Time for anti-matter

Belle II Germany meeting

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DESY.

The group

- Helmholtz Young Investigator Group within the DESY Belle II group
Tadeas Bilka (PostDoc)
Xu Dong and Matilde Carminati (PhD students)

- 2023 - 2028

- University partner: Göttingen
Working with Ariane Frey and Benjamin Schwenker
Lukas Herzberg and Felix-Urs Meyer (undergrads)

Time-dependent precision measurement

Tadeas Bilka, Xu Dong, Urs-Felix Meyer

- Measurement of $\sin 2\beta$ with $B^0 \to J/\psi K_S^0$ and GNN tagger

  $\sin 2\beta = 0.724 \pm 0.035 \pm 0.009$

  $C_{CP} = -0.035 \pm 0.026 \pm 0.029$ (PRD110(2024)1,012001)

- Plan to improve precision by $\sqrt{2}$ and suppress systematic on C_{CP}:

  - Adding $B^0 \to J/\psi K_L^0$: ongoing K_L^0 reconstruction and control mode studies

  - Also increasing stat precision with $B \to J/\psi K_S^0(\pi^0\pi^0)$ and $B \to \psi(2S)K_S^0$

- Other related time-dependent studies possible in the future (α, $\Delta\Gamma$, ...)
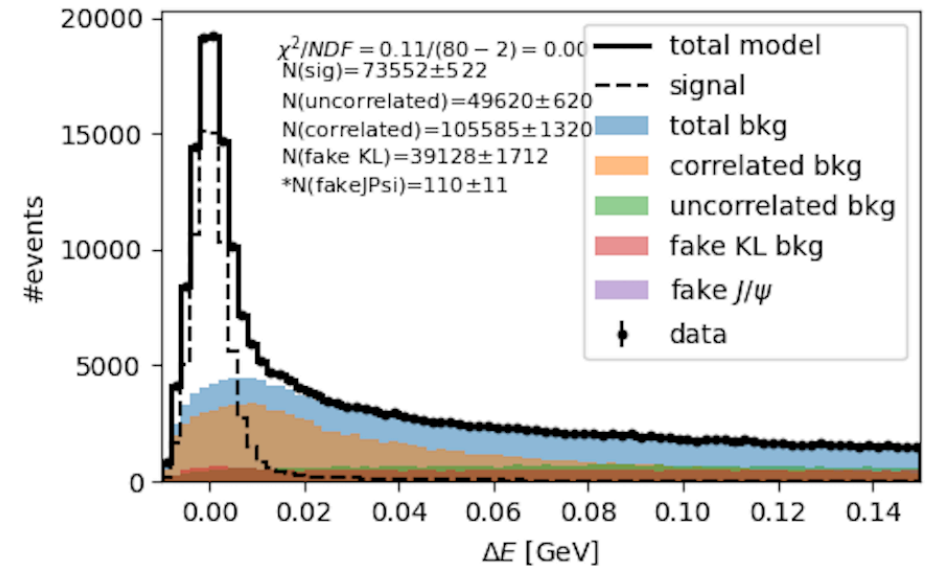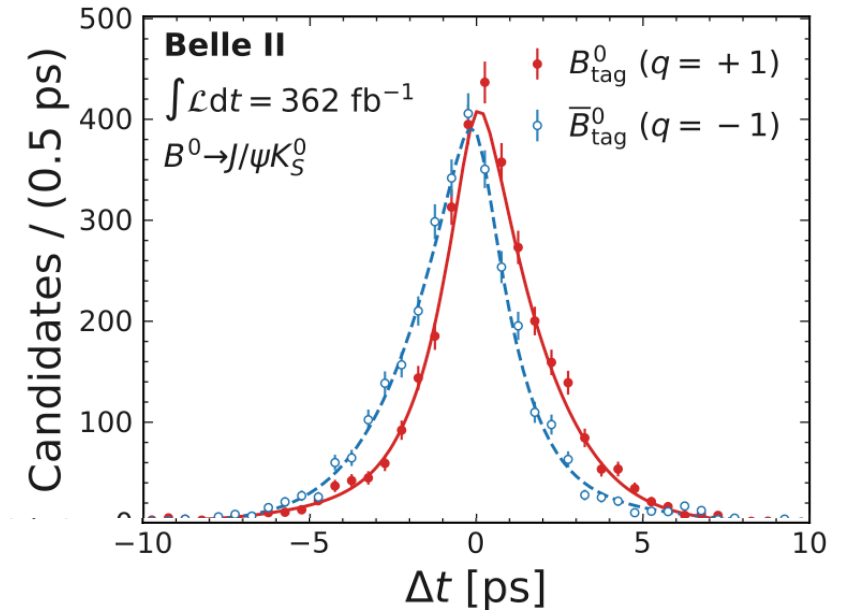
Plans with electroweak penguins

Electroweak penguin transitions very sensitive to new physics
and show some tensions wrt predictions:

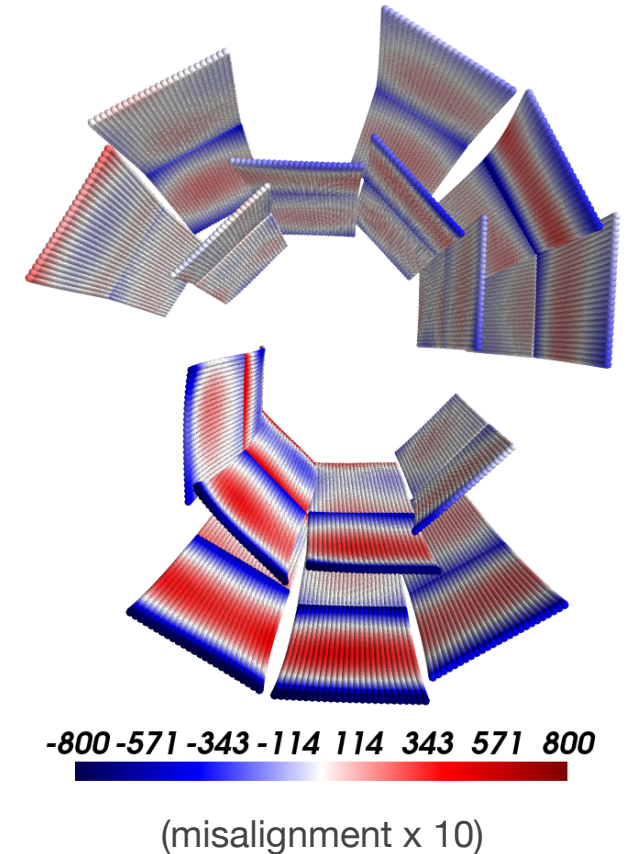$B^0 \to K^{*0}\mu^+\mu^-$ (LHCb), $K^+ \to \pi^+\nu\bar{\nu}$ (NA62), $B^+ \to K^+\nu\bar{\nu}$ (us)

- If there is new physics in these transitions, does it also bring
  more CP violation?

  $\to$ Measure decay-time-dependent CP violation in

  $B^0 \to K_S^0 \ell\ell$

  $\to$ Measurement needs at least 1 ab^{-1}

- Is there also enhancement in up-quark $c \to u\nu\nu$ transitions?

  $\to$ So far almost completely unexplored. Search for

  $\Lambda_c^+ \to p^+\nu\nu$ at Belle II?

TD CPV in $B^0 \to K_S\mu\mu$:
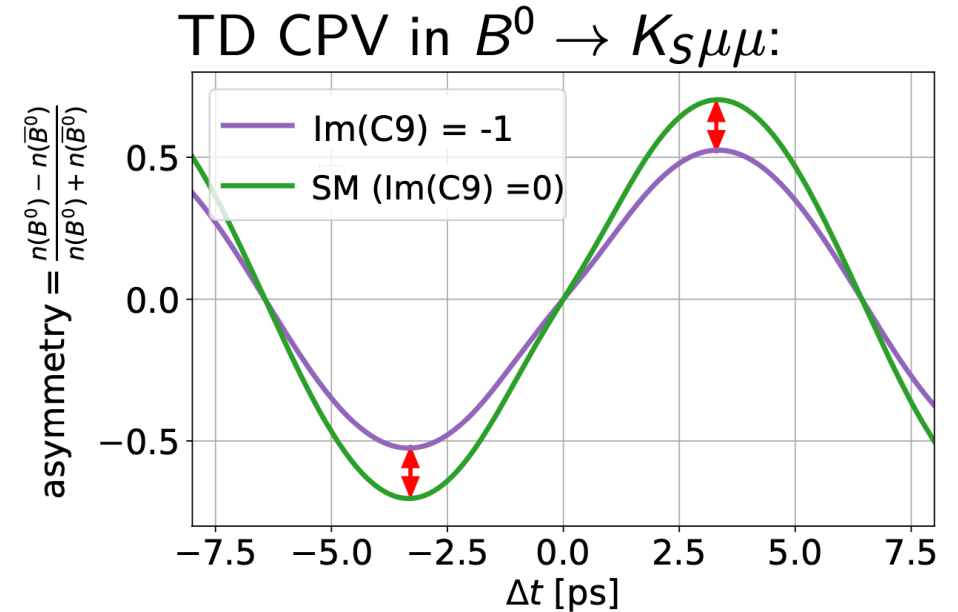
Vertex studies
Tadeas Bilka, Matilde Carminati, Lukas Herzberg

- Work on PXD and alignment:

  - Alignment of pre-summer shutdown data to be ready soon

  - Alignment used to check PXD bowing during operation

  - Matilde will use SVD→PXD track extrapolation to develop an online PXD bowing monitor and to study PXD hit residuals

- Full $\sin 2\beta$ measurement using simulated VTX

  - See Lukas poster!

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(misalignment x 10)

Thank you!