

Synthèse de la réunion BooST du 16-17 January 2020

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Thursday PM: Discussion on project objectives

Main objectives

1. Coherent measurements of the b-hadron decay modes involving $b \rightarrow s\tau\tau$ or $b \rightarrow s\tau e/\mu$ transitions, taking full advantage of LHCb and Belle II complementarity:

- $B^+ \rightarrow K^+ \tau \tau e/\mu$: Belle II + LHCb (μ only)
- $B^0 \rightarrow K_S \tau \tau e/\mu$: Belle II
- $B^0 \rightarrow K^{*0} \tau \tau e/\mu$: LHCb
- $B_{(s)} \rightarrow \tau \tau e/\mu$: LHCb (+ Belle II ?)
- $B_s \rightarrow \Phi \tau \tau e/\mu$: LHCb
- $\Lambda_b \rightarrow \Lambda \tau \tau e/\mu$: LHCb

These studies, performed in the context of the BooST project, will enforce the collaboration between theorists and Belle II or LHCb experimentalists, allowing to:

- a. Develop new reconstruction techniques
 - decay chain and B mass (Th - LHCb)
 - c-tag (Th - Belle and possibly FCC-ee)
 - discriminating isolation variable (Th - LHCb & Belle)
 - b. Optimise analyses and measurements for different NP scenarios (Th - Belle & LHCb)
 - consider benchmark NP scenarios and study the impact on the decay phase-space
 - study the sensitivity of the experimental measurements to phase-space in light on the differences observed for the different NP scenario. If useful, take this dependence into account early enough in the analysis.
 - propose and publish a method to present measurements coherently and easily interpretable by theorists.
 - can be quoted to support this idea: $M(X\mu)^2$ dependence (which mode ? Karim ?), difference between $X \mu^+ \tau^-$ and $X \mu^- \tau^+$, $K\tau\mu$ from Belle and LHCb.
 - c. Measure the $\tau \rightarrow 3\pi(\pi^0)\nu$ differential decay rate with Belle data, implementation of the model in an MC generator for LHCb measurements.
2. Interpretation of results using EFT in relation with 1.b above (Th)
 3. Preparation for next generation of experiments (FCC-ee)
 - a. development of new observables (Th)
 - b. prospective studies for FCC-ee for modes under considerations with inputs from Belle & LHCb analysis tools and techniques (Belle & LHCb)

Friday AM: Discussion on tasks organisation

Tasks:

- A. $\tau \rightarrow 3\pi(\pi^0)\nu$ differential BF with Belle data
- B. Study of decay phase space for different NP benchmark scenarios

- a. Identify the relevant NP scenarios and compute matrix element of decay with tau leptons
- b. Investigate the implication of these scenarios in the analyses (impact on efficiency, signal/background ratio)
- c. Coherent presentation of LHCb and Belle result and their combination to ease theoretical interpretation (in the different NP scenarios)
- C. Analysis techniques
 - a. c-tag for Belle + FCC-ee
 - b. preparation for run 3 LHCb (trigger and discriminating variables (isolation))
 - c. analysis tools for LHCb and FCC-ee (tau lepton identification, background characterisation & rejection with MVA, neutrino reconstruction and B mass estimation)
- D. Measurements
 - a. LHCb (+ prospects for FCC-ee)
 - b. Belle II (+ prospects for FCC-ee)
- E. Theoretical Interpretation
- F. New observables (for future experiments)

Requested manpower: 1 3-years post-doc, 4 2-years post-doc, 1 3-years PhD

- 1. 1 Post-doc 3 years, experimentalist on Belle
 - a. c-tag (C.a)
 - b. $\tau \rightarrow 3\pi$ (A)
- 2. 1 Post-doc 2 years, theorist (somehow experienced)
 - a. NP benchmark scenarios (B.a)
 - b. New observables (F)
- 3. 1 Post-doc 2 years, theorist
 - a. Coherence and combination of LHCb & Belle measurements (B.c)
 - b. Interpretation of results (E)
- 4. & 5. 2 Post-docs 2 years + 6. 1 PhD 3 years, experimentalists on LHCb
 - a. preparation for LHCb run3 (C.b)
 - b. analysis tools for LHCb and FCC-ee (C.c)
 - c. BF measurements (D.a)

Schematic view

			2021				2022				2023				2024			
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	Belle	IJC-Lab	A								C.a							
2	Th	CPT or IJC-Lab	B.a				F											
3	Th	CPT or IJC-Lab									B.c				E			
4	LHCb	CPPM or LPC or LPNHE	C.b				B.b											
5	LHCb										C.c				D.a			
6	LHCb						C.b				C.c				D.a			