# WG 2 : Review of Sept. Meeting

What can we learn from semileptonic / rare decays?

① FCNC decays

ex: $B \to K^* \mu^+ \mu^-$

- new physics (Hewett)
- measure form factors for $B \to \rho e \bar{\nu}$

② Semileptonics

- $V_{ub}$, $V_{cb}$ (but will presumably do better at $e^+e^-$ machines)
- testing HQ expansion (particularly in $\Lambda_b \to \Lambda_c e \bar{\nu}$)

③ Radiative decays
(ex: $B_s \to \phi \gamma$)

- competitive?

## ① FCNC's

**MODES:**

$B \to K^{(*)} \ell^+ \ell^-$ , $\varphi \ell^+ \ell^-$ (Hiller)
$\to X_s \ell^+ \ell^-$

$B_{d,s} \to \mu^+ \mu^-$ (Logan)

$B \to K^* e\mu$ , $e\mu$

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$b \to s \ell^+ \ell^-$ : additional constraints on new physics over $b \to s \gamma$

**EXCLUSIVE:** $B \to K^{(*)} \ell^+ \ell^-$ , $\varphi \ell^+ \ell^-$

- expect $O(10^3)$ events ($2 fb^{-1}$)

GOALS: $\frac{d\Gamma}{dm_{\ell\ell}}$ , $\frac{d\Gamma}{dE_\ell}$ , $m_{\ell\ell}^0$ (forward-backward asymmetry - less model dependent?)

→ extract form factors, combine with CLEO measurement of $B \to e\nu\nu$ via SU(3) to measure $|V_{ub}|$

**INCLUSIVE:** $B \to X_s \ell^+ \ell^-$

- theoretically clean (model-independent), at least when integrated over enough phase space (Bauer)

- DØ has already placed limits based on high invariant mass region ($3.9\ \text{GeV} < m_{\ell^+\ell^-} < 4.4\ \text{GeV}$)

Current limit: $< 4.2 \times 10^{-5}$ (CLEO)

SM: $6-8 \times 10^{-6}$

Run II: expect $O(10^3)$ events ($2\ \text{fb}^{-1}$)

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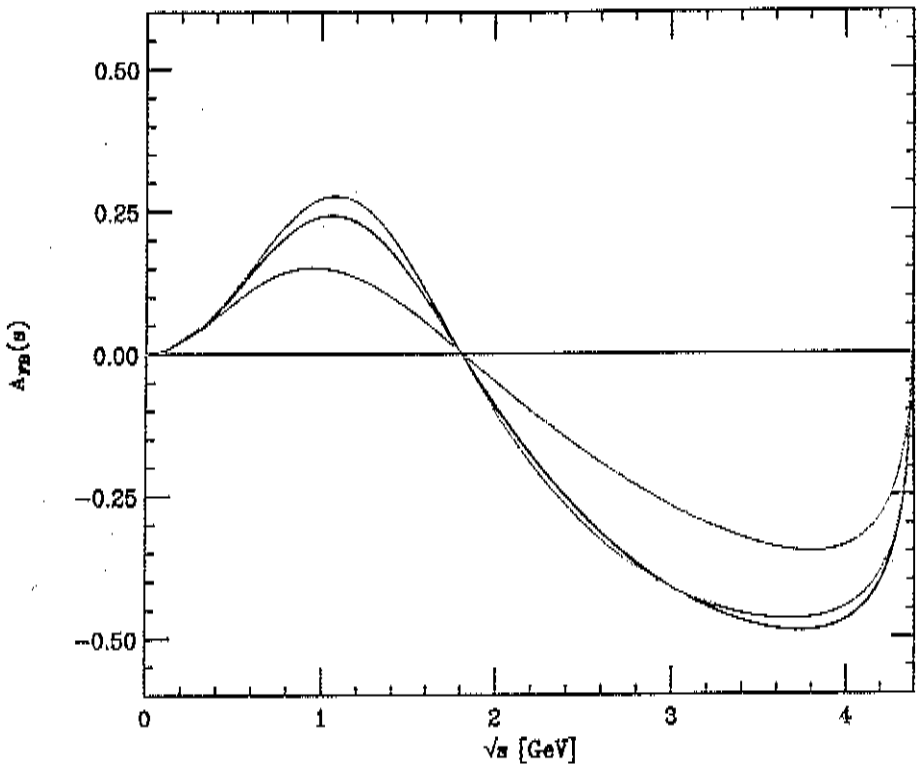
NB: Physics background : signal is 100 : 1 (with only invariant mass cuts) - need to study!

- strong competition from CLEO
- need strategies beyond cutting on lepton inv't mass (vertexing, impact parameter, pseudo-reconstruction, ...)

**THEORY:** OPE breaks down in high inv't mass region

* The ratio $R_V$ is very stable across models!




→ BSW*: Bauer, Stech and Wirbel, Z. Phys. C29, 637 (1985); Stech, Phys. Lett. B354, 447 (1995).

→ LCSR: Ball and Braun, Phys. Rev. D55, 5561 (1997).

→ MNS: Melikhov, Nikitin and Simula, Phys. Lett. B410, 210 (1997).

## ② Semileptonics

- exclusive modes are understood via HQET
- major capability is study of

$$\underbrace{\Lambda_b \to \Lambda_c \, l \, \bar{\nu}}$$

all form factors are related to a single universal function, including $1/M_b$ corrections

**Exp't:** goal is to measure form factors
- need to reconstruct $\nu$ (cf: 3D vertexing)
- need $q^2$ spectrum (need large sample)
- absolute or relative normalization?

**PROBLEM:** can this be distinguished from, for example,

$$\underbrace{\Lambda_b \to \Lambda_c^* \, l \, \nu}_{\hookrightarrow \Lambda_c + \text{soft prons}} \quad , \quad \Lambda_b \to \Sigma_c \pi \, l \, \nu \quad \hookrightarrow \Lambda_c \pi$$

Leibovitch & Stewart: ~30% of SL branch is $\Lambda_b \to \Lambda_c(2593/2625) \, l \, \bar{\nu}$

**MESONS:** $B \to D^{(*)} l \nu$ - validate techniques

## ③ Radiative Penguins

$B \to K^* \gamma$ ~$10^3$ events

$B_s \to \phi \gamma$

$B_s \to K^* \gamma$ (to get $\frac{|V_{ts}|}{|V_{td}|}$)

↳ $O(10)$ events...

- CDF is planning dedicated triggers for these modes
- $B \to K^* \gamma$ is also accessible at $e^-e^-$; not clear Tevatron will be competitive

$B \to X_s \gamma$

- inclusive mode is more difficult than $B \to X_s \mu^+ \mu^-$
- BTeV will study