Semileptonic B decays: $|V_{cb}|$ and $|V_{ub}|$

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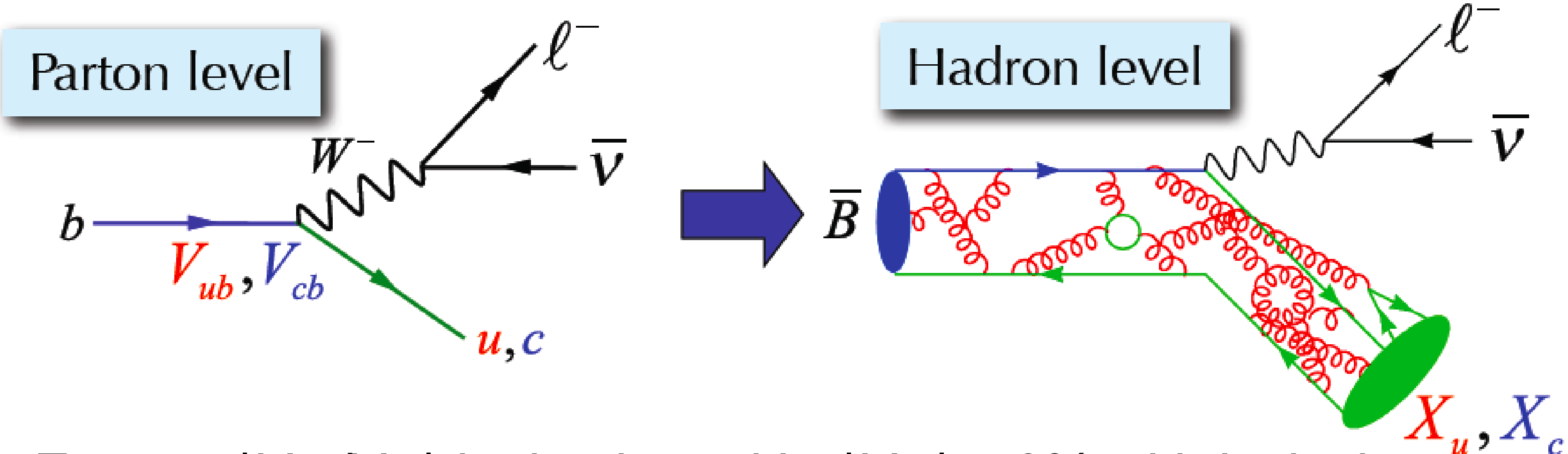
Semileptonic Decays

$$\Gamma(b \to x\ell\nu) \propto |V_{xb}| \cdot m_b^5$$



- *Error on $|V_{ub}/V_{cb}|$ is dominated by $|V_{ub}|$, ~9% with inclusive*
  - *~7% from the b-quark mass and b momentum inside the B meson*
  - *these parameters are extracted using inclusive $B \to X_c \ell \nu$ decays (and the $B \to X_s \gamma$)*
- *Impossible to study at LHC(b)*

Present Status (exp ⊕ theory)

- $|V_{ub}|$
  - *predicted with good precision in the CKM fit*
    - $|V_{ub}| \times 10^3 = 3.48 \pm 0.16$
  - *using esclusive $B \to \pi \ell \nu$ decays+Lattice QCD to normalize the Form Factor: good agreement with the CKM fit*
    - $|V_{ub}| \times 10^3 = 3.38 \pm 0.35$
  - *Inclusive $B \to X_u \ell \nu$ decays is larger (1.8-2.5 σ depending on the calculation) than CKM fit (and the exclusive)*
    - $|V_{ub}| \times 10^3 = 3.96 \pm 0.15\,^{+0.20}_{-0.23}$ *(average with GGOU)*
- $|V_{cb}|$
  - *Esclusive $B \to D(^*) \ell \nu$ decays + Lattice QCD:*
    - *D*:* $|V_{cb}| \times 10^3 = 37.4 \pm 0.8 \pm 1.0$, *D:* $|V_{cb}| \times 10^3 = 39.7 \pm 1.4 \pm 0.9$
  - *Moments of inclusive $B \to X_c \ell \nu$ + $B \to X_s \gamma$ decays:*
    - $|V_{cb}| \times 10^3 = 41.5 \pm 0.5 \pm 0.6$

Inclusive $B \to X_u \ell \nu$

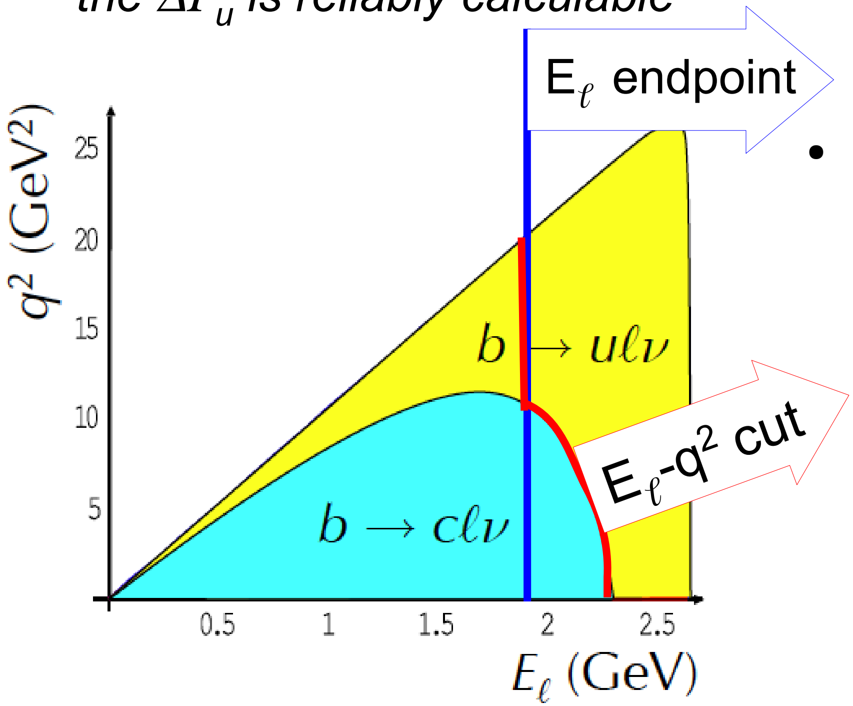
$$\frac{\Gamma(b \to u\ell\nu)}{\Gamma(b \to c\ell\nu)} \approx \frac{|V_{ub}|^2}{|V_{cb}|^2} \approx \frac{1}{50}$$

- *Experiment challenge is to separate $B \to Xc\ell\nu$ from signal*

- *$m_u \ll m_c$, different kinematics: signal have larger E_ℓ and q^2*
- *Measure partial $\Delta B(B \to X_u \ell\nu)$ in a region where the S/N is good and the $\Delta\Gamma_u$ is reliably calculable*

$$\Delta B(B \to X_u \ell\nu) = \tau_B |V_{ub}|^2 \zeta_c$$

Cut dependent constant, from Theory (many frameworks available)



- *OPE convergence is compromised: non perturbative effects at $O(1/m_b)$*
  - *Light cone distribution of b-quark (**Shape Function**) is needed*
  - *Detailed shape not known, in particular the tail, but mean and r.m.s constrained from moment measurement in $B \to X_c \ell\nu$ (and $B \to X_s \gamma$)*

Tagged sample: B_{reco}

- *Fully reconstruct one B in hadronic decays*

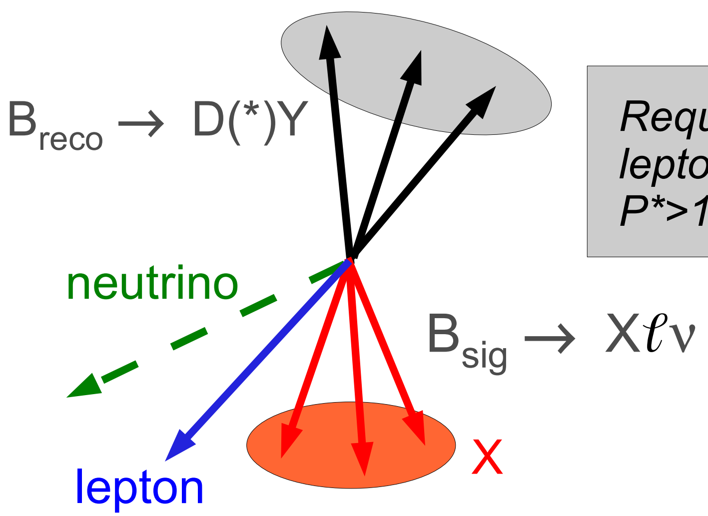
$B \to D^{(*)} n_1 \pi^{\pm} n_2 K^{\pm} n_3 K^0_S n_4 \pi^0,\ n_1 + n_2 \le 5,\ n_3 \le 2,\ n_4 \le 2$	*BaBar*
$B^+ \to \overline{D}^{(*)0}(\pi^+, \rho^+, a_1^+),\ B^0 \to D^{(*)-}(\pi^+, \rho^+, a_1^+)$	*Belle*

- *Kinematic consistency of B_{reco} checked with* $\Delta E = E^*_B - \sqrt{(s)}/2$

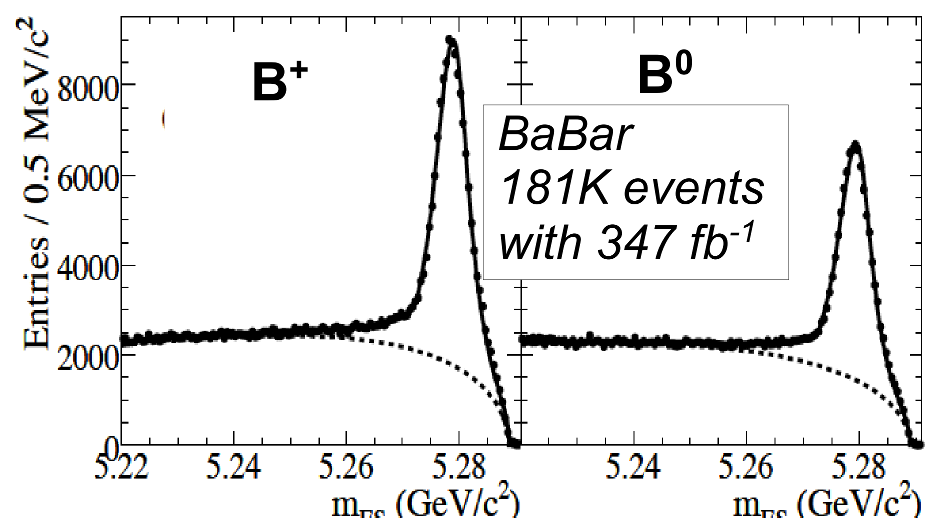
$$m_{ES} = \sqrt{s/4 - |p^*_B|^2}$$

- Small efficiency *- 0.3% B^0B^0* *- 0.5% B^+B^-*	*Access to signal B information:* *- Charge* *- Flavor* *- 4-momentum*

Useful for both inclusive and exclusive decays

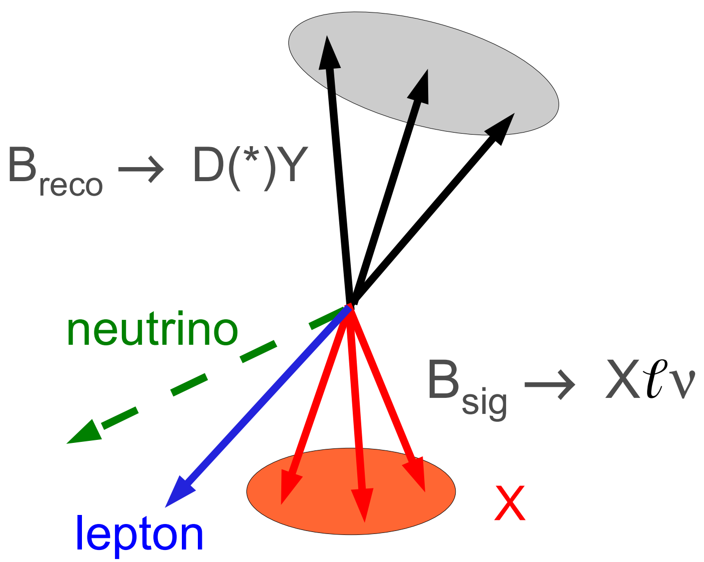


Requiring a lepton with P>1GeV/c*



Inclusive $|V_{ub}|$: strategy

- B_{reco} *sample allows the best access to kinematics*

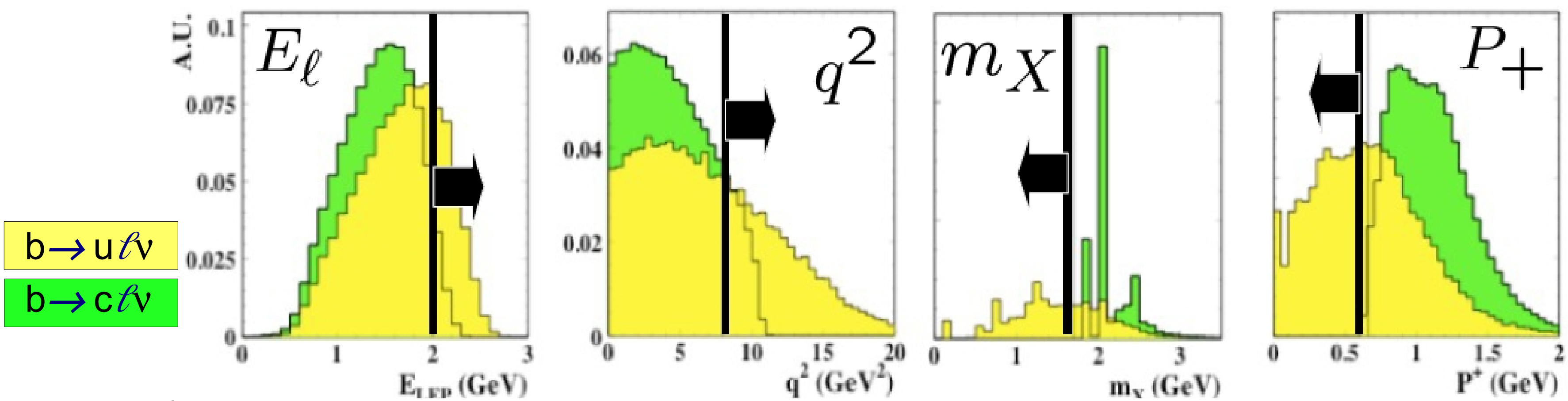


- $p_{miss} = p_{\Upsilon(4S)}$ $p_{reco} - p_X - p$ $_{lepton}$

- X: all remaining particles

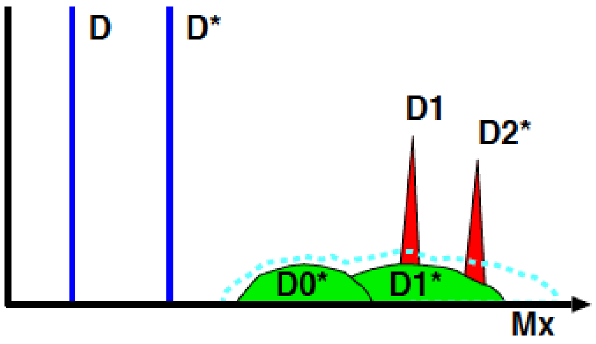
- *m_X and P_+ require a sample of B_{reco}*
- *Experimental Resolution leads to irreducible $b \rightarrow c\ell\nu$ contamination:*
  - *Require good charged and neutral acceptance (hermeticity)*

$P_+ = m_X - |p_X|$



$B \to X_c \ell \nu$ background

- ***$B \to X_c \ell \nu$ model:*** *sum of $B \to D \ell \nu$, $B \to D^* \ell \nu$, $B \to D^{**} \ell \nu$ and $B \to D(^*) \pi \ell \nu$*
  - *$B \to D \ell \nu$ $B \to D^* \ell \nu$: HQET based form factor (Caprini et al.)*
    - *PDG/HFAG branching fractions*
  - *$B \to D^{**} \ell \nu$: Well established narrow states*
    - *Parameters for wider are less known*
    - *Decay FF from Leibovich et al. (LLSW)*
  - *$B \to D(^*) \pi \ell \nu$: Goity-Robertson*



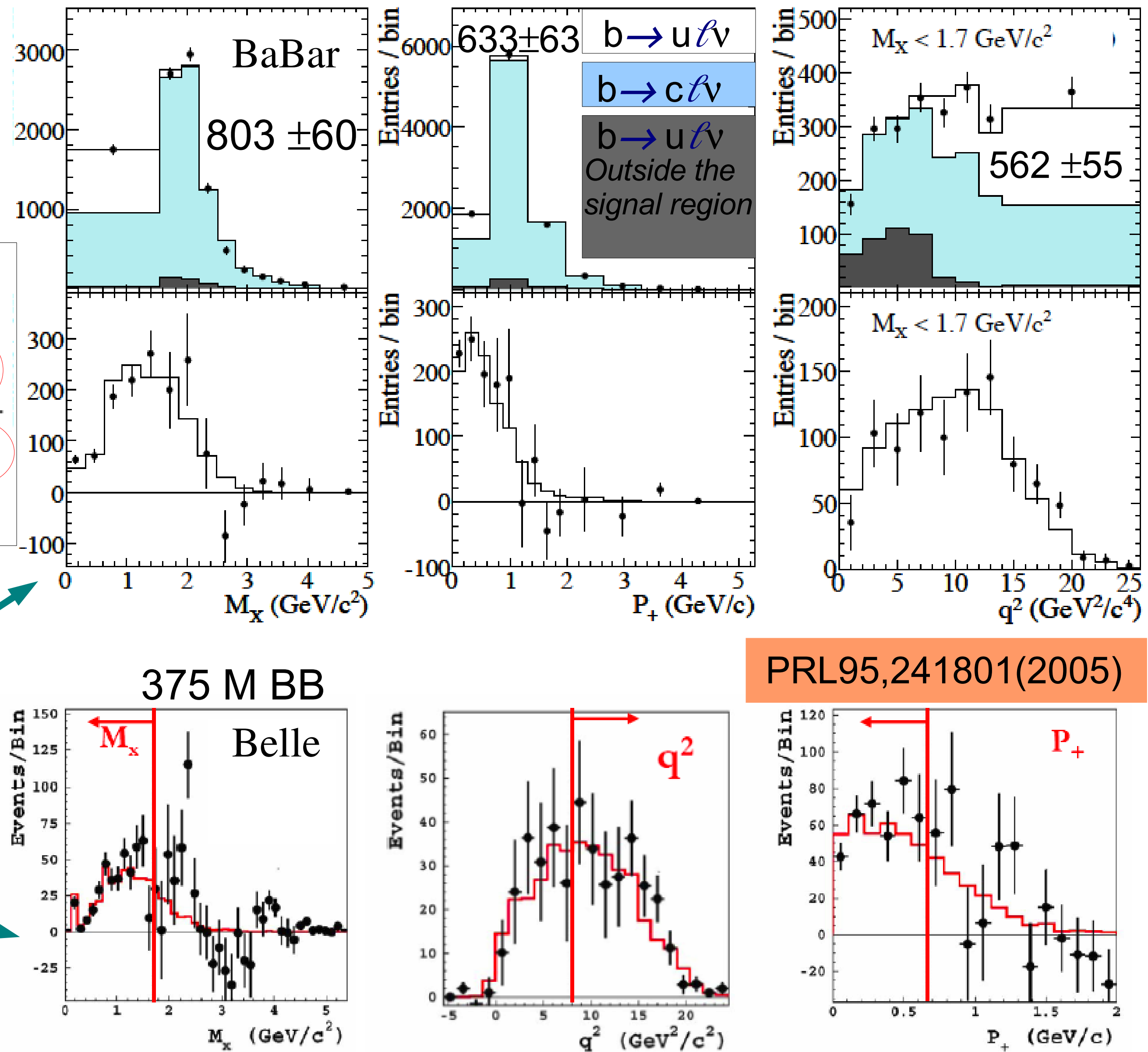
- ***$B \to X_c \ell \nu$ suppression:***
  - *No additional leptons, to suppress $B \to D X \ell \nu$ with $D \to Y \ell$*
  - *Require $M_{miss}^2 < 0.5$ GeV^2: reduce events with extra ν*
  - *No strangeness to suppress the $b \to c \to s$ chain: veto evnts with $K^{+/-}$ and K_s*
    - *K_L cut (used only by Belle)*
  - *$B^0 \to D^{*+} \ell \nu$, reconstruct the soft π^+ (remove about 36% of the bkg, 90% eff.)*
  - *$B^{0/+} \to D^{*+/*0} \ell \nu$, exploit the presence of soft π^0, less efficient but effects on both B^0 and B^+ (require studies)*

Inclusive $|V_{ub}|$: results

ArXiv: 0708.3702[hep-ex] accepted by PRL

Measure the partial branching ratio relative to the number of total semileptonic events

383 M BB



Unfolding factor

$$\frac{\Delta B(X_u\ell\nu)}{B(X\ell\nu)} = \frac{N_{b\to u}}{N_{X\ell\nu}} \cdot \frac{F}{\epsilon_{sel}}$$

Signal efficiency

Background subtracted distributions: not efficiency corrected

PRL95,241801(2005)

Systematics

Belle
(2005)

TABLE II. Partial rates to the three kinematic signal regions with relative errors (in %).

$\Delta\Phi$	$\Delta\Gamma_{u\ell\nu}(\Delta\Phi)$	Stat	Syst	$b \to u$	$b \to c$
M_X/q^2	5.24×10^{-4} ps^{-1}	10.0	8.9	6.2	5.3
M_X	7.71×10^{-4} ps^{-1}	9.1	7.1	6.1	2.2
P_+	6.89×10^{-4} ps^{-1}	9.4	9.3	6.4	8.7

BaBar
(2008)

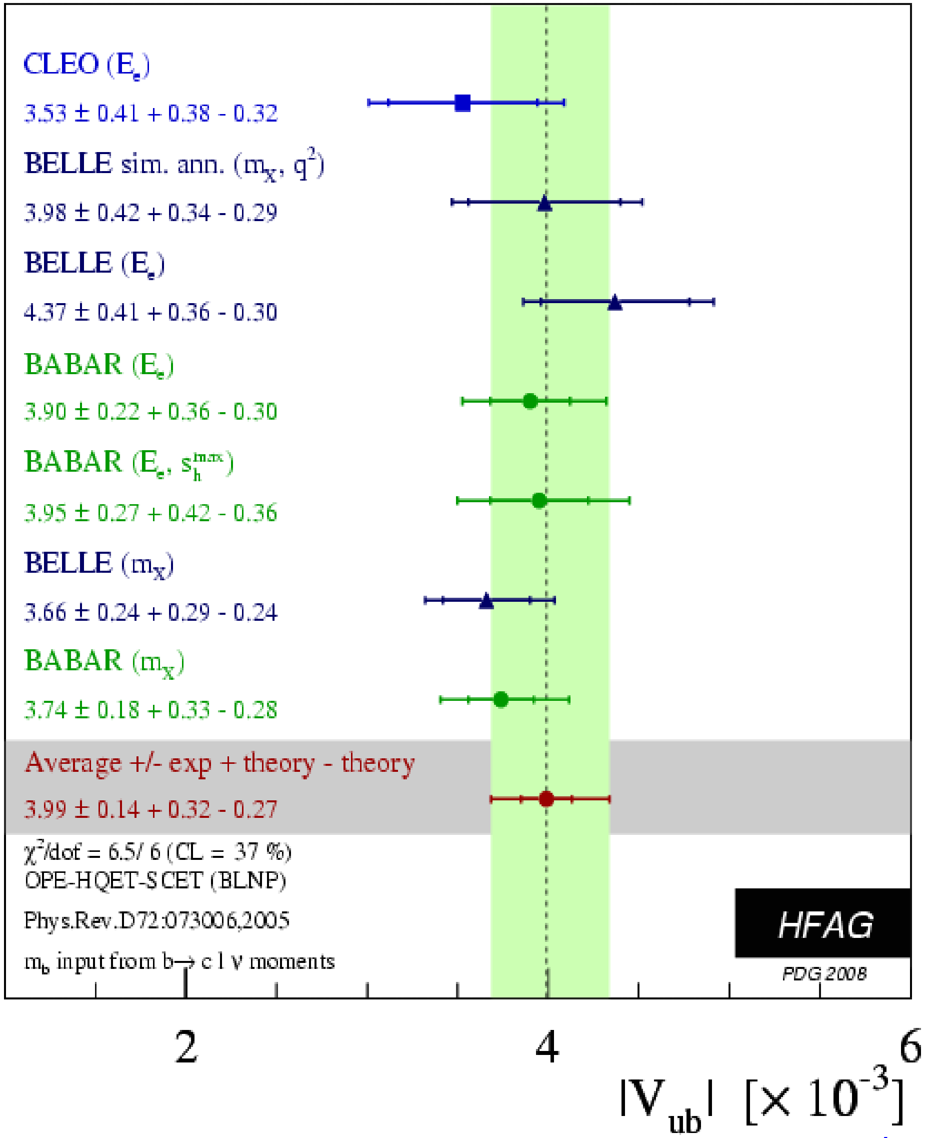
Experimental systematics on $\Delta\mathcal{B}(B \to X_u \ell \nu)$ expressed in %

Method	Detector effects	Shape function	$\mathcal{B}(\bar{B} \to X_u \ell \bar{\nu})$ $X_u = \pi, \rho, \ldots$	Gluon splitting	$\mathcal{B}(\bar{B} \to X_c \ell \bar{\nu})$	$B \to D^* \ell^- \bar{\nu}$ form factors	$\mathcal{B}(D)$	m_{ES} fit	Monte Carlo statistics	Total
M_X	1.92	0.90	2.08	1.62	0.87	0.21	0.44	3.71	3.22	6.07
P_+	3.88	1.31	2.22	1.47	2.80	0.39	0.73	3.98	4.62	8.38
M_X, q^2	3.83	2.43	2.71	1.02	1.17	0.55	0.79	5.17	4.29	8.81

- *Detector effects not dominant (thanks to the tagging)*
- *The selection require complex fits, for example the m_{ES} fits*
  - *the statistics will improve the fit convergence (but more details to account for!)*
- *Dominant systematics are in the modelling of signal (resonant and non-resonant) and background contributions*

$|V_{ub}|$ results (HFAG average, BLNP)

- *Many different theoretical approach ⇒many $|V_{ub}|$ values*



- *Here only BLNP, with m_b from $B \to Xc\ell\nu$ Global Fit (Kinetic Scheme), including also uncertainty on the KS⇔SF Scheme translation*

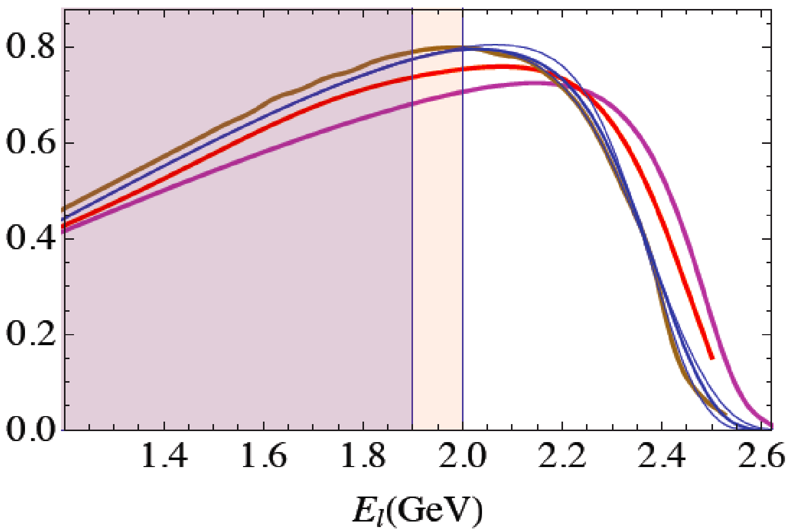
$$|V_{ub}|=(3.99 \pm 0.14 \pm 0.30)10^{-3}$$

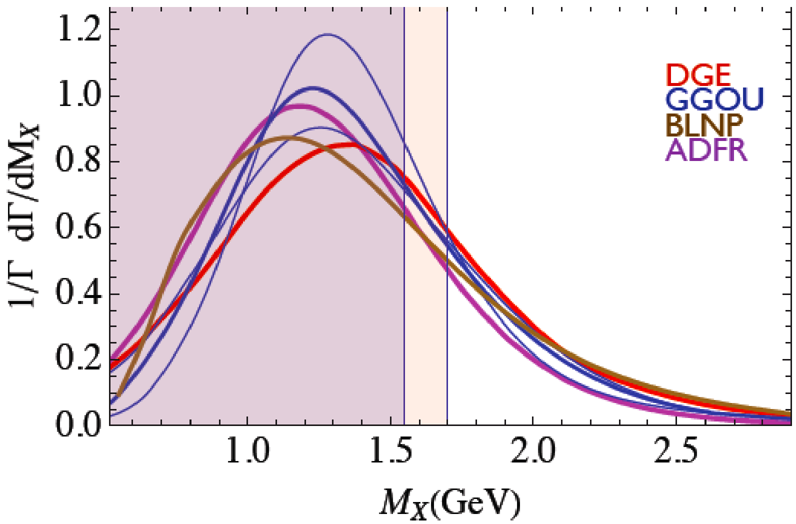
$\delta|V_{ub}|$	+8.8% -7.7%
Statistical	2.0%
Exp.systematics	2.3%
$b \to c\ell\nu$ model	1.3%
$b \to u\ell\nu$ model	1.4%
HQ parameters	7.0%
SF + Sub. SF	0.6%
matching	3.6%
Weak Annihilation	1.3%

For B_{reco} analysis use only m_X cut:
- large unpublished correlations with P+ and q2

Future: spectra

- *The only way to test frameworks is to extract spectra*

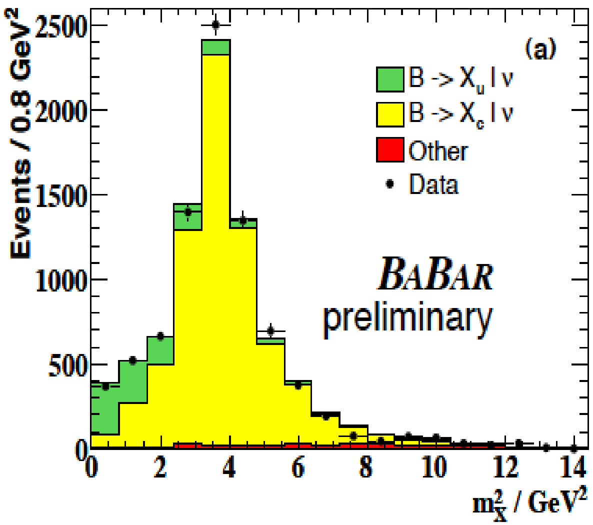


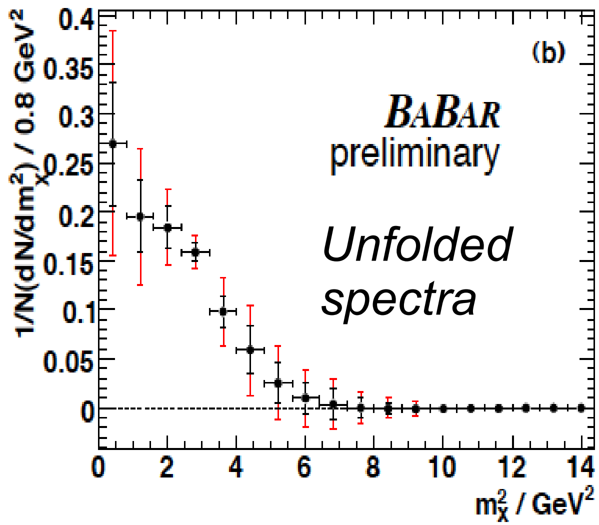


- *WA, SF and HQE parameters dependence, and SSF uncertainty are reduced increasing the measured phase space*
  - *Power dependence on mb scale inversely with the phase space coverage*
  - *The OPE expantion can be restored*

Hadronic Moments in $B \to X_u \ell \nu$ decays

- *Measure hadronic mass spectrum over full m_X range (same strategy/datasample used to extract $|V_{ub}|$)*
- *Mass moments related to m_b: extract moments with upper cut $m_x^2 < 6.4$ GeV^2*





ArXiv: 0801.2985[hep-ex]

Calculation: Gambino, Ossola, Uraltsev JHEP09(2005)010

First measurement of m_b in $B \to X_u \ell \nu$ decays (in the Kinetic scheme)

$$m_b = 4.604 \pm 0.250 \text{ GeV}$$

compatible with Global Fit

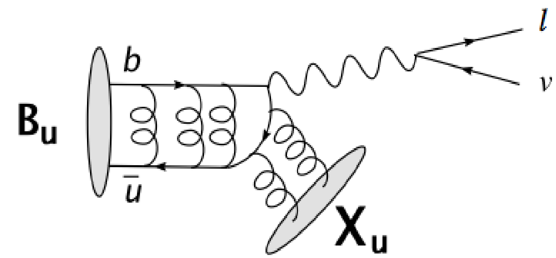
Weak annihilation in $B \to X_u \ell \nu$

ArXiv: 0708.1753
383 M BB

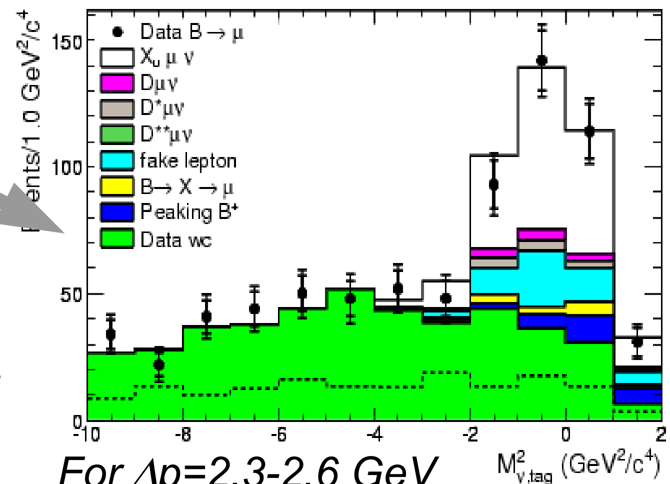
- *Small contribution to $B \to X_u \ell \nu$ decays:*

$$\frac{|\Gamma_{WA}|}{\Gamma_u} < 7.4\% \text{ at } 90\% C.L.$$

CLEO, studing the q^2 spectra PRL96,121801 (2006)



- *Introduce difference between B^0 and B^+ decays*
- *Tag with partial reconstructed $B^0 \to D^{*+} \ell \nu$*
- *Neutrino mass from kinematics: $m_\nu^2 = (P_B - P_{D^*} - P_\ell)^2$*
  - *Compare B^0 partial rate to charge averaged $B \to X_u \ell \nu$ rate in the large p_ℓ region (to enhance the WA contribution) PRD73,012006(2006)* $A^{+/0} = \dfrac{\Delta\Gamma^+ - \Delta\Gamma^0}{\Delta\Gamma^+ + \Delta\Gamma^0}$



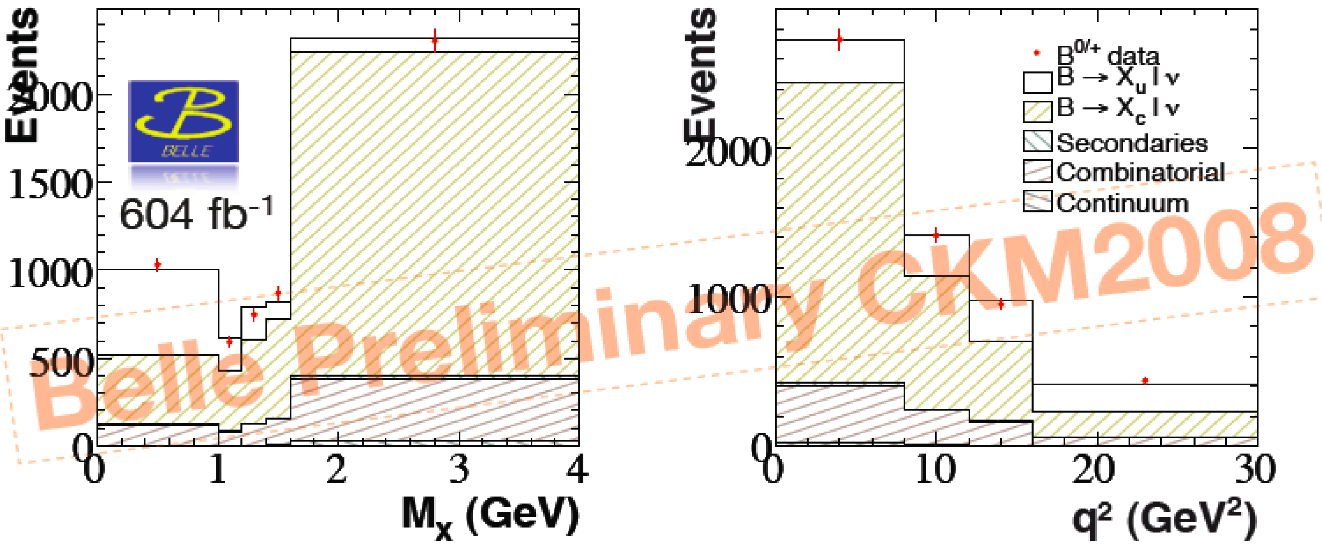
For Δp=2.3-2.6 GeV
~300 X_u events (e+μ)/340fb^{-1}

$$\frac{|\Gamma_{WA}|}{\Gamma_u} < \frac{3.8\%}{f_{WA}(2.3-2.6)} \text{ at } 90\% C.L.$$

- *With the B_{reco} sample at a Super B factory will be easy to determine the charge asymmetry and even study the q^2 spectrum*
  - *Limit on WA at <1% level are easy to reach*

Full phase space analysis

- *Preliminary Belle analysis*
  - *B_{reco} sample: only Pl>1 GeV/c, 90% of the available phase space*
  - *Multivariate analysis to exploit the many non-linear correlations between kinematics and events variables available with the B_{reco} sample that separate $b \rightarrow u$ and $b \rightarrow c$*
  - *MM^2, dZ, dr, Q_{total}, N_{lepton}, D* partial reco etc*

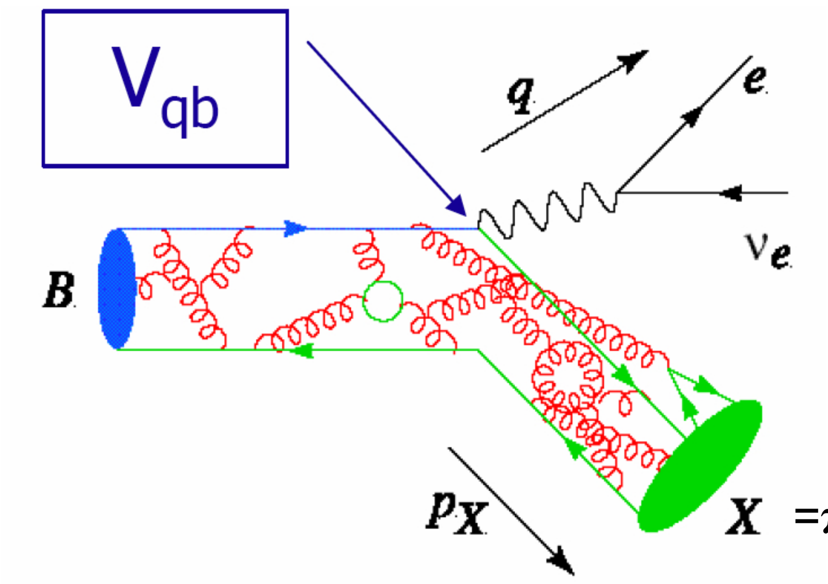


2D fit in q2 mx. (projections shown)

More such measurements needed

- ***$|V_{ub}| x10^3$ = 4.42 ± 0.14 ± 0.22 (3.2% + 5.0% = 6%)***
  - *No SF or WA dependence, this value far from CKM fit results*

Exclusive $|V_{ub}|$



=π, η, η', ρ, ω

$$\frac{d\Gamma(B \to \pi \ell \nu)}{dq^2} = \frac{G_F^2}{24\pi^3} |V_{ub}|^2 \; p_\pi^3 \; |f_+(q^2)|^2$$

Untagged $B \to \pi \ell \nu$

- *Reconstruct neutrino from full event*

$$(p_{miss}, E_{miss}) = (p_{beams}, E_{beams}) - (\sum_i p_i, \sum_i E_i)$$

- *Extract signal yield in 12 q2 bins from fit to ΔE vs m_{ES}*

$$\Delta E = E_B^* - \sqrt{(s)}/2 \qquad m_{ES} = \sqrt{s/4 - |p_B^*|^2} \qquad q^2 = (p_B - p_\pi)^2 = (p_\ell + p_\nu)^2$$

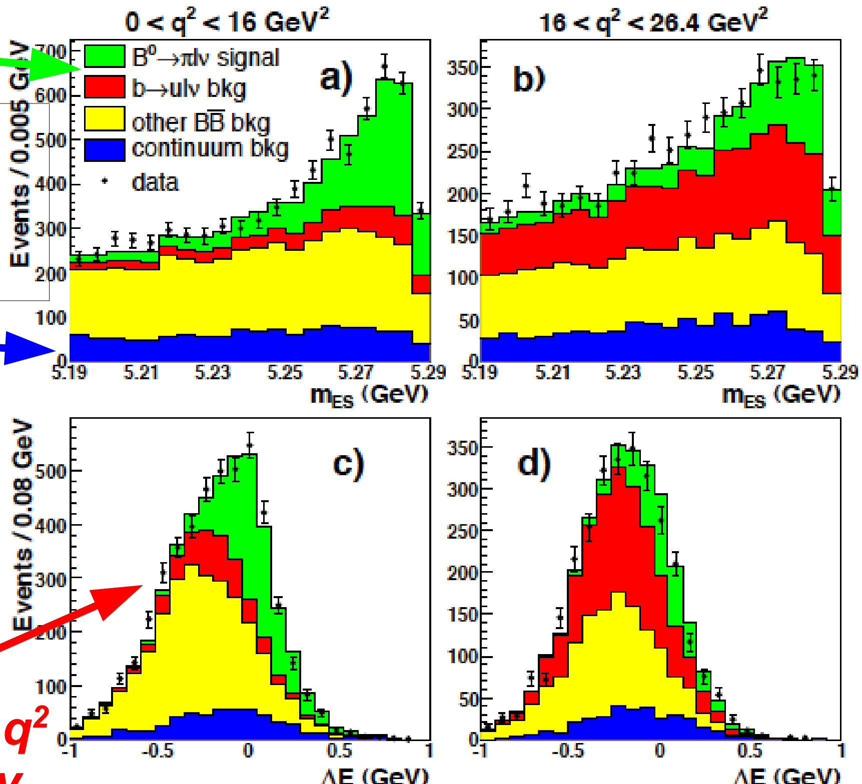
Signal

Total: N_{sig}=5000 ev.
~400-500 per q^2 bin
with 206 fb^{-1}

Continuum
- checked with off resonance data

$B \to X_c \ell \nu$
- largest backg.

$B \to X_u \ell \nu$
- relevant at high q^2
- large uncertainty



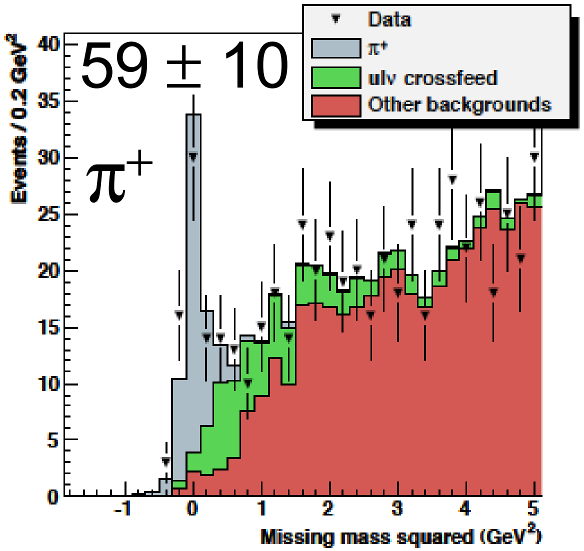
Br=(1.46±0.07±0.08)x10⁻⁴

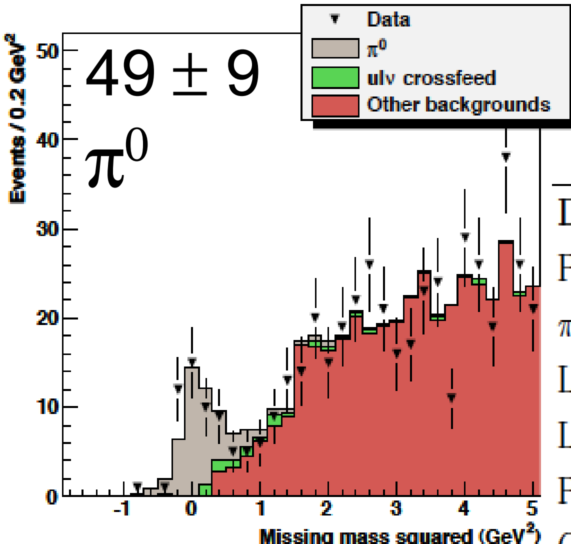
q^2 bins (GeV^2)	4–6	16–18	q^2<16	q^2>16
BF (10^{-4})	0.16	0.13	1.09	0.38
Fit error	12.8	17.6	5.3	10.3
Detector effects	3.7	5.0	4.4	4.5
Continuum bkg	1.2	1.7	2.8	3.5
$B \to X_u \ell \nu$ bkg	3.0	3.1	2.3	4.7
$B \to X_c \ell \nu$ bkg	1.7	1.8	1.2	1.2
Other effects	3.4	3.0	2.3	2.3
Total error	14.2	19.0	8.2	12.9

Hadronic Tag $B \to \pi \ell \nu$

- *Tag one B in hadronic decay*
- *Know kinematics and flavor of signal B*
- *Extract signal yields from $M_{miss}^2 \sim M_\nu^2$ in bins of q^2*

605 fb^{-1}



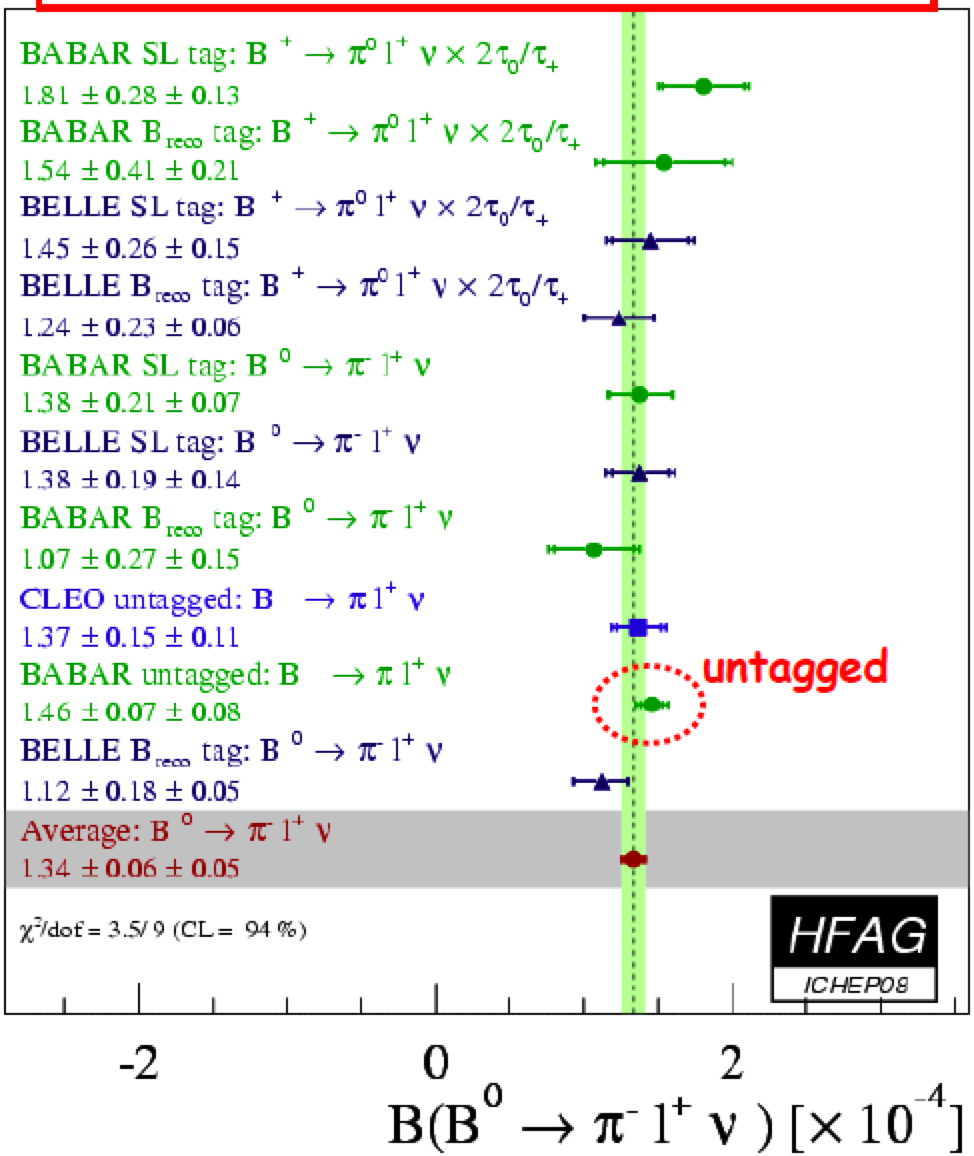


	$B \to \pi^+ \ell \nu$	$B \to \pi^0 \ell \nu$
Detector Simulation:		
Pion track finding eff.	1.0%	-
π^0 reconstruction eff.	-	2.0%
Lepton track finding eff.	1%	1%
Lepton identification	2.1%	2.1%
Pion identification	2.0%	2.0%
Combined	3.2%	3.7%
N($B\overline{B}$) uncertainty	1.36%	1.36%
Form Factor Shapes:		
π (LCSR $\to$ ISGW2)	1.5%	0.0%
ρ, ω (LCSR $\to$ ISGW2)	1.8%	0.5%
Branching Fractions:		
$b \to u \ell \nu / b \to c \ell \nu$ norm.	0.3%	0.2%
Total systematic error	4.2%	3.9%

Clean sample
Possible to apply loose cuts (es: low momentum cut):
- reduce model dependence

$Br(\pi^0) \times 2 = (1.24 \pm 0.23 \pm 0.06) \times 10^{-4}$
$Br(\pi^+) = (1.12 \pm 0.18 \pm 0.05) \times 10^{-4}$

$\mathcal{B}(B^0 \to \pi^- \ell^+ \nu_\ell) = (1.34 \pm 0.06 \pm 0.05) \times 10^{-4}$

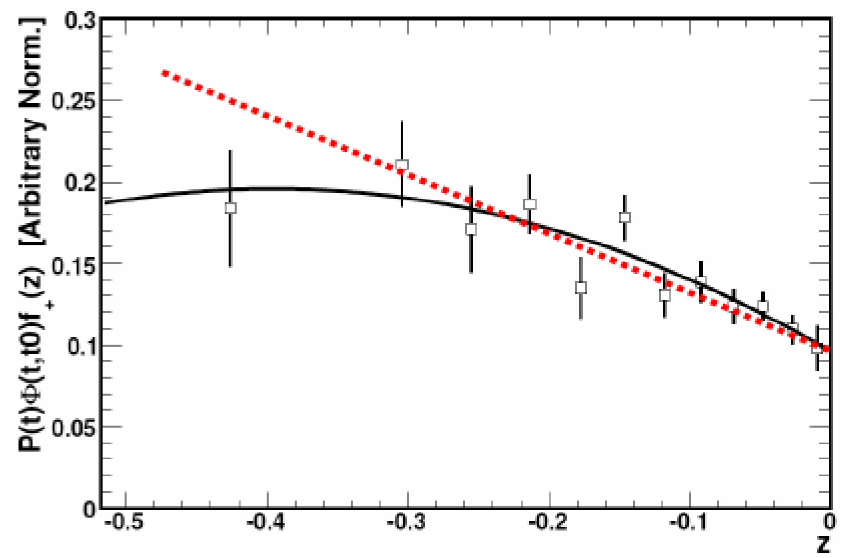


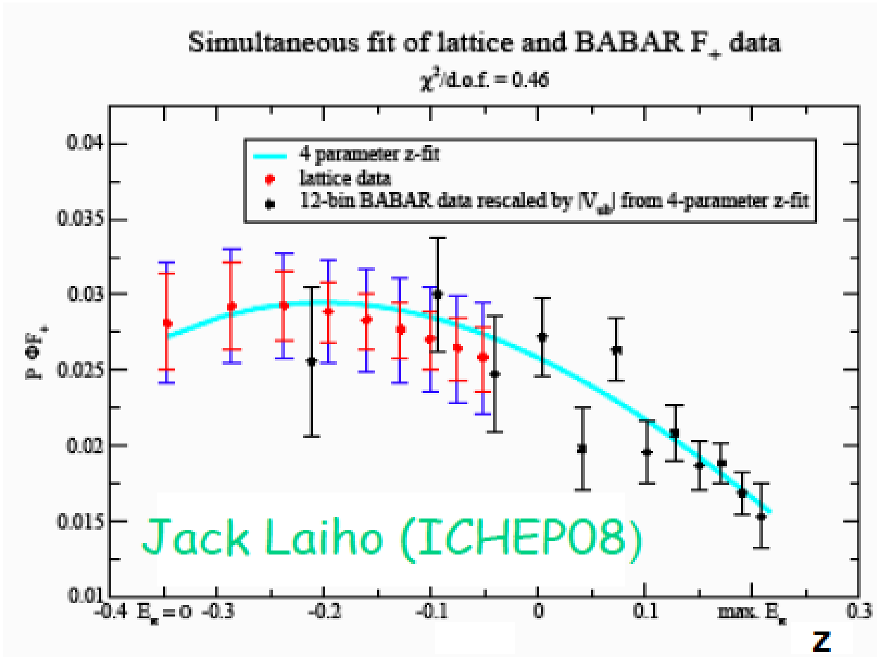
Stat:5% Syst: 4%

- *Measurements done with and without recoil B tagging*
- *With present statistics (Babar+Belle), untagged measurements dominate the average*
- *And gives useful q^2 shape information (next slide)*
  - *Tagged measurements improve the BF accuracy*
- *Super B flavor:*
  - *Tagged measurements much cleaner, many systematics can be reduced*

$|V_{ub}|$ extraction

Babar data (untagged)





Linear shape or quadratic?
Esperimentally high q^2 (low z) data are difficult
- Large background from $B \to X_u \ell \nu$, smaller rate

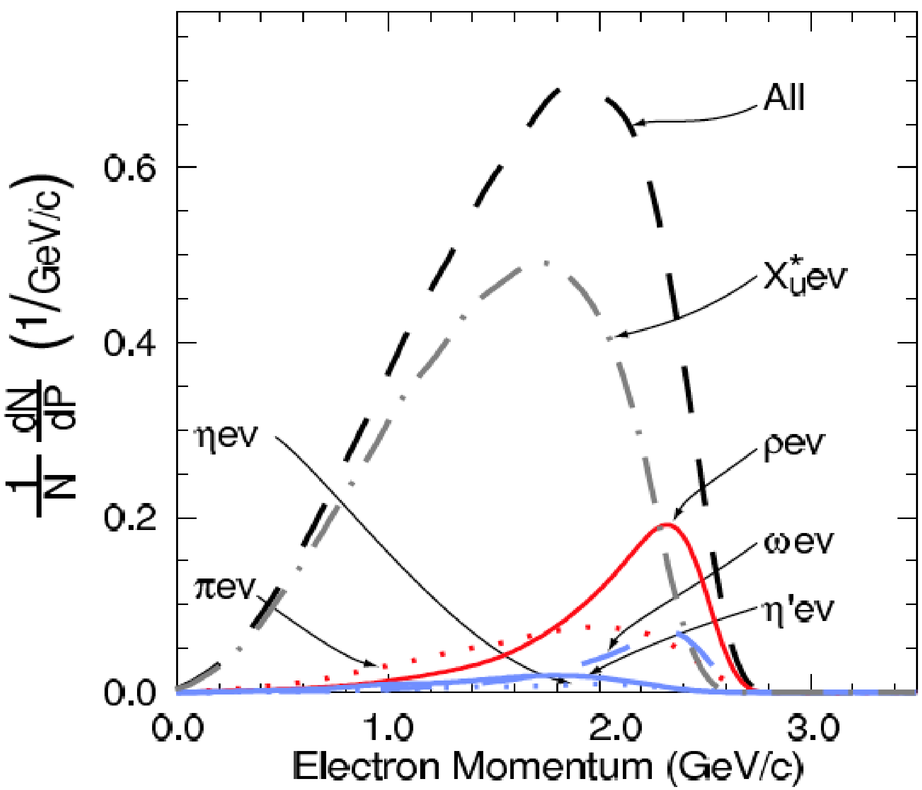
LQCD prefer a curvature

- *New FNAL lattice result, fit to lattice points and Babar $\Delta BF(q^2)$ in z expansion*
- ***$|V_{ub}| x10^3$ = 3.38 ± 0.35*** *(Total error 11%, comparable contributions from Lattice stat, syst and experiment)*

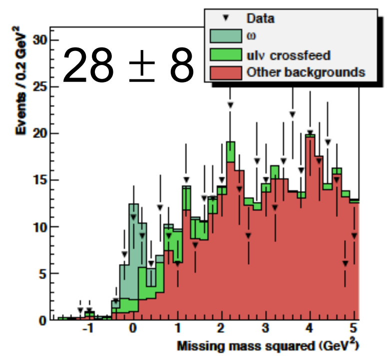
Need more precise experimental data

X_u sample composition

- *The study of the higher mass state*
  - *Help to constrain theoretical calculations*
  - *Cross-check $|V_{ub}|$*
  - *Understand the composition of the $B \to X_u \ell \nu$ events: important systematics for both inclusive and exclusive determination of $|V_{ub}|$*

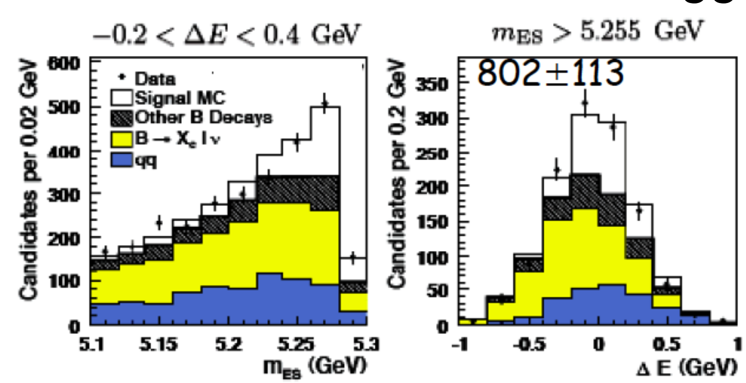


For example: the ω



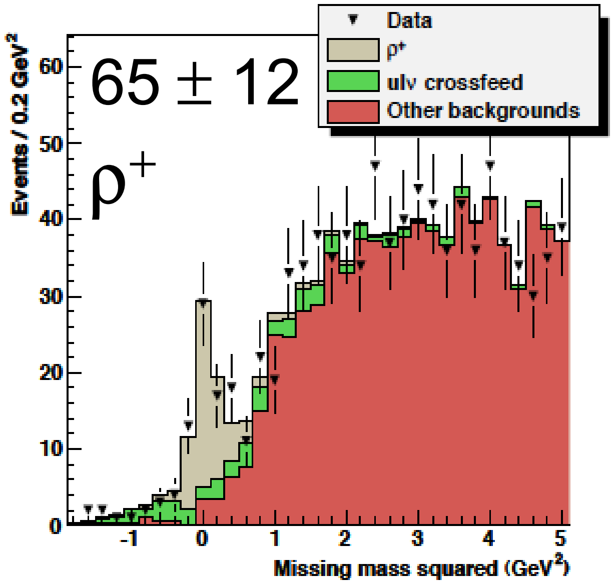
Had. Tag

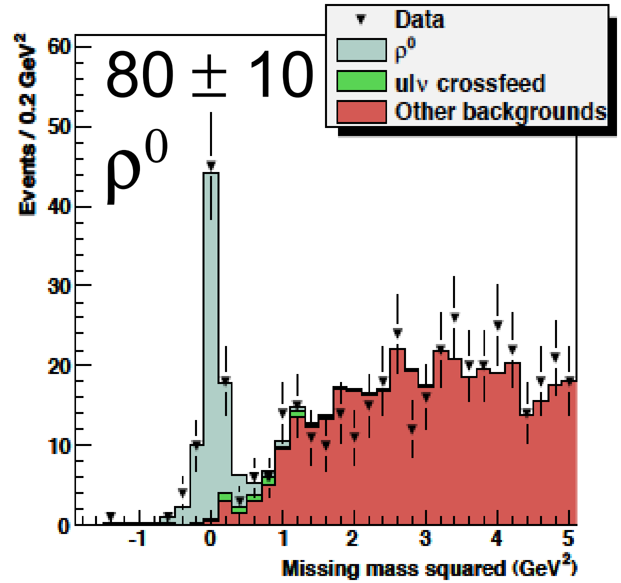
Untagged



$B \to \rho \ell \nu$

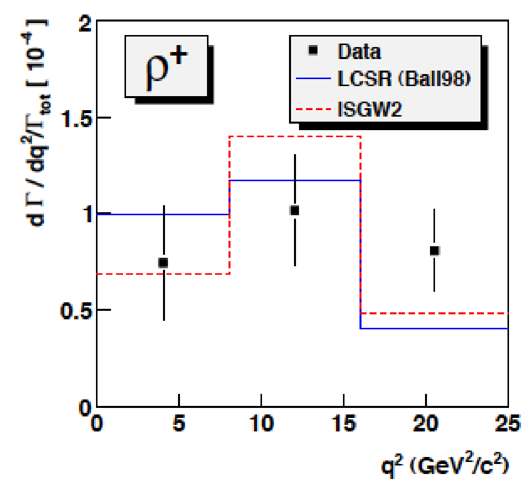
Belle with hadronic tag: 605 fb^{-1}



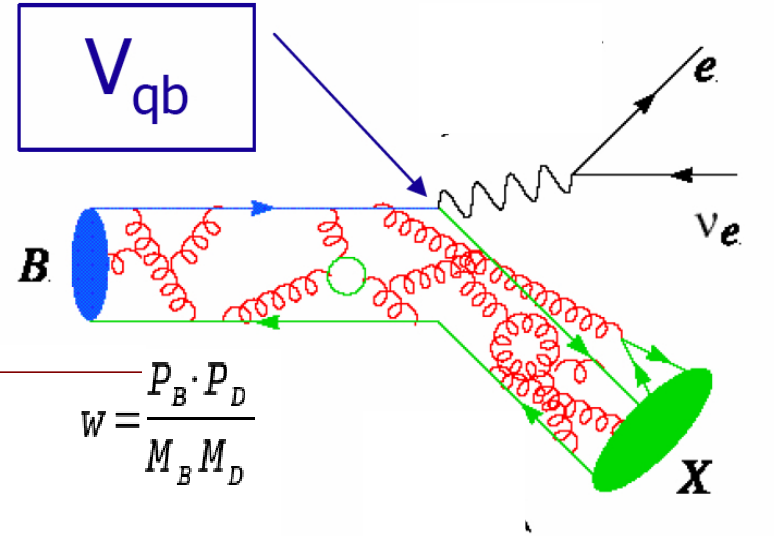


Very clean sample
Three q^2-dependent form factors: need a 4 dimentional fit -> high statistics is needed

- *Tagged will be soon competitive with the untagged (even with present data)*
- *Untagged suffers of problems:*
  - *Large combinatoric due to tracks from the other B*
  - *Kinematic cuts (e.g. P_{lep}) to suppres the large bkg*
    - *Increase the model dependence*
  - *The $B \to X \ell \nu$ bkg very similar to the signal, resulting in large syst. error*



Exclusive $|V_{cb}|$



- *HQET expansion of Form Factors:*

$$\frac{d\Gamma}{dw}(D) = \frac{G_F^2}{48\pi^3\hbar}(M_B+M_D)^2\, M_D^3 (w^2-1)^{3/2}\, |V_{cb}|^2\, G^2(w)$$

$$w = \frac{P_B \cdot P_D}{M_B M_D}$$

$$\frac{d\Gamma}{dw}(D^*) = \frac{G_F^2}{48\pi^3\hbar}(M_B-M_{D^*})^2 M_{D^*}^3 (w^2-1)^{1/2}(w+1)^2\, |V_{cb}|^2\, h_{A_1}^2(w)\Sigma_{+,0,-}|\tilde{H}_i(w)|^2$$

- *Use Caprini et al. Parameterization, for the D:*

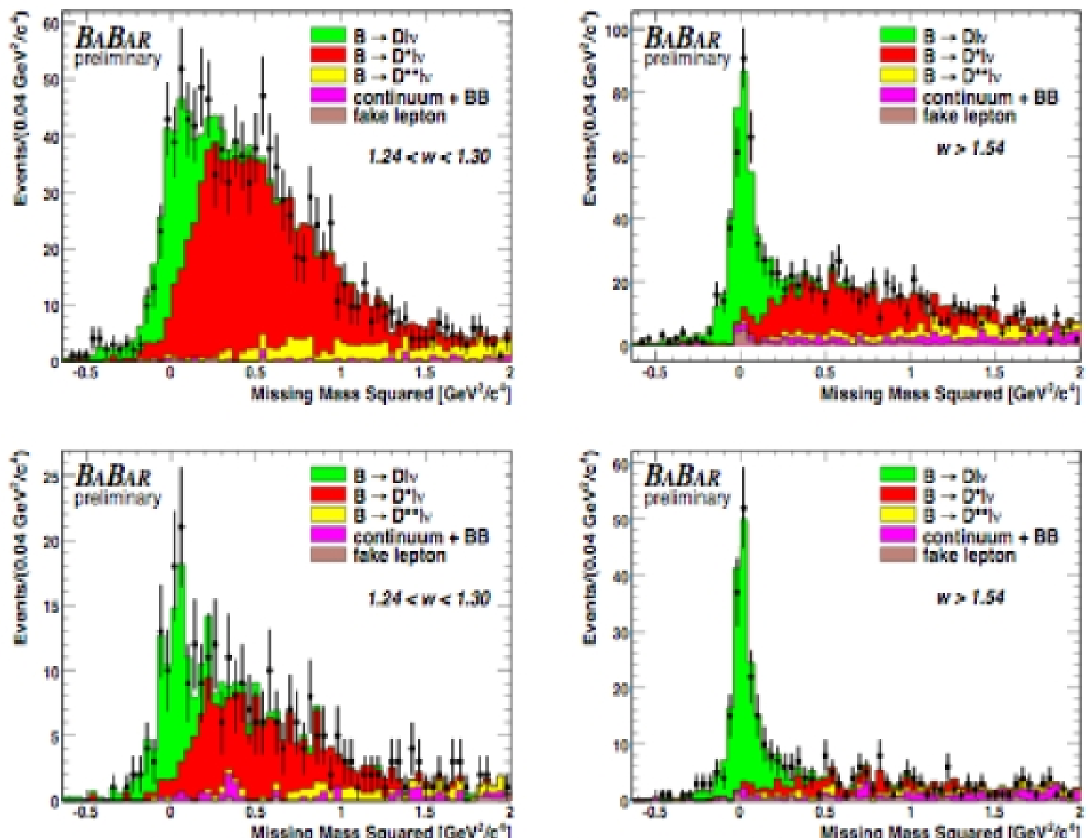
$$\mathcal{G}(w) = \mathcal{G}(1)\left[1 - 8\rho^2 z + (51\rho^2 - 10)z^2 - (252\rho^2 - 84)z^3\right] \qquad z = \frac{\sqrt{w+1}-\sqrt{2}}{\sqrt{w+1}+\sqrt{2}}$$

- *Lattice QCD calculation at w~1. Un-quenched start to be available*
- *Quenched available at w>1*
  - *Tantalo et al. 2007*

$\mathcal{G}(1) = 1.074 \pm 0.018 \pm 0.016$
(M.Okamoto et al NPPS 140, 461 (2005))
$h_{\mathcal{A}}(1) = 0.924 \pm 0.012 \pm 0.019$
(J.Laiho et al arXiv:0710.1111 [hep-lat]

$|V_{cb}|$ and FF with tagged $B \to D \ell \nu$

- *Use the B_{reco} tag sample*
  - *Recoil: $B \to D \ell \nu$*
  - *Avoid the use of ν-reco*
  - *Reduce the combinatoric*
  - *Good w resolution*



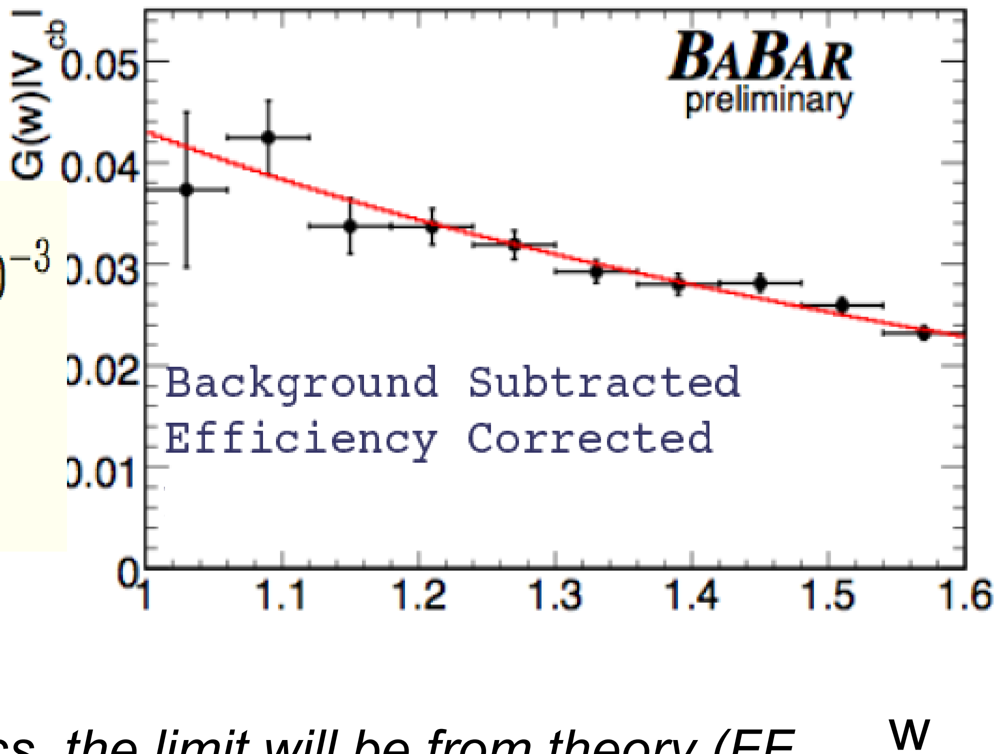
$$MM^2 = (P_B - P_D - P_l)^2 \equiv M_\nu^2 \; [GeV^2/c^4]$$

- *Event yield: MM2 fit in 10 w bins (1<w<1.6)*
  - *D^0: 2147$\pm$69 events/417 fb^{-1}*
  - *D^+: 1108$\pm$45 events/417 fb^{-1}*

$|V_{cb}|$ and FF with tagged $B \to D \ell \nu$

- *Fit the w distribution:*

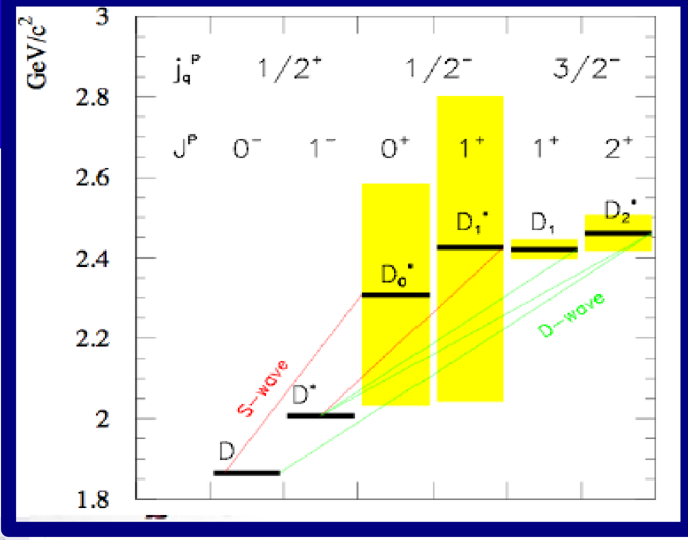
$$\mathcal{G}(1)|V_{cb}| = (43.0 \pm 1.9 \pm 1.4) \times 10^{-3}$$
$$\rho^2_G = 1.20 \pm 0.09 \pm 0.04$$
$$\mathcal{B}(\bar{B}^0 \to D^+ \ell^- \bar{\nu}_\ell) = (2.17 \pm 0.06 \pm 0.07)\%.$$



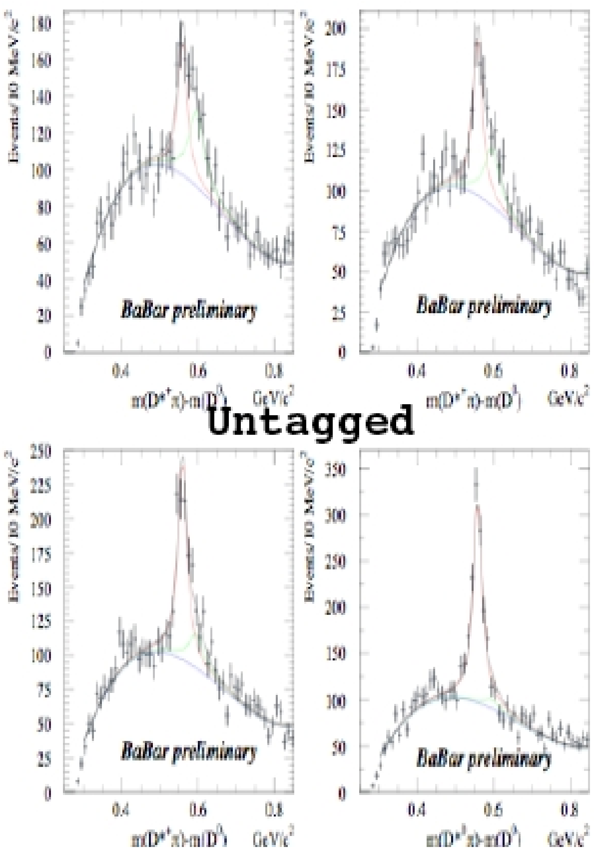
- *5.5% error on G(1)$|V_{cb}|$, mostly statistics*
- *Easy to improve with more statistics, the limit will be from theory (FF normalization)*
  - *Only one unquenched calculation, 2005, not published*
- *Calculation of FF away from 0 recoil, available in the quenched approximation (w~1.2): very useful, Interpolation instead of Estrapolation*
  - *Large statistical benefit for D: helicity suppression*
  - *Large systematic benefit for D*: soft pion*

D**: composition

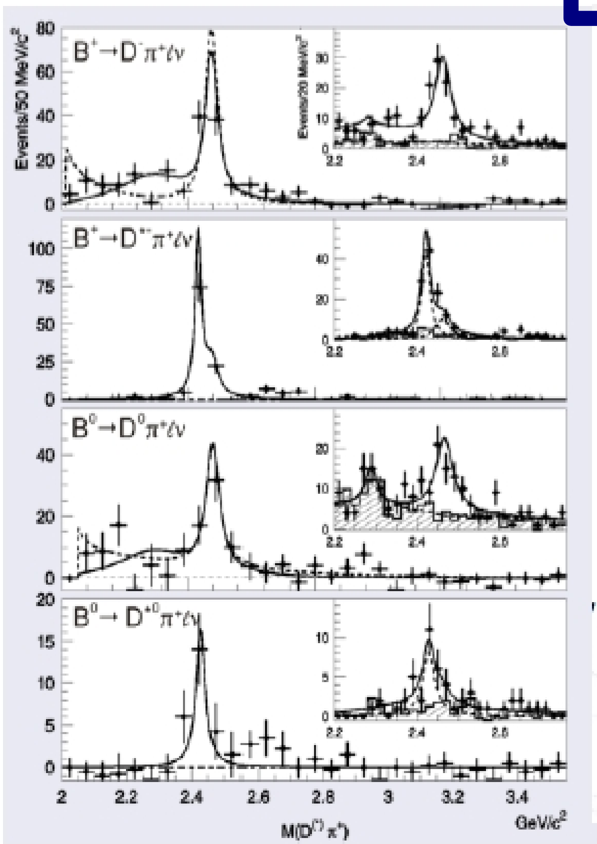
- *Untagged: access only to narrow resonances*
- *Tagged (B_{reco}): both narrow and wide states*
  - *No evidence of non resonant $D(*)\pi$ production*

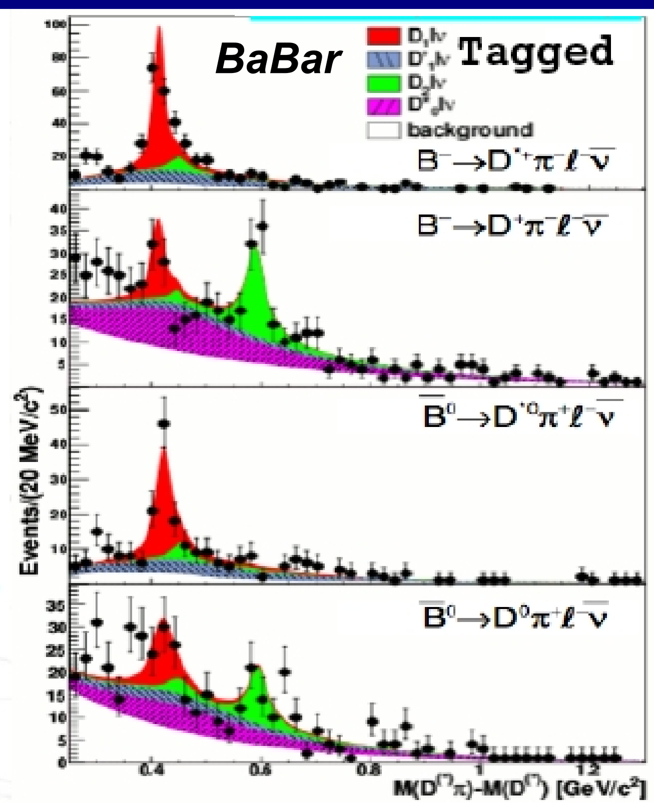


BaBar



Belle





$|V_{cb}|$: present status

☺ Six independent measurements from B-factories, from D and D* decays provide precise consistent results both as for $|V_{cb}|$ and for shape parameters

☺ V_{cb} from D almost as precise as from D* . Time to start thinking of correlated errors between $G(1)$ and $h_A(1)$

☺ V_{cb} from exclusive decays might tackle inclusive result. Time to worry ?

$$|V_{cb}| = (39.7 \pm 1.4_{exp} \pm 0.9_{theo})\ 10^{-3} \quad (D)$$

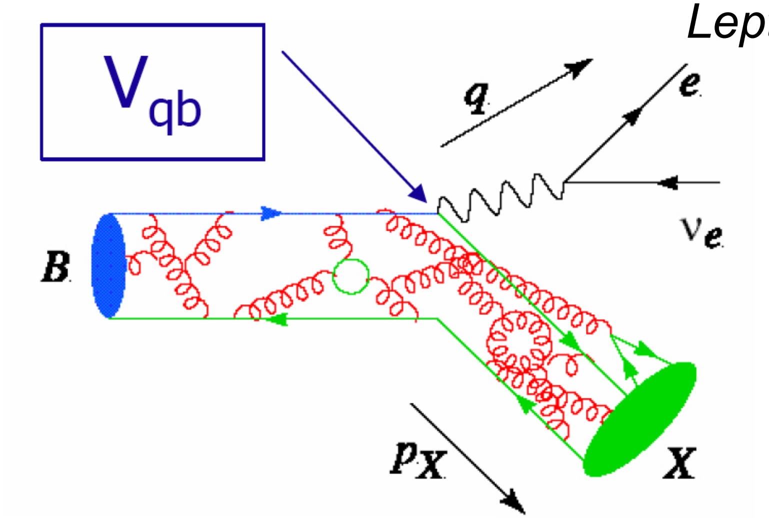
$$|V_{cb}| = (38.1 \pm 0.6_{exp} \pm 0.9_{theo})\ 10^{-3} \quad (D^*)$$

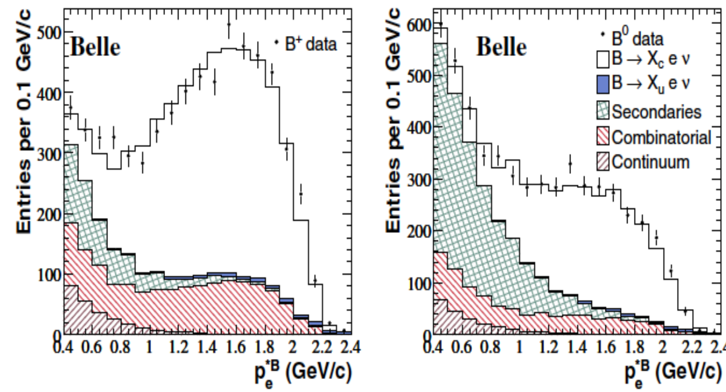
Franco Simonetto INFN & Universita' di Padova

Σ D+D+D** < Inclusive: further investigations are required,*
High statistics studies with tagged sample can help to understand the X_c anatomy

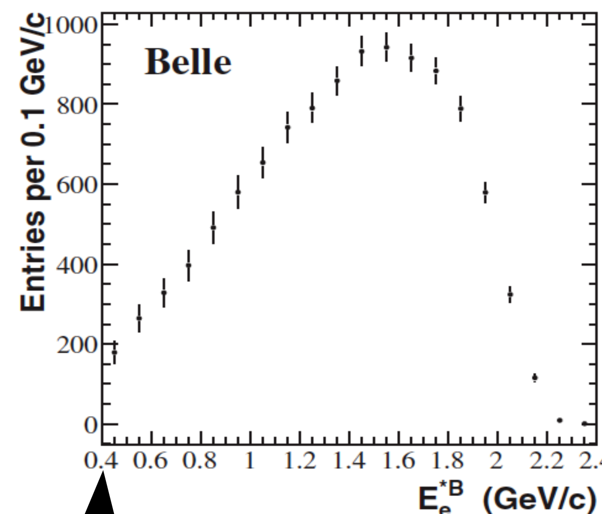
Inclusive $|V_{cb}|$ Observables

Lepton Momentum



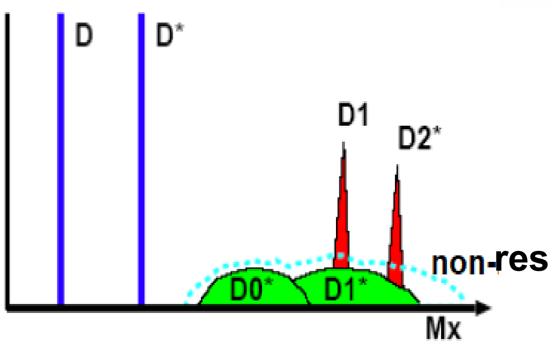


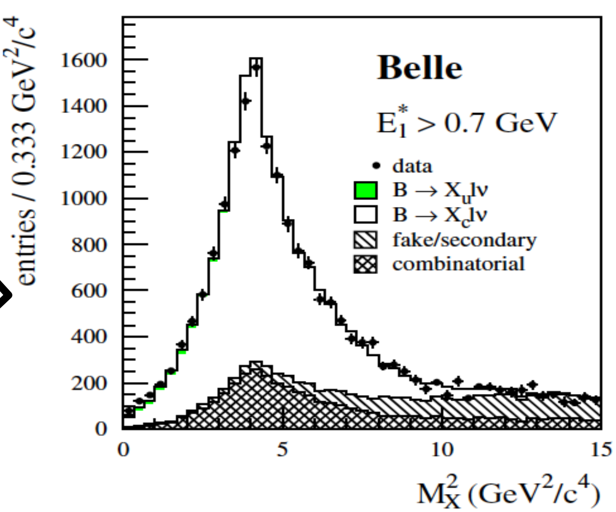
Unfolding



$E_e > 0.4$ GeV

Hadron Mass Spectra





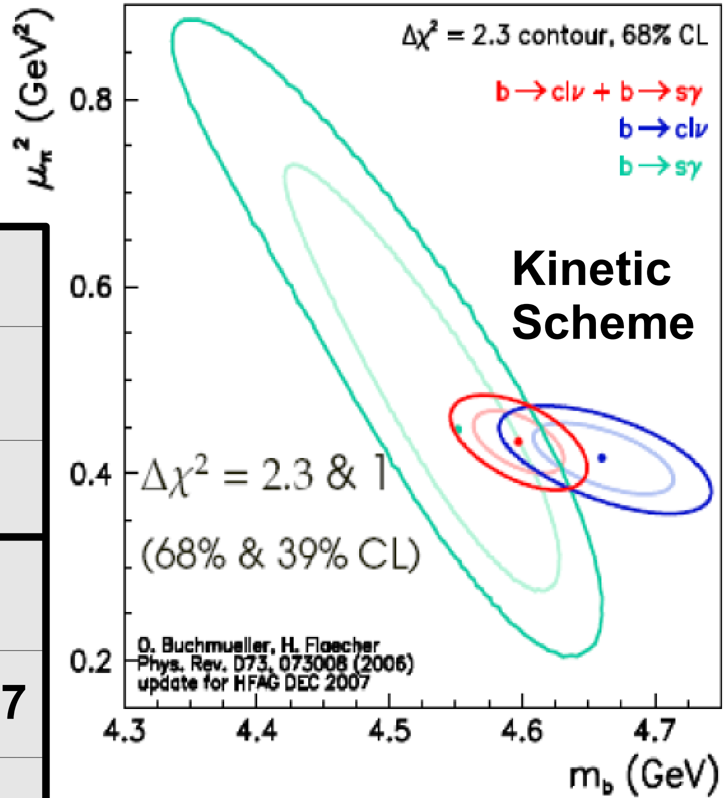
PRD75,032005(2007)
154 M BB

PRD75,032001(2007)
154 M BB

Inclusive $|V_{cb}|$: global OPE fit

- *Global fit with all available results*
  - *Babar, Belle, CLEO, CDF, Delphi*

1S	**$V_{cb}(10^{-3})$**	**m_b (GeV)**
	41.78±0.30±0.08	**4.701±0.030**
no b→ sγ	**41.56±0.39±0.08**	**4.751±0.058**
KS	**$V_{cb}(10^{-3})$**	**m_b (GeV)**
	41.91±0.19±0.28±0.59	**4.613±0.022±0.027**
no b→ sγ	**41.68±0.39±0.58**	**4.677±0.053**



>100 measurements, different HQE fit implementations, results in very good agreement:

$\sigma_{|Vcb|}$**<2% and** σ_{mb}**<~1%**

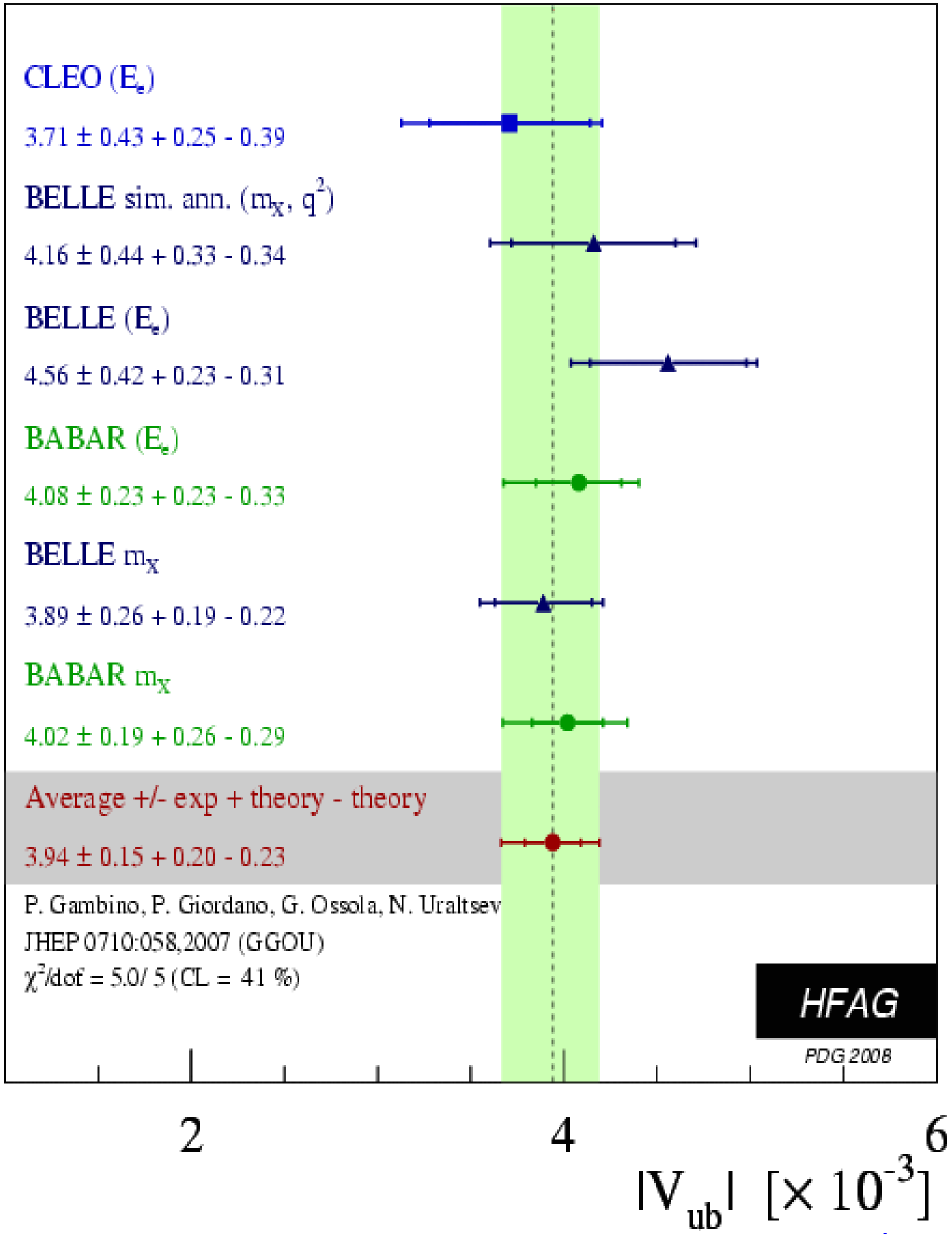
Hadronic moments most important input: need tagging
Experimentally limited by systematics:
- neutral reco, tracking, D**

$|V_{xb}|$ determination: program

- *Impossible to make at LHC(b)*
- *Super B factory ideal environment to improve the knowledge on semileptonic decays*
- *Uncertainties from theory dominant: can be improved?*
- *Use both inclusive and exclusive decays:*
  - *Complementary*
- *Use the tagging sample (hadronic and semileptonic) & with high statistics*
  - *experimental systematics can be reduced and many masurements become possible*
- *CKM favored $B \to X_c \ell \nu$ decays are crucial:*
  - *Test the theory, extract $|V_{cb}|$*
  - *Constrain the background (CKM favored)*
  - *Crucial input to m_b*

Backup Slides

$|V_{ub}|$ results (HFAG average, GGOU)



Gambino, Giordano, Ossola, Uraltsev
JHEP0710:058(2007)

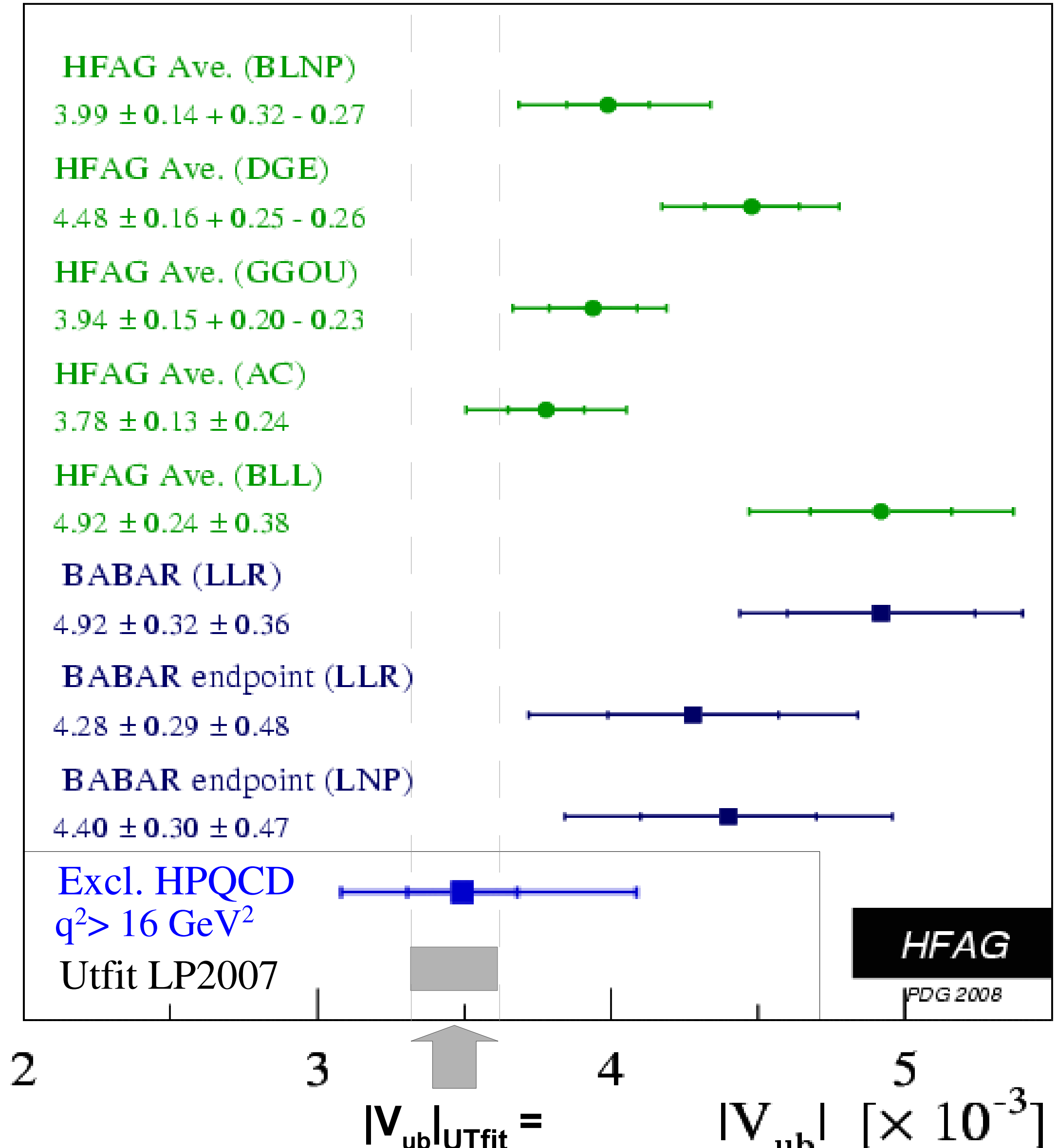
- *m_b from Global Fit (Kinetic Scheme), including also $B \rightarrow Xs\gamma$*

$$|V_{ub}|=(3.94 \pm 0.15 \pm 0.23)10^{-3}$$

δ|Vub|		+6.3% -7.0%
Statistical		2.2%
Exp.systematics		2.2%
$b \rightarrow c\ell\nu$	model	1.3%
$b \rightarrow u\ell\nu$	model	1.5%
Non pert.-		3.9%
Higher order par.		1.8%
q2 tail model		2.6%
Weak Annihilation		-3.1%

For B_{reco} analysis use only m_x cut:
- large unpublished correlations with P+ and q2

$|V_{ub}|$ results (different calculations)



$|V_{ub}|_{UTfit}$ = $(3.44 \pm 0.16)10^{-3}$

8 May 2008

OPE approach

SF free

Different theoretical calculation

Results vary from $3.78\text{x}10^{-3}$ (AC) to $4.92\text{x}10^{-3}$ (BLL)

very different b-quark masses dependences

Goal for the future: quote one value of $|V_{ub}|$

Comparison with Excl. (HPQCD)

$$|V_{ub}|_{excl.} = (3.47 \pm 0.20^{+0.60}_{-0.39\,FF})10^{-3}$$

BLNP-HPQCD=0.5 +/- 0.7