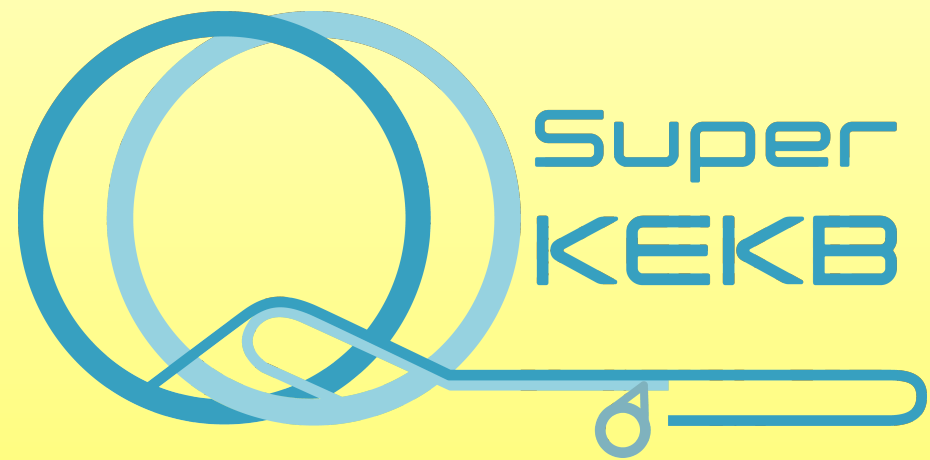




# Early physics prospects for radiative and electroweak penguin decays at Belle II

Masanobu Yonenaga (On behalf of the Belle II collaboration)  
Tokyo Metropolitan University

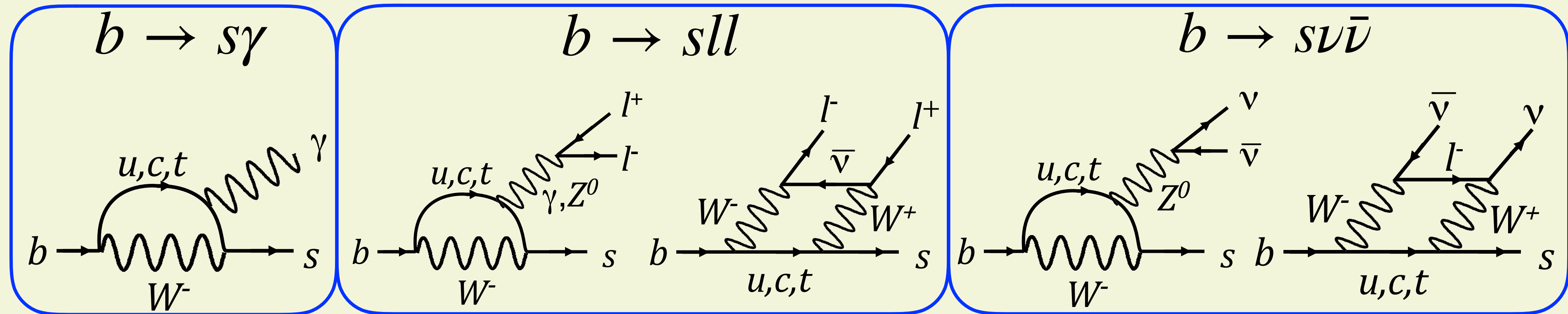


XXIX International Symposium on Lepton Photon Interactions at High Energies  
Westin Harbour Castle, Toronto Canada, Toronto, Canada. 5-10 August 2019

## Introduction

B-decays with flavor changing neutral currents hint at deviation from the Standard Model (SM) prediction.

- Forbidden at tree-level in the SM. → only via loop or box diagrams.
- High sensitivity to potential New Physics contributes in loops or new tree diagrams.

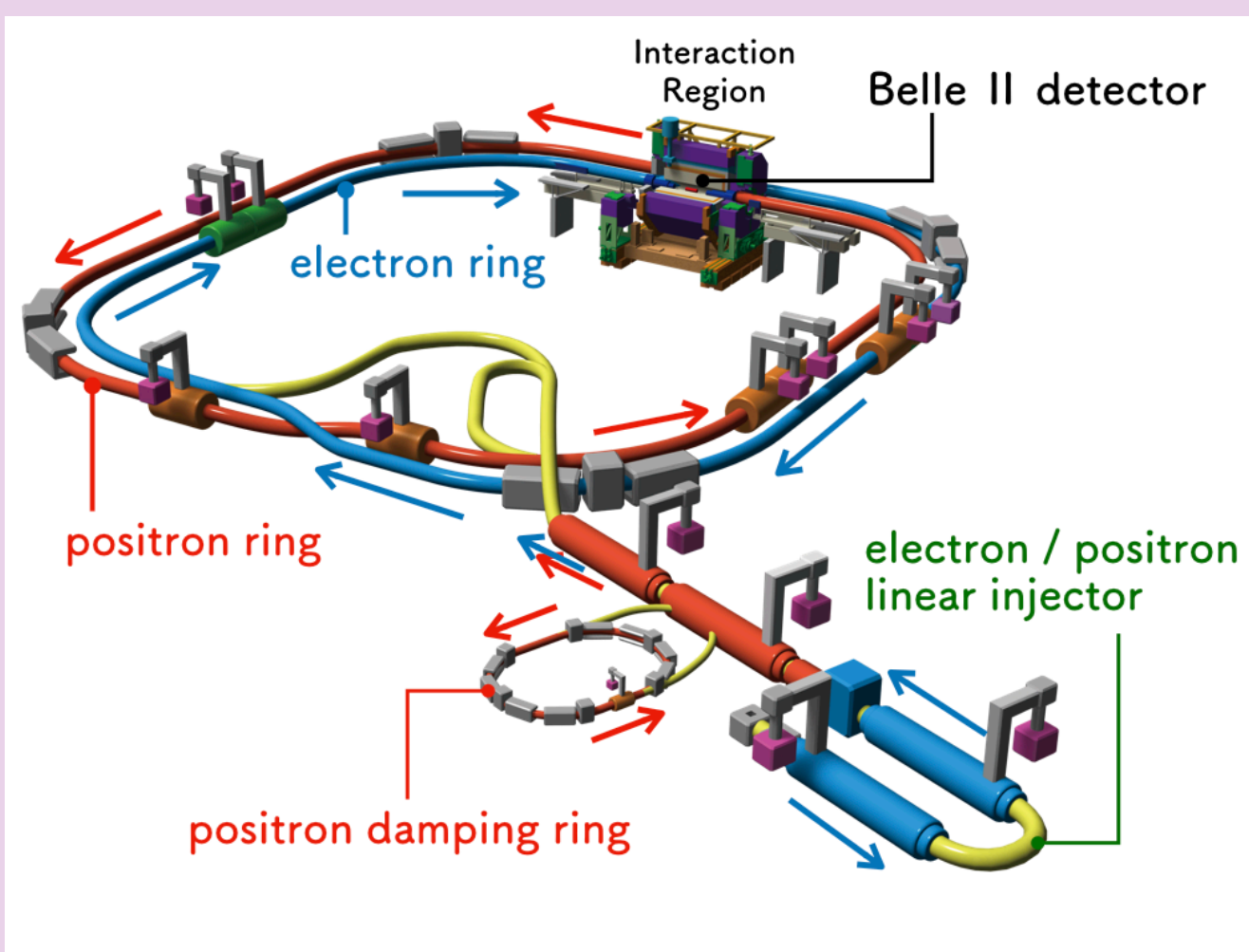


Radiative and electroweak penguin decays are ideal probe to search New Physics!

## Belle II experiment

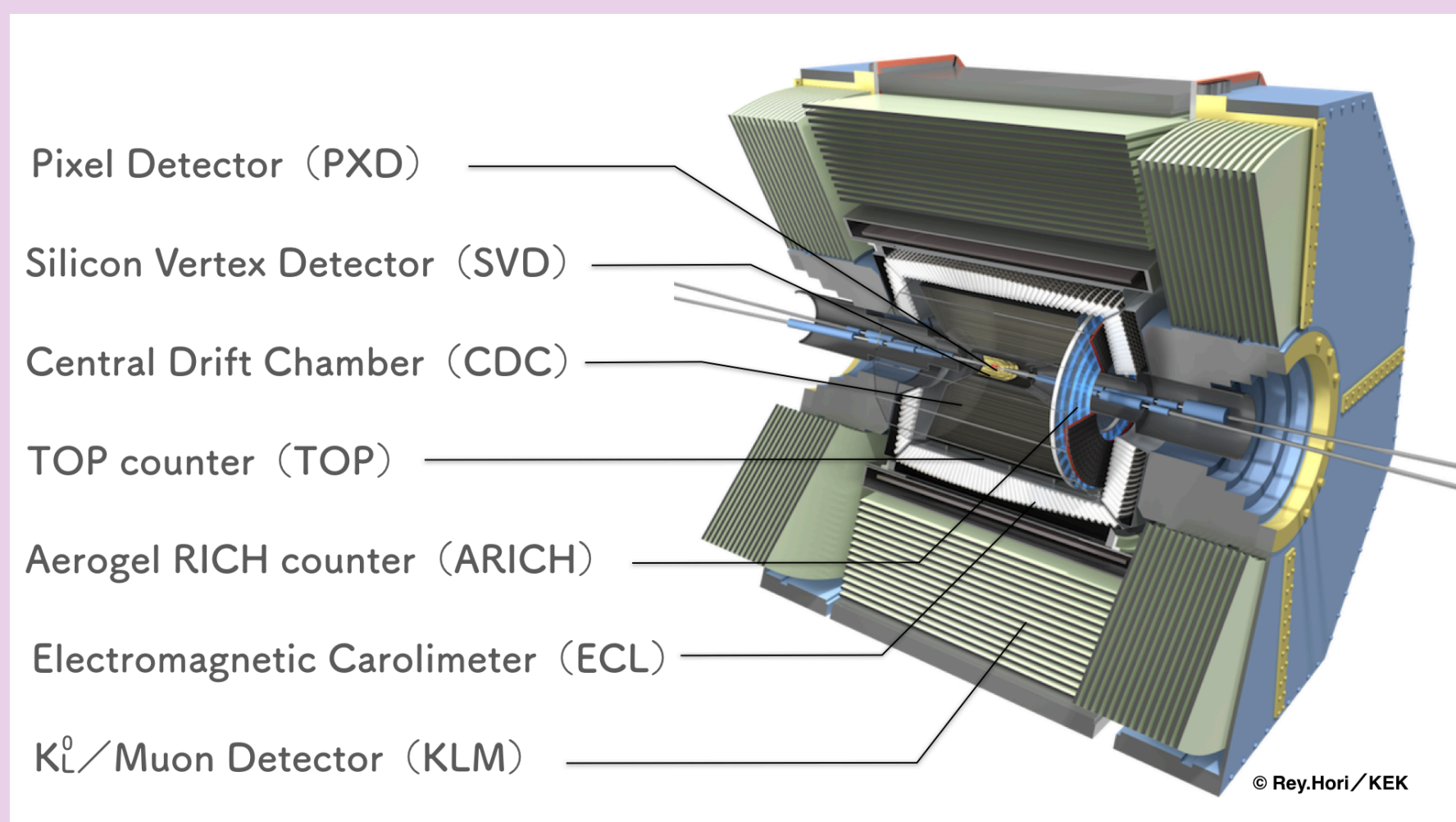
The Belle II experiment aims to search for new physics beyond the SM using 50 ab<sup>-1</sup> integrated luminosity.

### The SuperKEKB accelerator



- Asymmetric beam energy
  - e<sup>-</sup> (7 [GeV]) and e<sup>+</sup> (4 [GeV])
  - e<sup>-</sup> → ← e<sup>+</sup> ⇒ Υ(4S) ⇒ B $\bar{B}$
- Boosted B $\bar{B}$  pairs
  - Lorentz factor  $\beta\gamma=0.28$
- target luminosity : 8 × 10<sup>35</sup> [cm<sup>-2</sup>s<sup>-1</sup>]
- Luminosity at KEKB ×40

### The Belle II Detector

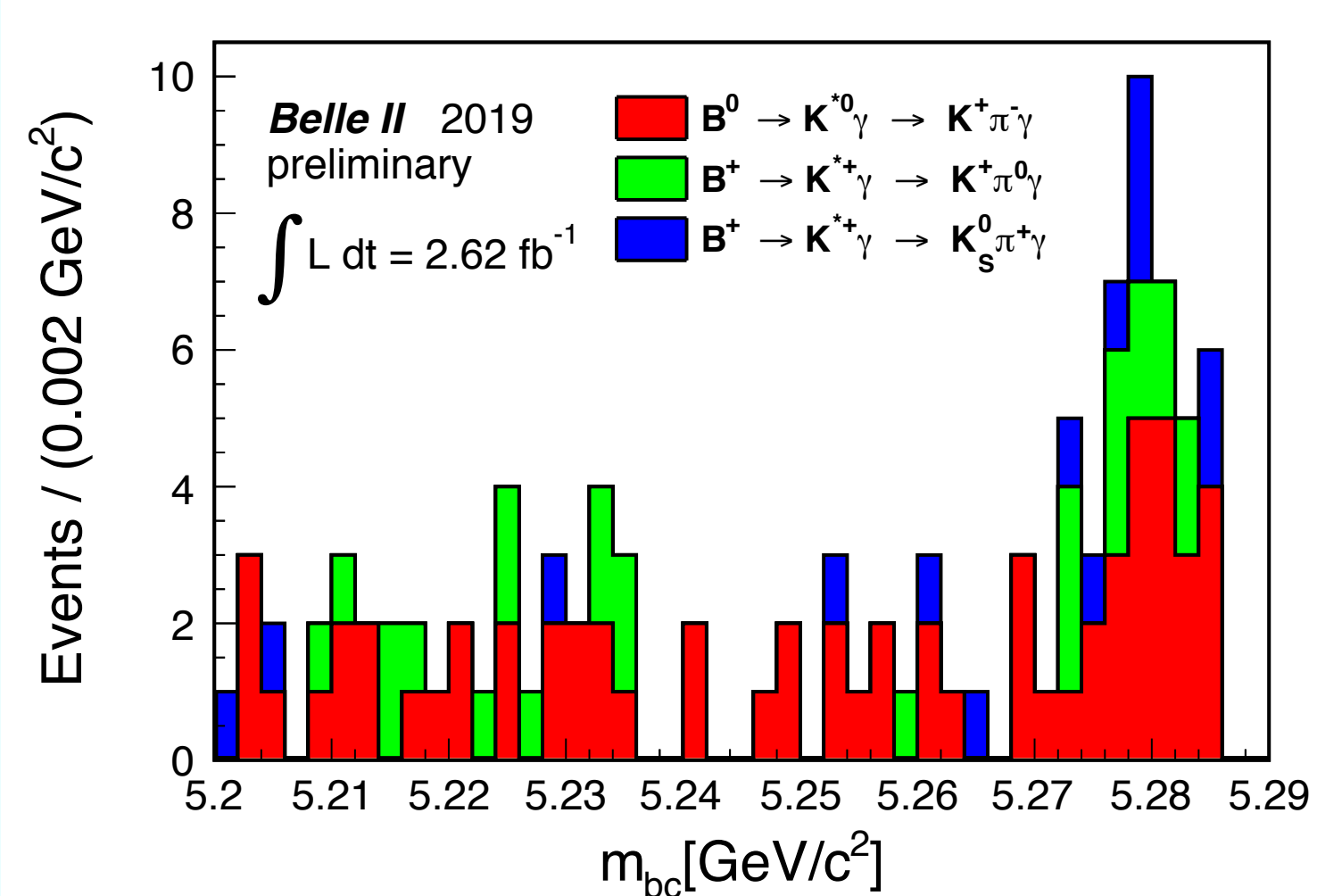


- General purpose spectrometer
- Seven sub-detectors
- 4π acceptance
- 30 kHz readout
- high background resistance
- Good particle identification

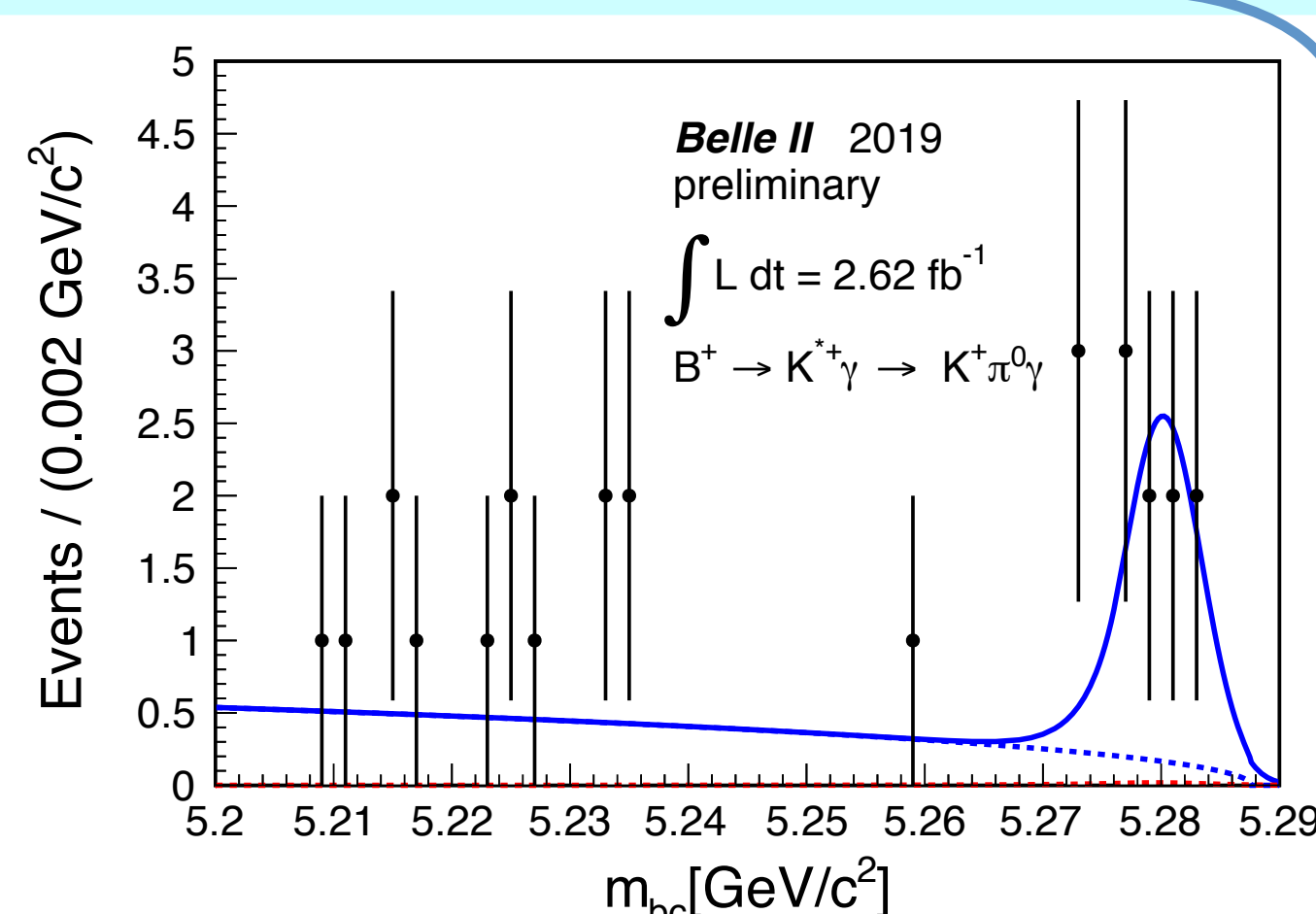
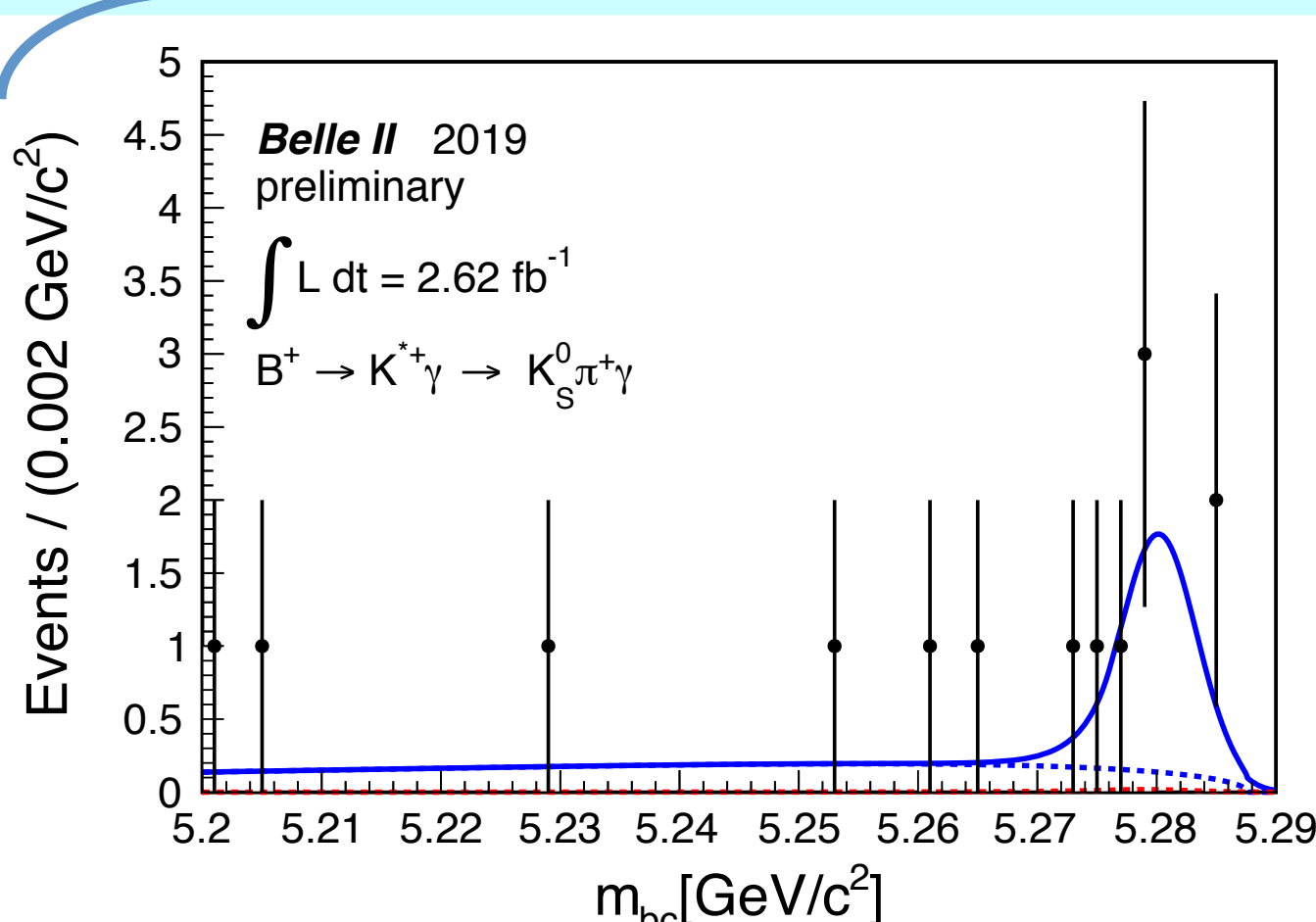
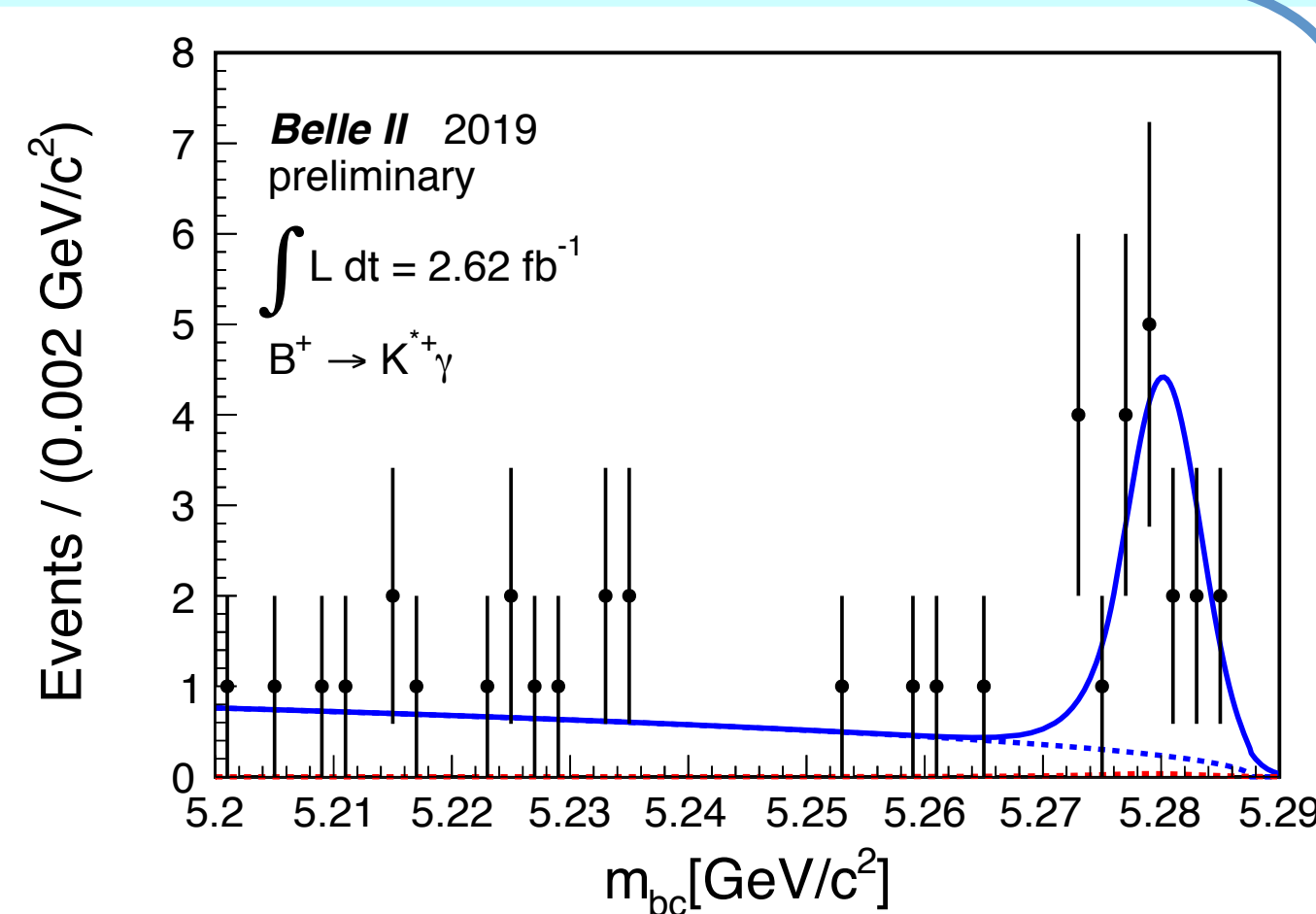
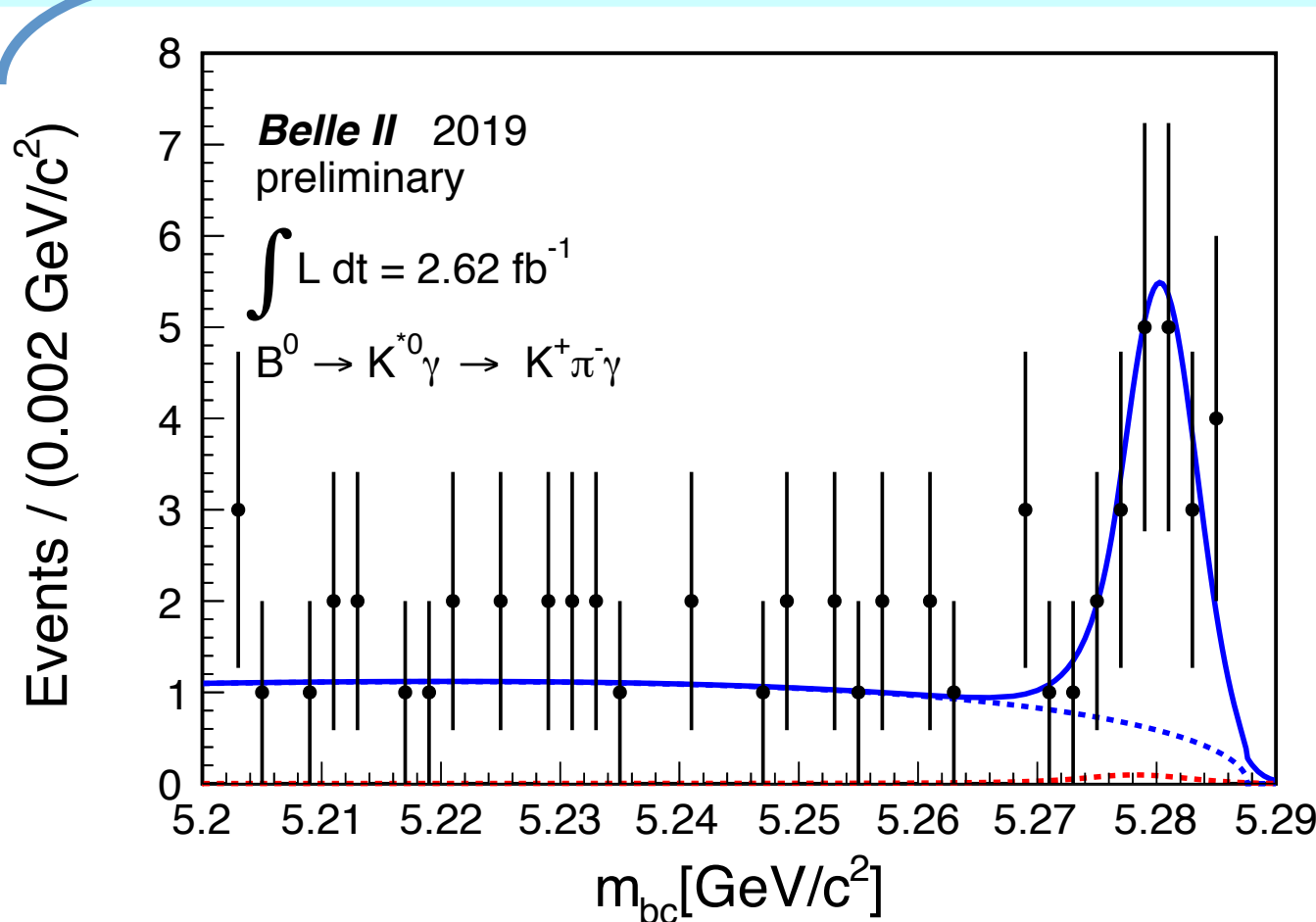
## Rediscovering Radiative Penguins

Search B → K\*γ decay in early Belle II data using three decay modes

- B<sup>0</sup> → K\*<sup>0</sup>γ → K<sup>+</sup>π<sup>-</sup>γ
- B<sup>+</sup> → K\*<sup>+</sup>γ → K<sup>+</sup>π<sup>0</sup>γ
- B<sup>+</sup> → K\*<sup>+</sup>γ → K<sub>S</sub><sup>0</sup>π<sup>+</sup>γ
- Distribution of beam energy constrained mass  $m_{bc} = \sqrt{E_{beam}^2 - p_B^{*2}}$  has clear peak at  $m_B = 5.28 \text{ GeV}/c^2$
- Signal yield and significance is obtained by fitting.



- : sum of all components
- - - : e<sup>+</sup>e<sup>-</sup> → qq̄ (q = u, d, s, c) background
- · - · : peaking background

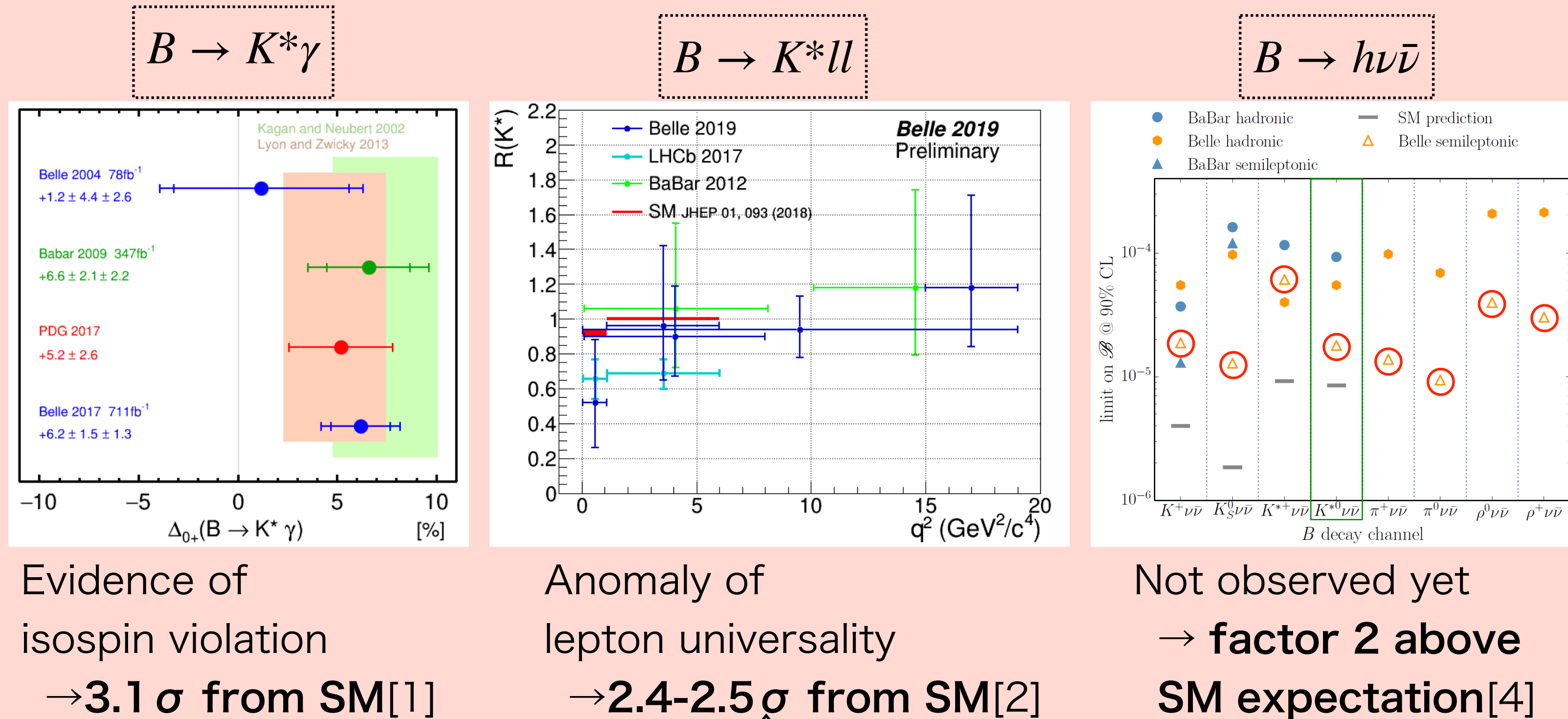


	signal yield (statistics only)	expected number of signals	significance
B <sup>0</sup> → K <sup>+</sup> π <sup>-</sup> γ	19.1 ± 5.2	18.2	4.4σ
B <sup>+</sup> → K <sup>+</sup> π <sup>0</sup> γ	9.8 ± 3.4	5.5	3.7σ
B <sup>+</sup> → K <sub>S</sub> <sup>0</sup> π <sup>+</sup> γ	6.6 ± 3.1	4.8	2.1σ
B <sup>+</sup> → K* <sup>+</sup> γ	17.0 ± 4.5	10.0	4.4σ

- Signal yield is consistent with expected number of signals.
- Combining neutral mode and charged mode, significance is 6.2σ.

B → K\*γ is rediscovered at Belle II.

## Status



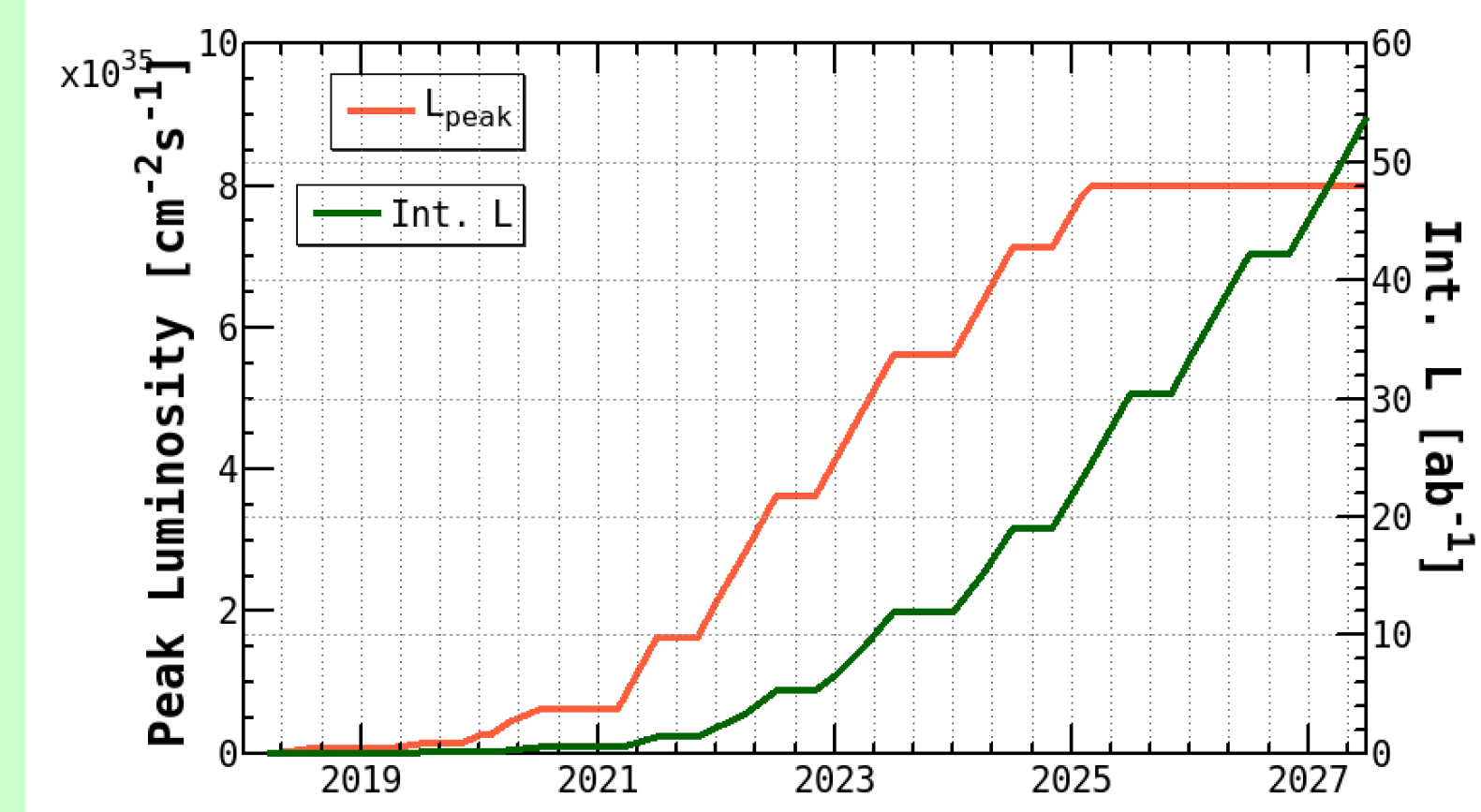
Evidence of isospin violation → 3.1σ from SM[1]

Anomaly of lepton universality → 2.4-2.5σ from SM[2]

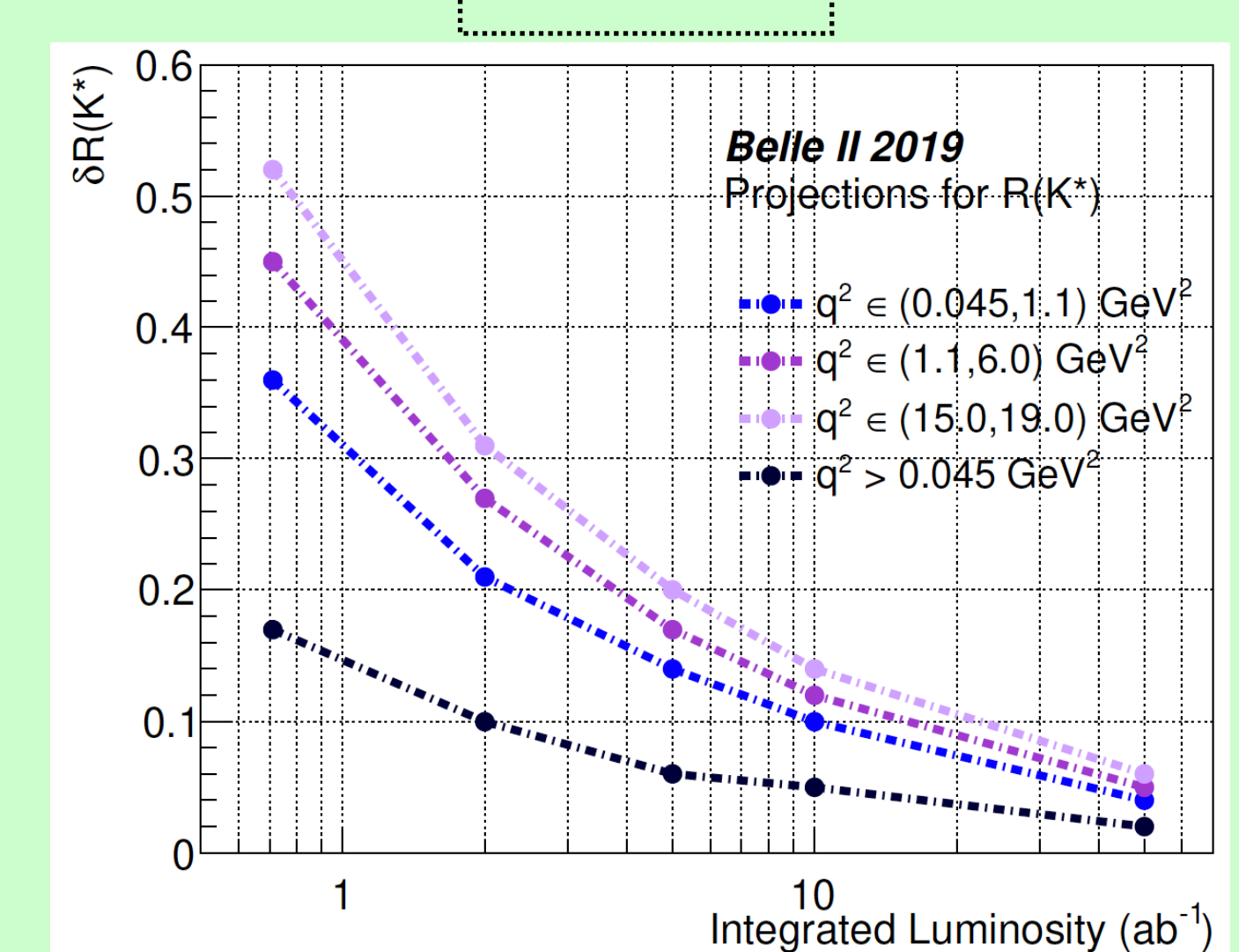
Not observed yet → factor 2 above SM expectation[4]

## Prospect

SuperKEKB aims to accumulate 50 ab<sup>-1</sup>.



- K\*γ : verify Isospin violation
- K\*(\*)ll : verify Lepton Universality violation
- hνν̄ : can be observed at early Belle II



δR(K\*) (q<sup>2</sup> > 0.045 GeV<sup>2</sup>/c<sup>4</sup>) : 0.17 (0.7 ab<sup>-1</sup>) → 0.06 (5 ab<sup>-1</sup>)

## Summary

- Flavor changing neutral current is an ideal probe to search New Physics.
- Belle II have started collecting beam collision data.
- B → K\*γ decay has been rediscovered at Belle II (6.2σ).
- We search New Physics with radiative and electroweak penguin : K\*γ, K\*(\*)ll, hνν̄ etc. **stay tuned!**

## Reference

- T. Horiguchi *et al.* (Belle Collaboration), Phys. Rev. Lett. 119 (2017), 191802
- R. Aaij *et al.* (LHCb Collaboration), JHEP 08 (2017), 055
- A. Abdesselam *et al.* (Belle Collaboration), arXiv:1904.02440v2 [hep-ex]
- J. Grygier *et al.* (Belle Collaboration), Phys. Rev. D 96 (2017), 091101