Search for the rare decays $B \to K\nu\bar{\nu}$ at Belle II

Group Meeting - B2Knunu

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29 November 2024

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Belle II

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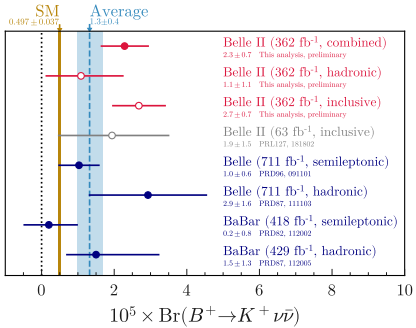
State of the art

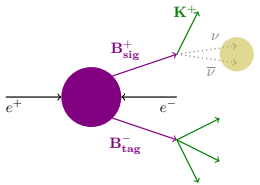
State of the art:

- Analyses carried at Belle II for Hadronic Tagged Analysis (HTA), Inclusive Tagged Analysis (ITA) and combined
- Decay channel: $B^+ \to K^+ \nu\bar{\nu}$
- Results: evidence for 2.7σ above the SM expectation from combined analysis

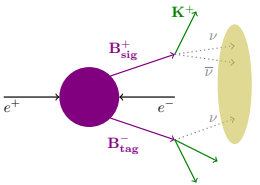


Tagged analysis strategies

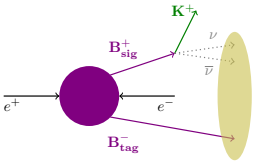
Hadronic Tagged Analysis (HTA)



Semileptonic Tagged Analysis (STA)



Inclusive Tagged Analysis (ITA)



Tagging efficiency

$\mathcal{O}(0.1\%)$ $\mathcal{O}(10\%)$

Tagging purity

$80\% - 20\%$ $\mathcal{O}(1\%)$

Main goal

- Carry the same analysis for the Semileptonic Tagged Analysis (STA)
- Compare the results on $B^+ \to K^+ \nu\bar{\nu}$ with STA for consistency check
- Will also do the analysis for one of the $B \to K^* \nu\bar{\nu}$ channel

First approach

- Very similar to HTA since exclusive analysis
- Will use *semileptonic* FEI instead of hadronic
- Important variables for HTA: ΔE and M_{bc}

$\rightarrow$ Important variable for STA: $\cos(\theta_{BY})$

Quests

Main quests:

1. Take the previous workflow, understand it and automatize it using B2LUIGI (95% done)
2. Adapt the workflow to the STA (partly done by Jacopo)
3. Test the new workflow with and without the Tree Fitter

Side quests:

1. Switch the plots from homemade functions to PLOTHIST
2. Change computation of uncertainties to more standardized way $\rightarrow$ will use SYSVAR or PYHFCORR
3. Check CABINETRY for management of PYHF fits

Current tasks

Active quests:

1. Take the previous workflow, understand it and automatize it using B2LUIGI (95% done)
2. Adapt the workflow to the STA (partly done by Jacopo)
   - Change the FEI corrections to semileptonic (for cross-check with respect to embedded)
   - Change the corrections to run dependent
3. Test the new workflow with and without the Tree Fitter
   - Try $\Upsilon(4S)$ vertex fitting with TwinB

Current main quests status

Active main quests:

1. Take the previous workflow, understand it and automatize it using B2LUIGI ✓
2. Adapt the workflow to the STA (partly done by Jacopo)
   - Change the corrections to run dependent (FEI and PID)✓
3. Test the new workflow with and without the Tree Fitter
   - Try $\Upsilon(4S)$ vertex fitting with TwinB

Current side quests status

Side quests:

1. Switch the plots from homemade functions to PLOTHIST (*in progress*)
2. ~~Change computation of uncertainties to more standardized way~~ → will use SYSVAR
3. Check CABINETRY for management of PYHF fits

Git repositories

Gitlab repository: