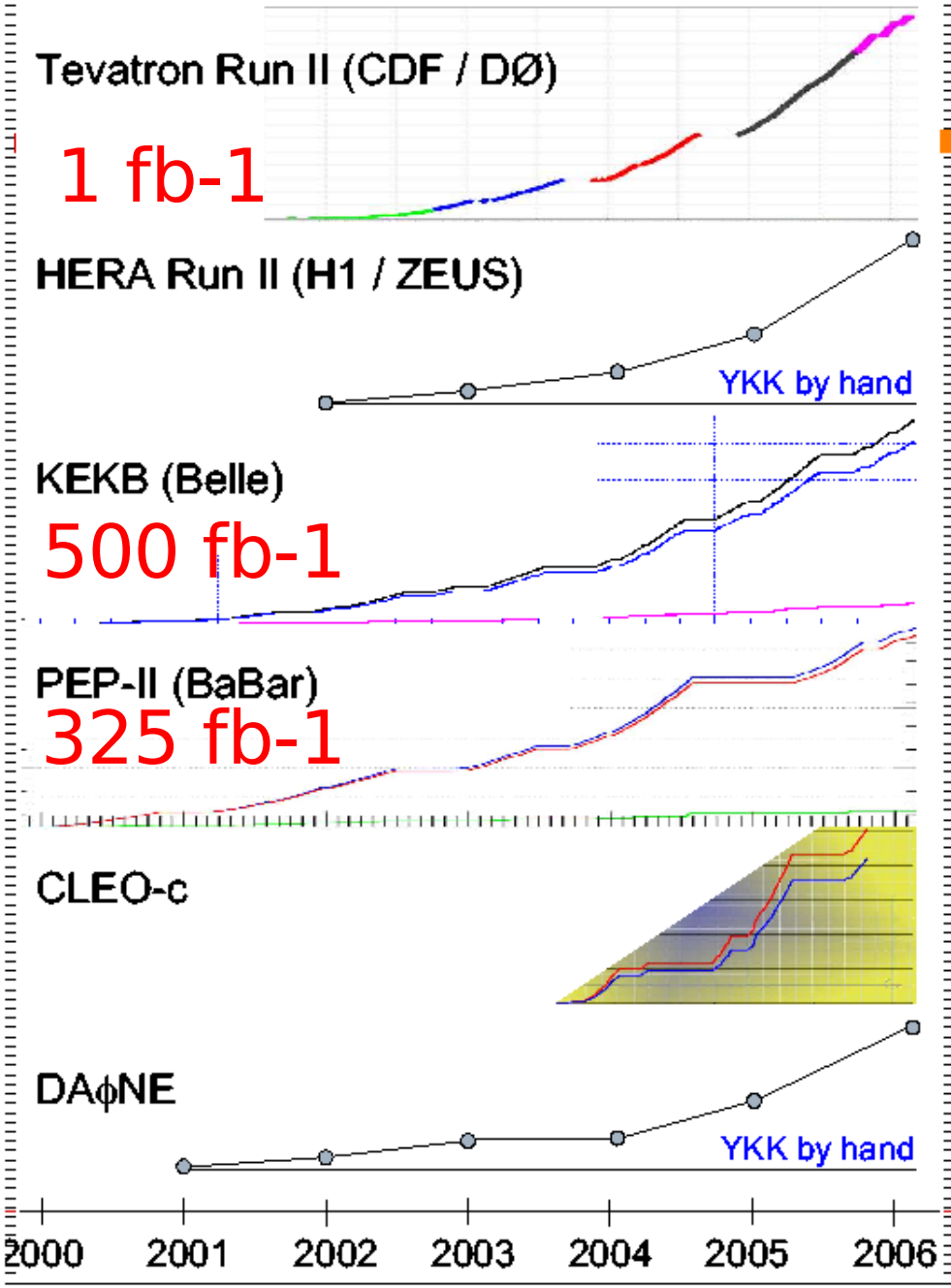
Resume de conference Hiver 06 (Moriond EW)

Avertissement :

- Ce résume est :
  - très incomplet
  - complètement subjectif
- Pour plus de résultats et détails :
  http://moriond.in2p3.fr/EW/2006/Transparencies/index.html

+ Beaucoup de donnees
-- Surtout ameliorations d'analyses existantes



Datasets for Moriond '06

All the major accelerators are in their peaks!

Used for results:

- 20 ~ 80% of data

Expected luminosity:

- Tevatron x5 by 2009
- HERA x3 by 2007
- KEKb x2 by 2008
- PEP-II x2 by 2008

Moriond 2010

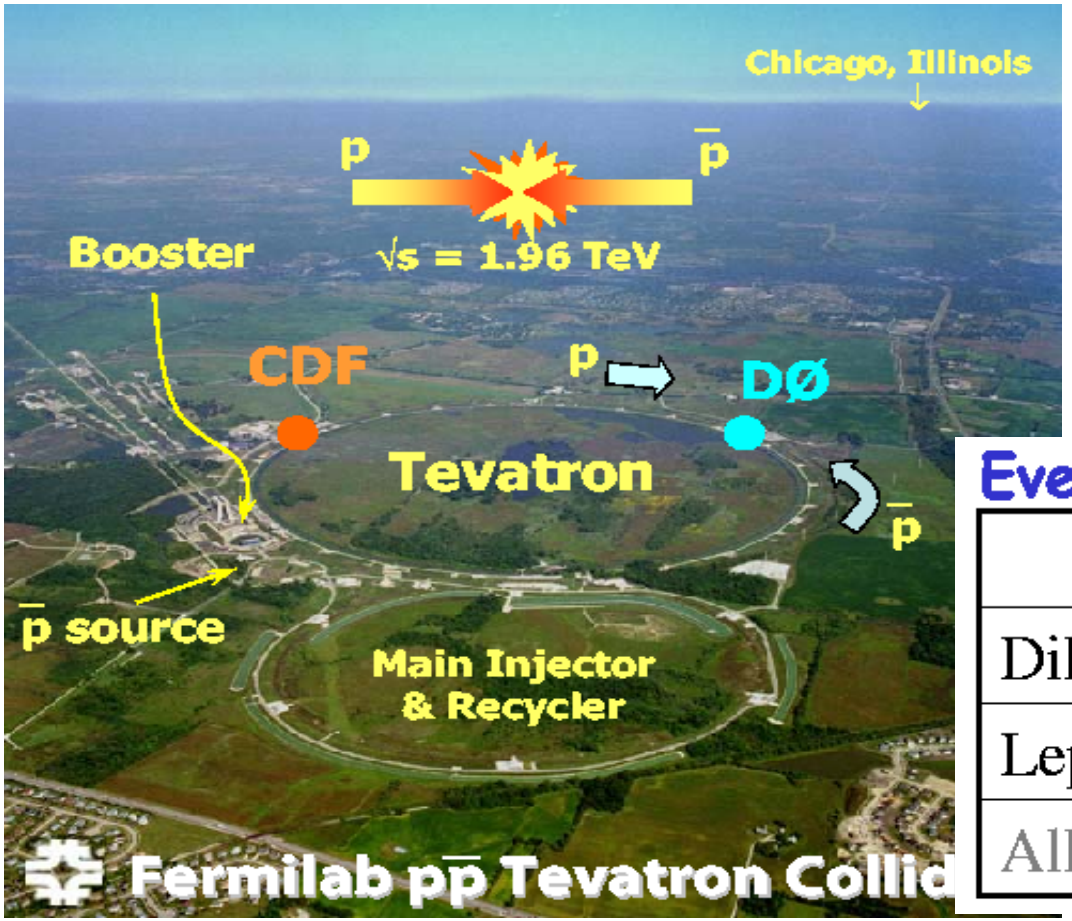
- Results/discoveries with x10 statistics

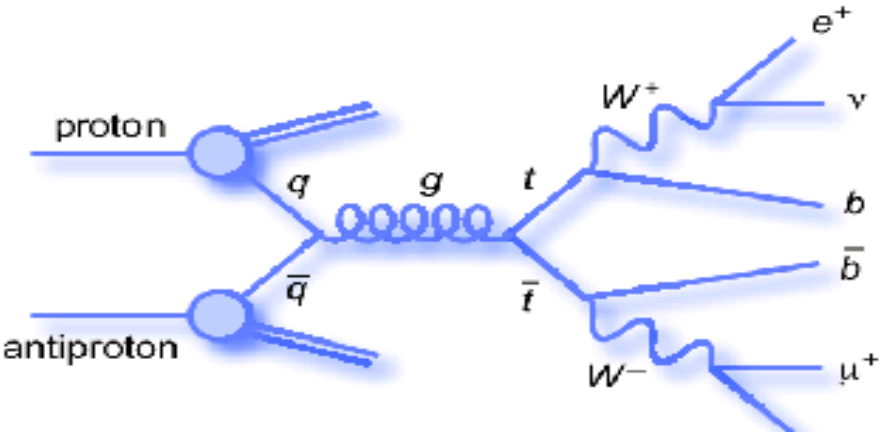
Contenu

- Tevatron :
  - Physique du Top
  - Recherche du Higgs : prévisions pour Run II
- Matrice CKM, violation CP :
  - B-factories
  - Premières mesures de Bs au Tevatron !
- Belle : premières données a Y(5S) -> B_s

Physique du Top au Tevatron

- 1 fb-1 enregistre par D0 et CDF (10x Run I).
- ~ 7000 paires tt produites par expérience
- Début de mesures de précision





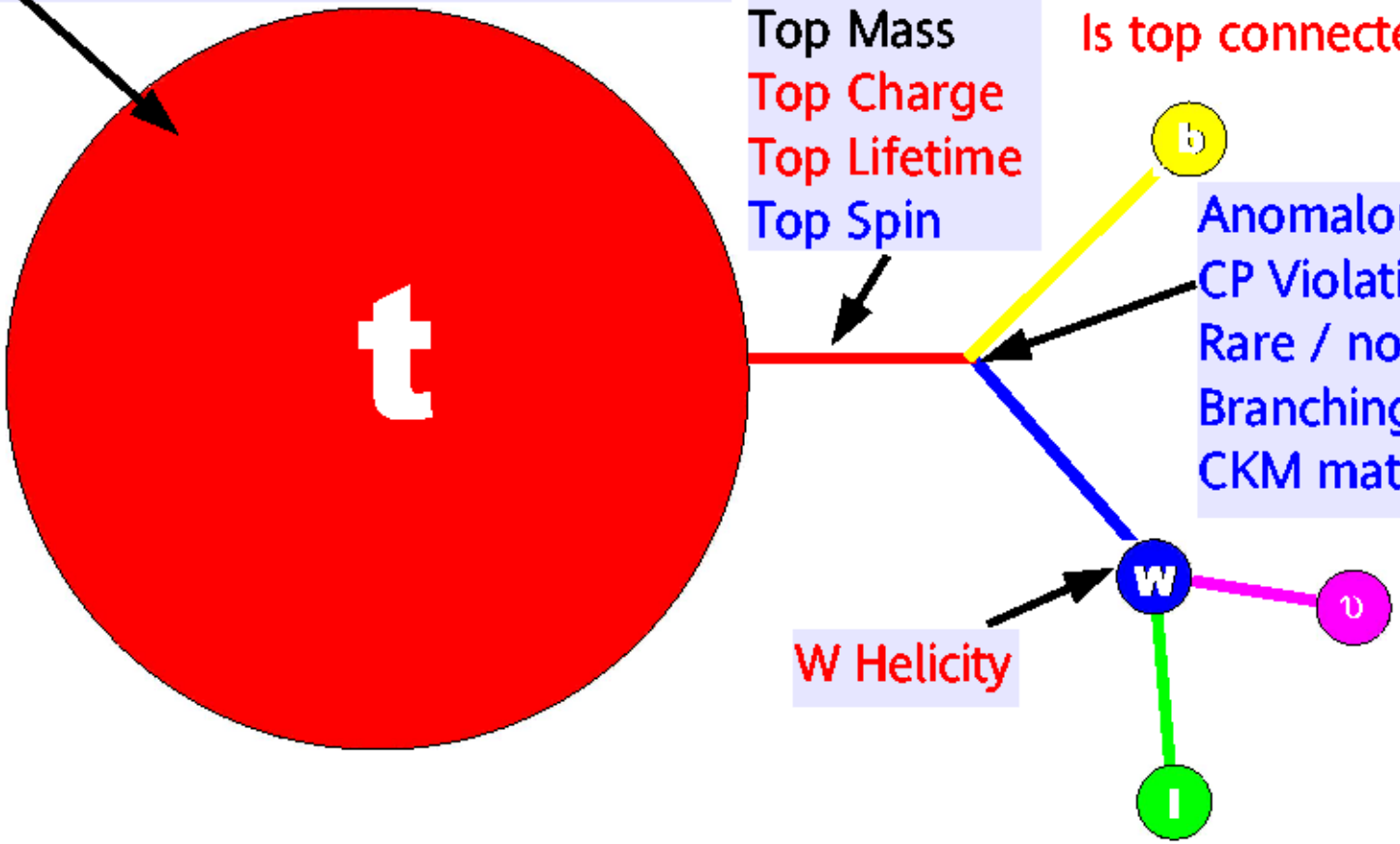
Events (S+B) in 680–750 pb^{-1} (CDF)

	Pretag	≥1 b tag	2 b tags
Dilepton	64	27	7
Lepton + Jets	360	252	57
All-hadronic		O(600)	

Top Quark Physics

Production Cross-Section
Production Kinematics
Spin Polarization
Production via interm. Resonances
t' Production

Tevatron Run I: top quark discovery
Tevatron Run II: high precision tests ...
Why is top so heavy ?
Is top/third generation special ?
Is top involved in EWSB ?
Is top connected to new physics ?



Top Mass
Top Charge
Top Lifetime
Top Spin

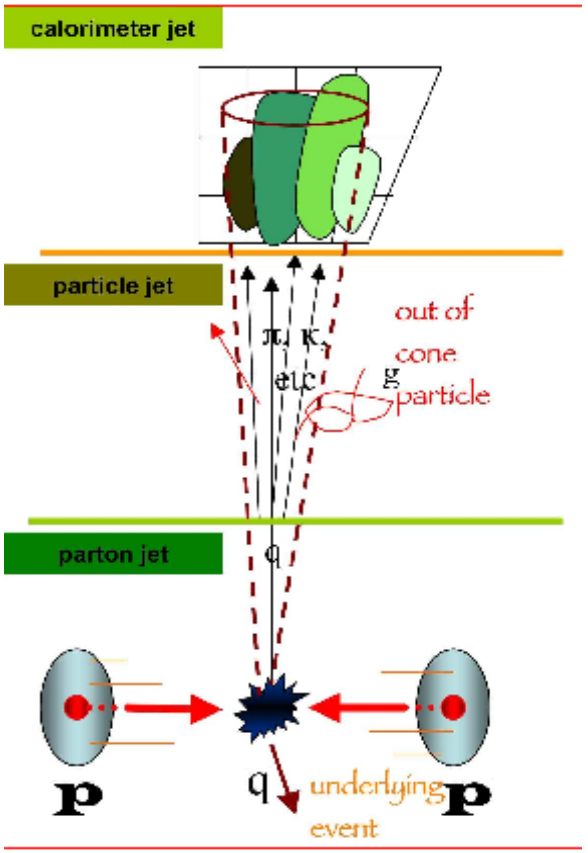
Anomalous Couplings
CP Violation
Rare / non-SM Decays
Branching Fractions
CKM matrix element $|V_{tb}|$

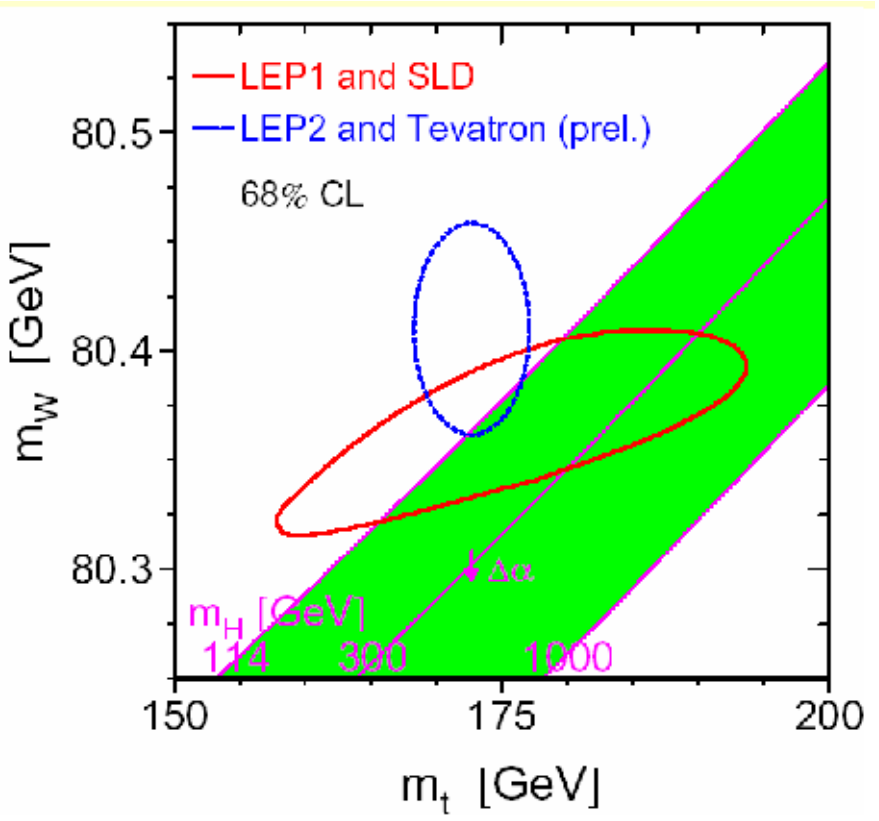
W Helicity

Very rich Top Physics program at the Tevatron.

Mesure de la masse du top

- Important paramètre EW :
- Erreur dominante : échelle d'énergie des jets.

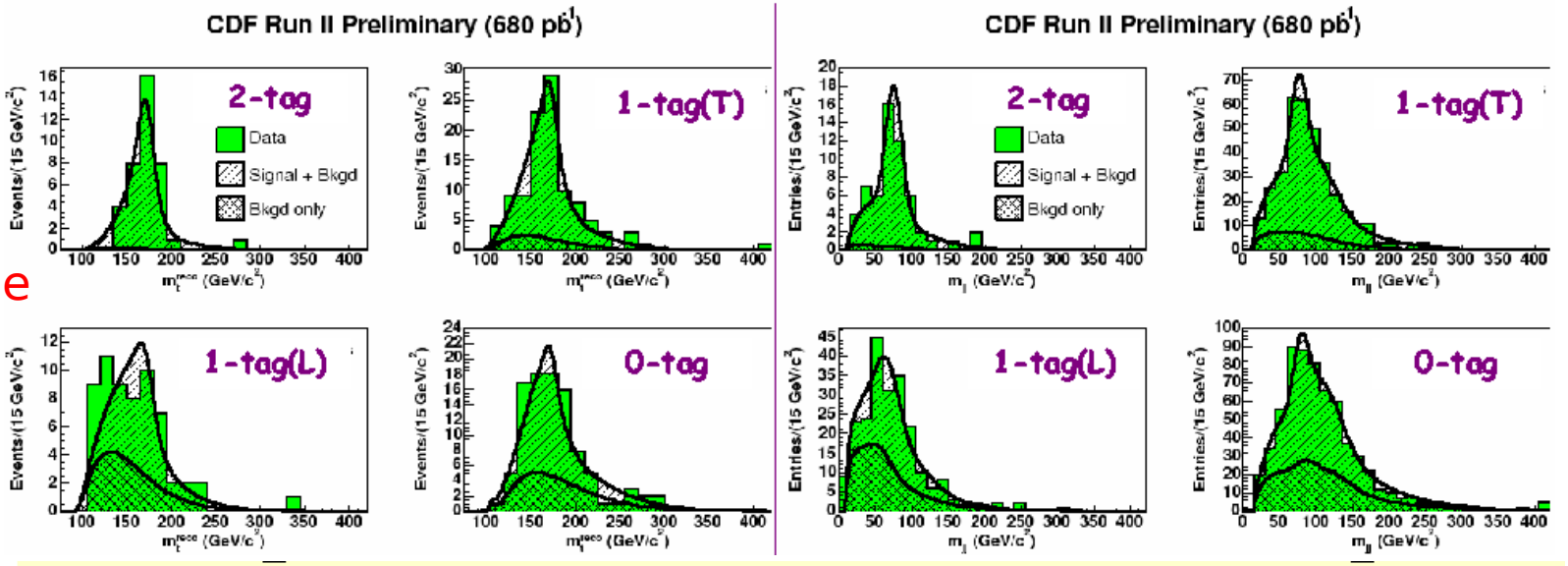




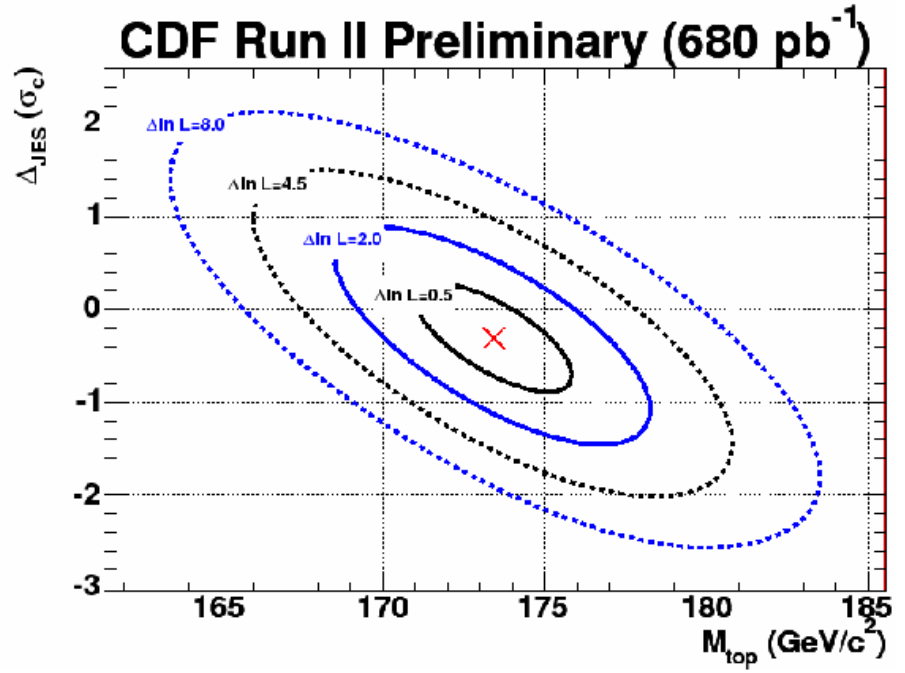
$$M_t = \frac{1}{\sqrt{2}}\lambda_t v$$

$$\Rightarrow \lambda_t = \frac{M_t}{173.9\ \mathrm{GeV}/c^2}$$

Calibration
In-situ des jets
avec W hadronique



Likelihood contours in M_{top}-Δ_{JES} plane

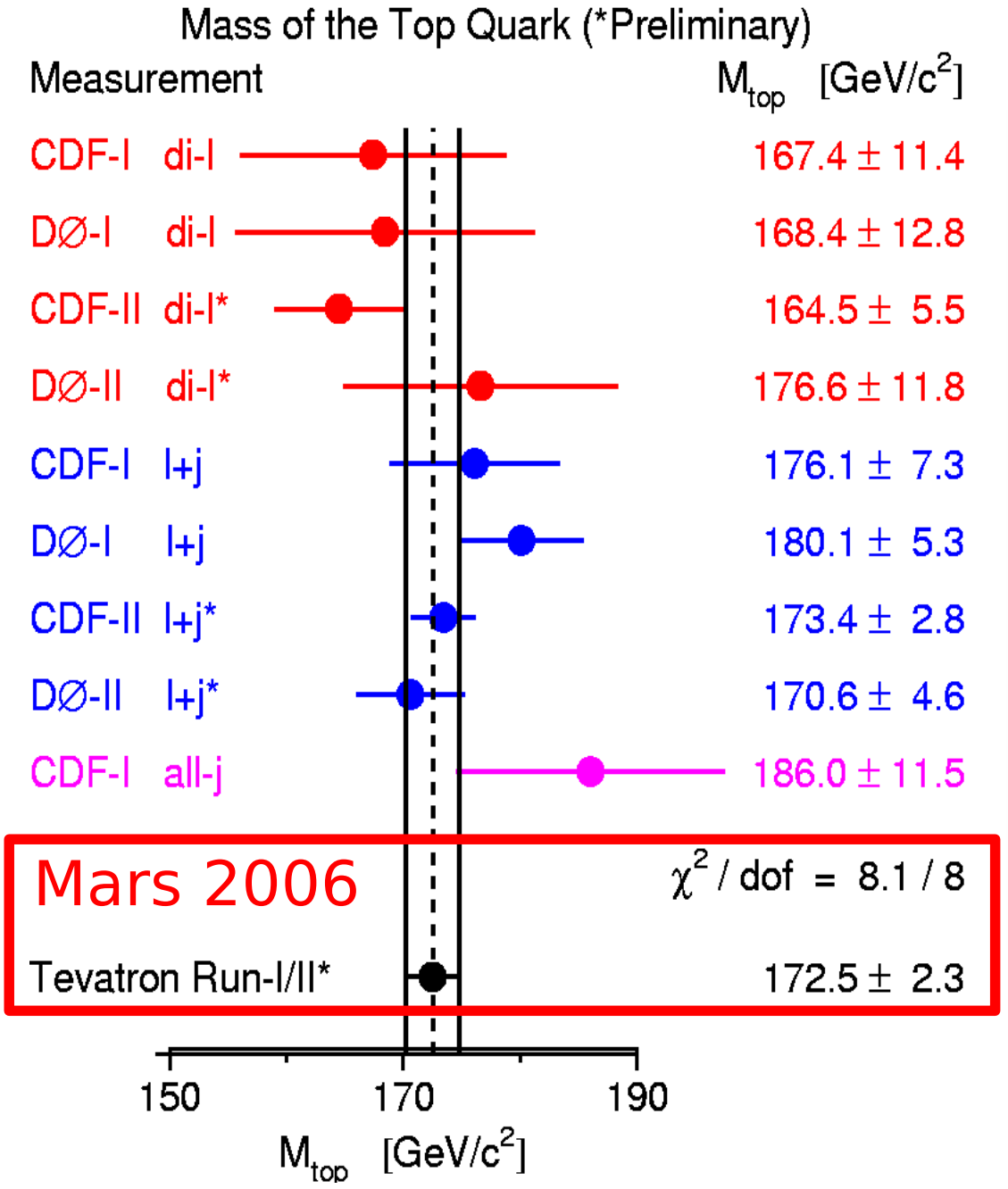


Systematic	ΔM_{top} (GeV/c^2)
Residual JES	0.7
B-jet energy scale	0.6
Bkgd JES	0.4
Bkgd Shape	0.5
ISR	0.5
FSR	0.2
Generators	0.3
PDFs	0.3
MC stats	0.3
B-tagging	0.1
TOTAL	1.3

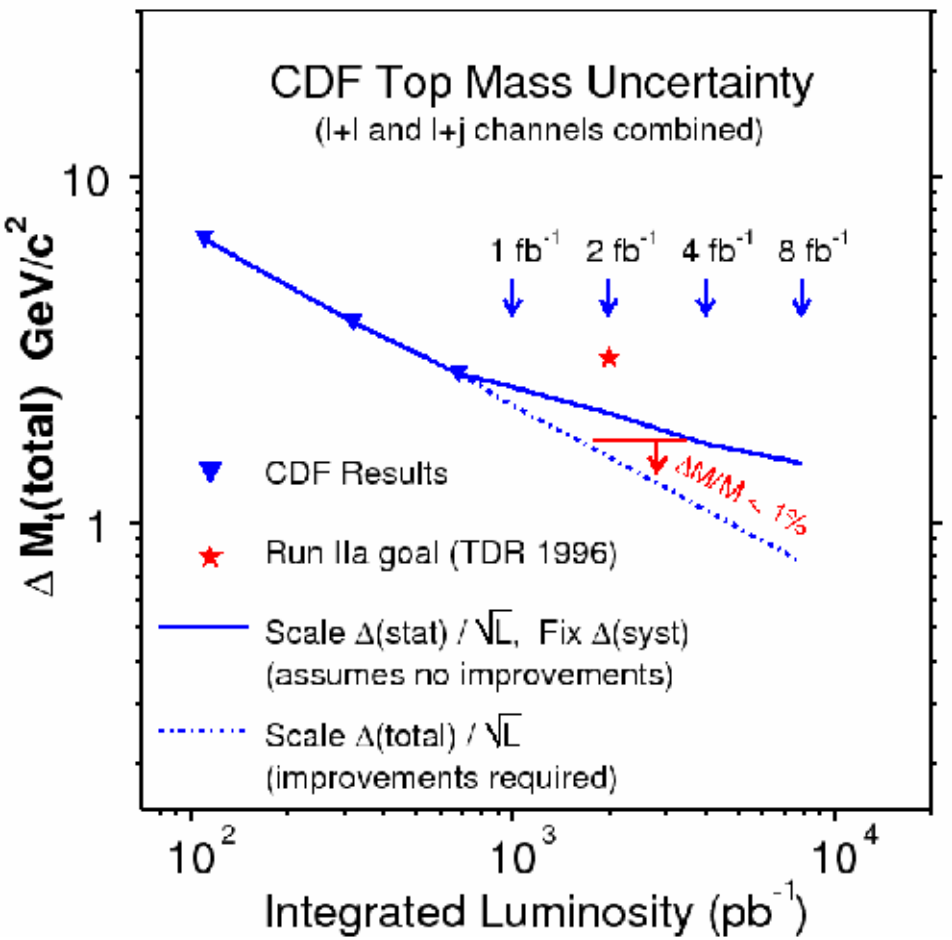
Meilleure mesure individuelle:

2 Mai 2006

$$M_{\text{top}} = 173.4 \pm 2.5\,(\text{stat}) \pm 1.3\,(\text{syst})\ \text{GeV}/c^2$$



Prévisions pour Run II :

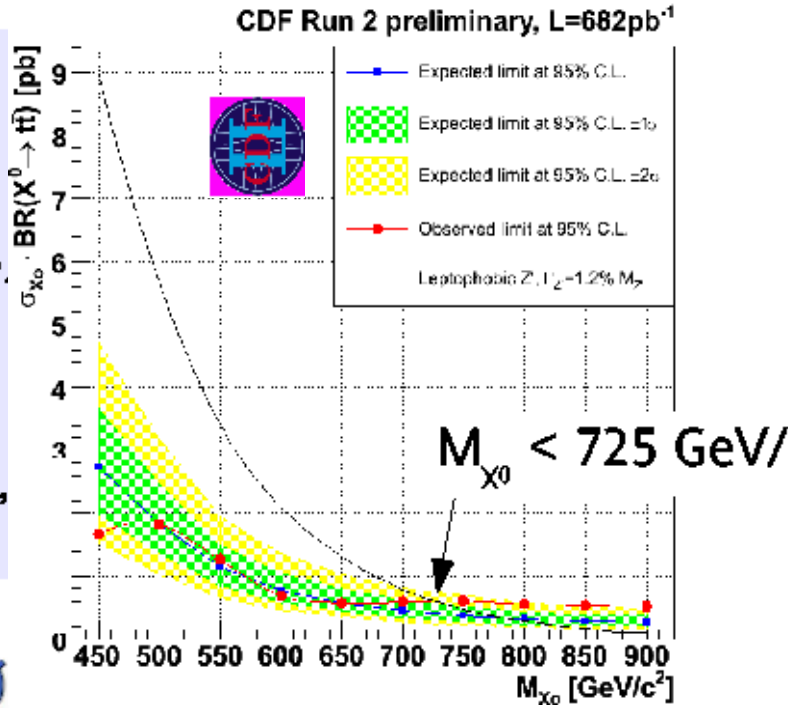


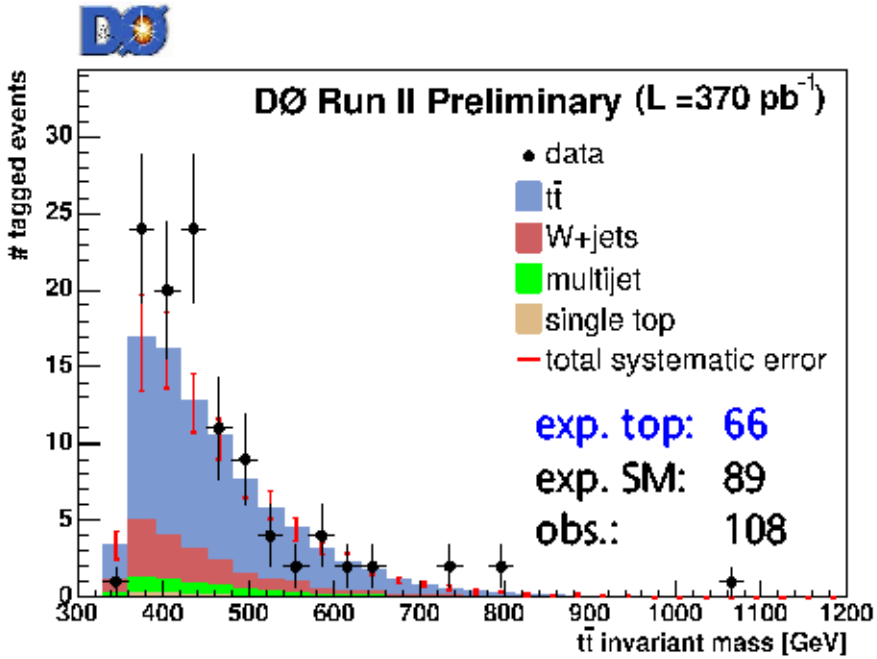
Précision de <1.5GeV accessible

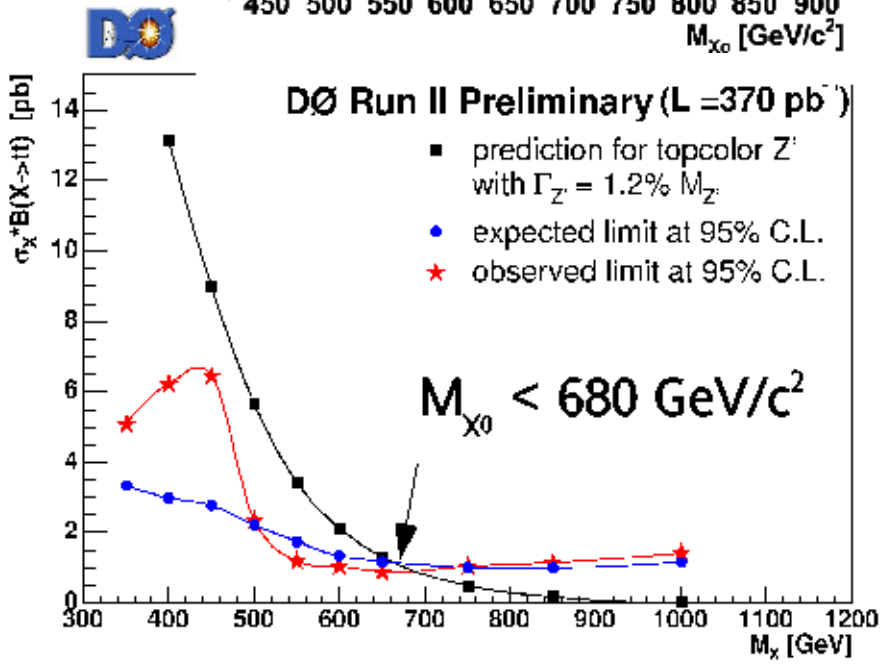
Search for Top Production via intermediate Resonances (I)

Does something new produce top pairs (at D0) ?

- lepton+≥4 jets with ≥1 b-tag in 370pb^{-1}.
- kinematic fit to ttbar hypothesis.
- fix SM ttbar production to expected rate (6.7pb).
- no significant excess observed.
- derive limit on $\sigma_X \times BR(X \rightarrow t\bar{t})$.
- interpret in terms of mass limit in possible model,
  e.g. topcolor assisted technicolor Z' (hep-ph/9911288)



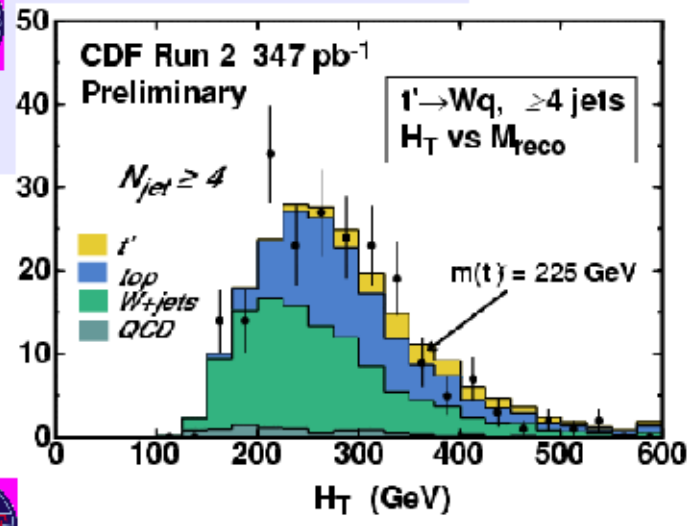




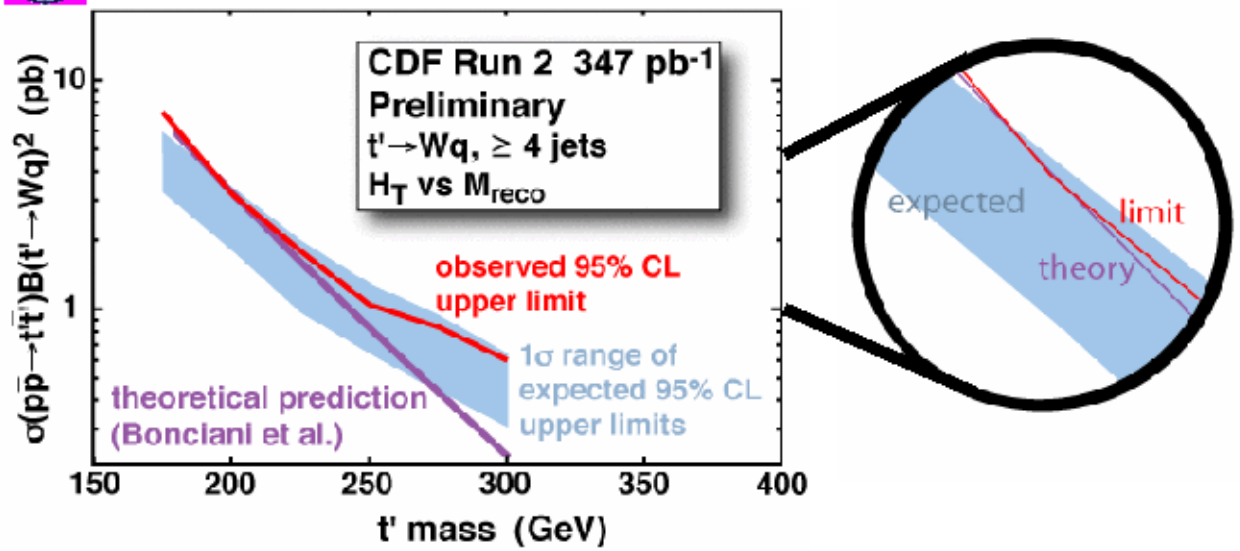
Top' Quark Search

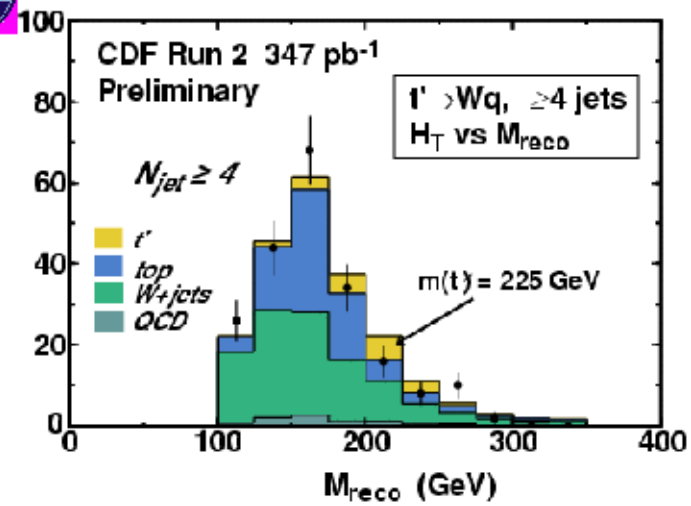
Can we find something new with large mass and top properties?

- heavy 4th generation quark (He et al, hep-ph/0102144)
- search for t' → Wq in lepton + jets + missing E_T events (CDF, 347pb^{-1})
- try to remain model independent
- reconstruct t' candidate mass
- fit templates in (H_T, $M_{t'}$)



t' cross section limit.





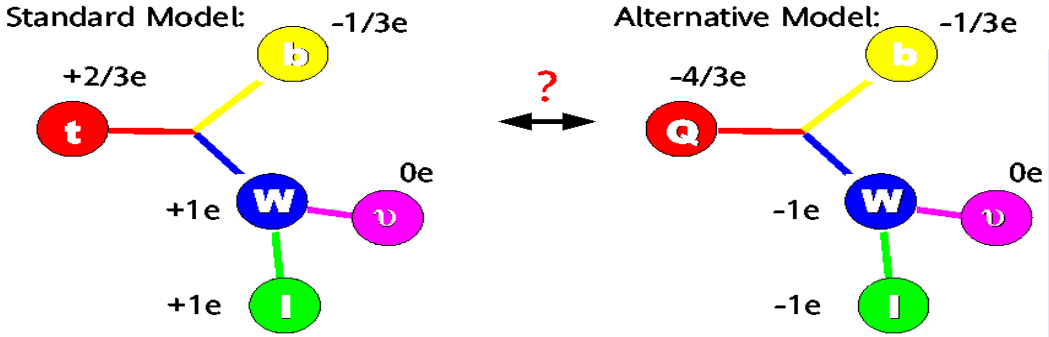
translate cross section limit into a t' prime mass limit of

196 – 207 GeV/c^2 @ 95 CL

expect m(t') > 300 GeV/c^2 with 2fb^{-1} unless ...

Top Quark Charge (II)

Very first measurement of one of the most fundamental top properties:



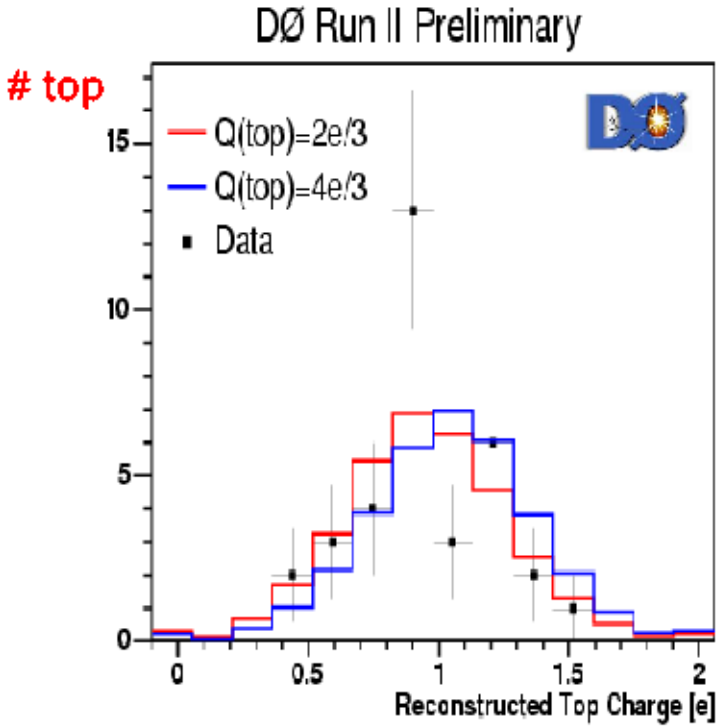
- discriminate b and bbar with jet charge algorithm,

$$q_{jet} = \frac{\sum_i q_i p_{Ti}^{0.6}}{\sum_i p_{Ti}^{0.6}}$$, pT > 0.5 GeV & $\Delta R < 0.5$.

- calibrate Monte Carlo with data using two jet heavy flavor sample with opposite jet tagged with μ charge.

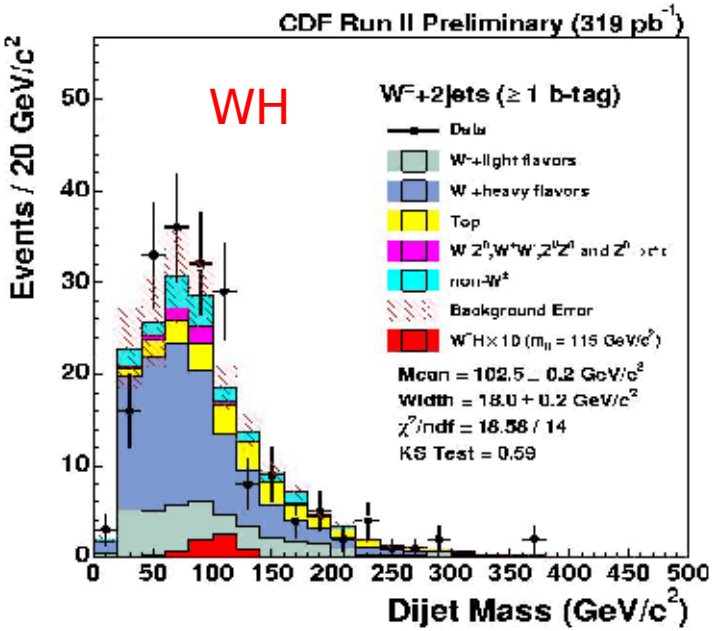
- excluded the hypothesis of an exotic quark with charge = -4/3 e at 94% confidence level.

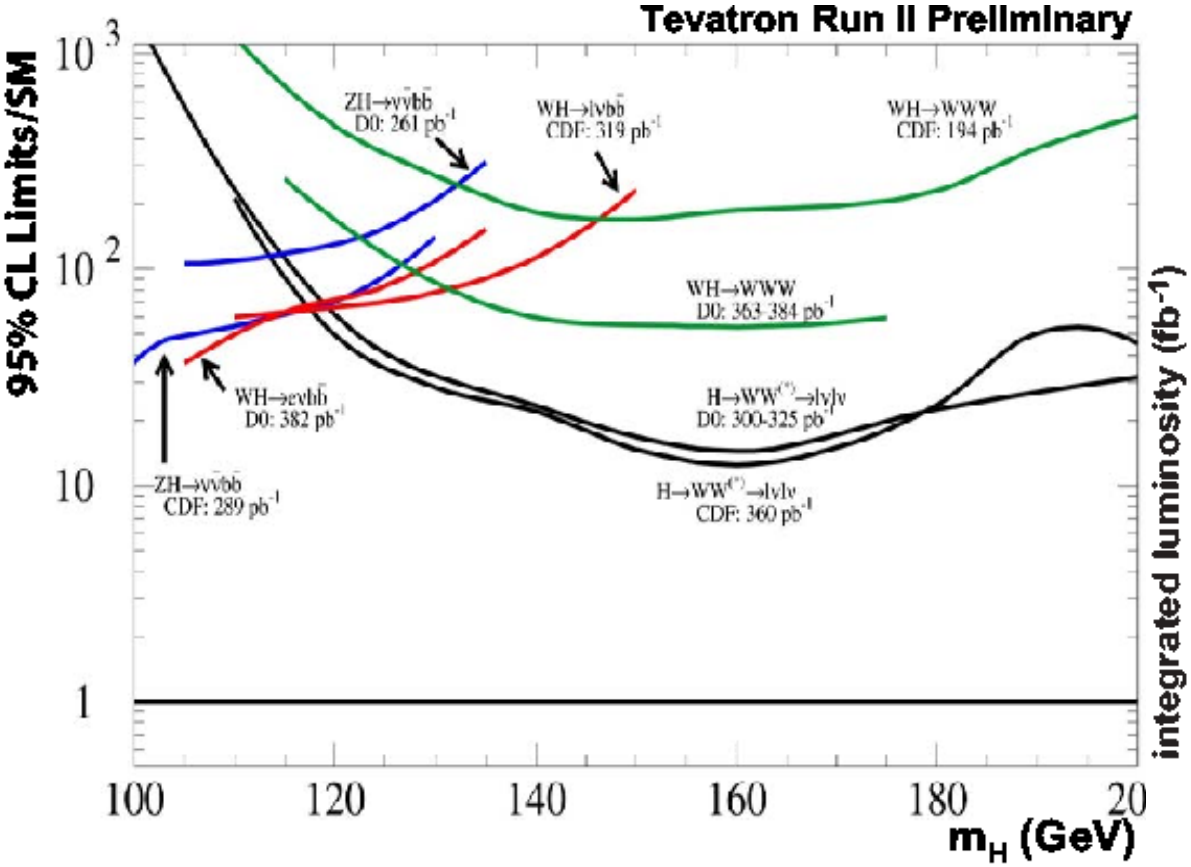
- CDF result with 1fb^{-1} coming ...

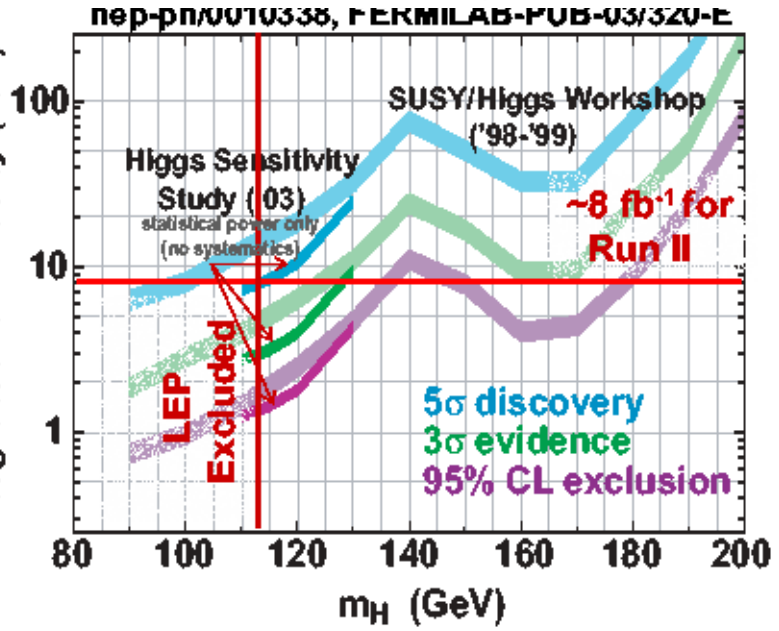


Recherche du Higgs au Tevatron

- Limites dans plusieurs canaux
- Mais pas encore atteint la sensibilité escomptée
- Encore très loin d'une observation...







Matrice CKM, violation CP

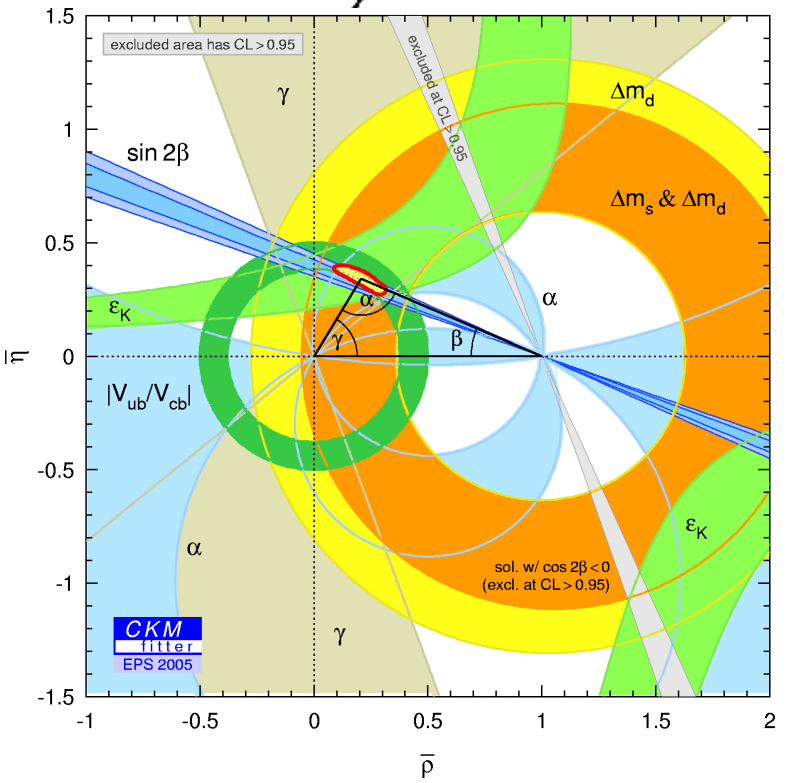
- Matrice de mélange des quarks
- Unitarité : 4 paramètres, dont une phase -> violation CP

$$V = \begin{pmatrix} V_{ud} & V_{us} & V_{ub} \\ V_{cd} & V_{cs} & V_{cb} \\ V_{td} & V_{ts} & V_{tb} \end{pmatrix} \approx \begin{pmatrix} 1-\lambda^2/2 & \lambda & A\lambda^3(\rho - i\eta) \\ -\lambda & 1-\lambda^2/2 & A\lambda^2 \\ A\lambda^3(1-\rho-i\eta) & -A\lambda^2 & 1 \end{pmatrix}$$

Contrainte d'unitarité :

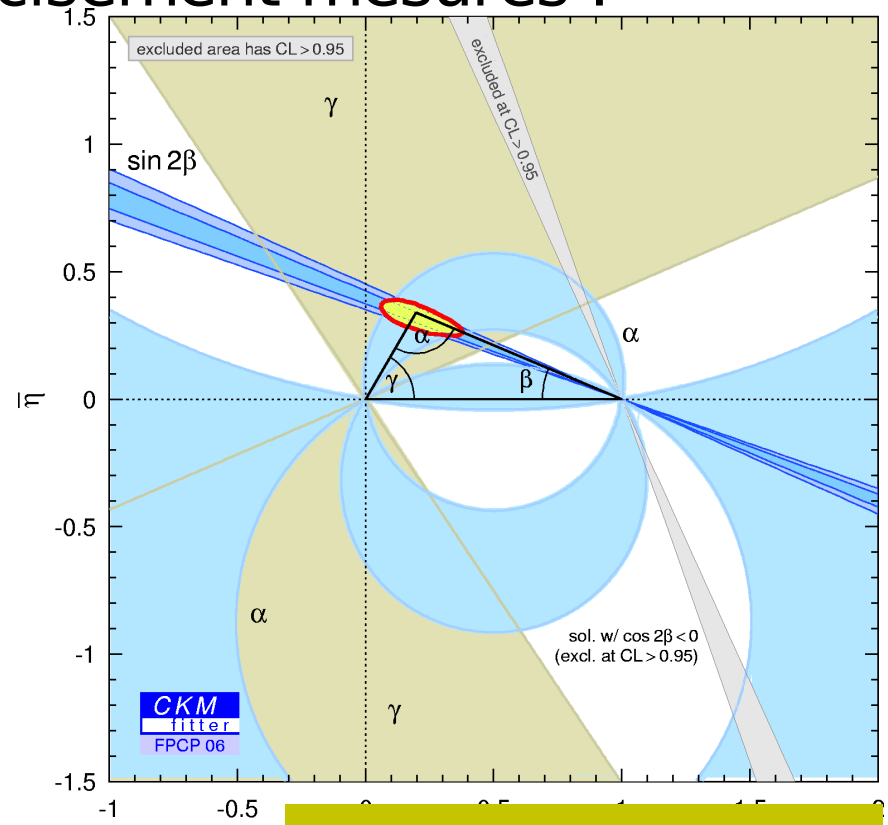
$$V_{ub}^* V_{ud} + V_{cb}^* V_{cd} + V_{tb}^* V_{td} = 0$$

$$\frac{V_{ub}^* V_{ud}}{V_{cb}^* V_{cd}} + 1 + \frac{V_{tb}^* V_{td}}{V_{cb}^* V_{cd}} = 0$$



Mesure des angles

- Les 3 angles sont maintenant precisement mesures :
- Beta : J/Psi Ks. 1ere mesure de violation CP dans le secteur des B. Très précise
- Alpha et gamma ~ 10-20% grâce a de nouvelles analyses et grande luminosité :
  - Alpha: B->rhô-rhô
  - Gamma: violation CP directe dans $B^{+/-}$ ->$DK^{+/-}$
- Contrainte sur le triangle par la mesure des angles seule !

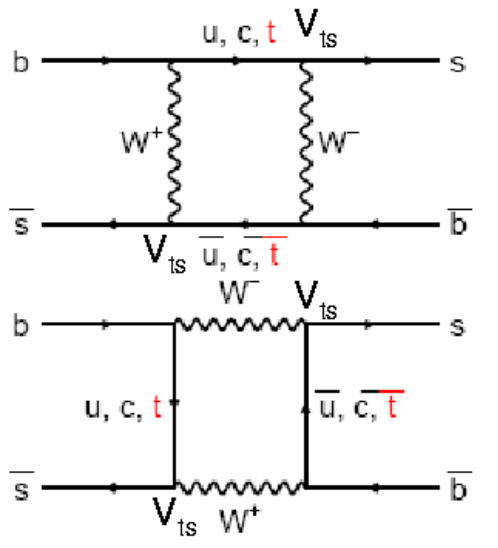


beta = $\phi_1 = (22 \pm 1)^\circ$

alpha = $\phi_2 = (99\ ^{+12}_{-9})^\circ$

gamma = $\phi_3 = (57\ ^{+16}_{-17})^\circ$

Mesure de Delta(ms)



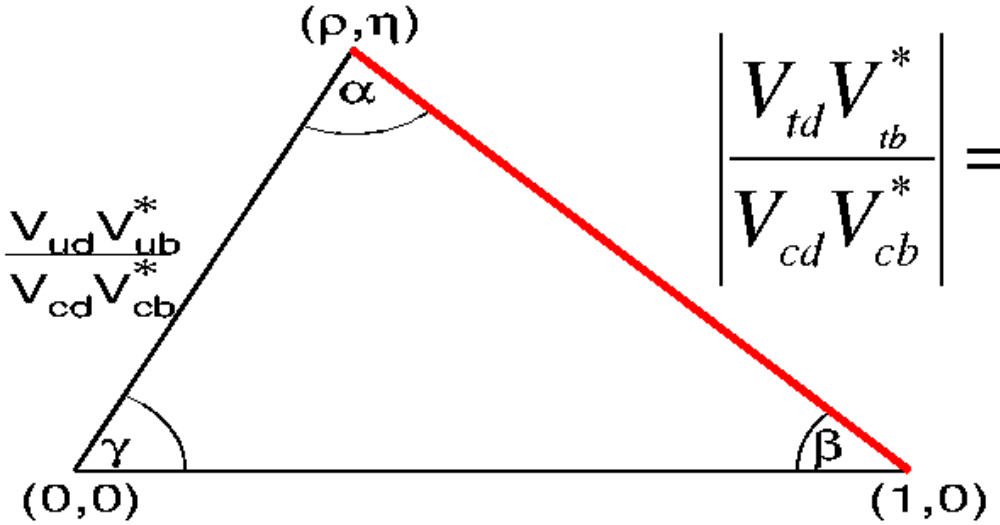
Ratio of frequencies for B^0 and B_s

$$\frac{\Delta m_s}{\Delta m_d} = \frac{m_{Bs}}{m_{Bd}} \frac{f_{Bs}^2 B_{Bs}}{f_{Bd}^2 B_{Bd}} \frac{|V_{ts}|^2}{|V_{td}|^2} = \frac{m_{Bs}}{m_{Bd}} \xi^2 \frac{|V_{ts}|^2}{|V_{td}|^2}$$

$\xi = 1.210\ ^{+0.047}_{-0.035}$ from lattice QCD

(hep/lat-0510113)

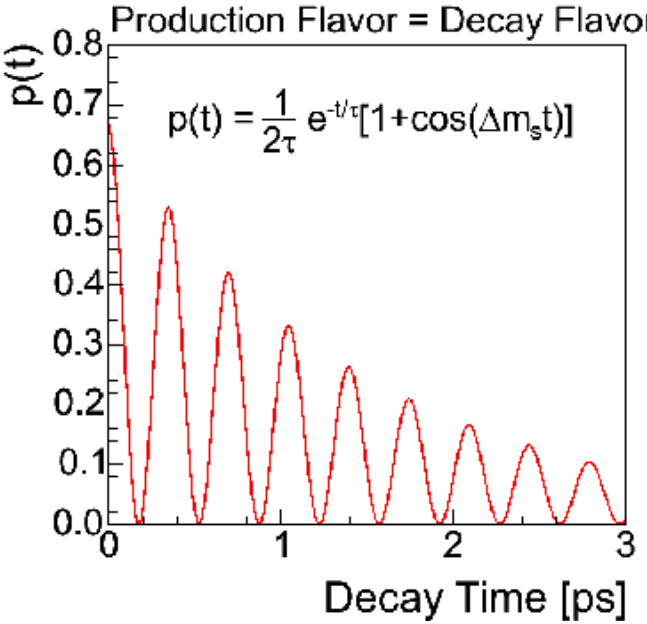
$V_{ts} \sim \lambda^2$, $V_{td} \sim \lambda^3$, $\lambda = 0.224 \pm 0.012$

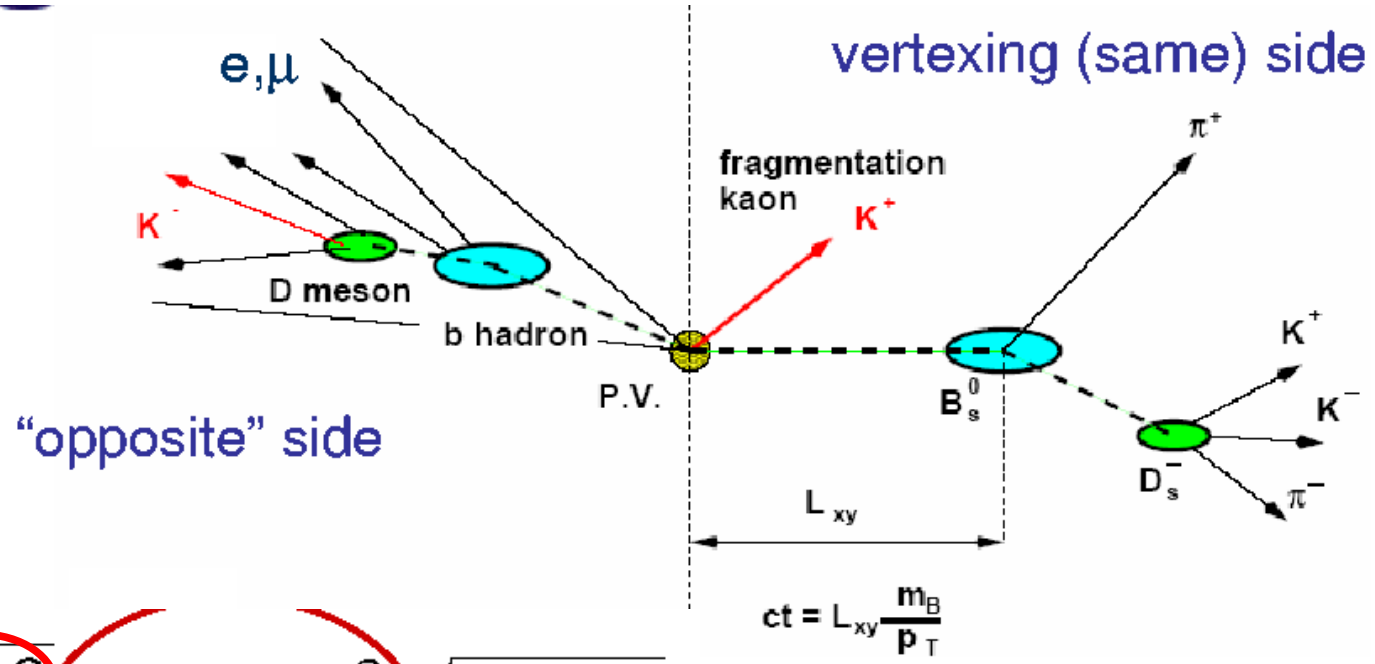


$$\left|\frac{V_{td}V_{tb}^*}{V_{cd}V_{cb}^*}\right| = \frac{|V_{td}|}{|V_{ts}|} \times \frac{1}{|V_{cd}|}$$

$$\sim \sqrt{\frac{\Delta m_d}{\Delta m_s}}$$

Oscillations Bs au Tevatron





$$\frac{1}{\sigma} = \sqrt{\frac{S\epsilon D^2}{2}} e^{-\frac{(\Delta m_s \sigma_t)^2}{2}} \sqrt{\frac{S}{S+B}}$$

- Identification d'un Bs et mesure du temps de vie
- Tagging de la saveur initiale :
  - Cote oppose : jet-charge, soft lepton
  - Même cote, avec id. de kaon de fragmentation

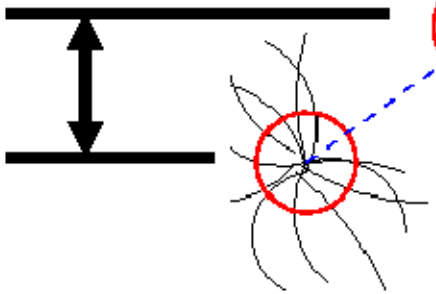
$$FOM = \sqrt{\frac{N\varepsilon D^2}{2}} e^{-0.5(\Delta m_s \sigma_t)^2} \sqrt{\frac{S}{S+B}}$$

Reco → Proper time → Flavor tagging → Δm_s

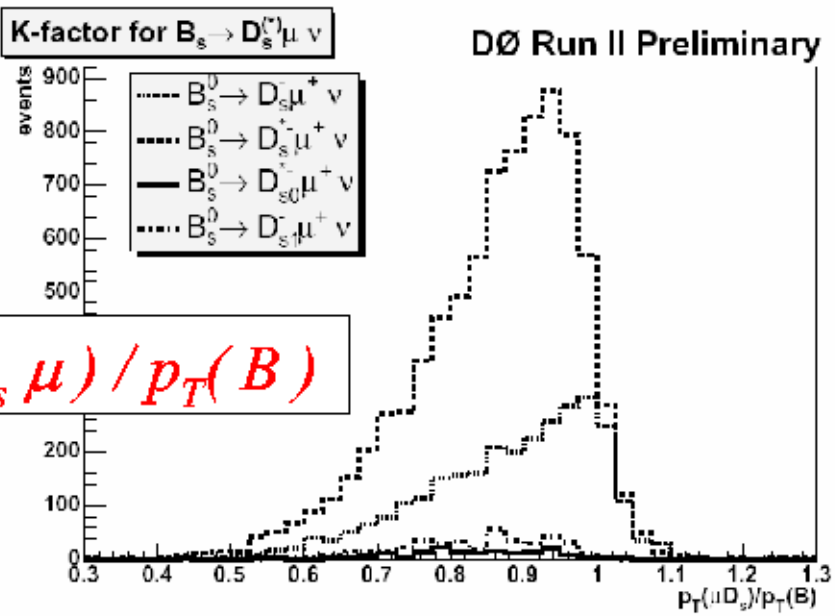
Proper time determination

Déclenchement et reconstruction des désintégrations semi-leptoniq

Distance from PV to SV in transverse plane



$$B_s \to D_s \mu^+ \nu$$



$p_T(D_s \mu) / p_T(B)$

For boost:

Correct for missing neutrino using MC

$$FOM = \sqrt{\frac{N\varepsilon D^2}{2}} e^{-0.5(\Delta m_s \sigma_t)^2} \sqrt{\frac{S}{S+B}}$$

Reco → Proper time → Flavor tagging → Δm_s

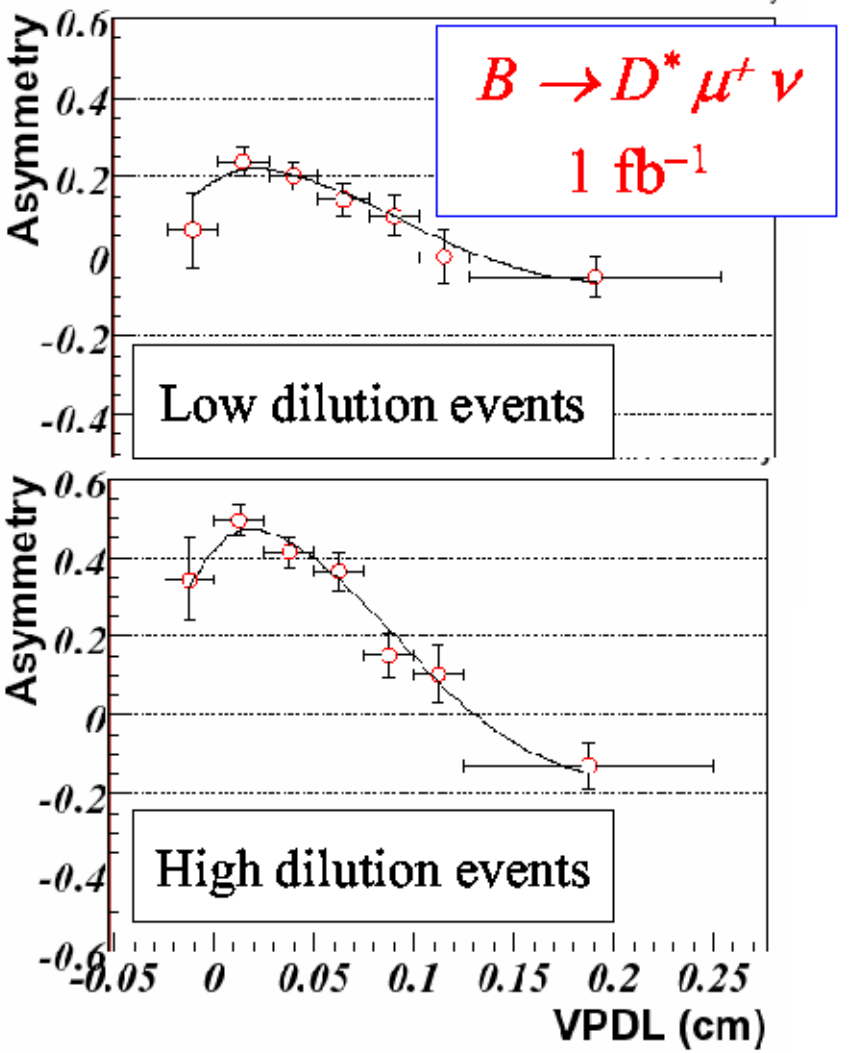
Flavor Tagging

DØ Preliminary

Inputs:

- Jet charge centered on lepton (e or μ)
- Secondary vertex charge
- Recoil charge

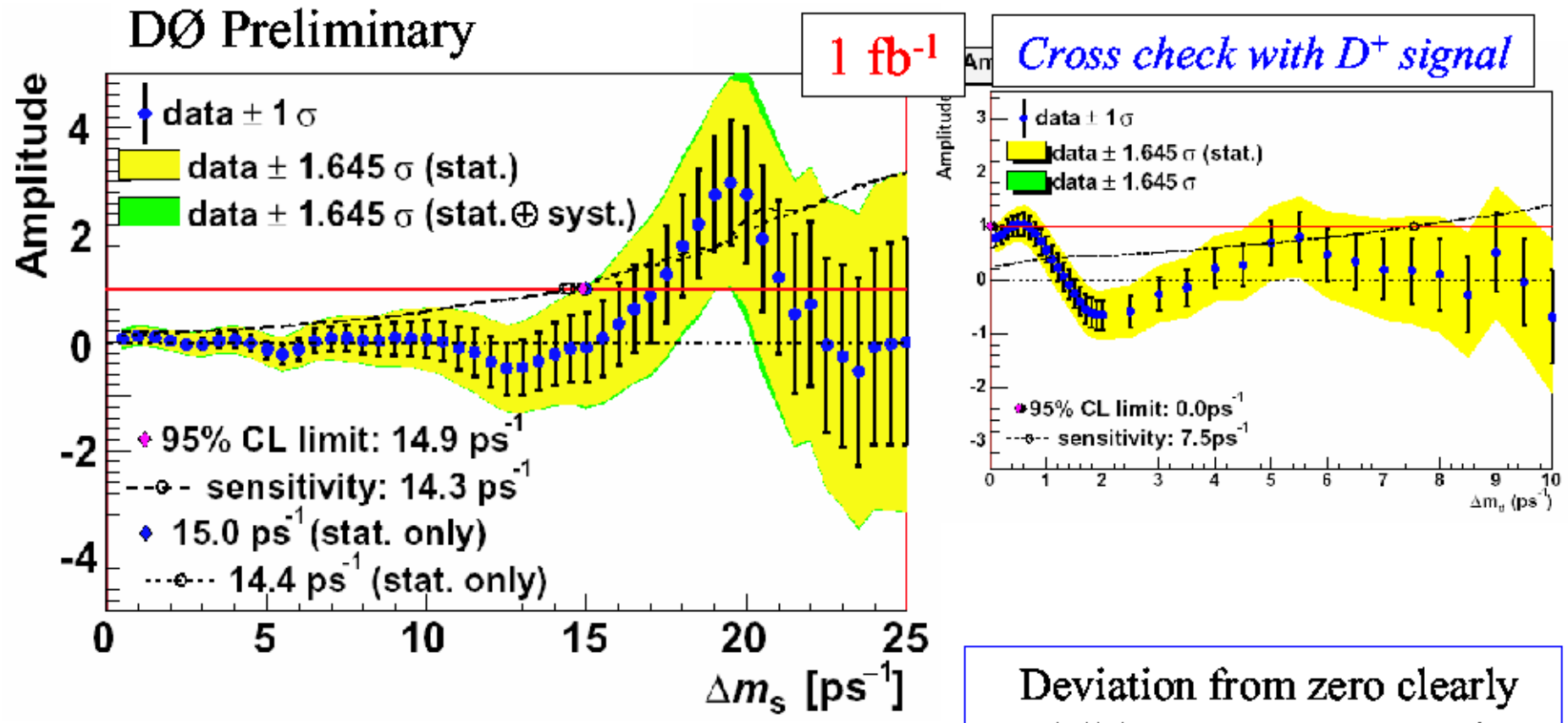
Tuned using B_d mixing



Combined opposite side tag:

$$\varepsilon D^2 = (2.48 \pm 0.21^{+0.08}_{-0.06})\%$$

Amplitude Method Results

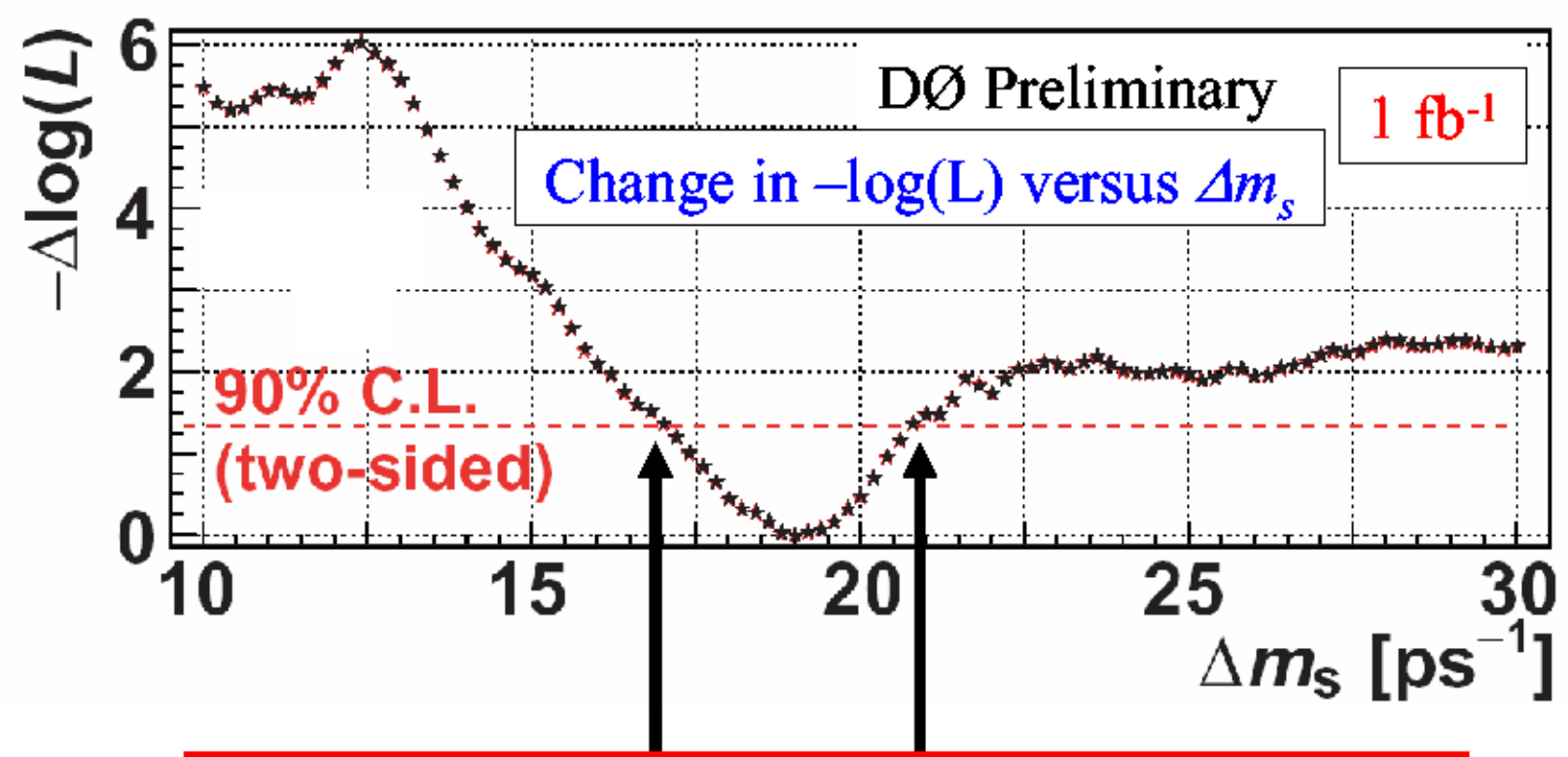


$\Delta m_s > 14.9\ \text{ps}^{-1}$ @ 95% CL

Deviation from zero clearly visible near $\Delta m_s \sim 19\ \text{ps}^{-1}$.

Difficult to quantify with amplitude method

Switch Back to Likelihood Fit



$17 < \Delta m_s < 21\ ps^{-1}$ @ 90% CL

Maximum likelihood at $\Delta m_s = 19\ ps^{-1}$

First time Δm_s bounded on both sides!!!!!

Mesure de CDF (après Moriond)

- CDF compense une moins bonne id des muons par :
- Trigger de vertex ->désintégrations hadronique
  - Meilleure mesure du temps de vie
- Particle id (Time-of-flight) ->same-side-kaon-tagging

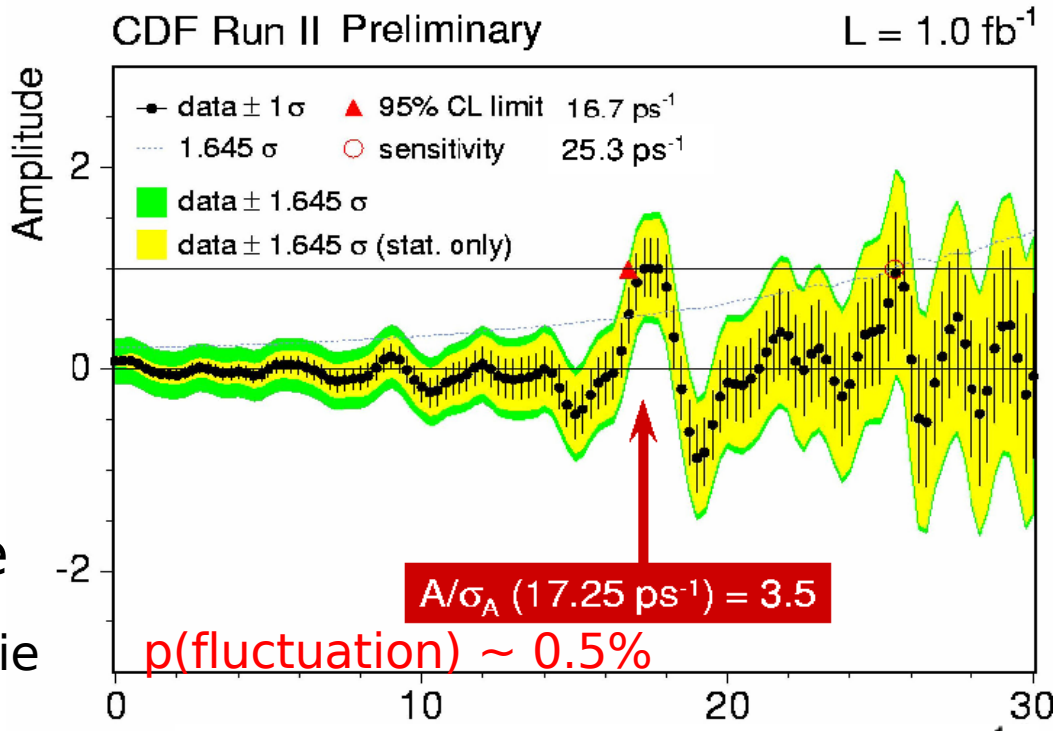
$$\epsilon D^2_{OST} = 1.5\%$$

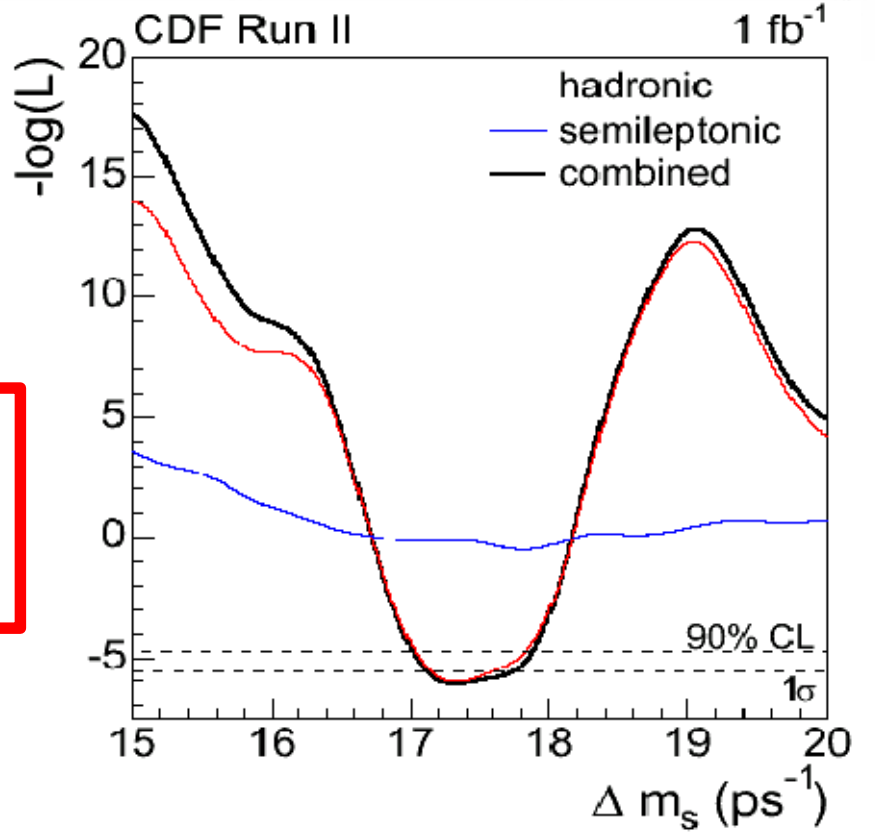
$$\epsilon D^2_{SST} = 4.0^{+0.9}_{-1.2}\%$$

$\Delta m_s = 17.33\ ^{+0.42}_{-0.21}\ (stat) \pm 0.07\ (syst)\ ps^{-1}$

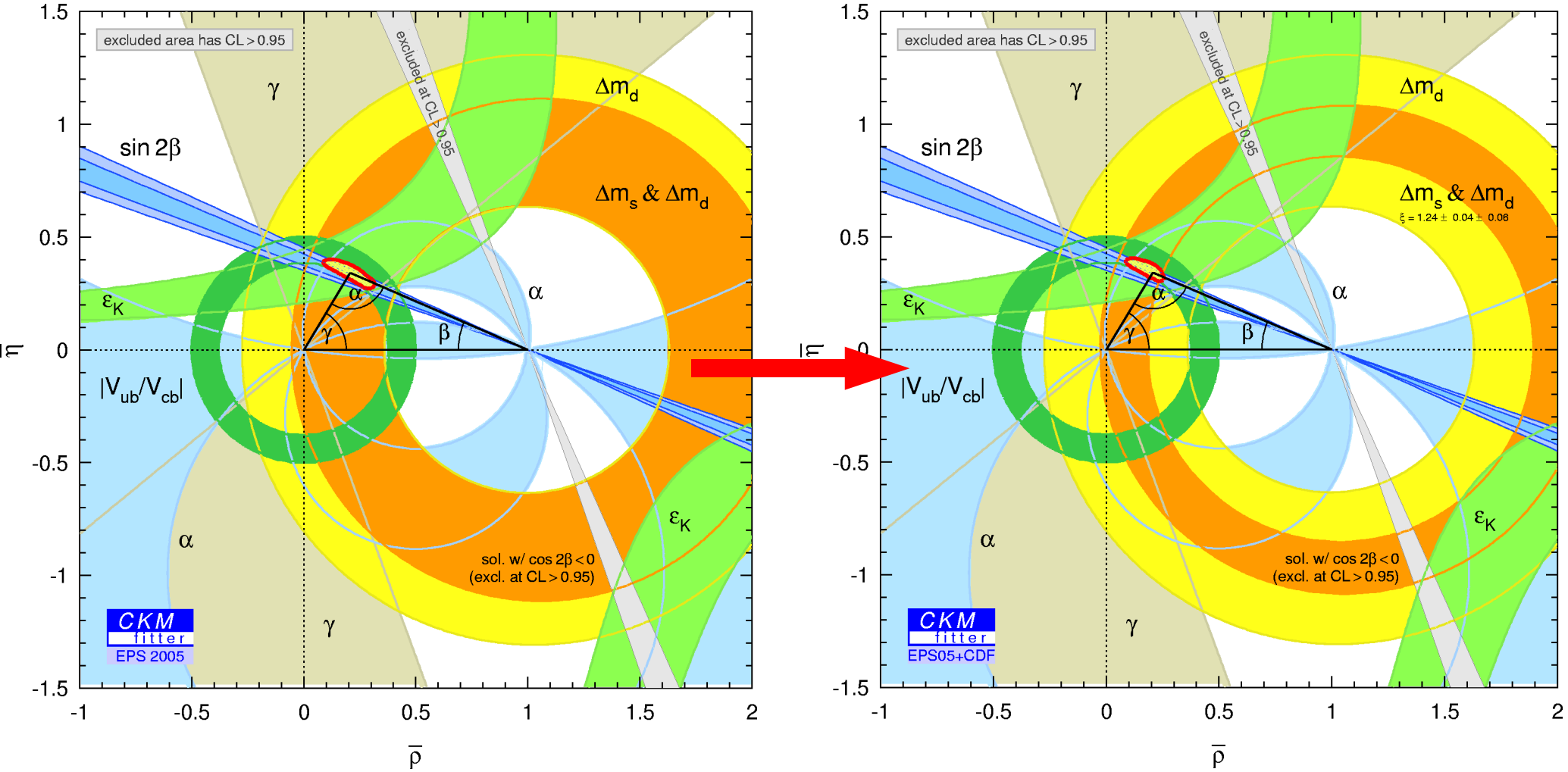
$|V_{td} / V_{ts}| = 0.208\ ^{+0.008}_{-0.007}\ (stat + syst)$

Domine par stat. Deja précis a qques % !

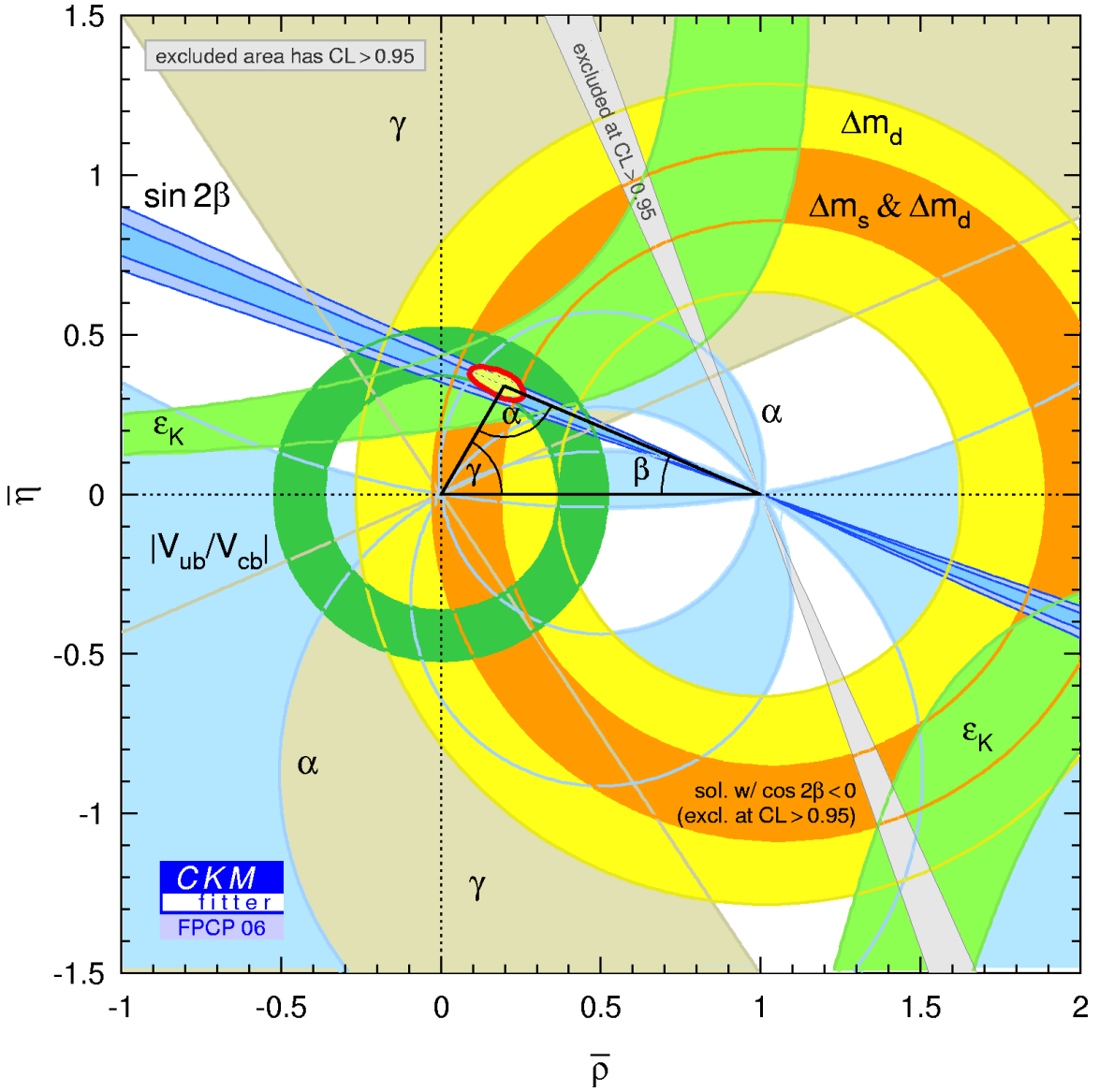




Nouvelle mesure de Delta(ms)



CKM fitter, avril 2006



T/CP/CPT Violation in B^0 Mixing in di-lepton ev

General complex amplitudes for neutral meson mixing:

$$|B_L\rangle = p\sqrt{1-z}|B^0\rangle + q\sqrt{1+z}|\overline{B}^0\rangle$$
$$|B_H\rangle = p\sqrt{1+z}|B^0\rangle - q\sqrt{1-z}|\overline{B}^0\rangle$$

$$\Delta m_q = m_H - m_L$$
$$\Delta\Gamma_q = \Gamma_H - \Gamma_L$$
$$\mathrm{Re}\, z \approx (m_{\overline{B}^0} - m_{B^0})/\Delta m$$
$$\mathrm{Im}\, z \approx (\Gamma_{\overline{B}^0} - \Gamma_{B^0})/\Delta m$$

CPT conservation → z = 0 **T conservation → |q/p| = 1**

CP conservation → z = 0 and |q/p| = 1

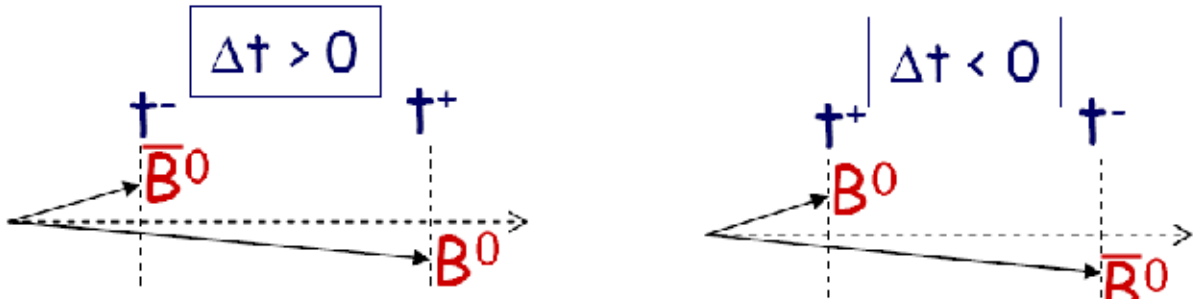
Standard Model CP violation in B^0 mixing expected to give $1 - |q/p|^2 \sim 10^{-3}$ or less

Measure mixing matrix via asymmetries in Δt distribution of B^0-B^0 syste

$$\Delta t = \Delta z/\langle\beta\gamma\rangle c$$

$$\Delta t = t^+ - t^-$$

$$\langle\beta\gamma\rangle = 0.55$$

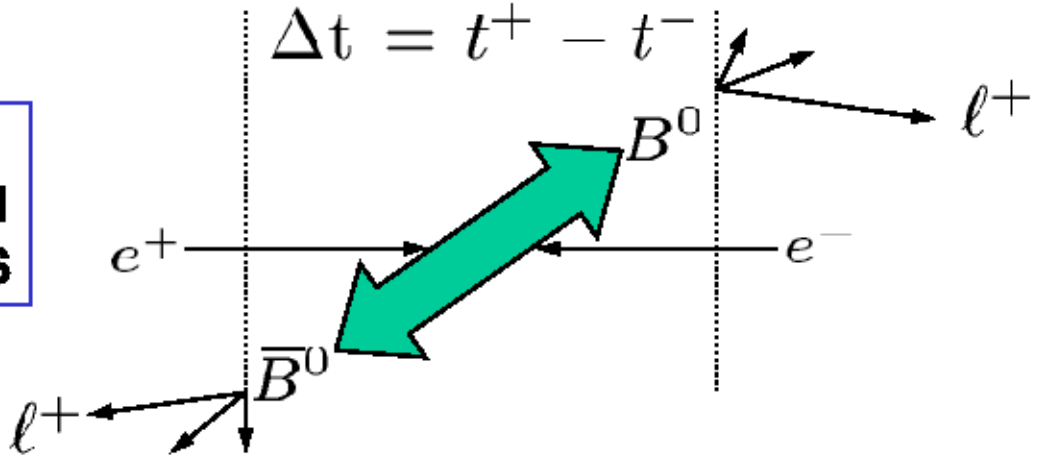


Δt sign determined by which B flavor decayed first

T/CP/CPT Violation in B^0 Mixing

Traditional mixing method at Y(4S): count charge combinations where both B's decay semileptonically, as a function of lifetime difference Δt

CASE I: SAME-SIGN DILEPTONS

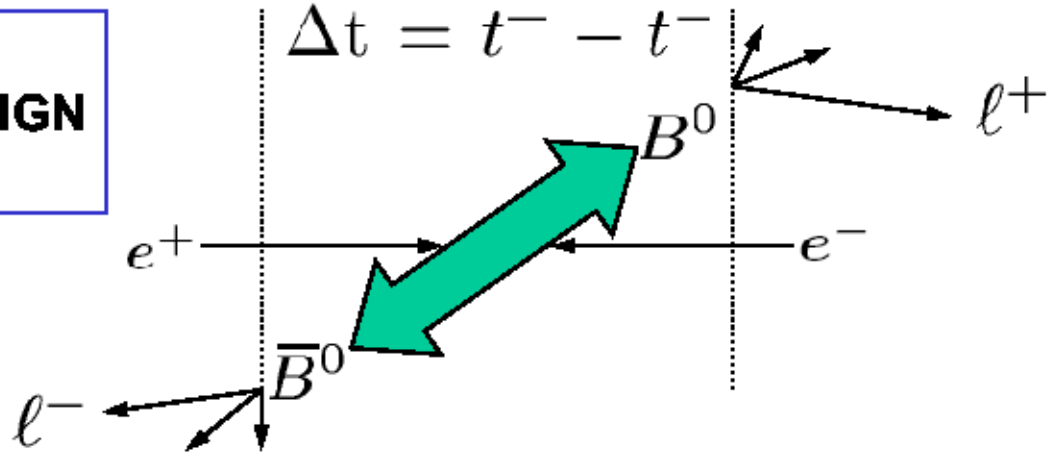


$$A_{T/CP}(\Delta t) = \frac{N(\ell^+\ell^+) - N(\ell^-\ell^-)}{N(\ell^+\ell^+) + N(\ell^-\ell^-)}$$
$$\approx \frac{1 - |q/p|^4}{1 + |q/p|^4}$$
$$\approx 2\left(1 - |q/p|\right)$$

Same-sign dilepton charge asymmetry sensitive to CP or T violation in |q/p|

T/CP/CPT Violation in B^0 Mixing

CASE II: OPPOSITE-SIGN DILEPTONS

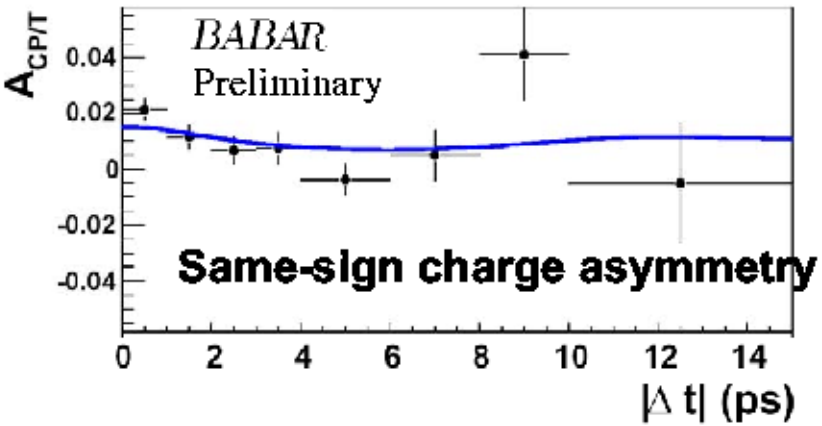


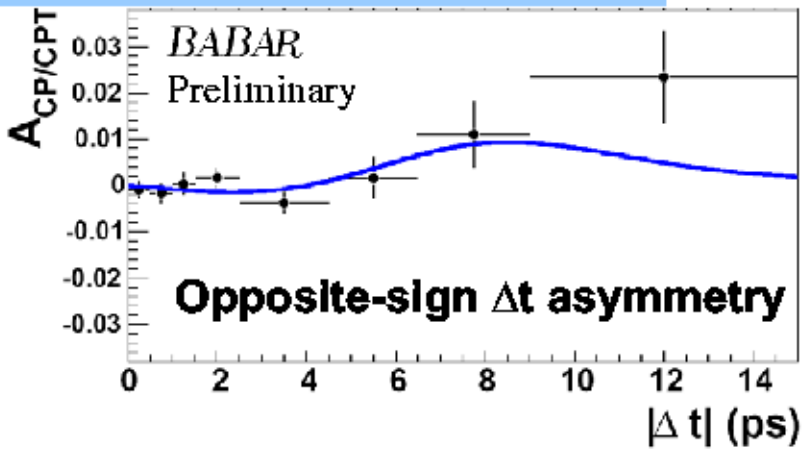
$$A_{CP/CPT}(|\Delta t|) = \frac{N^{+-}(\Delta t > 0) - N^{+-}(\Delta t < 0)}{N^{+-}(\Delta t > 0) + N^{+-}(\Delta t < 0)} \quad (4)$$

$$\simeq 2\frac{\mathrm{Im}\, z \sin(\Delta m \Delta t) - \mathrm{Re}\, z \sinh(\frac{\Delta\Gamma\Delta t}{2})}{\cosh(\frac{\Delta\Gamma\Delta t}{2}) + \cos(\Delta m \Delta t)}.$$

Opposite-sign dilepton Δt asymmetry:
Δt sign-asymmetry amplitude sensitive to CPT or CP violation in z
Im z or $\Delta\Gamma$ Re z (fix $\Delta\Gamma$ in cosh term)

T/CP/CPT Violation in B^0 Mixing





Consistent with CP/T/CPT conservation

$|\Delta\Gamma|$ fixed to 0.005 ps^{-1}

Re z, Im z 76% corr.

$$
\begin{aligned}
|q/p| - 1 &= (-0.8 \pm 2.7(\text{stat.}) \pm 1.9(\text{syst.})) \times 10^{-3}, \\
\Delta\Gamma \times \text{Re}\, z &= (-7.1 \pm 3.9(\text{stat.}) \pm 2.0(\text{syst.})) \times 10^{-3}, \\
\text{Im}\, z &= (-13.9 \pm 7.3(\text{stat.}) \pm 3.2(\text{syst.})) \times 10^{-3}.
\end{aligned}
$$

$\text{Re}(\varepsilon)/(1 + |\varepsilon|^2) = (1 - |q/p|^2)/4 =$ $(+0.4 \pm 1.4 \pm 0.9) \times 10^{-3}$ BaBar Preliminary 2006

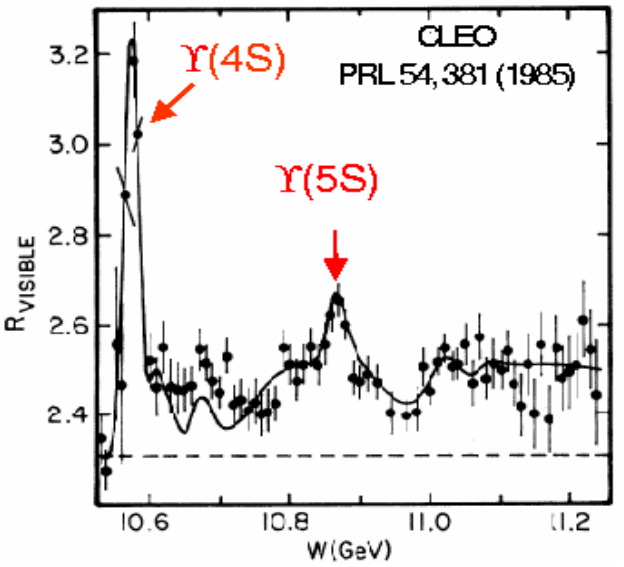
$(-1.1 \pm 1.0 \pm 0.7) \times 10^{-3}$ D0 Preliminary 2006

$(-0.3 \pm 2.0 \pm 1.8) \times 10^{-3}$ Belle 2005

Belle : run d'essai a Y(5S)

$e^+ e^- \to \Upsilon(4S) \to B^0\bar{B}^0,\ B^+ B^-$

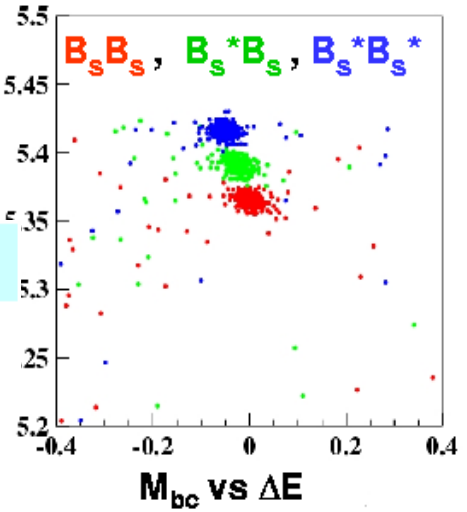
$e^+ e^- \to \Upsilon(5S) \to B\bar{B},\ B^*\bar{B},\ B^*\bar{B}^*,\ B\bar{B}\pi,\ B\bar{B}\pi\pi,\ B_s\bar{B}_s,\ B_s^*\bar{B}_s,\ B_s^*\bar{B}_s^*$

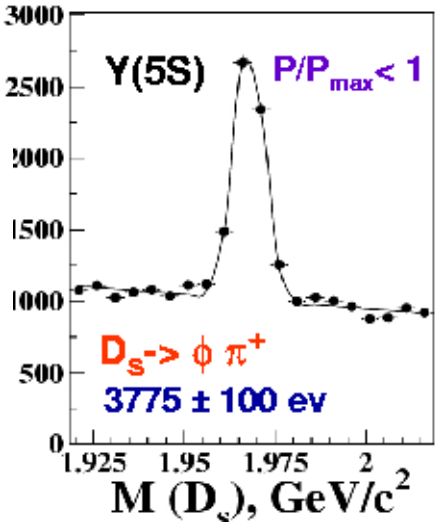


- Compétitif après seulement 3 jours de prises de données (1.86 fb-1) !
- ~92000 événements Bs
- Mesure inclusive : $f_s = (16.4 \pm 1.4 \pm 4.1)\%$
- Séparation Bs/Bs*
- Désintégrations rares :

90% *CL* UL with 1.86 fb^{-1} : $Bf(B_s \to \gamma\gamma) < 0.56 \times 10^{-4}$.

PDG limit : $Bf(B_s \to \gamma\gamma) < 1.48 \times 10^{-4}$





Conclusion

- Beaucoup de données.
- ... peu de surprises.
- Le Modèle Standard fait de la résistance
- La nouveauté de l'hiver :
  - Oscillations dans le système Bs (D0/CDF) :

$$\Delta m_s = 17.33\ ^{+0.42}_{-0.21}\ (\text{stat}) \pm 0.07\ (\text{syst})\ \text{ps}^{-1}$$ (CDF prelim.)

$$|V_{td} / V_{ts}| = 0.208\ ^{+0.008}_{-0.007}\ (\text{stat + syst})$$