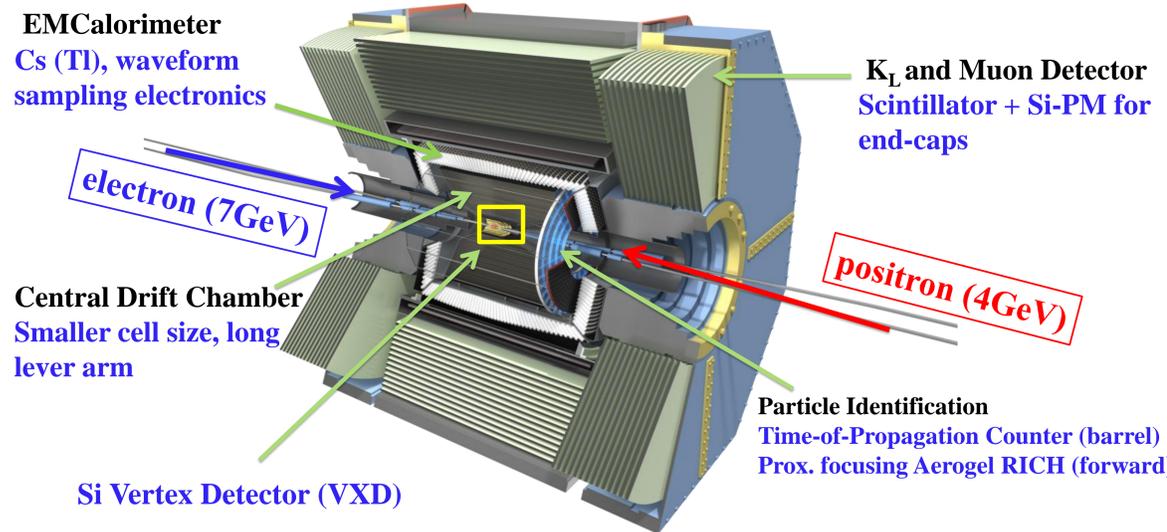


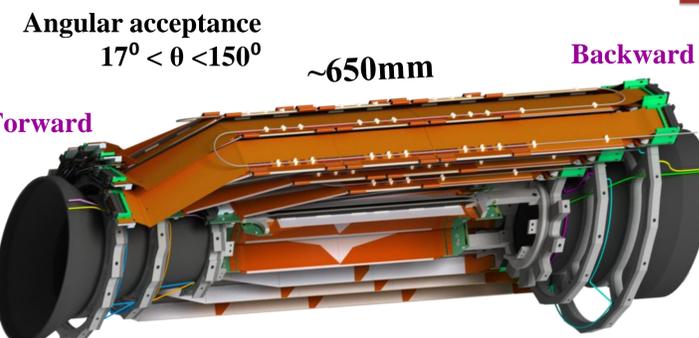
### Introduction

- Design luminosity of SuperKEKB:  $8 \times 10^{35} \text{ cm}^{-2} \text{ s}^{-1}$  that would enable Belle II to collect  $50 \text{ ab}^{-1}$  of data, 50 times more than its predecessor (Belle).
- Leads to harsh background environment in the Belle II.
- To validate the performance of the SVD, a systematic study is needed in the offline reconstruction software.
- The excellent performance of the Belle II SVD will provide the measurements of CP asymmetry in the B-meson system with higher precision.
- To achieve the physics goals, reconstruction of tracks with a high efficiency and a good resolution is needed.

### Belle II Detector



### SVD Structure

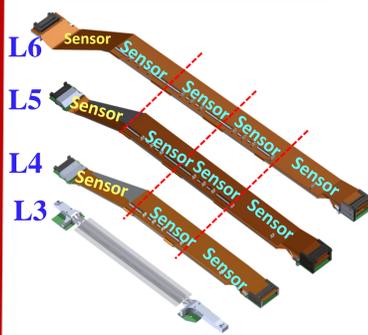


### Four Layer Structure

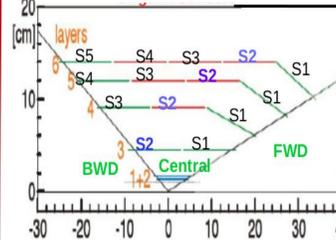
Layer	Institute
3	University of Melbourne
4	TIFR Mumbai, INDIA
5	HEPHY Vienna
6	IPMU University of Tokyo
FW, BW	INFN Pisa

### Belle II Silicon Vertex Detector

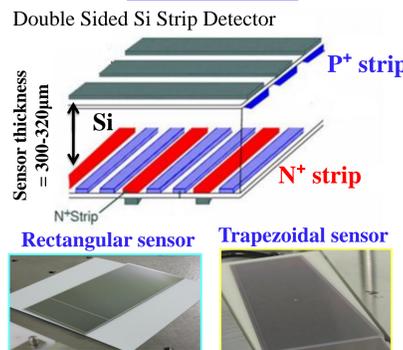
#### Ladder Structure



#### Sensor's position on ladders



#### Si-Sensors



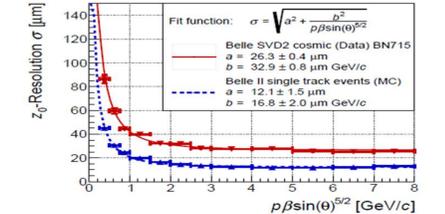
	Rectangular	Trapezoidal
No of Strips		
# of p-strips	768	768
p-strip pitch (um)	75 (L3:50)	50...75
# of n-strips	512 (L3:768)	512
n-strip pitch (um)	240 (L3:160)	240
Active area (mm <sup>2</sup> )	7030 (L3:4738)	5890

Belle II SVD is shifted outward to a maximum radius of 140mm as compared to Belle.

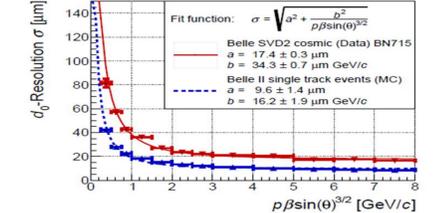
- Better vertex resolution
- Low  $p_T$  track finding efficiency
- Improved  $K_S^0$  reconstruction efficiency.

#### Impact Parameter Resolution

##### Transverse ( $d_0$ )



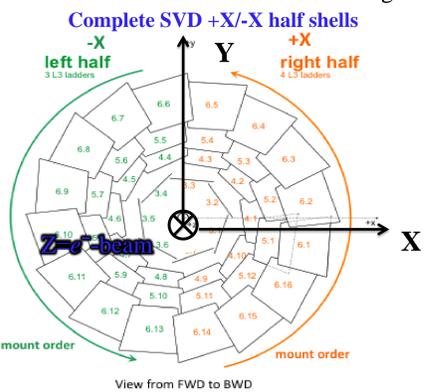
##### Longitudinal ( $z_0$ )



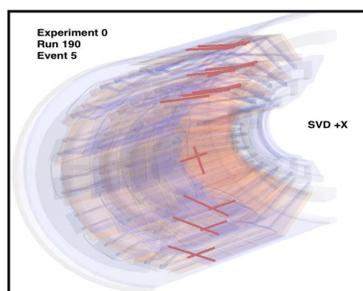
Improved resolution at IP with respect to Belle (PTEP-2018).

### Commissioning of the SVD

- The full SVD +X and -X half shells have been installed at KEK, Japan.
- Testing of full SVD with cosmic rays is carried out during the commissioning period from July 21 to September, 2018. (Collected:  $30 \times 10^6$  cosmic events)
- Performance studies of the SVD using offline reconstruction software are in progress.

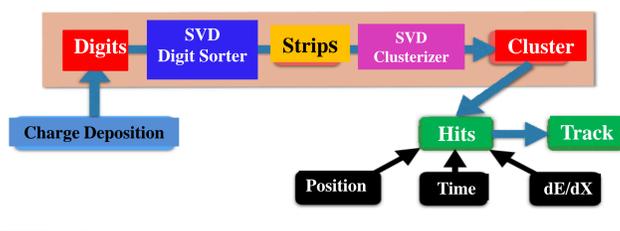


First cosmic event in SVD +X half (July 10, 2018)



### Results: Commissioning Data Analysis

#### Reconstruction Software (Framework)

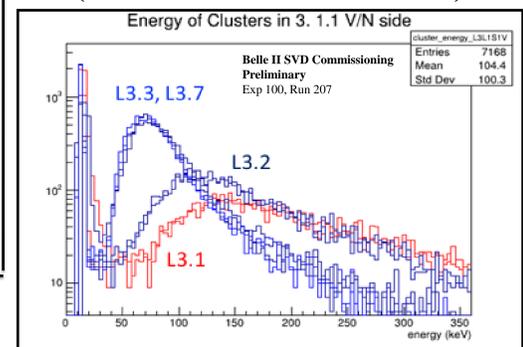


#### Information of Data:

Run no 702 (commissioning data) (July 2018)  
Trigger rate: 4.7Hz, N(evt) = 382278  
SVD ladders: +X half shell  
Module used: SVDB4 Commissioning Analysis Module

#### Cluster Energy

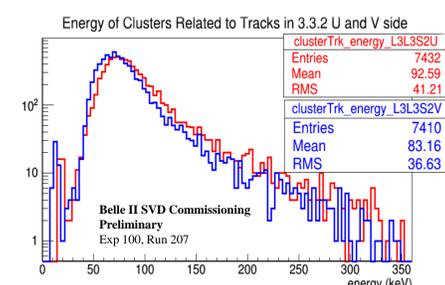
(not associate with tracks)



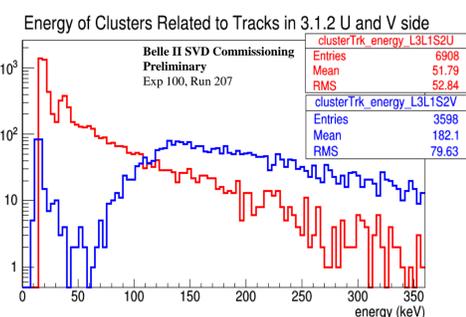
Distribution of the energy deposit in a horizontal silicon sensor ( $t=300\mu\text{m}$ ) by a cosmic ray ( $\sim\text{MIP}$ ) is peaking at 80keV. The deposit distribution for random-trigger events was peaking at  $\sim 20\text{keV}$ .

#### Cluster Energy Distributions (Cluster Associated with track)

##### Horizontal Sensors (L3.Ld3.S2)



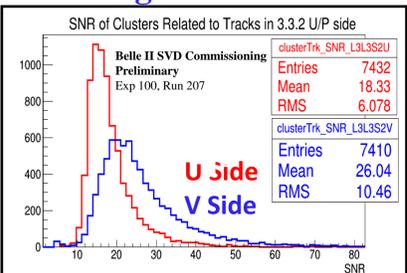
##### Vertical Sensors (L3.Ld1.S2)



- The cosmic track is perpendicular to the sensors (3.3)
- Clusters are correctly reconstructed on both sides (U, V)
- Cluster energy are in agreement for both side.

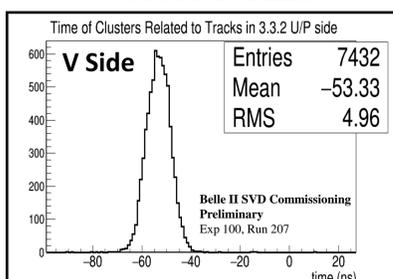
- For vertical sensors (3.1) cosmic particles are incident at large angles
- Hence deposit large energy on these sensors.
- Cluster energy for both sides are not in agreement.

#### Cluster Signal to Noise Ratio



S/N greater than 20, with the N side performing slightly better than the P side, as expected.

#### Cluster Time



The RMS of cluster times is in the order of 4 ns, nicely matching the design expectation.

### Summary

- Our detector has run smoothly during the commissioning period.
- Total  $30 \times 10^6$  cosmic events are collected.
- Performance of SVD is evaluated with cosmic runs for each side/sensor.

- Cluster energy are in agreement for U and V side for horizontal sensors but this is not true for vertical sensor due to cosmic particles are incident at large angles on vertical sensors
- Cluster SNR (for cluster associated with tracks)  $> 20$  for V side (expected).
- The RMS of Cluster time is in the order of 4ns, which is agreement with design parameter.