

PXD on/off challenge

Andrej Lozar, Ijeong Na, Krištof Špenko, Riccardo Manfredi

Physics week 2024 @ KEK

18. 10. 2024

Introduction

The new (complete) PXD was successfully installed during LS1

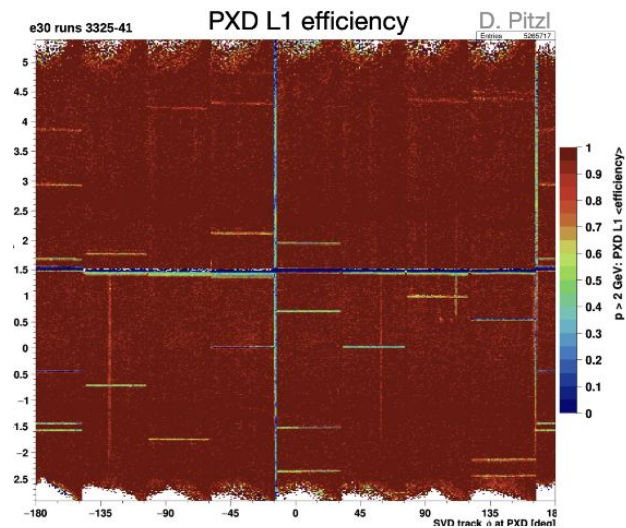
Sudden beam losses in Run2 damaged ~2% of the PXD

→ PXD was turned off for safety reasons on May 6

Operating with PXD off will result in worse resolution

→ Today showing tests on signal MC comparing PXD on/off

- Repeated D0 lifetime fit
- Impact on $D^+ \rightarrow \pi^+ e^+ e^-$ measurement
- Impact on $e^+e^- \rightarrow A'\gamma \rightarrow e^+e^-$

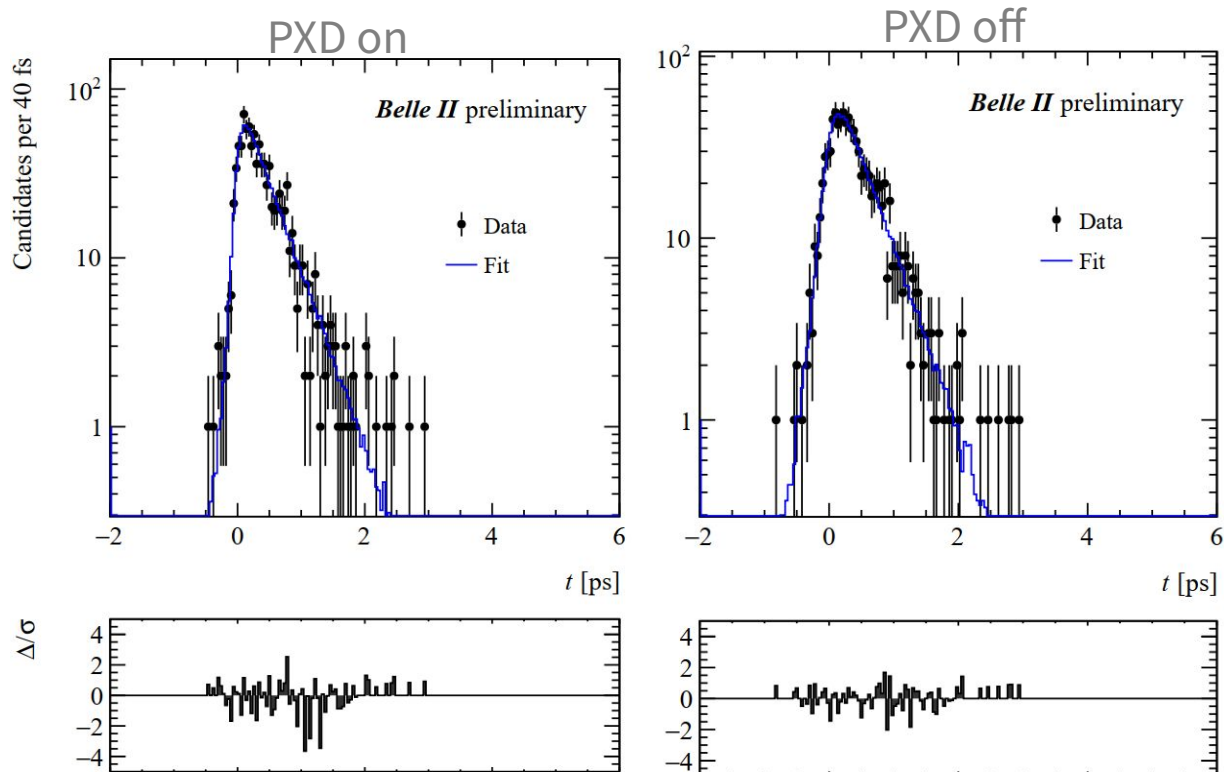


D⁰ lifetime (D→piK)

Sample size: 10k

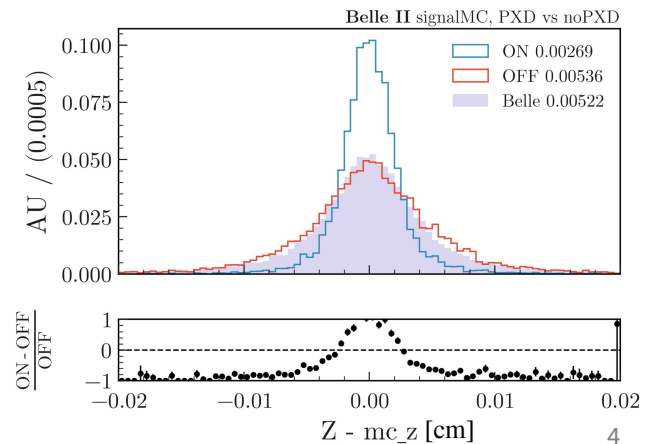
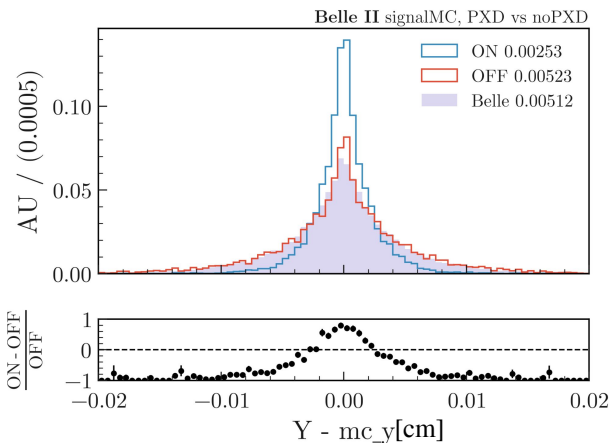
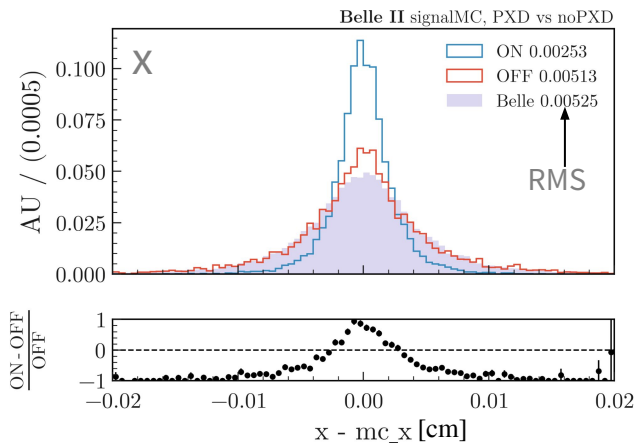
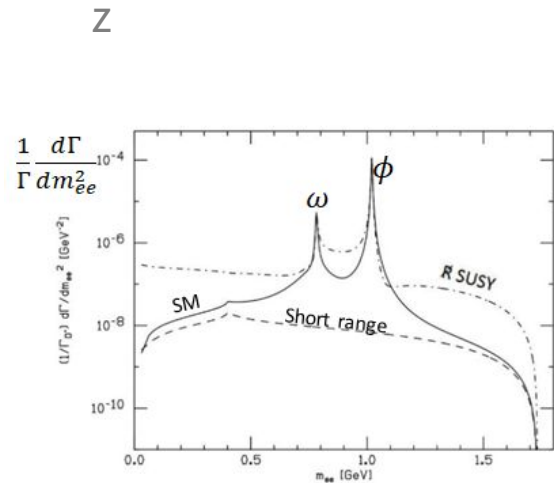
PXD on: 411 +/- 16

PXD off: 422 +/- 18



$D^+ \rightarrow \pi^+ e^+ e^-$

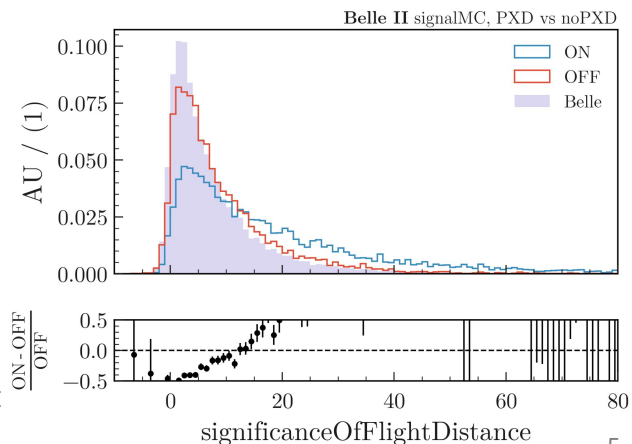
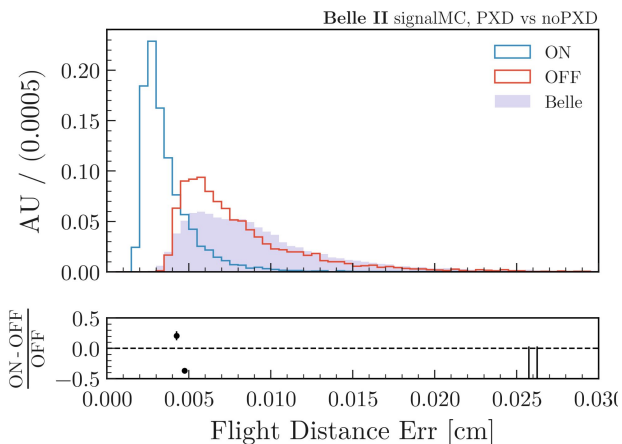
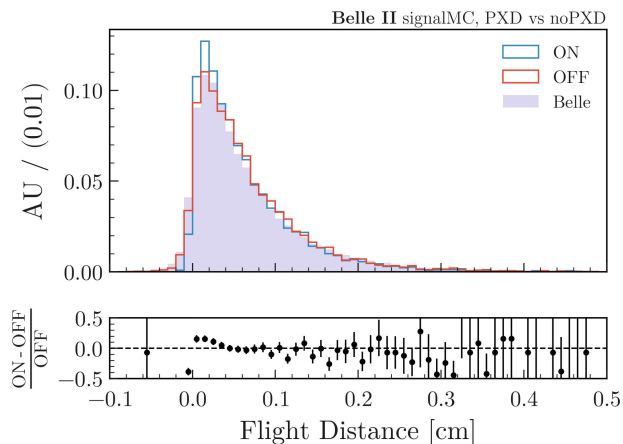
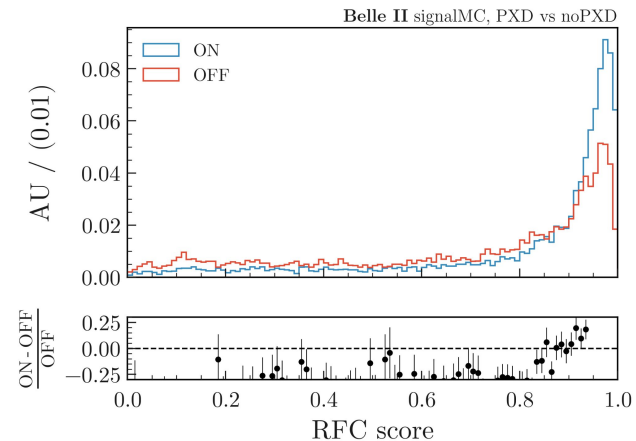
- Rare FCNC decay
- Search for signal by fitting $M(D^+)$ in $M(ee)$ region away from ϕ resonance
- Significant impact on vertex resolution in X, Y, Z
- RMS values with PXD off are comparable with Belle



$D^+ \rightarrow \pi^+ e^+ e^-$

→ Flight distance not affected, but the uncertainty is. Just slightly better than in Belle.

→ SoFD is used as input to RFC which impact its performance: $\varepsilon = 58\% \rightarrow 36\%$



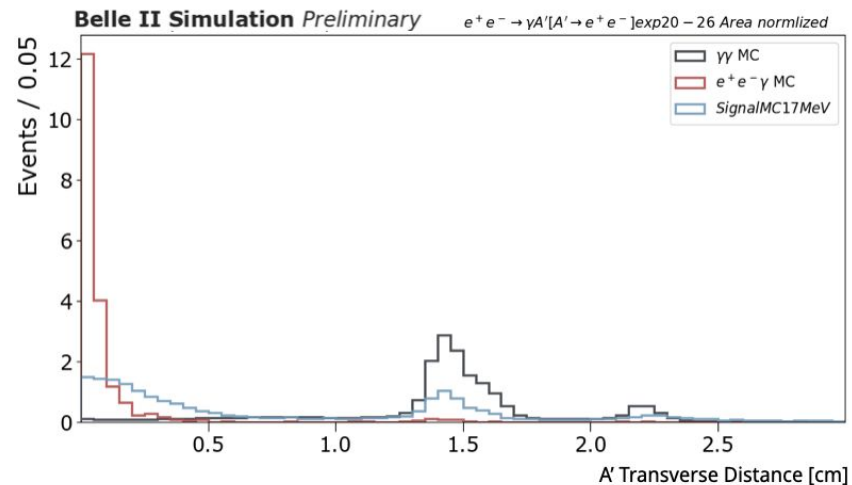
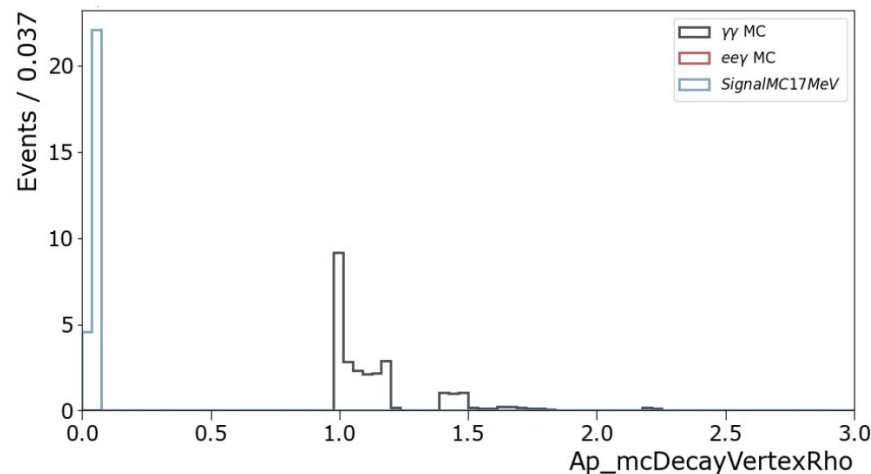
$$e^+e^- \rightarrow A'\gamma \rightarrow e^+e^-\gamma$$

Introduction :

- Dark photon visible, prompt decay into electron pair
- Signal : bump in Invariant mass dist.
- Background : photon conversion

Motivation :

- Vertex fit plays a major role in this analysis and it will be affected by the PXD off effect
- Compare the invariant mass and the vertex position from PXD on/off from Signal MC



Invariant mass & Transverse distance

Sample :

$$e^+e^- \rightarrow A'\gamma \rightarrow e^+e^-\gamma$$

17MeV SignalMC PXD On/Off

nEvents : 10k per each

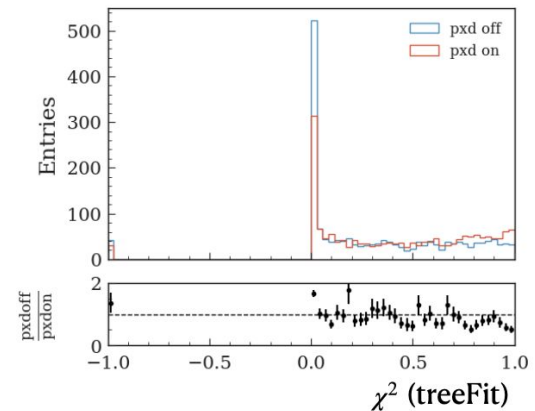
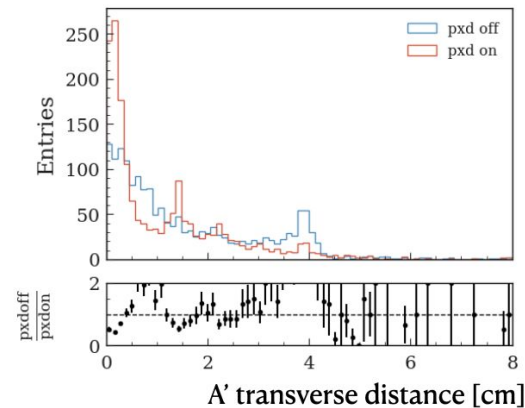
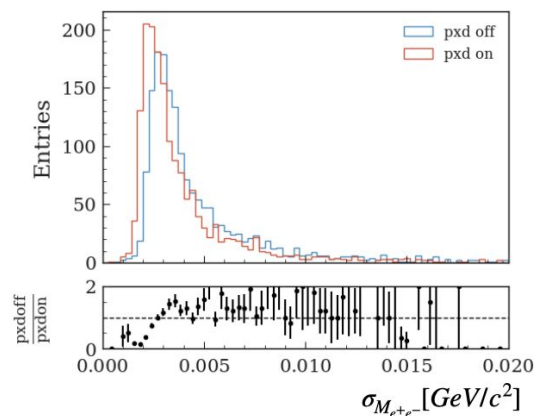
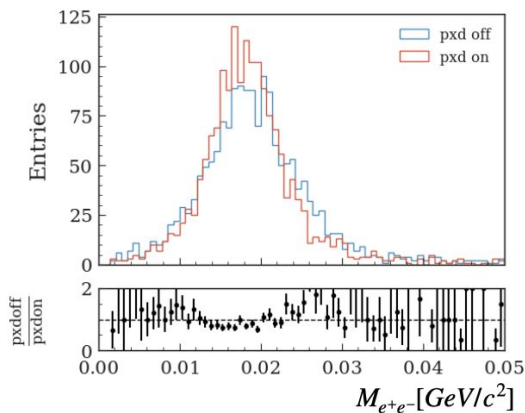
Event selection :

Select truth matched A' candidate
only (A' isSignal==1)

Entries after event selection :

PXD off : 1770

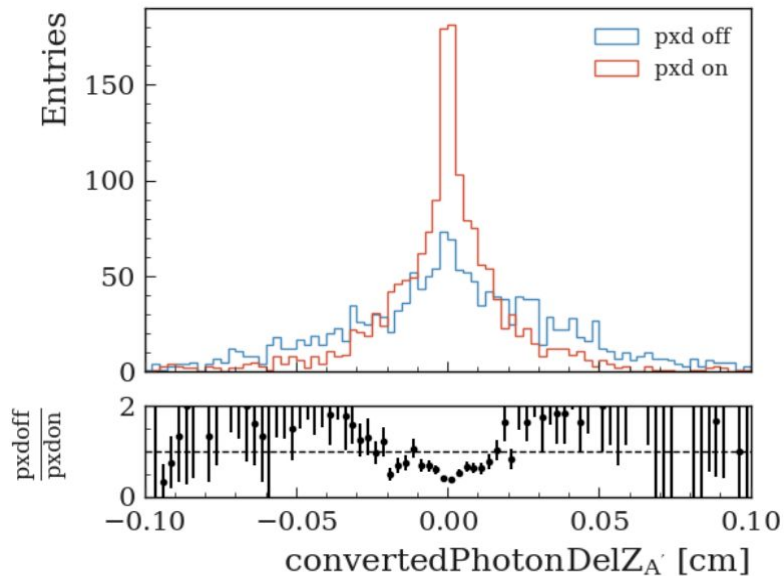
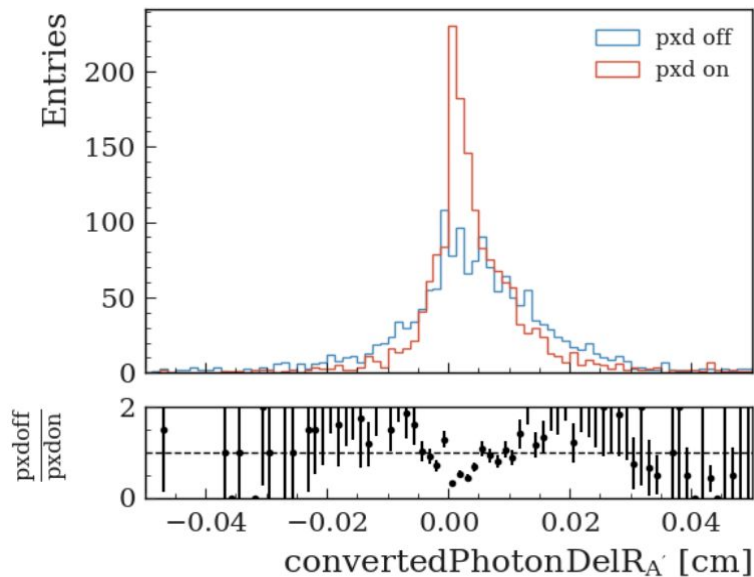
PXD on : 1753



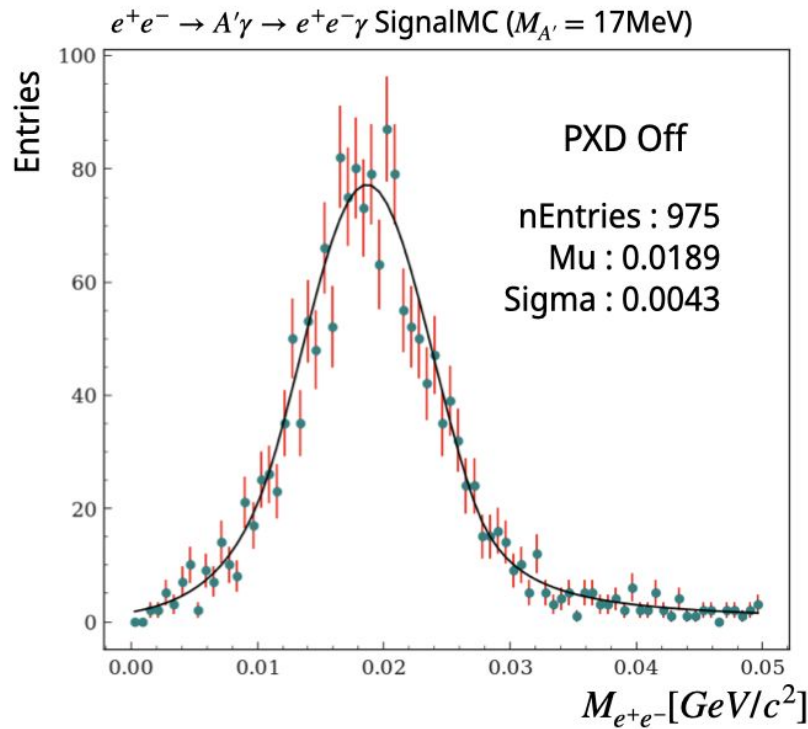
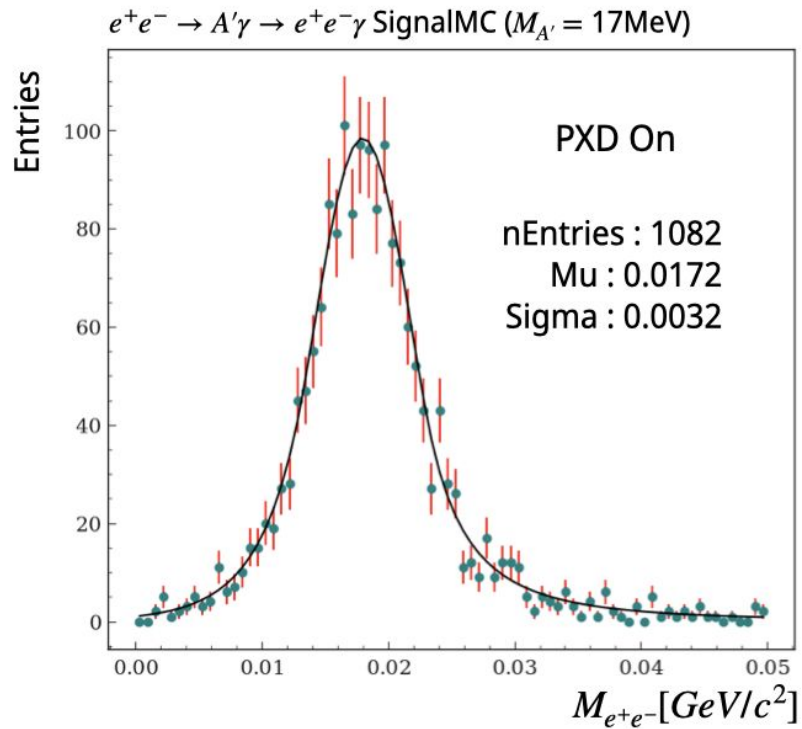
Photon conversion variables

Important information to suppress dominant background

https://indico.belle2.org/event/3644/contributions/18622/attachments/9401/14443/Photon_vertexin_B2GM.pdf



Invariant mass fit in analysis signal region ($dr < 1.2\text{cm}$)



Conclusion

Because of sudden beam losses during Run2, PXD was turned off since May 6

It is important to evaluate the effect of this on physics analyses

Today showed first tests on a few decay channels, showing non-negligible impact on performances