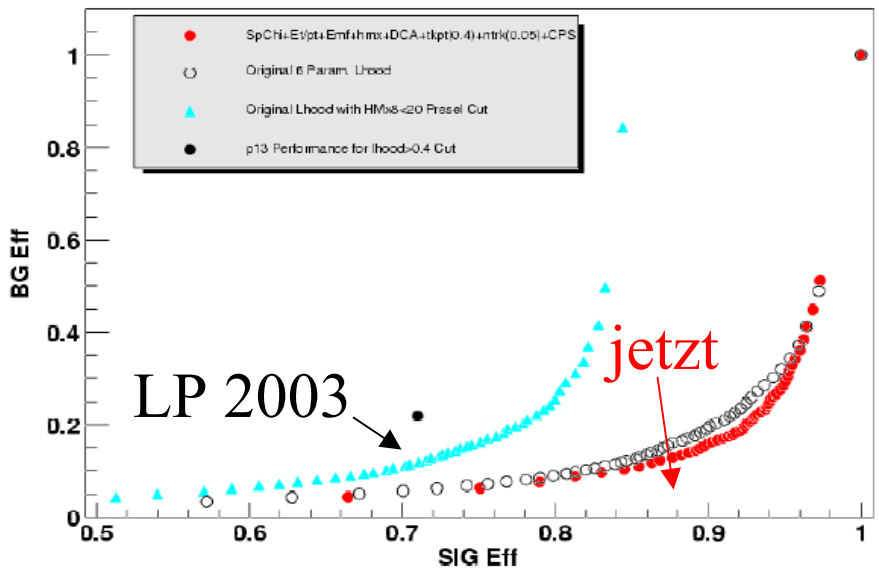


136 Ereignisse mit ≥ 4 Jets

"harte" Vorselektion:

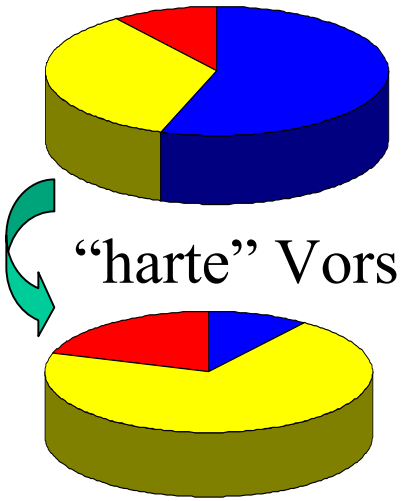
Schnitt auf e-Wahrscheinlichkeit, basiert u.a. auf:

- f_{EM}
- E_T^{Cal}/p_T^{trk}
- dca
- Shower-Form



→ Siehe Su-Jung Park, T 204.6

QCD-Untergrund Bestimmung



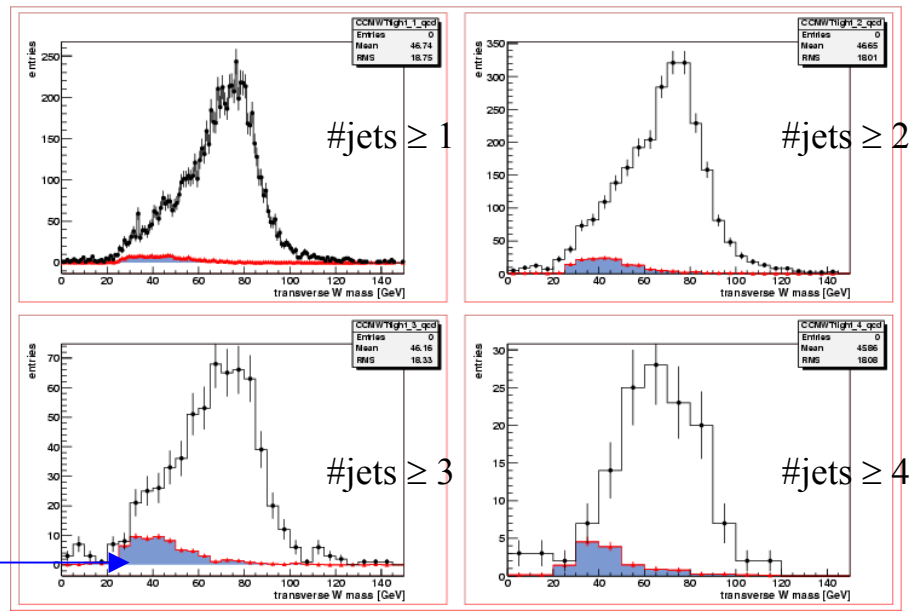
"harte" Vorselektion

$$N_w = N^{W+t\bar{t}} + N^{QCD}$$
$$N_h = \varepsilon_{W+t\bar{t}} N^{W+t\bar{t}} + \varepsilon_{QCD} N^{QCD}$$

$\varepsilon_{W+t\bar{t}} \approx 88\%$, $\varepsilon_{QCD} \approx 8\text{-}9\%$, bestimmt aus Daten

N_w, N_h = verbleibende Ereignisse im Signal-Datensatz

Rekonstruierte transversale W-Masse nach der harten Vorselektion für versch. inkl. Jet-Multiplizitäten



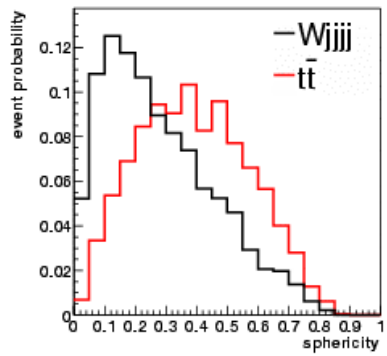
QCD

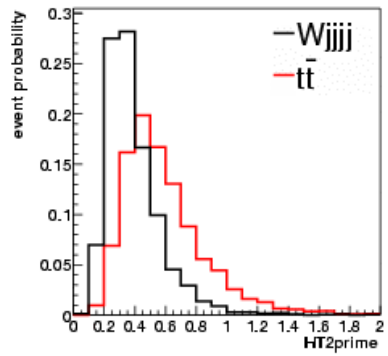
Topologische Diskriminierung

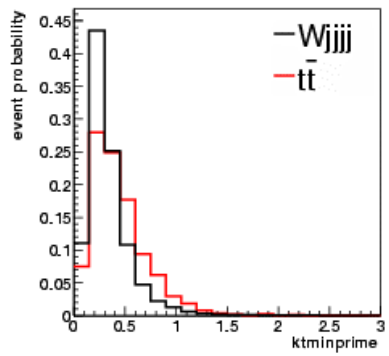
Auswahl topologischer Variablen:
- Diskriminierungsvermögen
- Sensitivität auf Jet-Energieskala

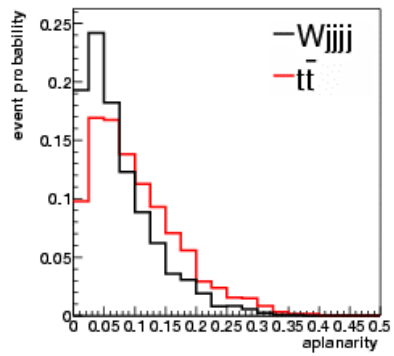
Verwendete Variablen:
winkelabhängig:
- Spherizität
- Aplanarität

Verhältnis energieabhängiger Größen:
- HT2prime
- ktminprime







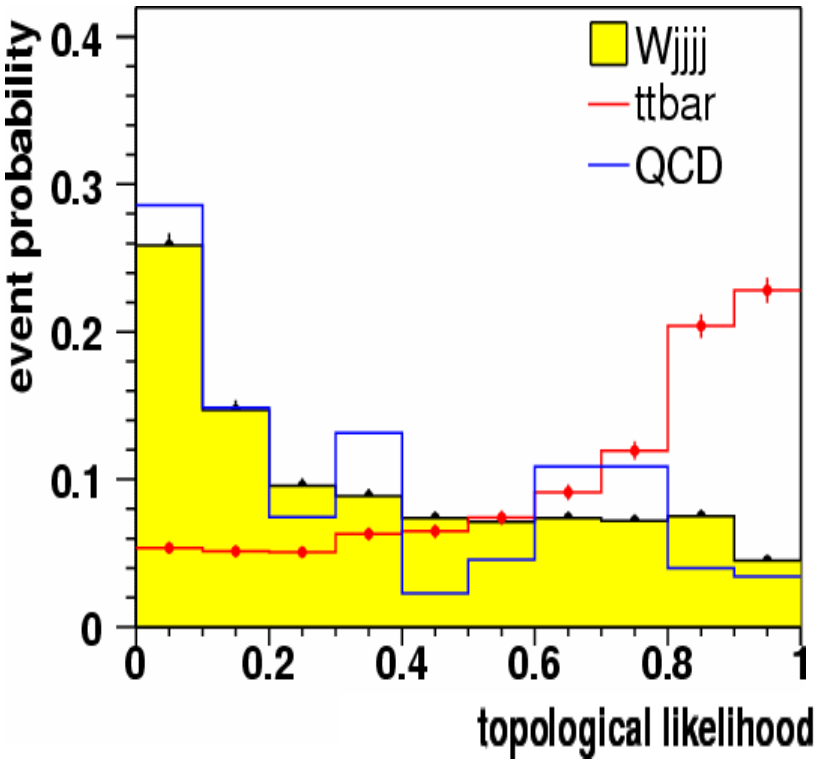


Topolog. Wahrscheinlichkeit: $P = \frac{\prod_i S_i}{\prod_i S_i + \prod_i B_i}$

i=1..4,
S = $t\bar{t}$-Verteilung,
B = Wjjjj-Verteilung

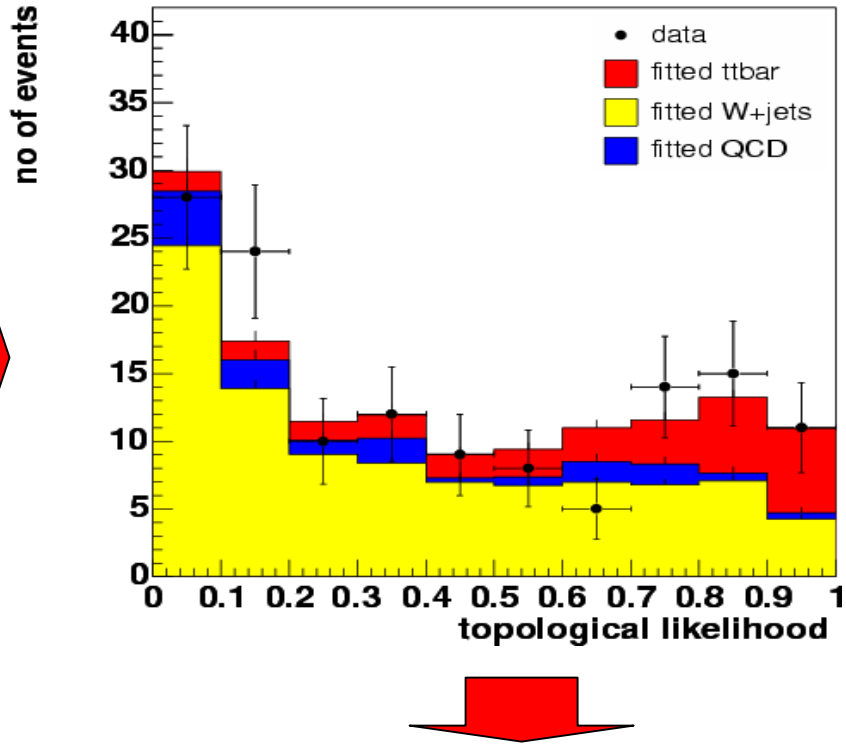
$t\bar{t}$ Wirkungsquerschnitt

Topolog. Wahrscheinlichkeit f. QCD Daten (≈ inv. harte Selektion) & Wjjjj, tt̄-Monte Carlo



Fit

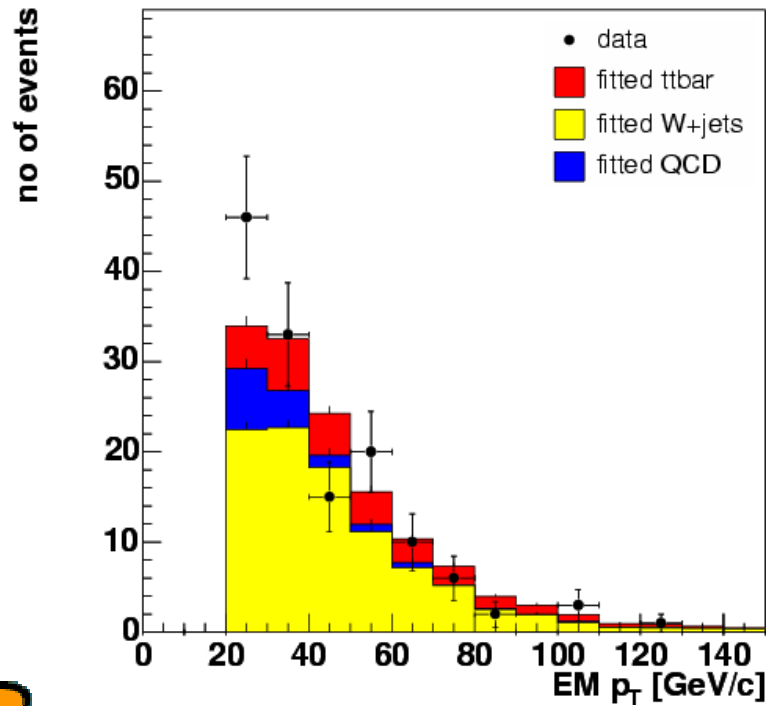
Fit der Daten mit Linearkombination der QCD, Wjjjj und $t\bar{t}$ Verteilungen:



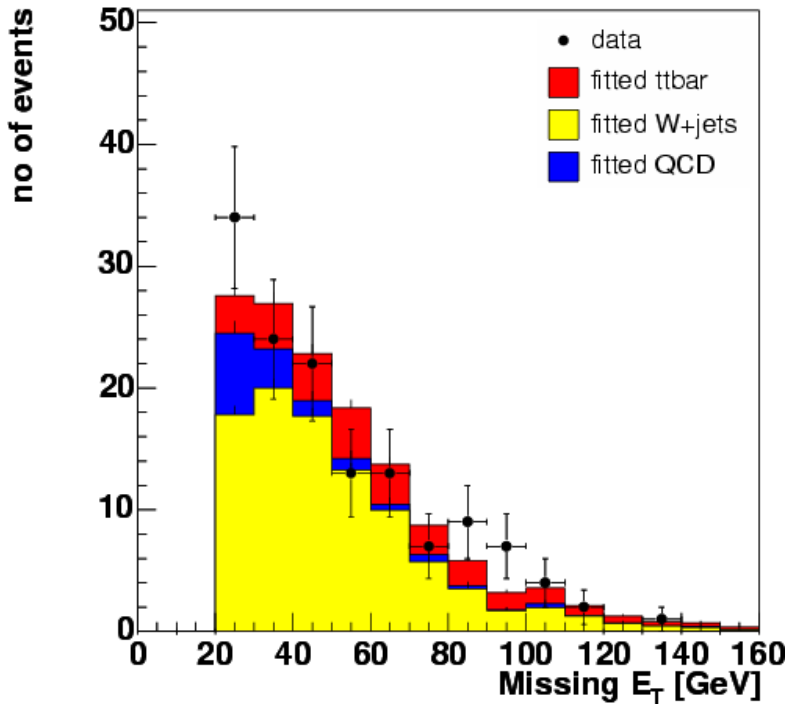
$$N_{t\bar{t}} = 27.45^{+12.69}_{-11.65}$$

Konsistenz-Checks

Elektron-p_T

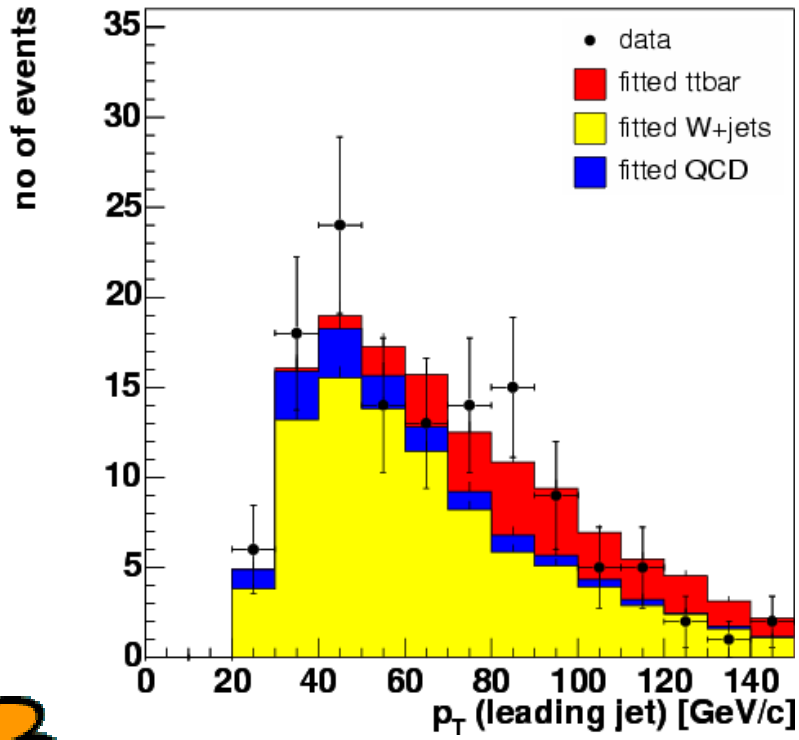


$\not\!\!E_T$

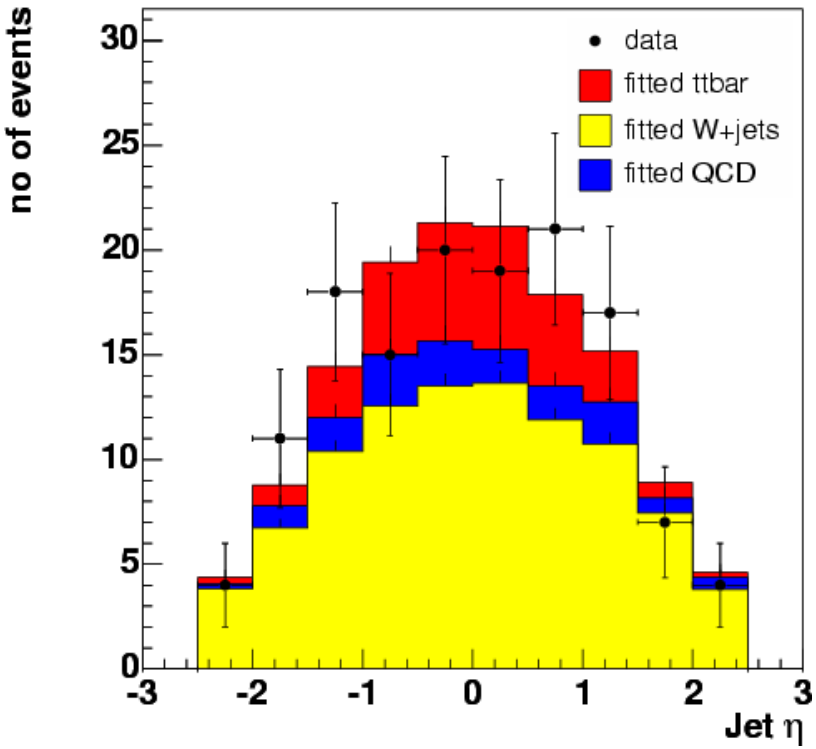


Konsistenz-Checks

p_T des "leading" Jets



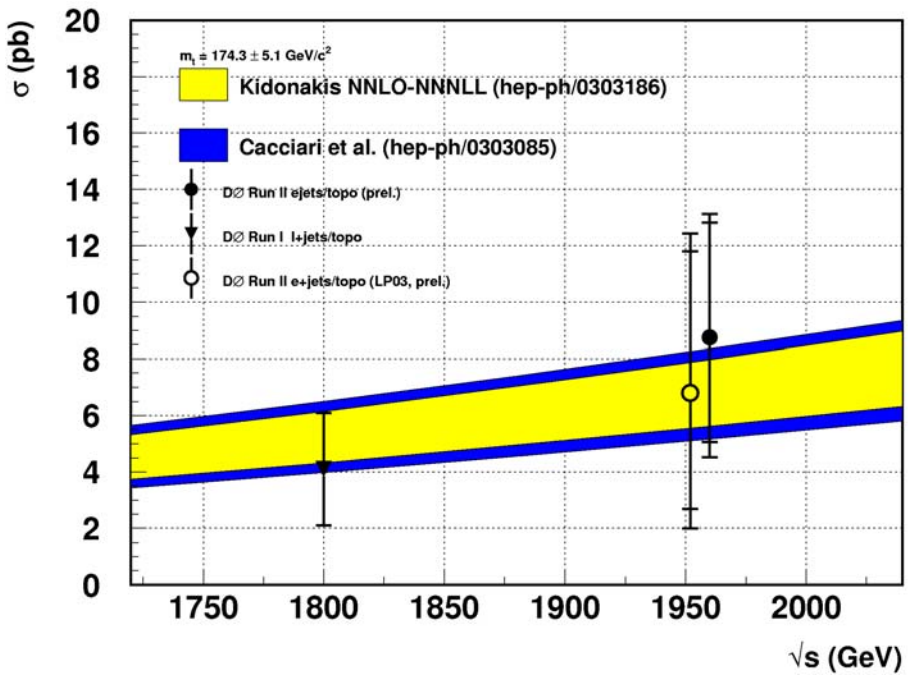
η des zweiten Jets

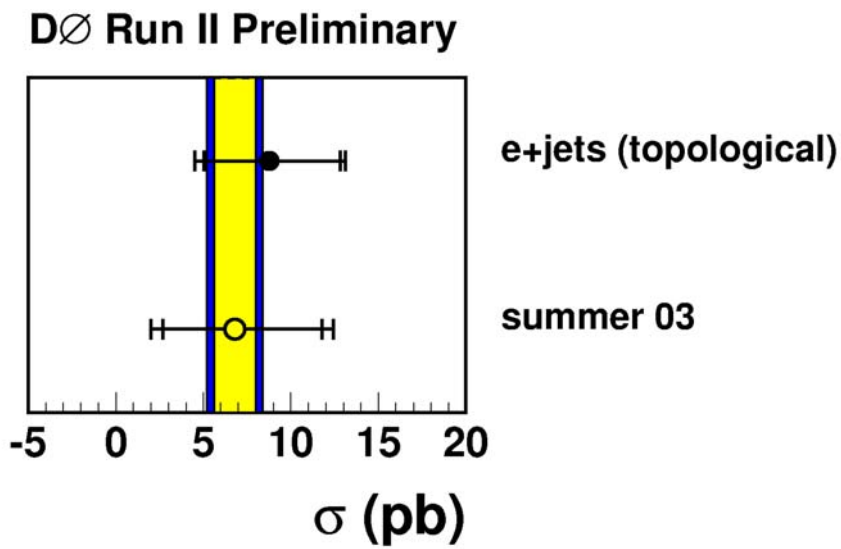


$t\bar{t}$ Wirkungsquerschnitt

$$N_{t\bar{t}} = 27.45^{+12.69}_{-11.65},\ \mathcal{L} = (141.2 \pm 9.2)\,\mathrm{pb}^{-1},\ \varepsilon_{sel} = (5.1 \pm 0.2)\%,\ \mathrm{Br}_{t\bar{t}\to l+\nu+jets} = (43.5 \pm 0.9)\,\%$$

$$\sigma_{p\bar{p}\to t\bar{t}+X} = 8.8^{+4.1}_{-3.7}\,(\mathrm{stat})\,^{+1.6}_{-2.1}\,(\mathrm{syst}) \pm 0.6\,(\mathrm{lumi})\,\mathrm{pb}$$





Dominierende Systematiken: Jet-Energieskala und Jet-Identifikation

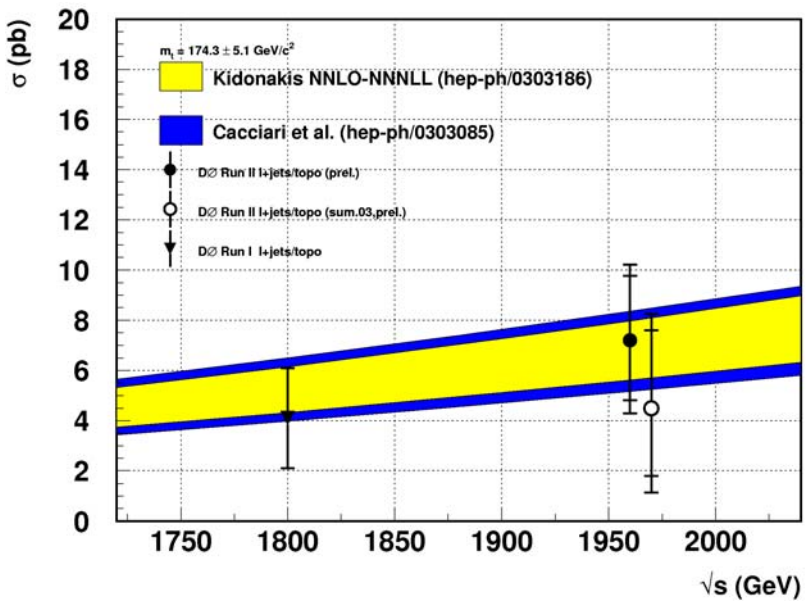
l+jetsWirkungsquerschnitt

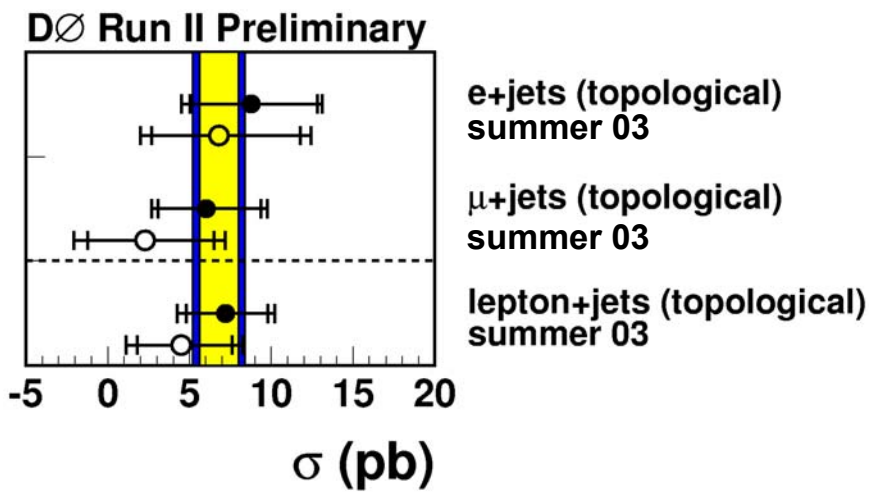
Kombiniertes Ergebnis von e+Jets, μ+jets:

$$\mathrm{e+jets\ (CC)}\ :\quad \sigma_{p\bar{p}\to t\bar{t}+X} = 8.8^{+4.1}_{-3.7}\,(\mathrm{stat})\,^{+1.6}_{-2.1}\,(\mathrm{syst}) \pm 0.6\,(\mathrm{lumi})\,\mathrm{pb}$$

$$\mu\mathrm{+jets}\ :\quad \sigma_{p\bar{p}\to t\bar{t}+X} = 6.0^{+3.4}_{-3.0}\,(\mathrm{stat})\,^{+1.6}_{-1.6}\,(\mathrm{syst}) \pm 0.4\,(\mathrm{lumi})\,\mathrm{pb}$$

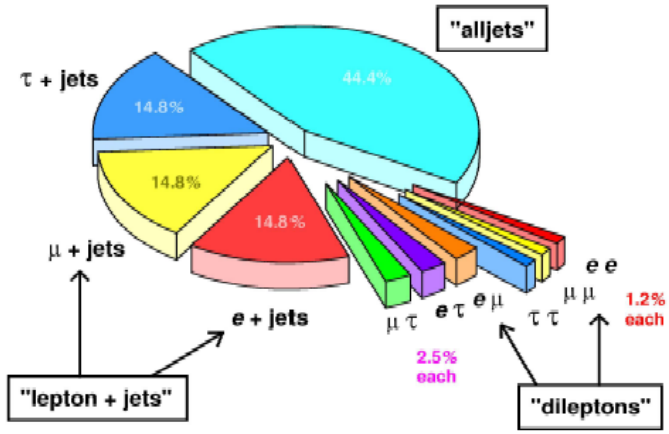
$$\mathrm{l+jets}\ :\quad \sigma_{p\bar{p}\to t\bar{t}+X} = 7.2^{+2.6}_{-2.4}\,(\mathrm{stat})\,^{+1.6}_{-1.7}\,(\mathrm{syst}) \pm 0.5\,(\mathrm{lumi})\,\mathrm{pb}$$





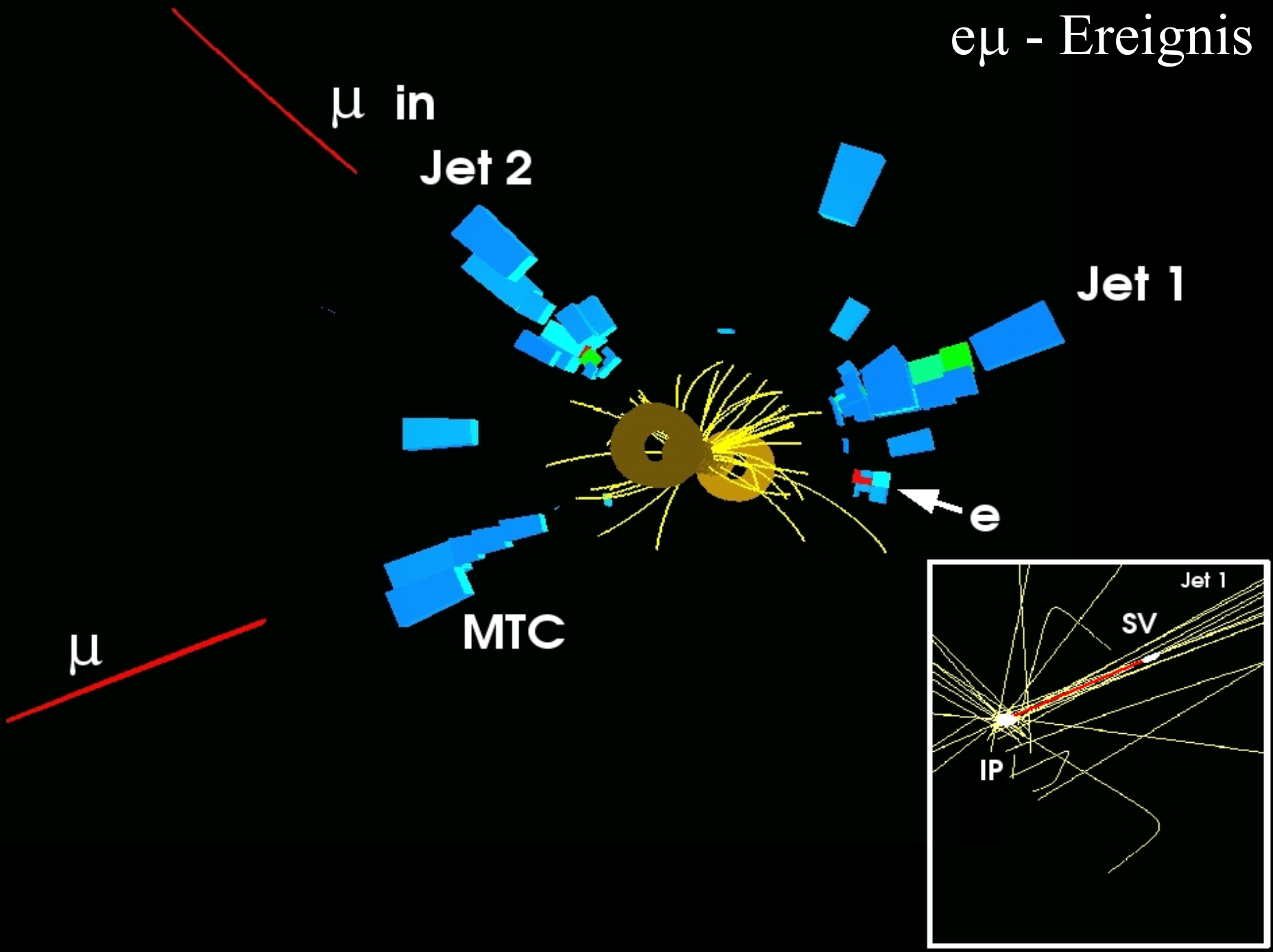
Dilepton-Analysen

- Signatur: ee,μμ,eμ mit hohem p_T, ≥ 2 Jets, $\not\!\!E_T$
- Kleines Verzweigungsverhältnis nach ee,μμ,eμ
- Untergrund:
  - WW(→ ee,μμ,eμ) + Jets
  - Z (→ ee,μμ) + Jets
  - Z (→ ττ→ eμ) + Jets
  - W + Jets (Jet fälscht e,μ)
  - ($b\bar{b}$ +) Multijet-Produktion (Jets fälschen e,μ)



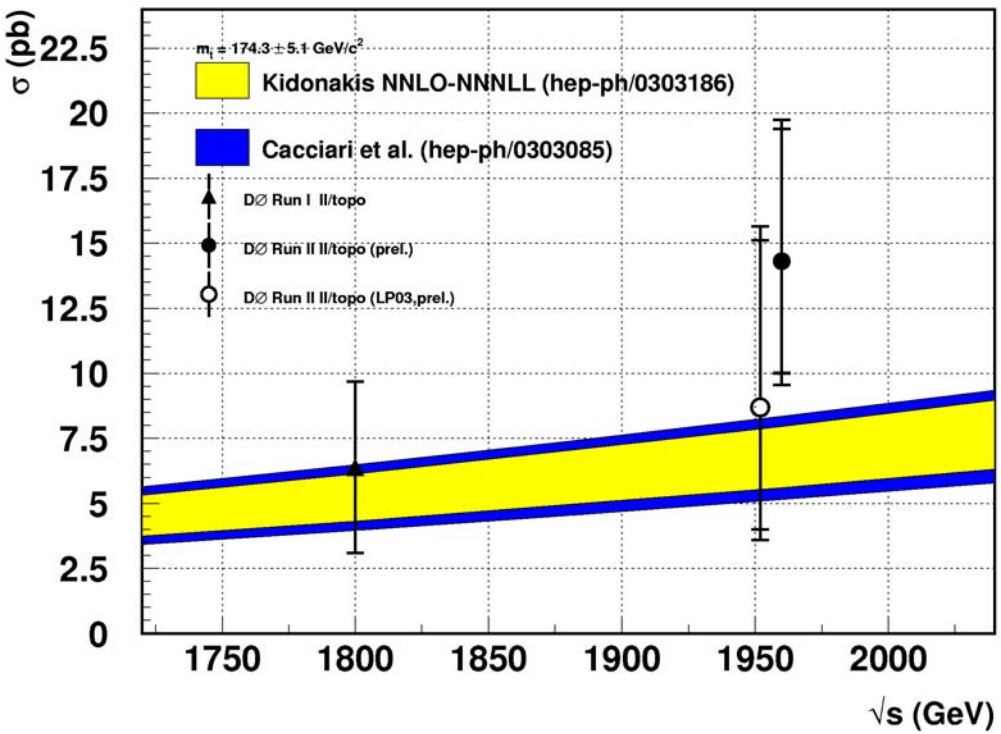
Category	ee	$\mu\mu$	$e\mu$	$\ell\ell$
Z/γ^*	0.15 ± 0.10	2.04 ± 0.49	0.47 ± 0.17	2.66 ± 0.53
WW	0.14 ± 0.08	0.10 ± 0.04	0.29 ± 0.06	0.53 ± 0.11
Fakes	0.91 ± 0.30	0.46 ± 0.20	0.19 ± 0.06	1.56 ± 0.36
Total background	1.20 ± 0.33	2.61 ± 0.53	0.95 ± 0.19	4.76 ± 0.65
Expected signal	1.39 ± 0.19	0.83 ± 0.15	3.77 ± 0.44	5.99 ± 0.50
SM expectation	2.59 ± 0.38	3.44 ± 0.55	4.73 ± 0.49	10.76 ± 0.83
Selected events	5	4	8	17

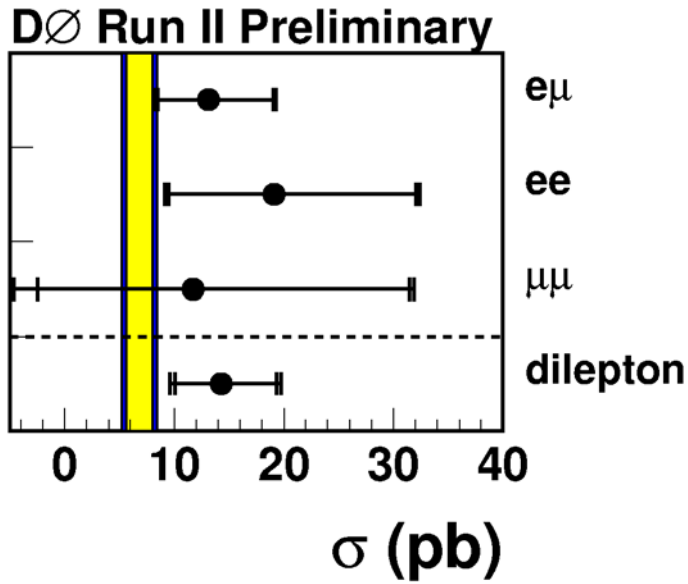
eμ - Ereignis



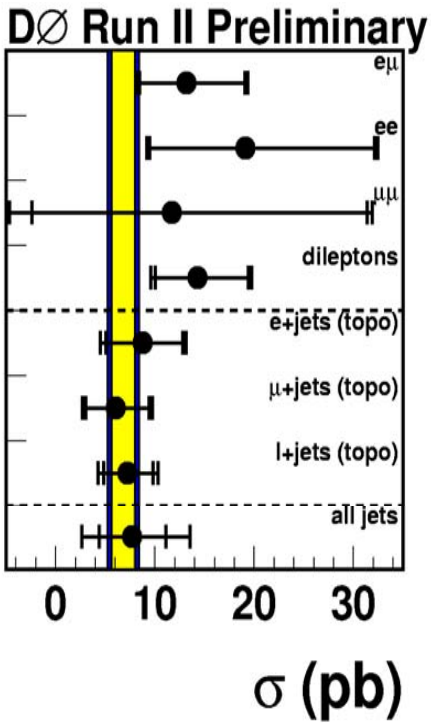
Dilepton-Analysen

$$
\begin{aligned}
\text{ee} &: \quad \sigma_{t\bar{t}} = 19.1^{+13.0}_{-9.6}\ (\text{stat})\ ^{+3.1}_{-2.6}\ (\text{syst})\ \pm 1.2\ (\text{lumi})\ \text{pb};\\
\mu\mu &: \quad \sigma_{t\bar{t}} = 11.7^{+19.7}_{-14.1}\ (\text{stat})\ ^{+4.1}_{-8.2}\ (\text{syst})\ \pm 0.8\ (\text{lumi})\ \text{pb};\\
\text{e}\mu &: \quad \sigma_{t\bar{t}} = 13.1^{+5.9}_{-4.7}\ (\text{stat})\ ^{+1.7}_{-1.7}\ (\text{syst})\ \pm 0.9\ (\text{lumi})\ \text{pb};\\
\text{dilepton} &: \quad \sigma_{t\bar{t}} = 14.3^{+5.1}_{-4.3}\ (\text{stat})\ ^{+1.9}_{-2.0}\ (\text{syst})\ \pm 0.9\ (\text{lumi})\ \text{pb}.
\end{aligned}
$$

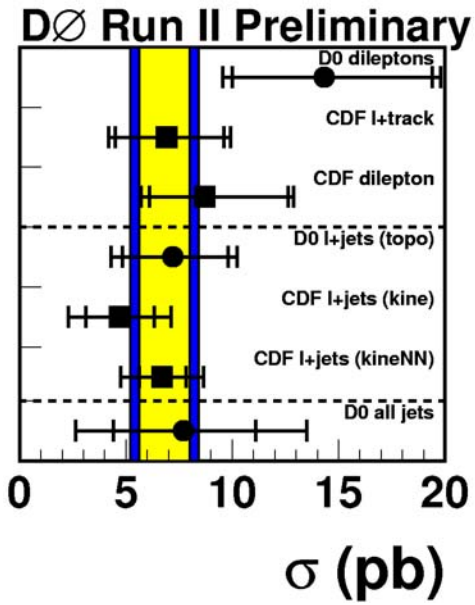




Zusammenfassung



143 pb^{-1}	$13.1^{+5.9}_{-4.7}\ ^{+1.7}_{-1.7}$	pb
156 pb^{-1}	$19.1^{+13.0}_{-9.6}\ ^{+3.1}_{-2.6}$	pb
140 pb^{-1}	$11.7^{+18.7}_{-14.1}\ ^{+4.1}_{-3.2}$	pb
140 pb^{-1}	$14.3^{+5.1}_{-4.3}\ ^{+1.9}_{-2.0}$	pb
141 pb^{-1}	$8.8^{+4.1}_{-3.7}\ ^{+1.6}_{-2.1}$	pb
144 pb^{-1}	$6.0^{+3.4}_{-3.0}\ ^{+1.6}_{-1.6}$	pb
141 pb^{-1}	$7.2^{+2.6}_{-2.4}\ ^{+1.6}_{-1.7}$	pb
162 pb^{-1}	$7.7^{+3.4}_{-3.3}\ ^{+4.7}_{-3.8}$	pb



140 pb^{-1}	$14.3^{+5.1}_{-4.3}\ ^{+1.9}_{-2.0}$	pb
200 pb^{-1}	$6.9^{+2.7}_{-2.4}\ ^{+1.8}_{+1.8}$	pb
193 pb^{-1}	$8.7^{+3.8}_{-2.6}\ ^{+1.5}_{-1.5}$	pb
141 pb^{-1}	$7.2^{+2.6}_{-2.4}\ ^{+1.6}_{-1.7}$	pb
195 pb^{-1}	$4.7^{+1.8}_{-1.6}\ ^{+1.8}_{-1.8}$	pb
195 pb^{-1}	$6.7^{+1.1}_{-1.1}\ ^{+1.6}_{-1.6}$	pb
162 pb^{-1}	$7.7^{+3.4}_{-3.3}\ ^{+4.7}_{-3.8}$	pb

…das ist nur die Spitze des Eisbergs…