

# Hadronic B decays in early Belle II data

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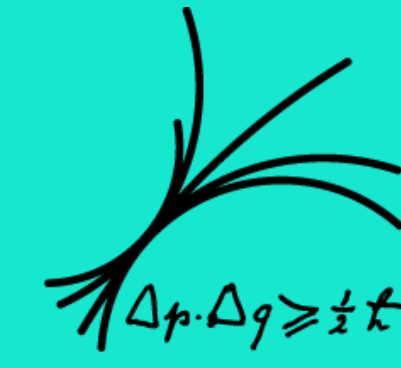
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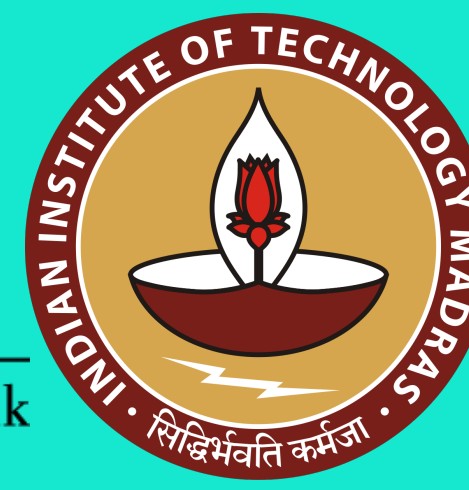
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Max-Planck-Institut für Physik  
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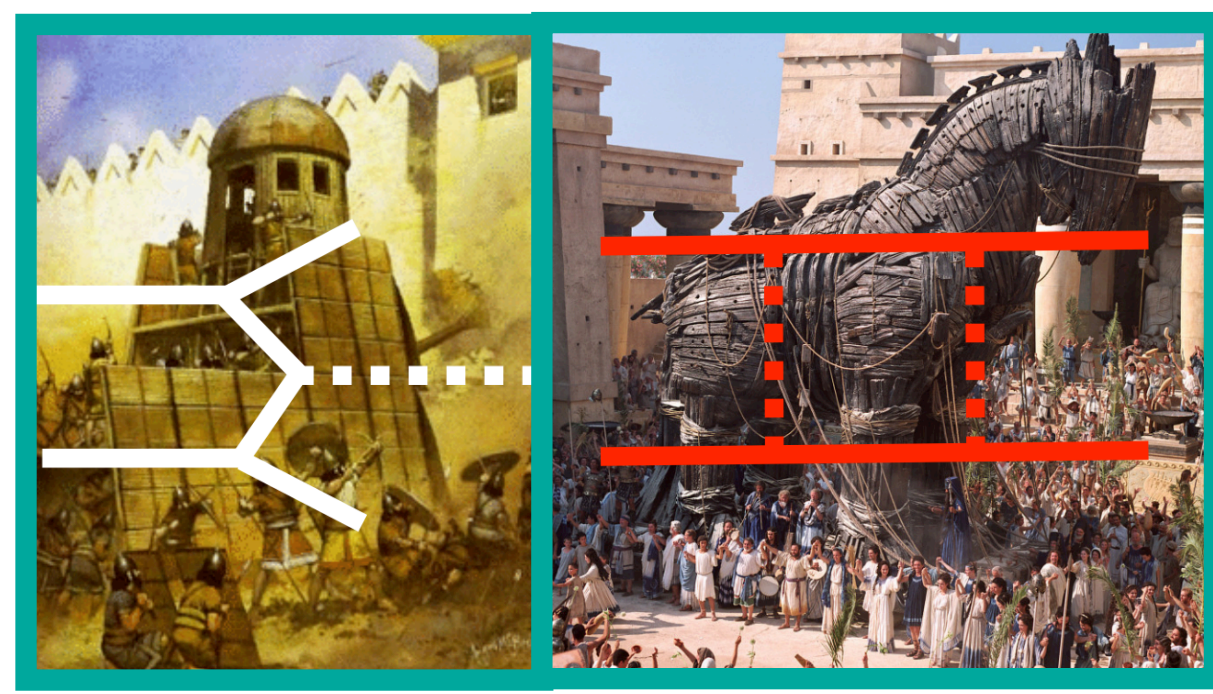


Completing the Standard Model at 10-10<sup>7</sup> TeV energies is the chief goal of today's particle physics.

Key role of Belle II hadronic B program in indirect searches based on flavor

- Reach ~few degree precision on  $\alpha/\varphi_2, \gamma/\varphi_3$  for tightened constraints on the CKM picture of CPV
- Probe non-SM sources of CPV in penguin-dominated  $b \rightarrow s$  and  $b \rightarrow d$  transitions ( $B \rightarrow \eta' K^0, B \rightarrow \phi K^0$ ).

Early hadronic B decays used to validate multiple aspects of detector performance.

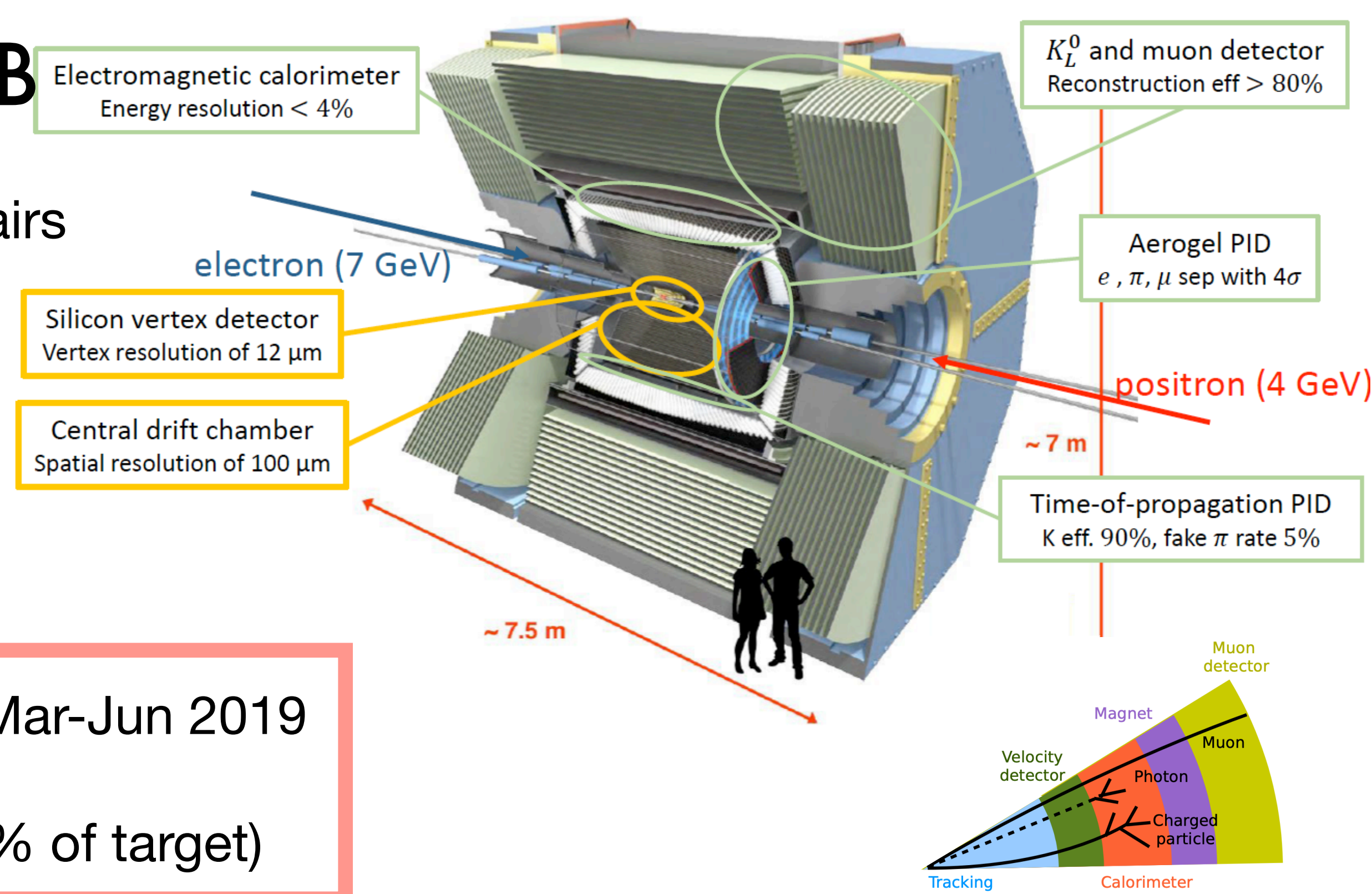


## Belle II at SuperKEKB

Goal: collect ~40 billion BB pairs (50x full Belle data)

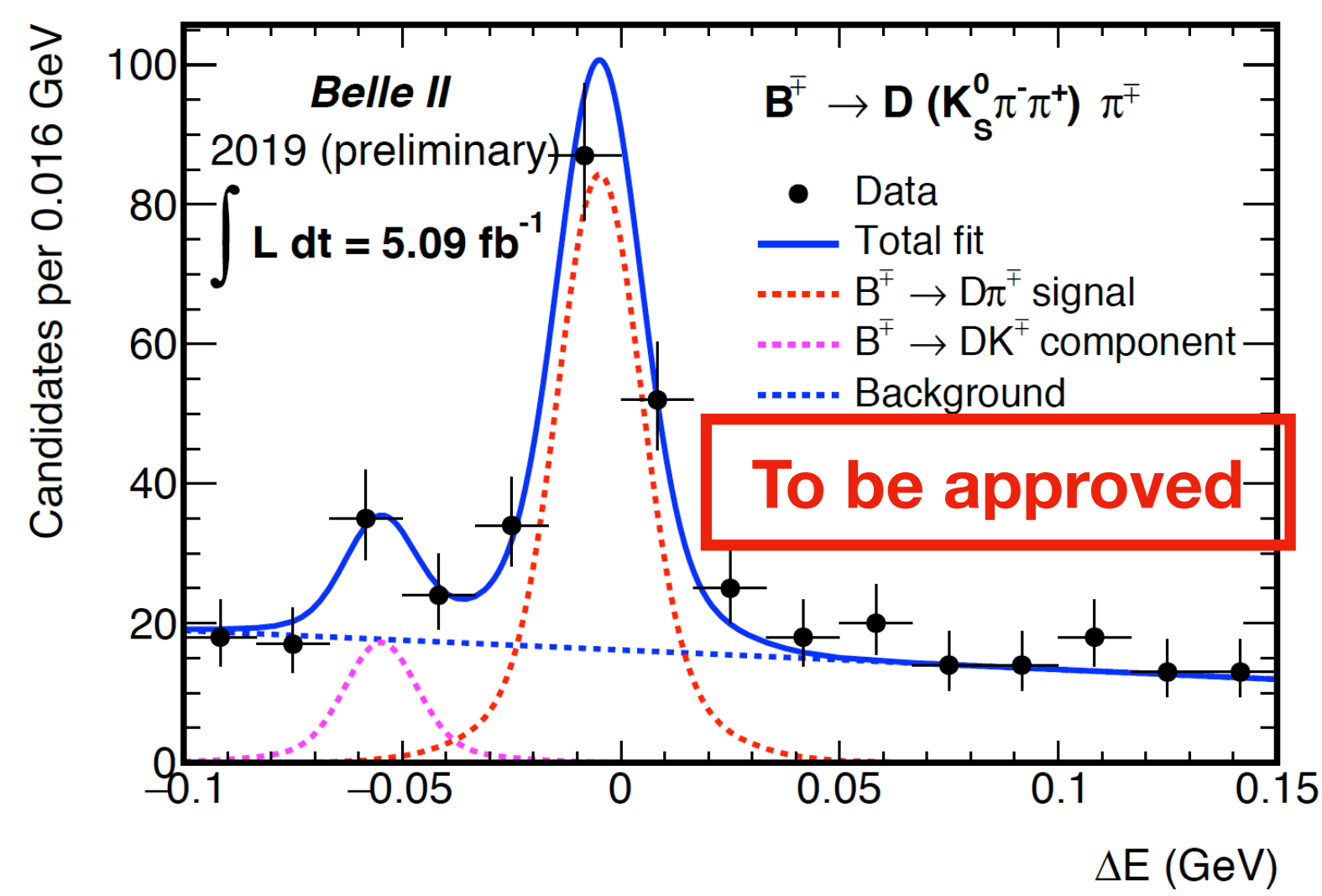
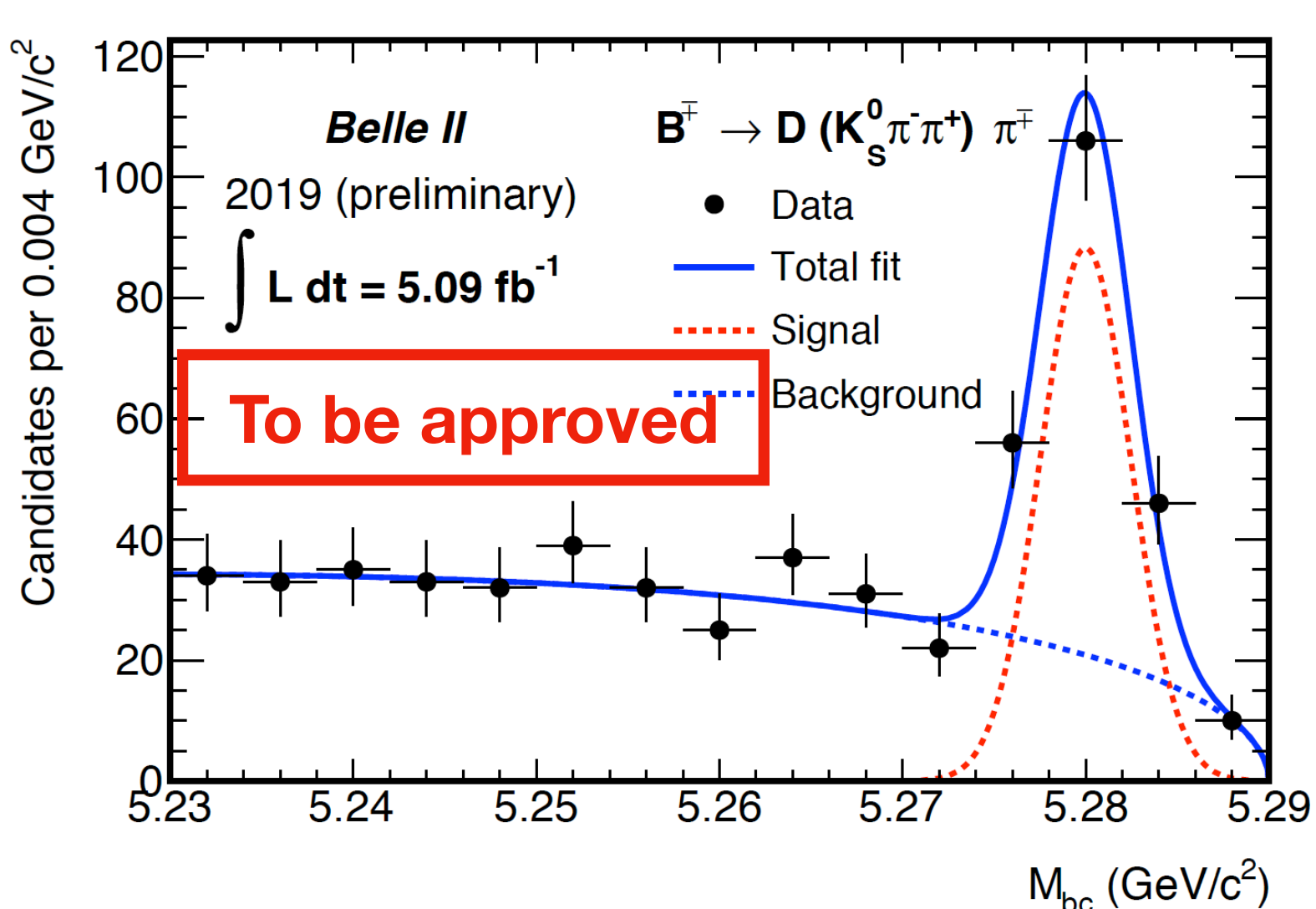
- low-background
- known collision energy
- coherent B-anti-B evolution

Collected first ~ 6.5 fb<sup>-1</sup> in Mar-Jun 2019 with complete detector  
 $\mathcal{L}_{\text{peak}} = 1.2 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$  (2% of target)

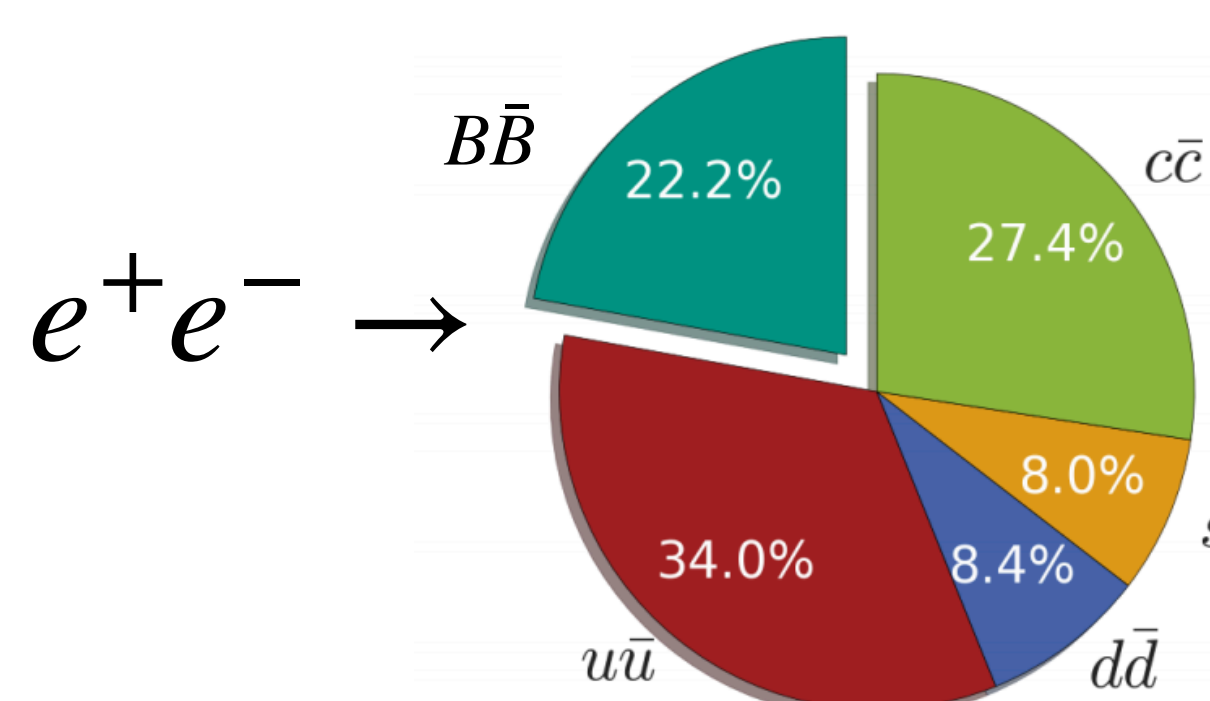


## B<sup>-</sup> → D<sup>0</sup>(K<sub>S</sub>π<sup>+</sup>π<sup>-</sup>)π<sup>-</sup>

Golden channel for  $\gamma/\varphi_3$

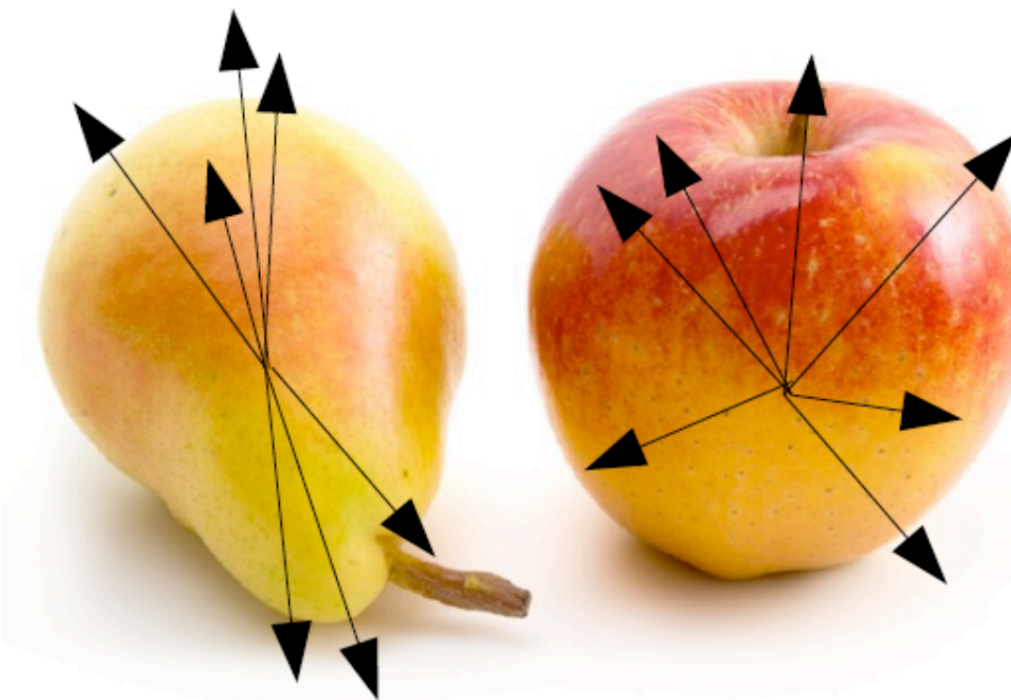


## Key challenge: continuum suppression

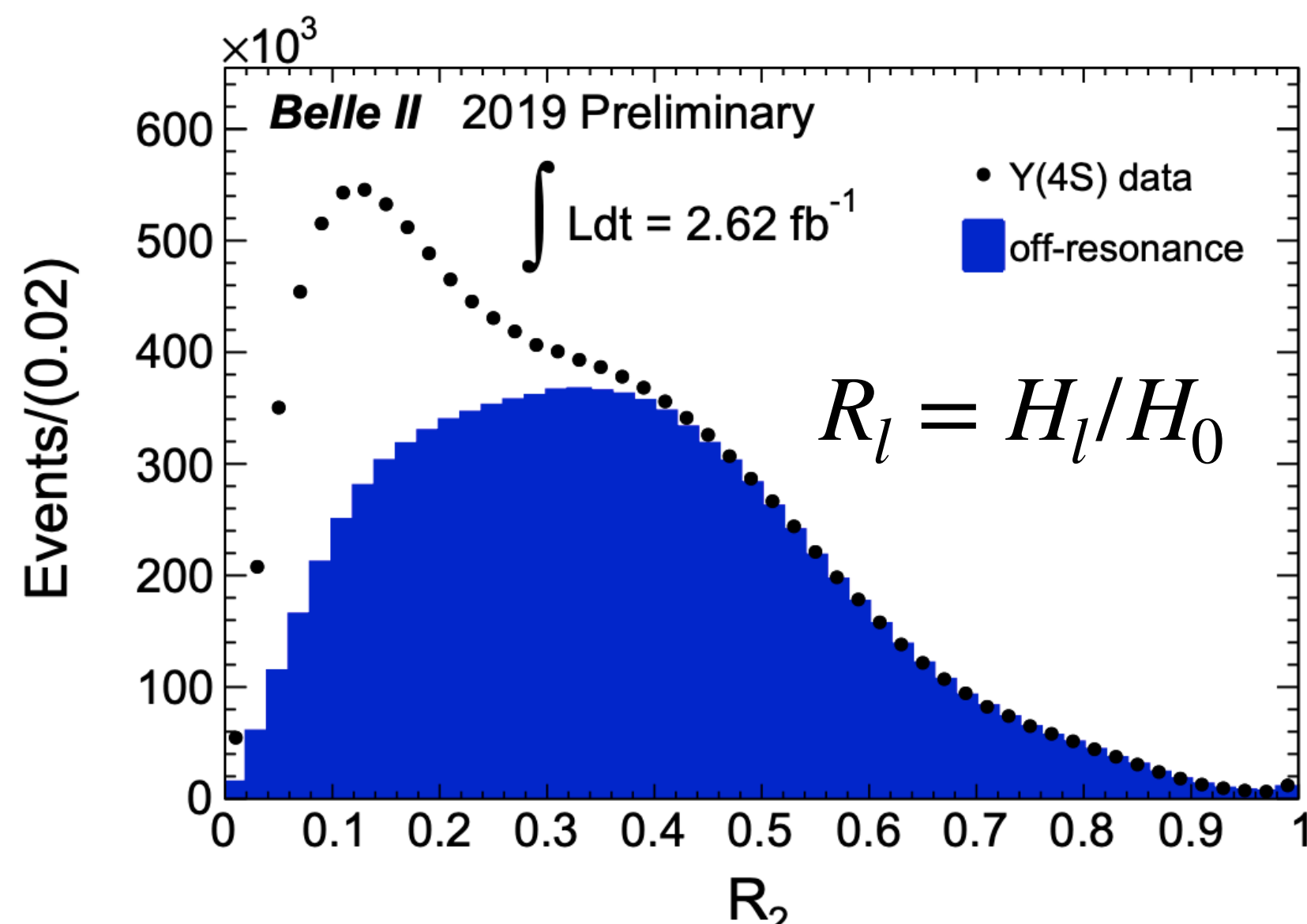


S/B at production is 10<sup>-3</sup> – 10<sup>-6</sup> due to light-quark production and BF.

$$\text{Fox-Wolfram } H_l = \sum_{ij} \frac{|p_i||p_j|}{E_{\text{vis}}^2} P_l(\cos\theta_{ij})$$

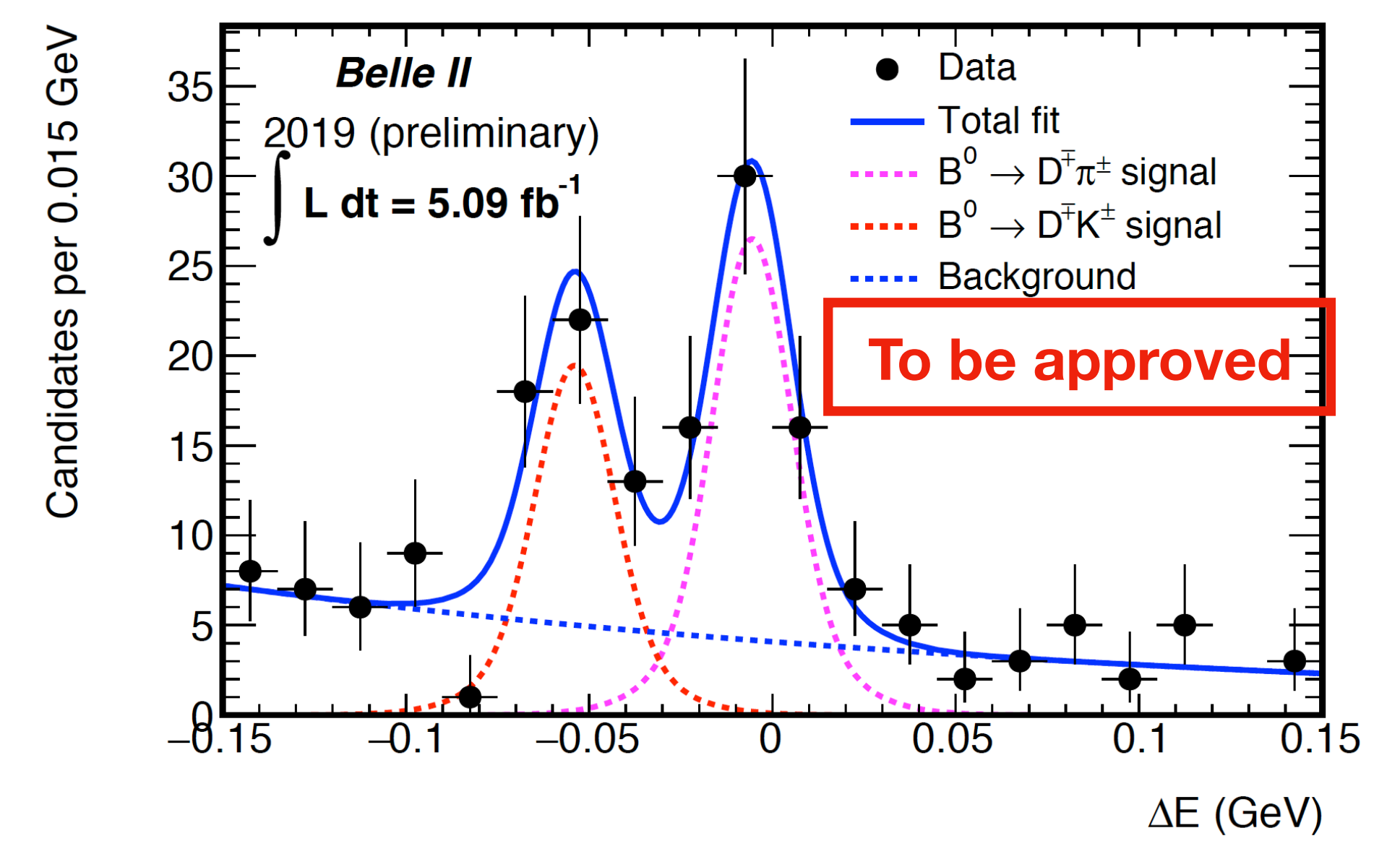
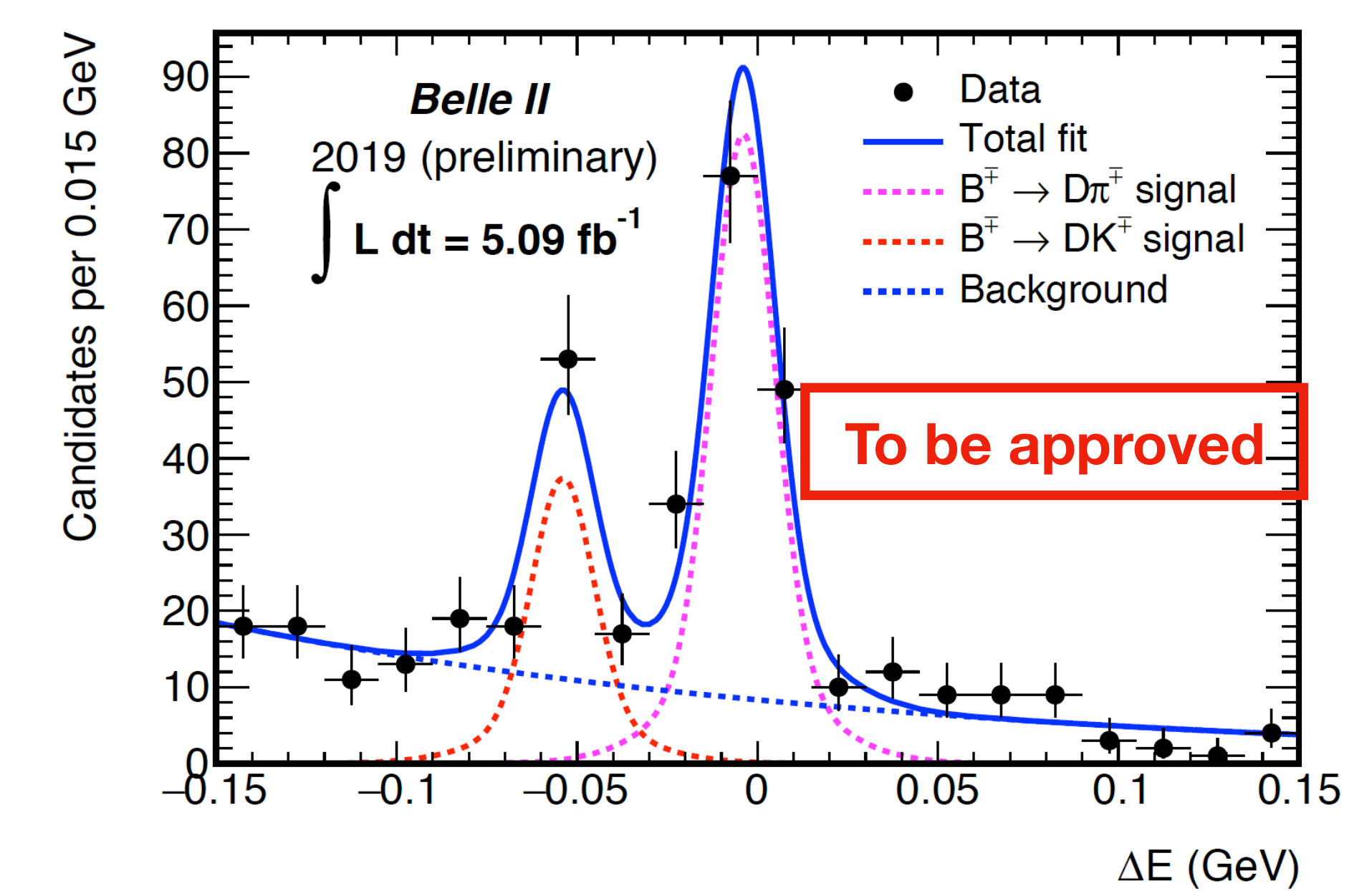


Exploit "event-shape" to separate b/w "collimated topology" continuum and "spherical topology" B production

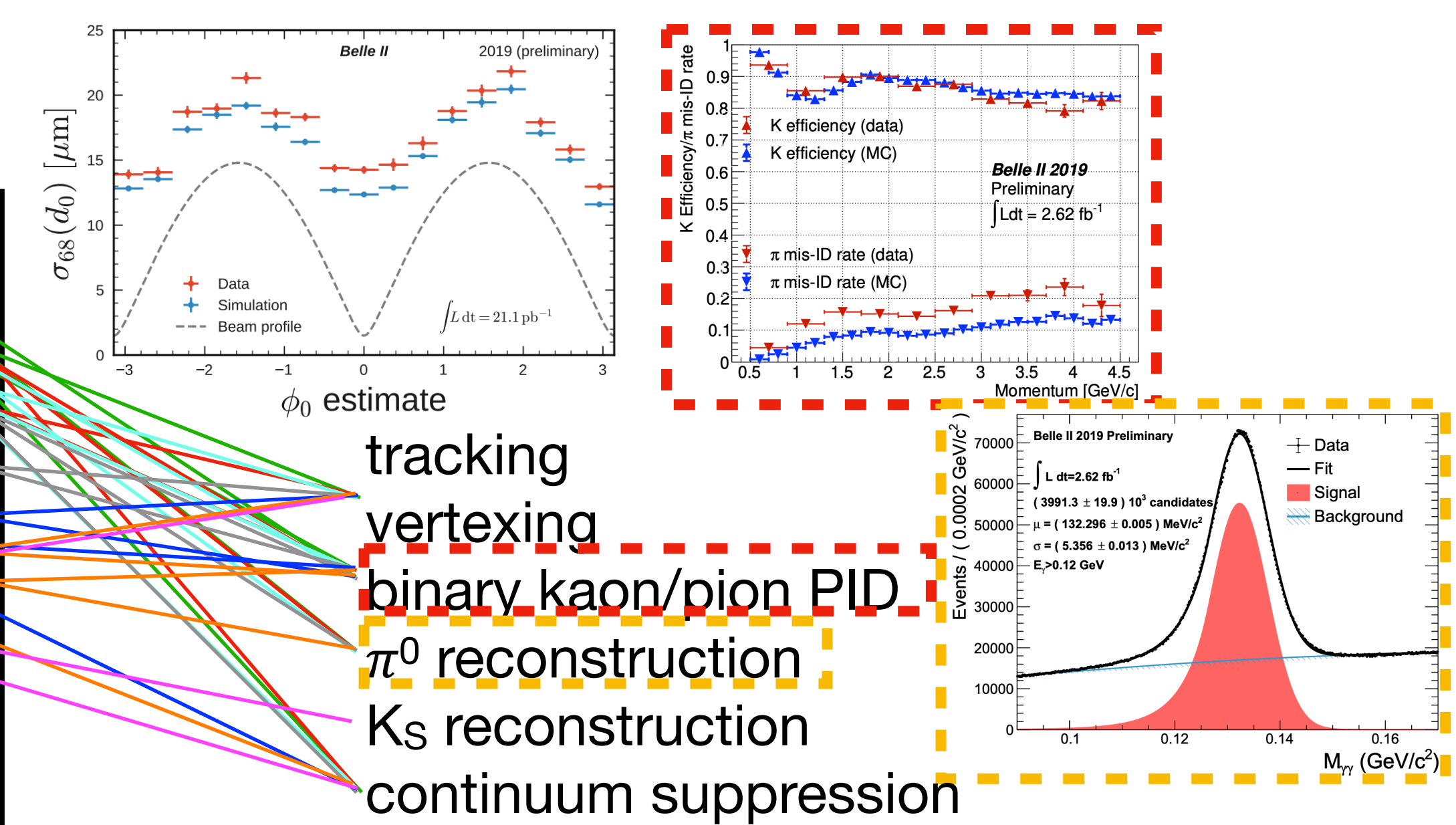
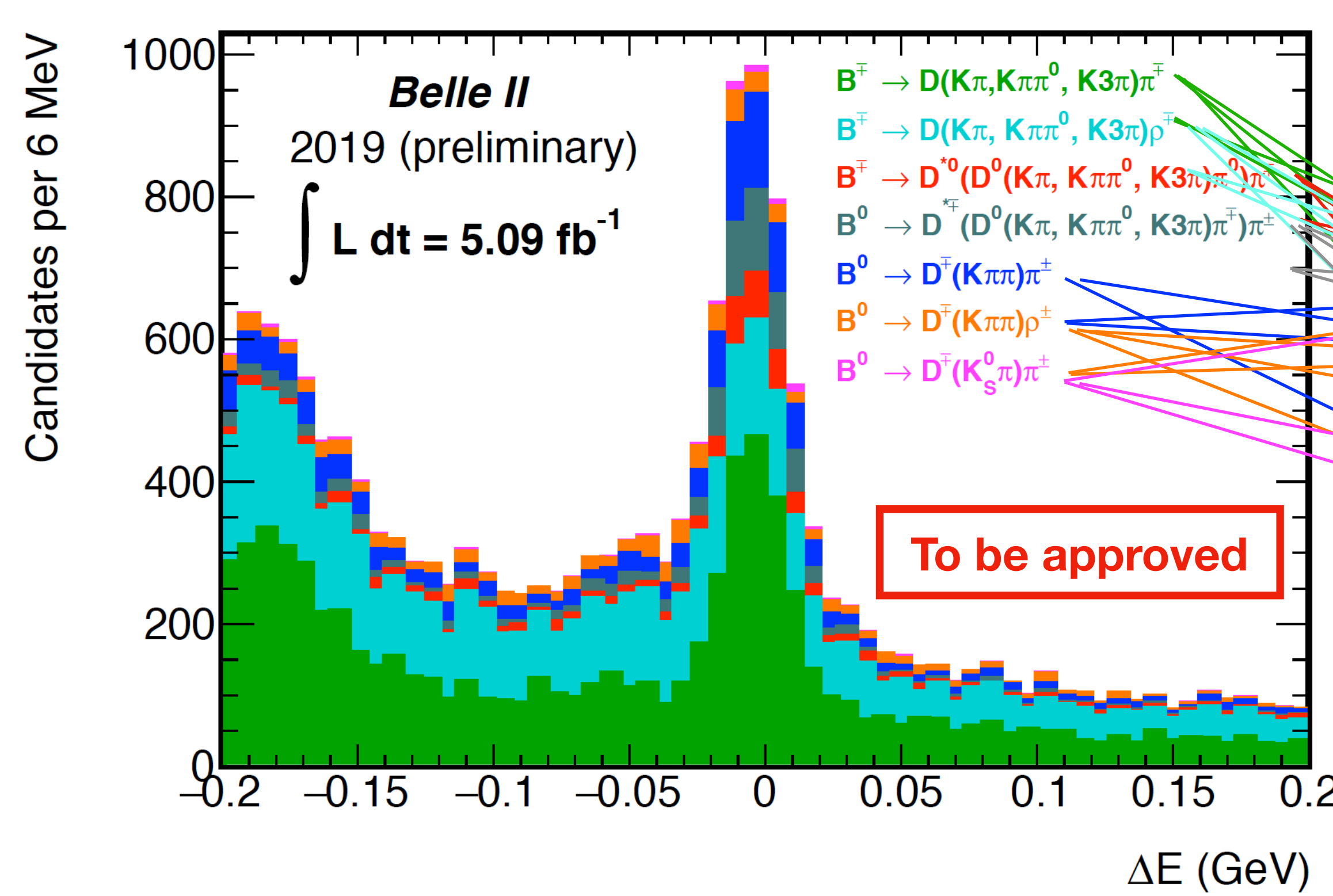
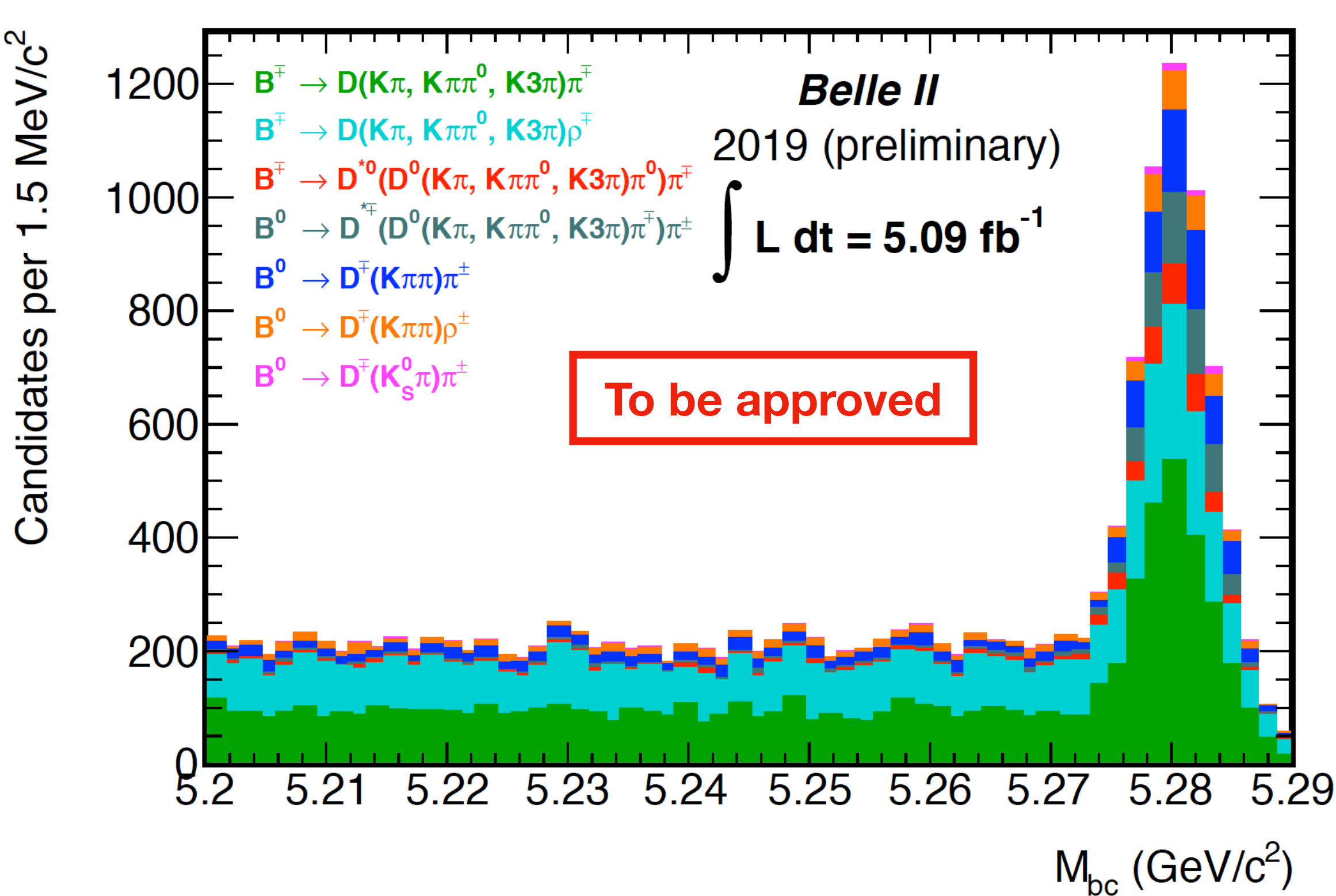


Use more information: combine nonlinearly 20+ kinematic, decay-time, PID and event-topology variables to maximize S/B

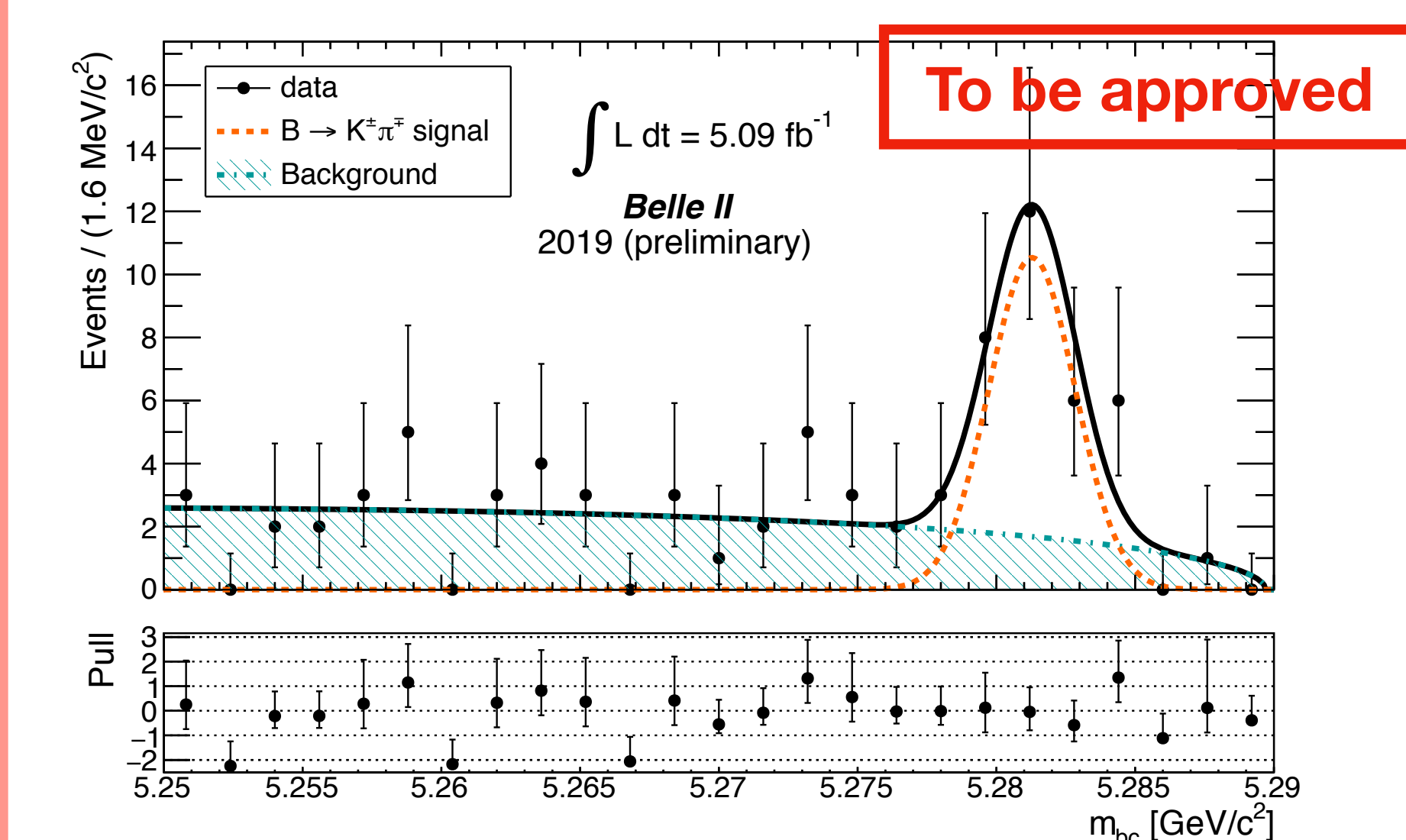
## B → DK



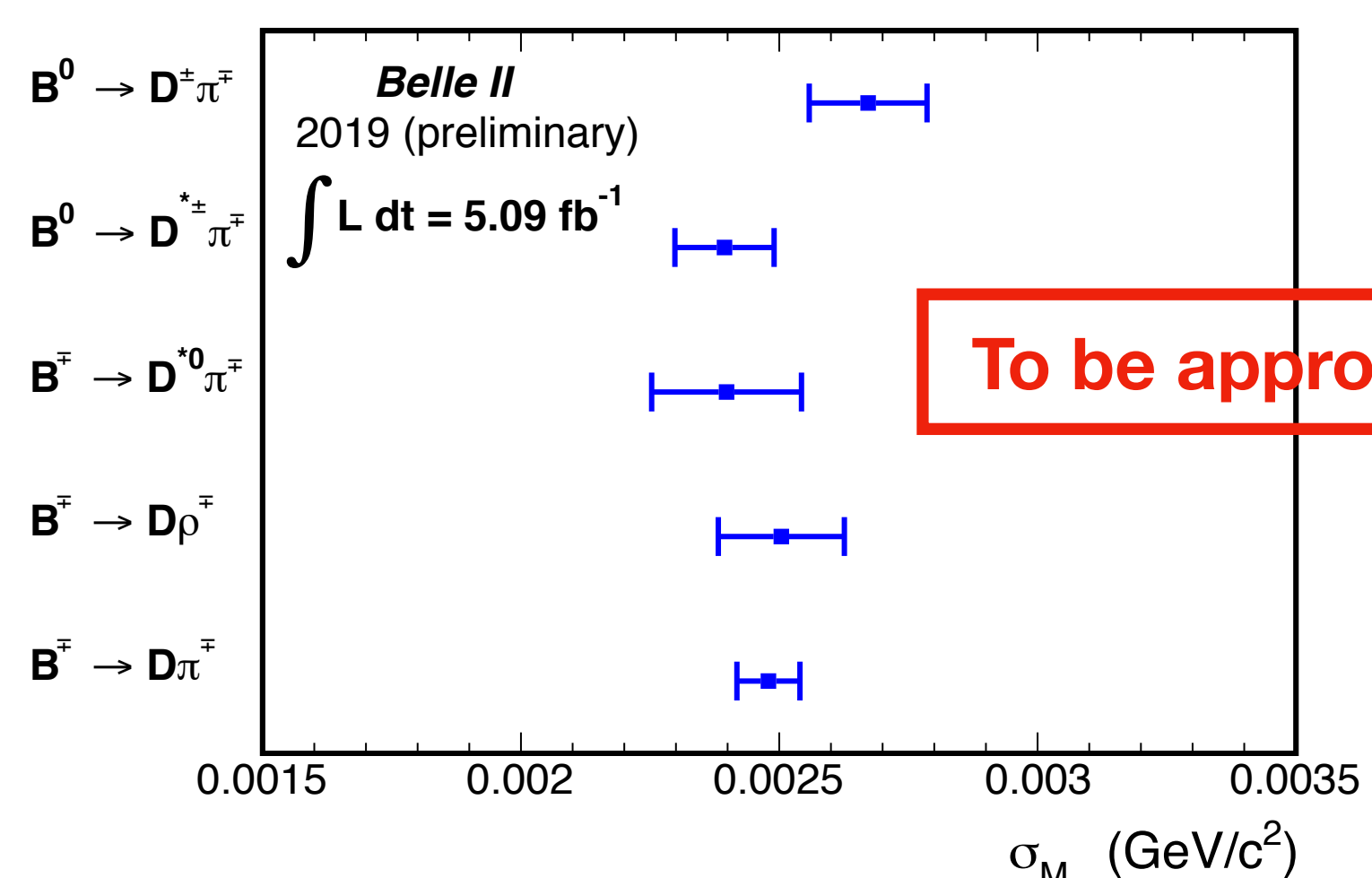
## Results



## First charmless signal from Belle II - new for Beauty!



## Beam energy spread



- Belle II: (co)lead the indirect exploration of non-SM physics with flavor
- Key role for hadronic B decays
- Mid-2019, first physics with complete detector, allow detailed validation of performance
- 4600 B → D<sup>0</sup>h reconstructed in 5.1 fb<sup>-1</sup>,
- First observation of rare B → DK, B → Kπ decays.
- Beam energy spread is less than 3 MeV.
- Early data shows remarkable detector performance — Belle II is ready for physics