COMPARISONS OF YFSWW AND KORALW

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1) TECHNICAL TESTS FOR "COMMON" CC03 RESULTS

2) PHYSICAL TESTS – SIZE OF 4 fermion AND $\mathcal{O}(\alpha)$ CORRECTIONS

3) UNCERTAINTY OF "KINEMATICS EXTRAPOLATION PROCEDURE"

ECFA-DESY
HAMBURG
20.09.2000

MODIFICATIONS OF KORALW 1.42.3

TO BE INCLUDED IN FUTURE RELEASE
FOR NOW AVAILABLE AS SEPARATE PATCH

1) NEW NORMALISATION OPTION (KEYBRA=3)
TO ALLOW FOR CONVENTION AS IN
RACOONWW (W-BRANCHING RATIOS)

2) NEW "KINEMATIC EXTRAPOLATION PROCEDURE"

$4f + N\gamma \longleftrightarrow 4f$

GENERATOR — BORN MATRIX EL.

UNDEFINED SUB-LEADING TERMS $\equiv$ FREEDOM OF ROTATING THIS "EFFECTIVE" FRAME

NECESSARY TO ADJUST BREMSSTRAHLUNG
TO THE ONE IN YFSWW

3) TECHNICALITIES - EASIER SIMULTANEOUS
HANDLING OF CC03 AND 4F WEIGHTS

WTSET(i) = 4f   i=1,..,4
WTSET(10-i) = CC03

CROSS-CHECKS:

YFSWW3 ⟷ KoralW

CUTS:

(YR2K: 4f-SECTION, hep-ph/0005309)

1. FERMIONS:
   - $\sphericalangle(f_{ch}, \text{beams}) > 10°$ f_{ch} – CHARGED FERMION
   - NO CUTS FOR ν'S
2. PHOTONS:
   - $\sphericalangle(\gamma, \text{beams}) > 5°$
   - $\min_{f_{ch}}\{M_{\gamma f_{ch}}\} < M_{rec}$ OR $E_\gamma < 1\,\text{GeV}$

     ⇒ γ RECOMBINED WITH f_{ch} (and discarded)

→ $M_{rec} = \begin{cases} 5\,\text{GeV}: & \text{BARE} \\ 25\,\text{GeV}: & \text{CALO} \end{cases}$

! PHOTON RADIATION FROM QUARKS INCLUDED

→ SPECIAL VERSION OF PHOTOS (THANKS TO Z.WAS)

→ CC11-TYPE CHANNELS

TECHNICAL COMPARISONS

CC03 YFSWW-KORALW

161 GeV

$e^+e^- \longrightarrow W^+W^- \longrightarrow u\bar{d}\mu^-\bar{\nu}_\mu$

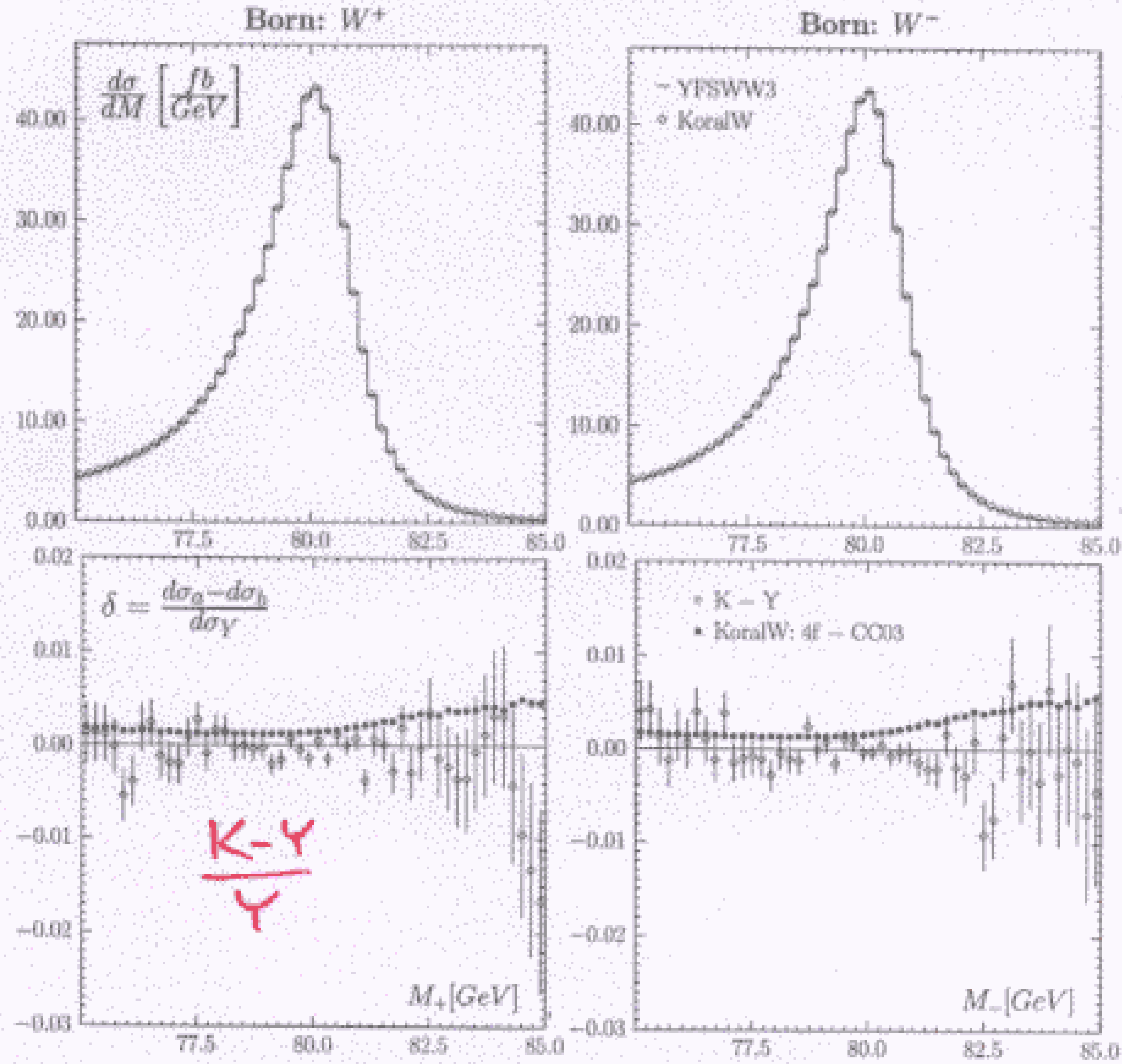

Figure 1: Distributions of the W^+ and W^- invariant masses in the Born approximation at $E_{CM} = 161\,GeV$.

TECHNICAL COMPARISONS

CC03 YFSWW - KORALW

$$e^+e^- \longrightarrow W^+W^- \longrightarrow u\bar{d}\mu^-\bar{\nu}_\mu$$

500 GeV

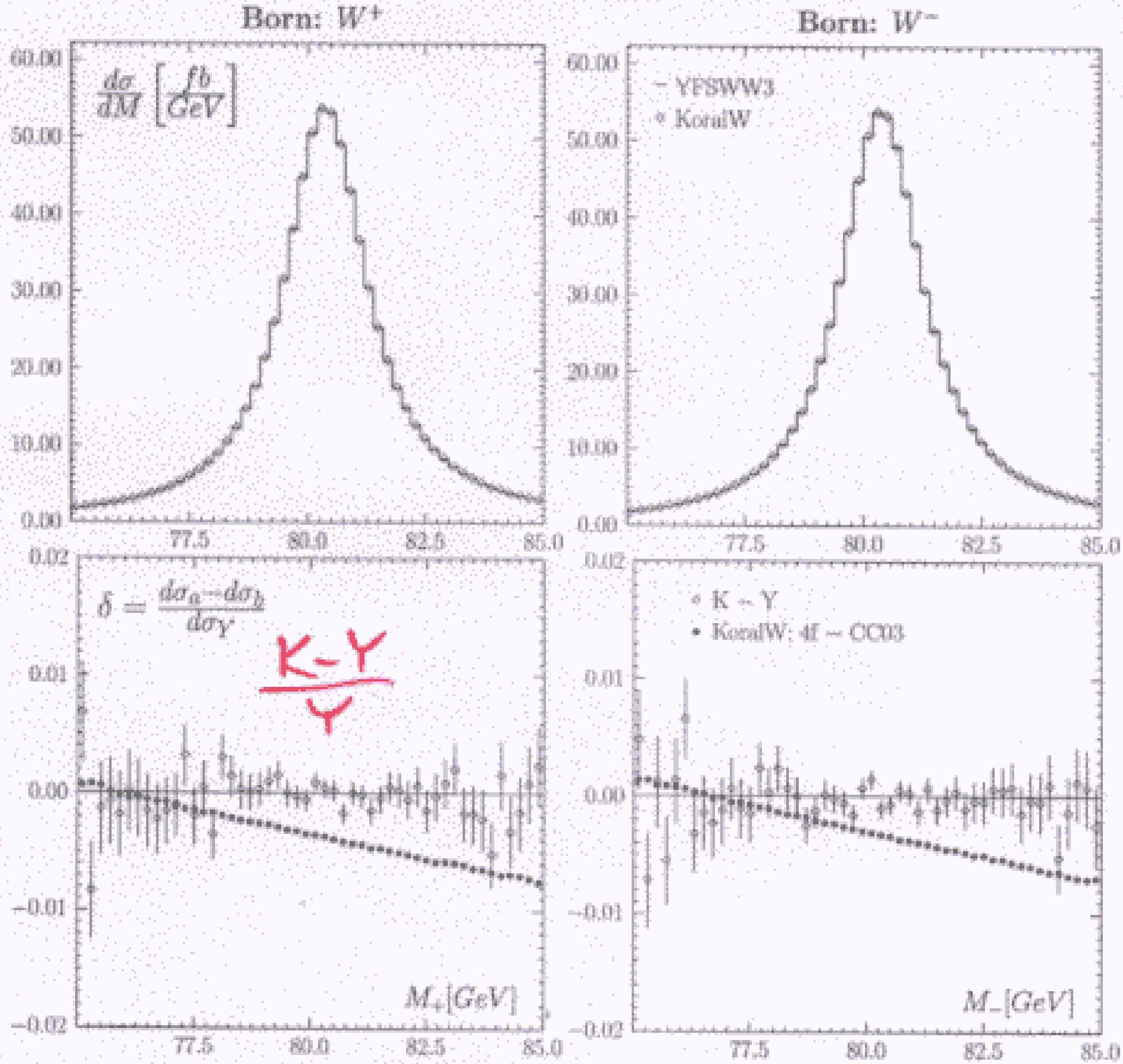

Figure 1: Distributions of the W^+ and W^- invariant masses in the Born approximation at E_{CM} = 500 GeV.

500

200 GeV

NO CUTS		σ_{WW} [fb]		δ_{4f} [%]		δ^{NL}_{WW} [%]
Final state	Program	Born	ISR	Born	ISR	
$\nu_\mu \mu^+ \tau^- \bar{\nu}_\tau$	YFSWW3	219.793 (16)	204.198 (09)	—	—	−1.92 (4)
	KoralW	219.766 (26)	204.178 (21)	0.041	0.044	—
	(Y−K)/Y	0.01 (1)%	0.01 (1)%	—	—	—
$u\bar{d}\mu^- \bar{\nu}_\mu$	YFSWW3	659.69 (5)	635.81 (3)	—	—	−1.99 (4)
	KoralW	659.59 (8)	635.69 (7)	0.073	0.073	—
	(Y−K)/Y	0.02 (1)%	0.02 (1)%	—	—	—
$u\bar{d}s\bar{c}$	YFSWW3	1978.37 (14)	1978.00 (09)	—	—	−2.06 (4)
	KoralW	1977.89 (25)	1977.64 (21)	0.060	0.061	—
	(Y−K)/Y	0.02 (1)%	0.02 (1)%	—	—	—

Table 1: The total WW cross sections from YFSWW3 and KoralW at the Borrn and ISR level, the $4f$ corrections from KoralW and $\mathcal{O}(\alpha)$ NL correction from YFSWW3 at $E_{CM} = 200\,GeV$, without cuts. The numbers in parentheses are statistical errors of the results corresponding to last digits.

WITH CUTS		σ_{WW} [fb]		δ_{4f} [%]		δ^{NL}_{WW} [%]
Final state	Program	Born	ISR	Born	ISR	
$\nu_\mu \mu^+ \tau^- \bar{\nu}_\tau$	YFSWW3	210.938 (16)	196.205 (09)	—	—	−1.93 (4)
	KoralW	210.911 (26)	196.174 (21)	0.041	0.044	—
	(Y−K)/Y	0.01 (1)%	0.02 (1)%	—	—	—
$u\bar{d}\mu^- \bar{\nu}_\mu$	YFSWW3	627.22 (5)	605.18 (3)	—	—	−2.00 (4)
	KoralW	627.13 (8)	605.03 (7)	0.074	0.074	—
	(Y−K)/Y	0.01 (1)%	0.02 (1)%	—	—	—
$u\bar{d}s\bar{c}$	YFSWW3	1863.60 (15)	1865.00 (09)	—	—	−2.06 (4)
	KoralW	1863.07 (25)	1864.62 (21)	0.065	0.064	—
	(Y−K)/Y	0.03 (2)%	0.02 (1)%	—	—	—

Table 2: The total WW cross sections from YFSWW3 and KoralW at the Borrn and ISR level, the $4f$ corrections from KoralW and $\mathcal{O}(\alpha)$ NL correction from YFSWW3 at $E_{CM} = 200\,GeV$, with cuts. The numbers in parentheses are statistical errors of the results corresponding to last digits.

TECHNICAL PREC. YFSWW-KORALW ~2×10−4 (LCØ3)

4f O(α)

O(α) > 4f

NO CUTS		σ_{WW} $[fb]$		δ_{4f} [%]		δ_{WW}^{NL} [%]
Final state	Program	Born	ISR	Born	ISR	
$u\bar{d}\mu^-\bar{\nu}_\mu$	YFSWW3	156.670 (16)	122.832 (08)	—	—	−1.41 (4)
	KoralW	156.601 (24)	122.836 (11)	0.29	0.25	—
	(Y−K)/Y	0.04 (2)%	0.00 (1)%	—	—	—

Table 1: The total WW cross sections from YFSWW3 and KoralW at the Born and ISR level, the $4f$ corrections from KoralW and $\mathcal{O}(\alpha)$ NL correction from YFSWW3 at $E_{CM} = 161\,GeV$, without cuts. The numbers in parentheses are statistical errors of the results corresponding to last digits.

4f O(α)

WITH CUTS		σ_{WW} $[fb]$		δ_{4f} [%]		δ_{WW}^{NL} [%]
Final state	Program	Born	ISR	Born	ISR	
$u\bar{d}\mu^-\bar{\nu}_\mu$	YFSWW3	151.158 (16)	118.482 (08)	—	—	−1.41 (4)
	KoralW	151.089 (24)	118.485 (11)	0.29	0.25	—
	(Y−K)/Y	0.05 (2)%	0.00 (1)%	—	—	—

Table 2: The total WW cross sections from YFSWW3 and KoralW at the Born and ISR level, the $4f$ corrections from KoralW and $\mathcal{O}(\alpha)$ NL correction from YFSWW3 at $E_{CM} = 161\,GeV$, with cuts. The numbers in parentheses are statistical errors of the results corresponding to last digits.

TECHNICAL PREC. KORALW-YFSWW ~ 2×10^{-4} (CC03)

- "REDUCTION PROCEDURE" AMBIGUITY $\leq 1\times10^{-3}$

4f $\mathcal{O}(\alpha)$

NO CUTS		σ_{WW} [fb]		δ_{4f} [%]		δ_{WW}^{NL} [%]
Final state	Program	Born	ISR	Born	ISR	
$u\bar{d}\mu^-\bar{\nu}_\mu$	YFSWW3	261.368 (23)	292.029 (18)	—	—	−4.95 (4)
	KoralW	261.348 (17)	291.979 (19)	−0.51	−0.51	—
	(Y−K)/Y	0.01 (1)%	0.02 (1)%	—	—	—

$\mathcal{O}(\alpha) \gg 4f$

Table 1: The total WW cross sections from YFSWW3 and KoralW at the Born and ISR level, the $4f$ corrections from KoralW and $\mathcal{O}(\alpha)$ NL correction from YFSWW3 at $E_{CM} = 500\,GeV$, without cuts. The numbers in parentheses are statistical errors of the results corresponding to last digits.

4f $\mathcal{O}(\alpha)$

WITH CUTS		σ_{WW} [fb]		δ_{4f} [%]		δ_{WW}^{NL} [%]
Final state	Program	Born	ISR	Born	ISR	
$u\bar{d}\mu^-\bar{\nu}_\mu$	YFSWW3	181.505 (22)	209.449 (17)	—	—	−6.34 (4)
	KoralW	181.480 (17)	209.[illegible] (18)	−0.69	−0.69	—
	(Y−K)/Y	0.01 (1)%	−0.07 (1)%	—	—	—

Table 2: The total WW cross sections from YFSWW3 and KoralW at the Borrn and ISR level, the $4f$ corrections from KoralW and $\mathcal{O}(\alpha)$ NL correction from YFSWW3 at $E_{CM} = 500\,GeV$, with cuts. The numbers in parentheses are statistical errors of the results corresponding to last digits.

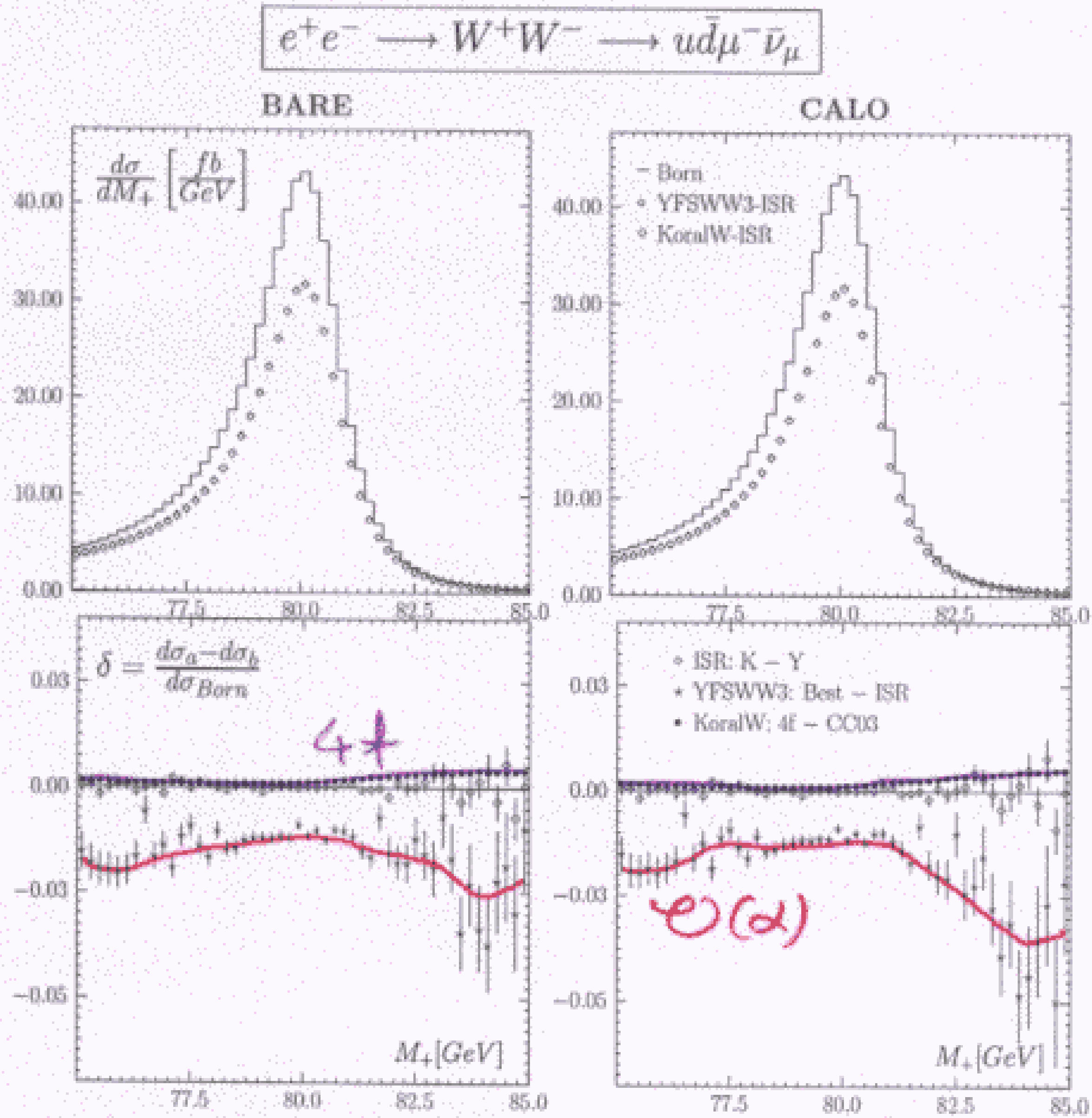

Figure 3: Distributions of the W^+ invariant mass for BARE and CALO acceptances at $E_{CM} = 161\,GeV$.

$\mathcal{O}(\alpha) \gg 4f$

161

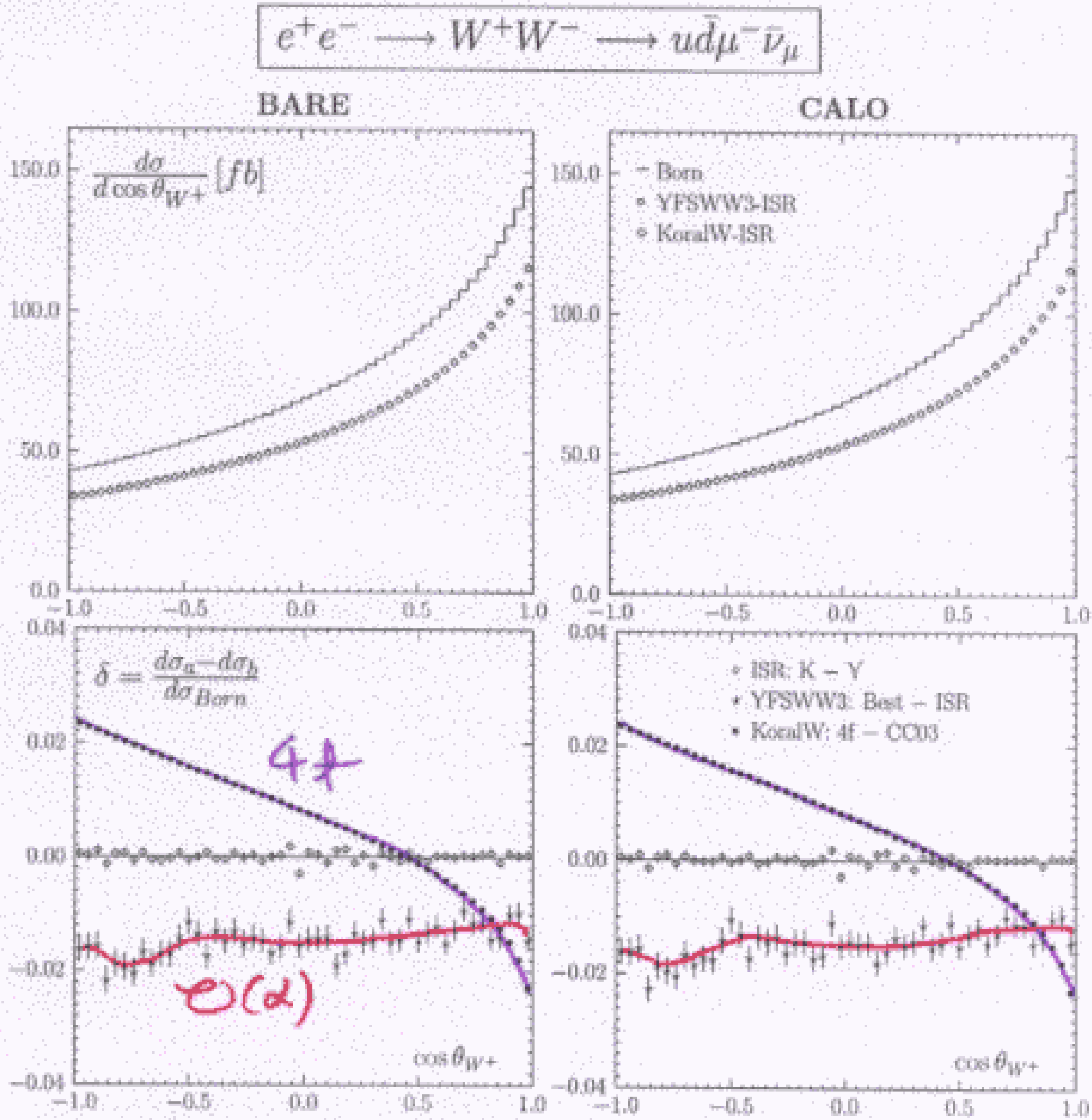

Figure 5: Distributions of *cosine* of the W^+ polar angle w.r.t. the e^+ beam for BARE and CALO acceptances at $E_{CM} = 161\,GeV$.

$O(\alpha) \sim 4f$

BUT! 4f CANCELS OUT!

161

200 GeV

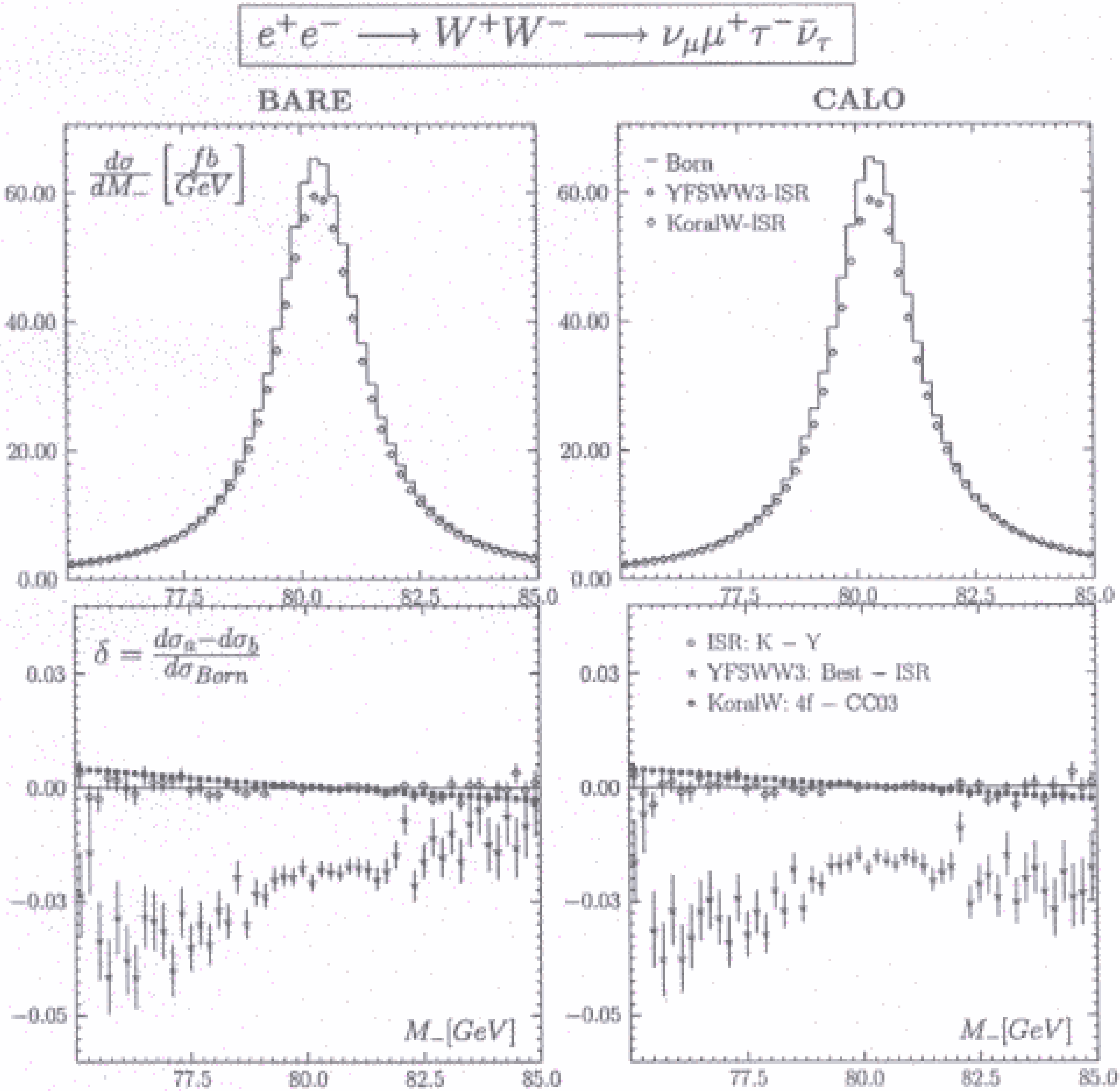

Figure 4: Distributions of the W^- invariant mass for BARE and CALO acceptances at $E_{CM} = 200\,GeV$.

200 GeV

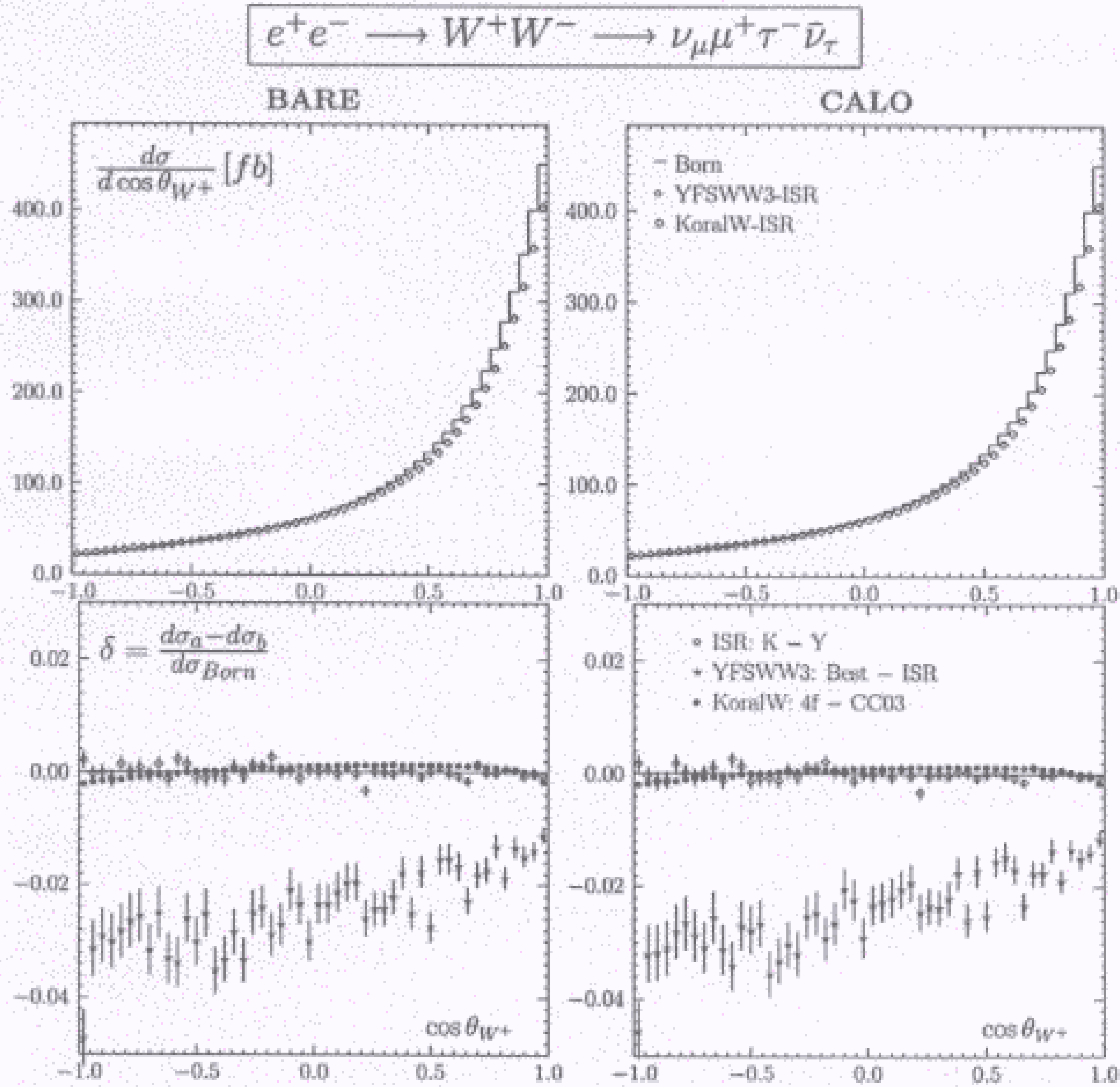

Figure 5: Distributions of *cosine* of the W^+ polar angle w.r.t. the e^+ beam for BARE and CALO acceptances at $E_{CM} = 200\,GeV$.

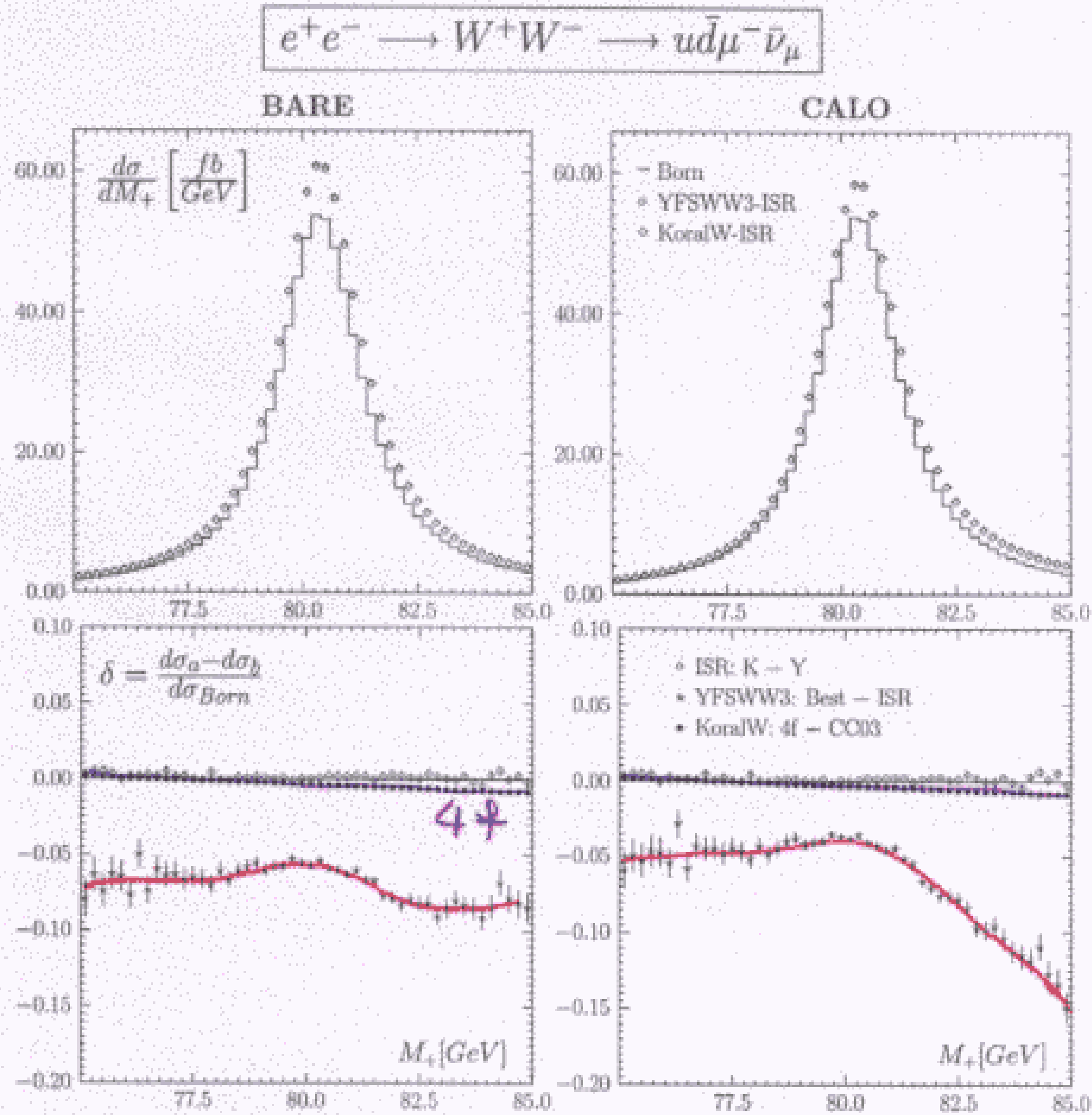

Figure 3: Distributions of the W^+ invariant mass for BARE and CALO acceptances at $E_{CM} = 500\,GeV$.

$\mathcal{O}(\alpha) \gg 4f$

500

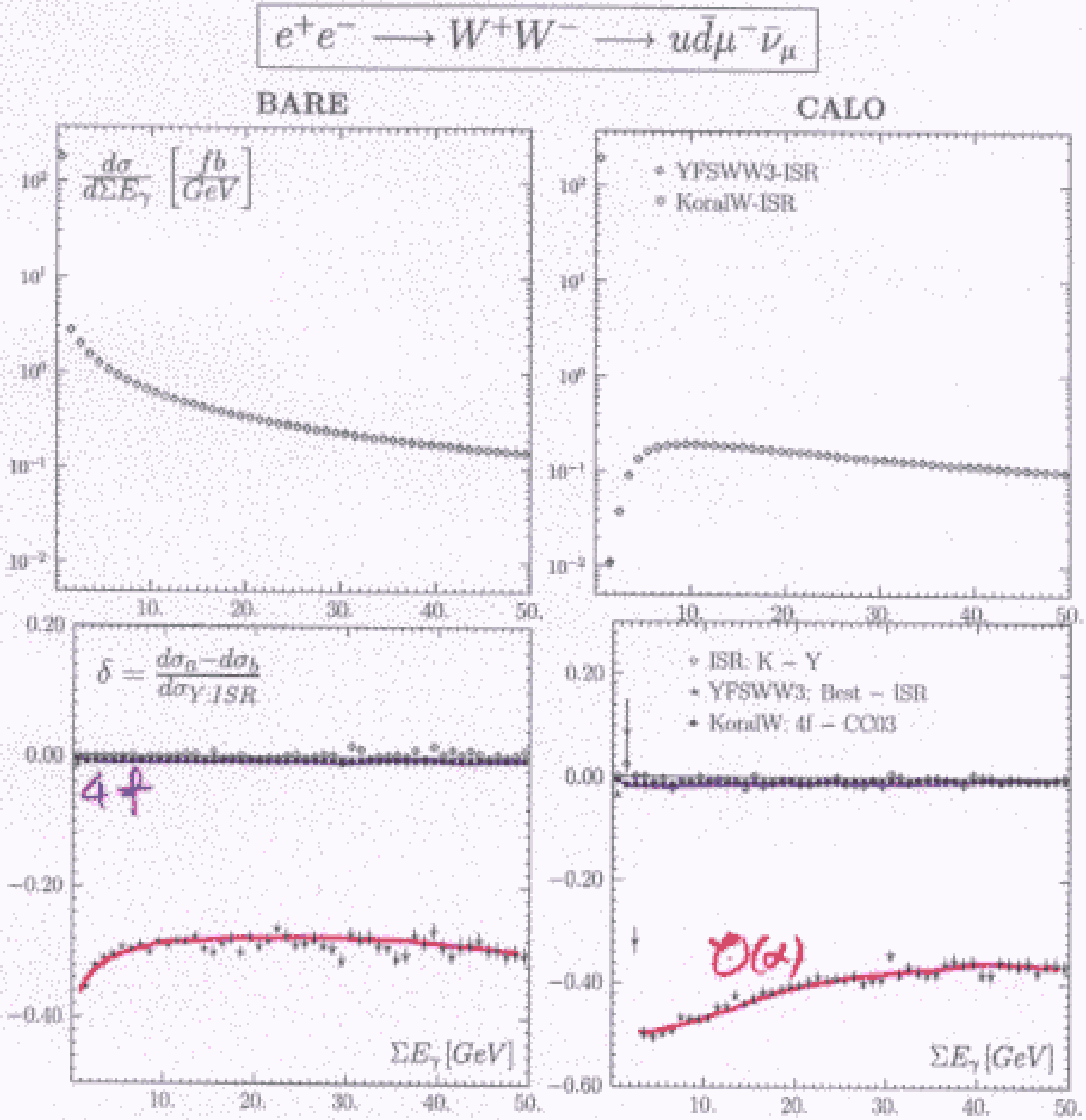

Figure 8: Distributions of the sum of the photon energy for BARE and CALO acceptances at $E_{CM} = 500\,GeV$.

$\mathcal{O}(\alpha) \gg 4f$

500

$$e^+e^- \longrightarrow W^+W^- \longrightarrow u\bar{d}\mu^-\bar{\nu}_\mu$$

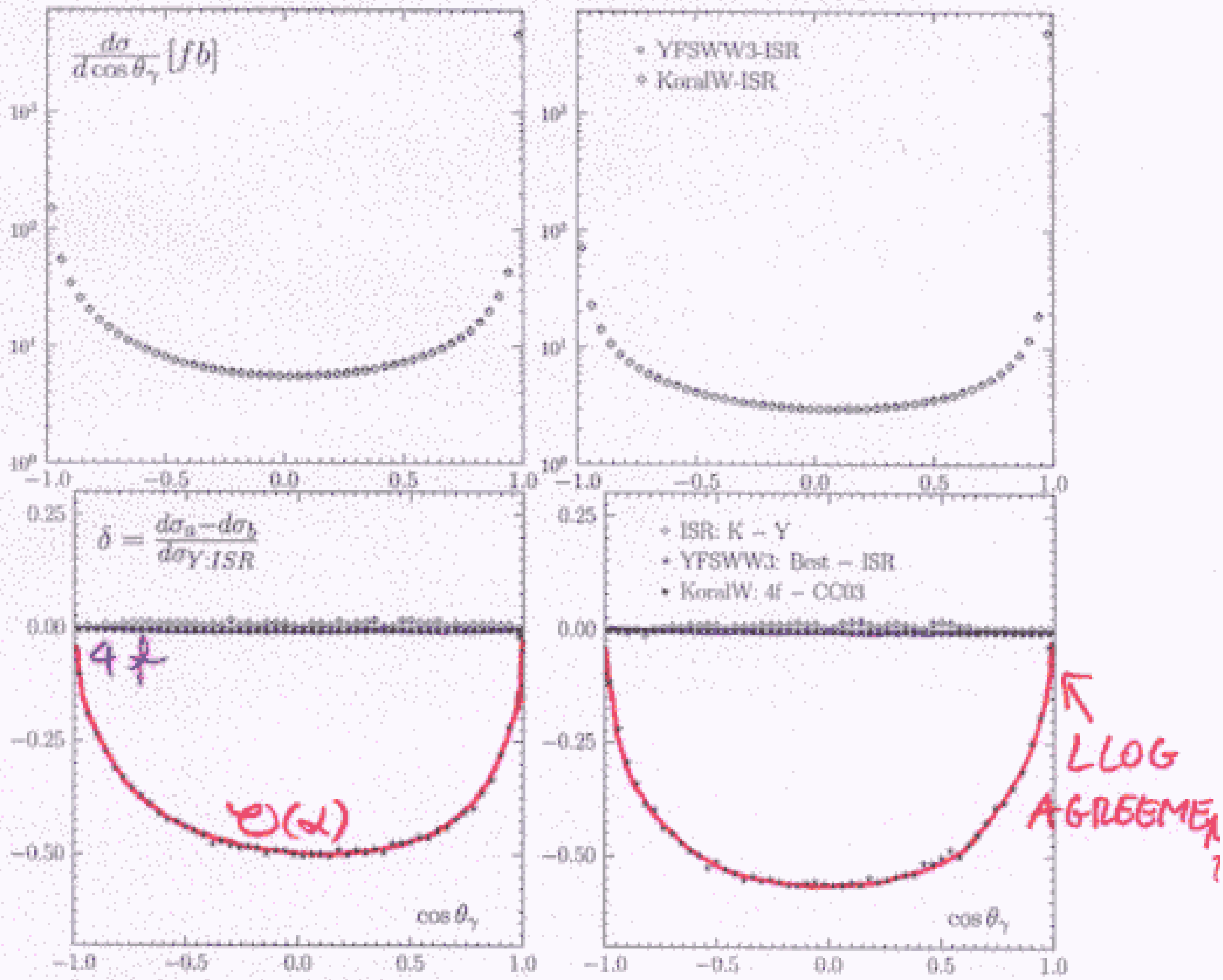

Figure 9: Distributions of *cosine* of the hardest photon polar angle w.r.t. the e^+ beam for BARE and CALO acceptances at $E_{CM} = 500\,GeV$.

$O(\alpha) \gg 4f$

500

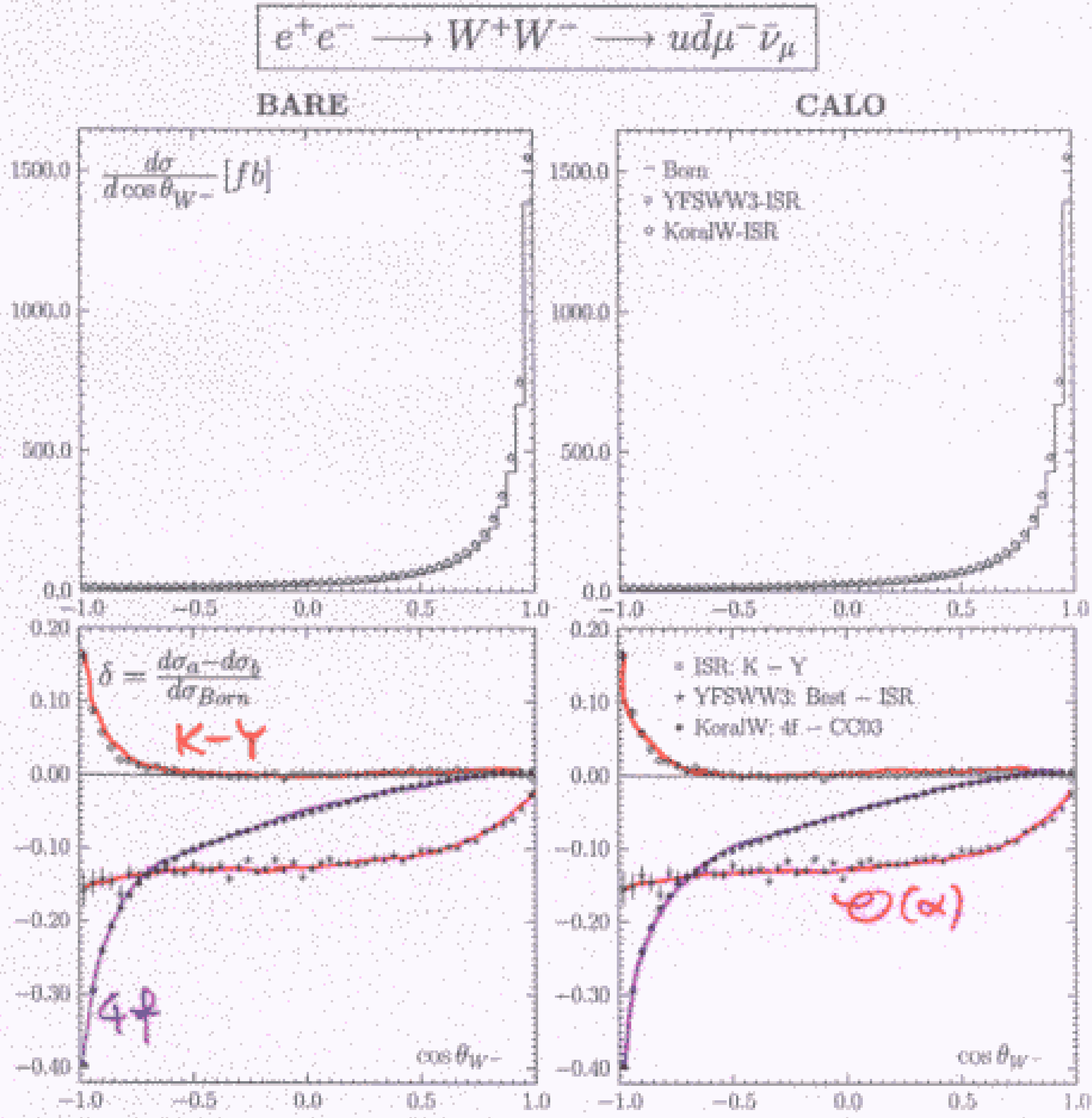

Figure 6: Distributions of *cosine* of the W^- polar angle w.r.t. the e^- beam for BARE and CALO acceptances at $E_{CM} = 500\,GeV$.

O(α) ~ 4f

K-Y → CC03 EXTRAPOLATION REDUCTION PROCEDURES DIFFERENCE

500

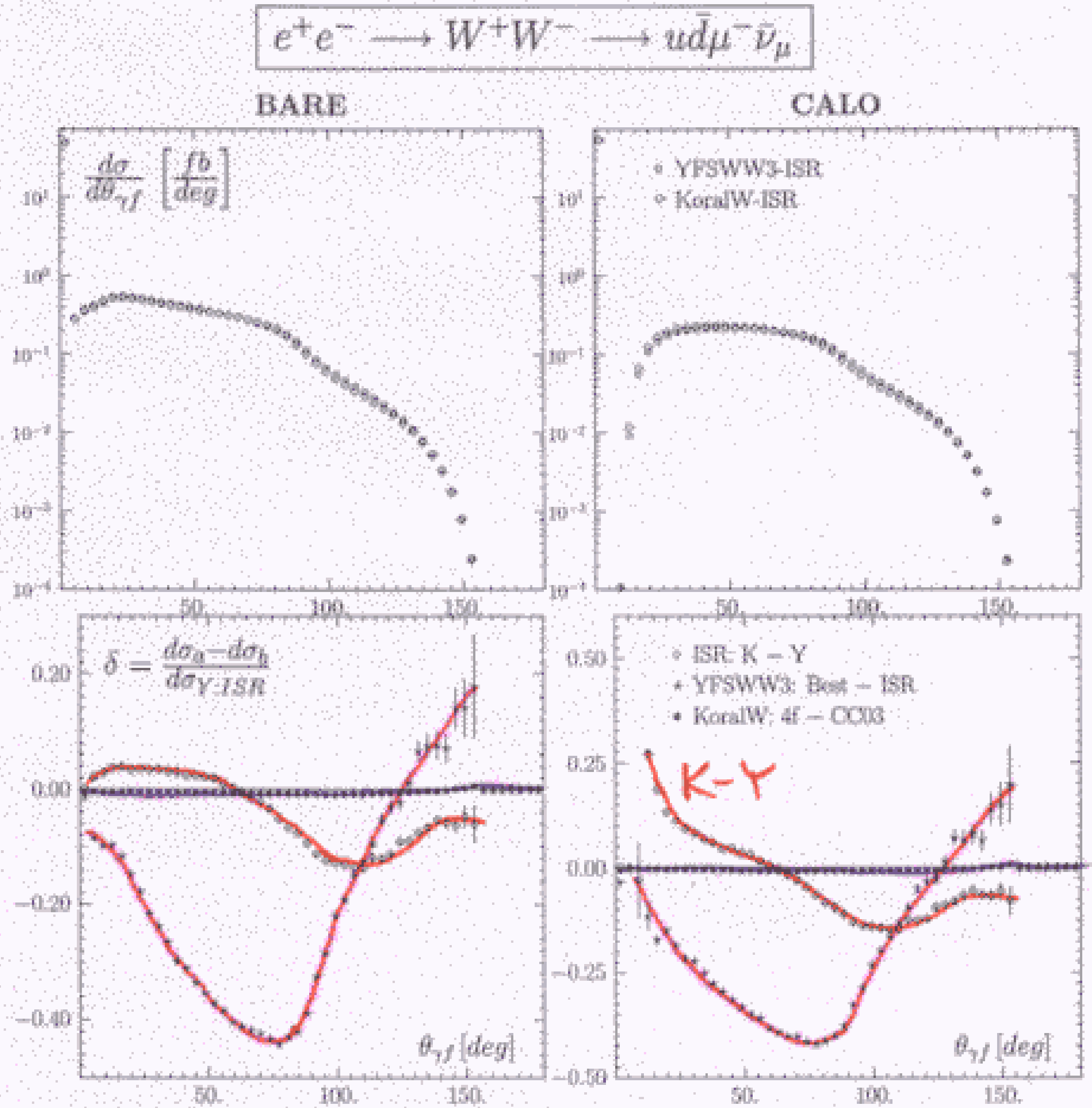

Figure 10: Distributions of the angle between the hardest photon and the nearest final state charged fermion for BARE and CALO acceptances at $E_{CM} = 500\,GeV$.

EXTRAPOLATION
K-Y → CC03 REDUCTION PROCEDURES
DIFFERENCE

500

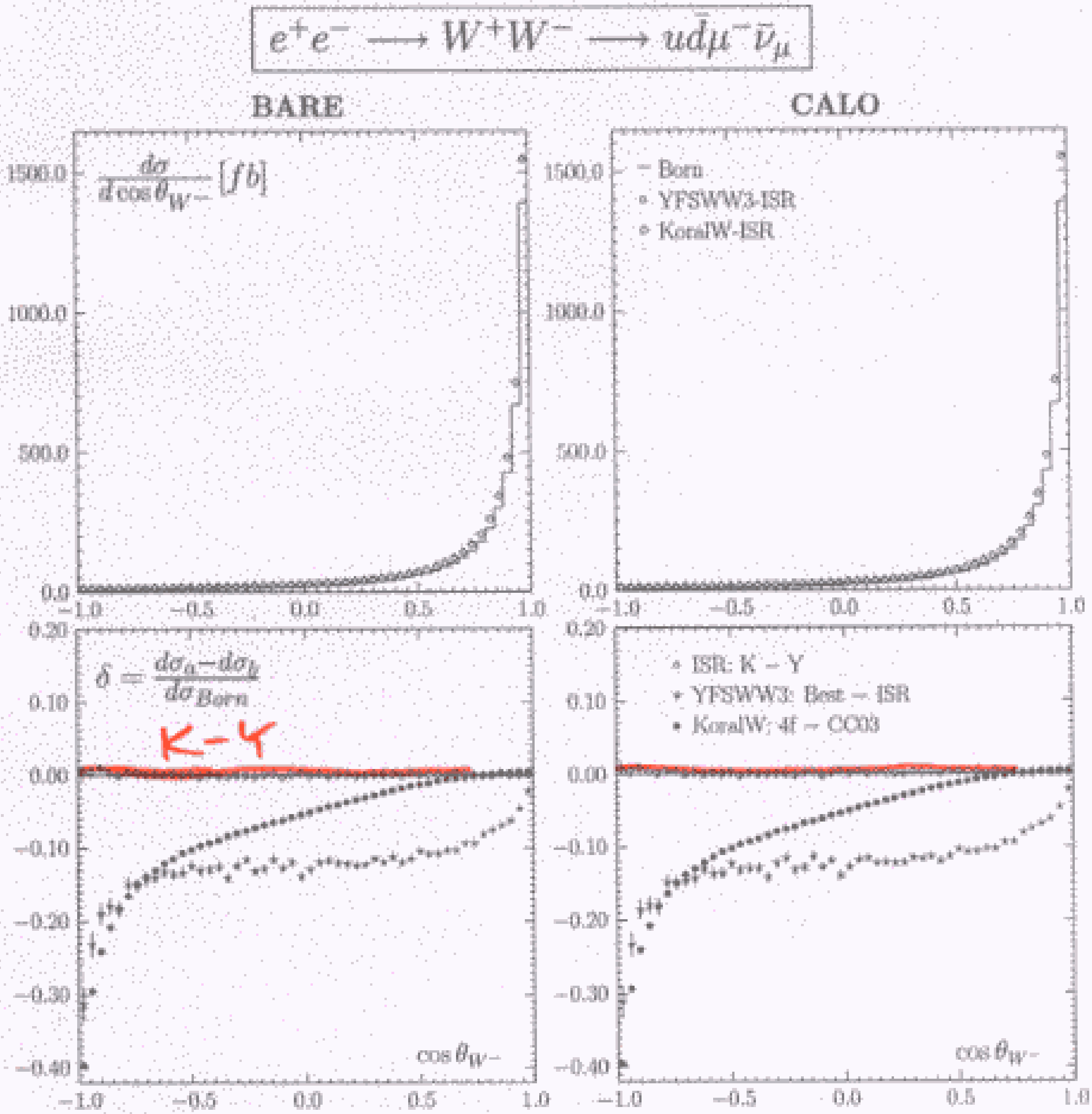

Figure 6: Distributions of *cosine* of the W^- polar angle w.r.t. the e^- beam for BARE and CALO acceptances at $E_{CM} = 500\,GeV$.

DIFFERENT EXTRAPOLATION REDUCTION PROCEDURE IN KORALW

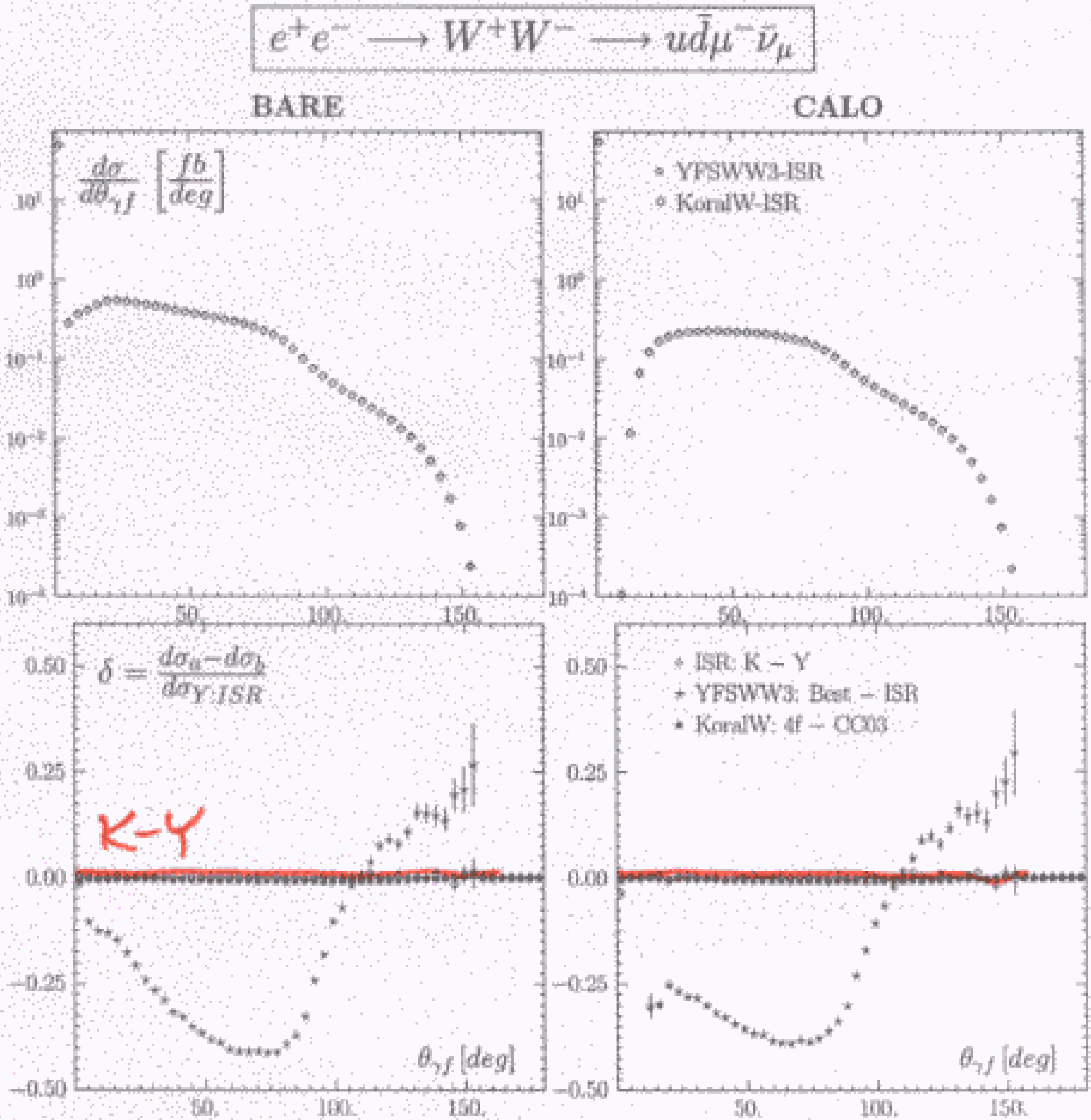

Figure 10: Distributions of the angle between the hardest photon and the nearest final state charged fermion for BARE and CALO acceptances at $E_{CM} = 500\,GeV$.

EXTRAPOLATION
DIFFERENT REDUCTION PROCEDURE IN KORALW

500KWrp

CONCLUSIONS

① TECHNICAL PRECISION OF YFSWW - KORALW COMPARISONS

2×10^{-4} (TOTAL X-SECT)

② $\mathcal{O}(\alpha)$ CORR. DOMINATES 4f CORR.
BUT FOR SOME ANGULAR DISTRIBS. 4f COMPARABLE TO $\mathcal{O}(\alpha)$ BOTH AT 161 GeV AND 500 GeV.
BUT IN TOTAL X-SECT. 4f CORR. SMALLER DUE TO ANGULAR CANCELLATIONS.

③ AN INTRINSIC FREEDOM/UNCERTAINTY PRESENT IN BREMSSTRAHLUNG SIMMULATIONS DUE TO "EXTRAPOLATION PROCEDURE" (UNDEFINED RESIDUAL SUB-LEADING NON-IR TERMS)