

# Contribution to the discussion: "Extreme Flavour"

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## 1 Preamble

We consider a high luminosity hadron machine with configuration of the experiment similar to LHCb, and focus on exclusive  $B$  and  $B_s$  rare processes with charged leptons and light hadrons (including  $\eta$ ,  $\eta'$ ) in the final state. Progress in measurements will be achieved before the construction of such a machine, at SuperBelle and at the new LHC runs: this should be taken into account in the discussion. Other interesting processes involve  $b$ -baryons and  $B_c$ .

## 2 Rare FCNC b-meson decays: modes and observables

### 2.1 CKM enhanced b decays

- $B \rightarrow K^*(K\pi)\ell^+\ell^-$  and  $B_s \rightarrow \phi(K\bar{K})\ell^+\ell^-$ 
  - $q^2$ ,  $F_L$  and AFB distributions
  - full angular distribution
  - role of the scalar  $K\pi$  contribution
  - $e - \mu$  universality
  - $\tau$  leptons (is polarization measurable?)
  - $B_s/B_d$  to reduce the hadron uncertainty
- $B \rightarrow K\ell^+\ell^-$  and  $B_s \rightarrow (\eta, \eta')\ell^+\ell^-$ 
  - $q^2$  distribution
  - $e - \mu$  universality
  - $\tau$  leptons

- $B_s/B_d$  to reduce the hadron uncertainty
- $B_s \rightarrow f_0(980)(\pi^+\pi^-)\ell^+\ell^-$ 
  - $q^2$  distributions
  - $e - \mu$  universality
  - $\tau$  leptons

## 2.2 CKM suppressed b decays and $V_{td}/V_{ts}$

- $B \rightarrow \pi\ell^+\ell^-$  and  $B_s \rightarrow K\ell^+\ell^-$ 
  - $q^2$  distribution
  - $e - \mu$  universality
  - $B_s/B_d$
  - $V_{td}/V_{ts}$  from  $(B \rightarrow \pi)/(B \rightarrow K)$
- $B \rightarrow \rho(\pi\pi)\ell^+\ell^-$  and  $B_s \rightarrow K^*(K\pi)\ell^+\ell^-$ 
  - $q^2$  and AFB distributions
  - angular distributions
  - $e - \mu$  universality
  - $B_s/B_d$
  - $V_{td}/V_{ts}$  from  $(B \rightarrow \rho)/(B \rightarrow K^*)$  and  $(B_s \rightarrow K^*)/(B_s \rightarrow \phi)$

## 3 FCNC b-baryon decays

- $\Lambda_b \rightarrow \Lambda\ell^+\ell^-$ 
  - $q^2$  distributions
  - angular distributions
  - $e - \mu$  universality
  - $\tau$  leptons (?)
- Are  $\Xi_b$  decay modes accessible?

decay mode	observable	2014	uncertainty 2014	20XX
$B \rightarrow K^*(K\pi)\ell^+\ell^-$	BR	✓	$\simeq 10\%$	
	$q^2$ distribution	✓		
	$F_L$ distribution	✓		
	AFB distribution	✓		
	angular distributions	✓		
$B_s \rightarrow \phi(K\bar{K})\ell^+\ell^-$	BR	(✓)		
	$q^2$ distribution	(✓)		
	$F_L$ distribution			
	AFB distribution			
	angular distributions			
$B \rightarrow K\ell^+\ell^-$	BR	✓	$\simeq 10\%$	
	$q^2$ distribution	✓		
$B_s \rightarrow (\eta, \eta')\ell^+\ell^-$	BR			
	$q^2$ distribution			
$B_s \rightarrow f_0(\pi^+\pi^-)\ell^+\ell^-$	BR			
	$q^2$ distribution			
$B \rightarrow \pi\ell^+\ell^-$	BR			
	$q^2$ distribution			
$B_s \rightarrow K\ell^+\ell^-$	BR			
	$q^2$ distribution			
$B \rightarrow \rho(\pi\pi)\ell^+\ell^-$	BR			
	$q^2$ distribution			
	AFB distribution			
	angular distributions			
$B_s \rightarrow K^*(K\pi)\ell^+\ell^-$	BR			
	$q^2$ distribution			
	AFB distribution			
	angular distributions			

Table 1: 2014 status and projections

## 4 FCNC $c \rightarrow u$ transition

The investigation of the  $c \rightarrow u$  transition naturally involves  $D$  mesons, but the LD contributions are usually dominant in this system and difficult to control. Examples are  $D \rightarrow (\pi, \rho)\ell^+\ell^-$  and  $D_s \rightarrow (K, K^*)\ell^+\ell^-$ .  $B_c$  decays can be useful for such investigations; the actual possibility of measuring such modes needs to be studied. Main processes:  $B_c \rightarrow B^{(*)}\ell^+\ell^-$  ( $q^2$  distribution,  $e - \mu$  universality) and  $B_c \rightarrow B^*\gamma$ .