Search for Σ^0 Dalitz Decay

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Outline

Motivation

A) The $\mathcal{B}(\Sigma \to \Lambda e^+ e^-)$ is predicted to be 0.00545 by G. Feinberg at 1958. (PhysRev.109.1019)

B) No evidence is found after 60 years.

Method

A) Search signal in channel:

$$J/\psi \to \Sigma^0\bar{\Sigma}^0$$

B) One Σ decay into $\gamma\Lambda$

C) Search for signal in the remaining tracks.

$$\Sigma \to \Lambda e^+ e^-$$

D) DataSet: all J/ψ sample collected in 2012 years.

Event Selection

I) Good charged track

- ✓ Vertex: $V_r < 1\ cm$, $V_z < 10\ cm$ (only aviable for electron)
- ✓ Polar angle: $cos\theta < 0.93$

II) Good photons

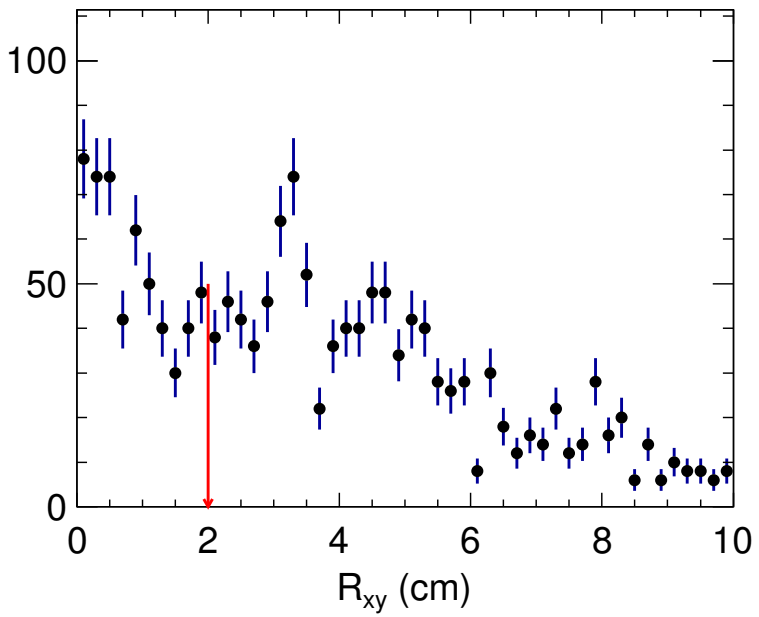
- ✓ Barrel: $cos\theta < 0.8$, $E_\gamma > 25$ MeV
- ✓ End Cap: $0.86 < cos\theta < 0.92$, $E_\gamma > 50$ MeV

III) Λ candidates:

- ✓ Mass: $[1.110, 1.121]$ GeV
- ✓ vertex fit: $\chi^2 < 100$
- ✓ No requirement on Second VertexFit

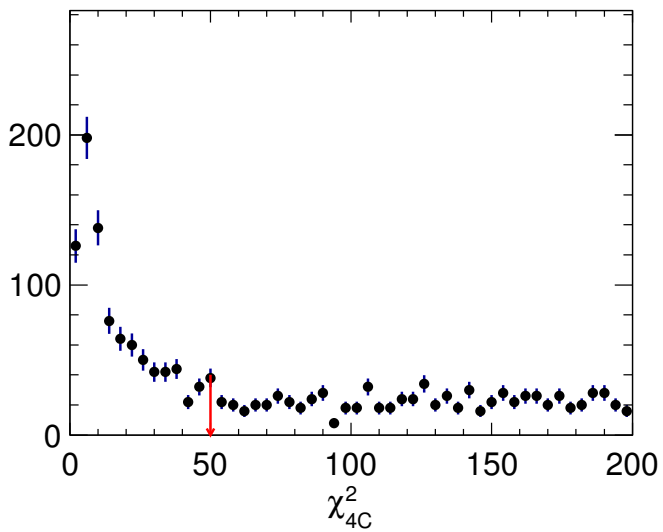
Veto gamma conversion

✓ Veto the events $R_{xy} > 2cm$

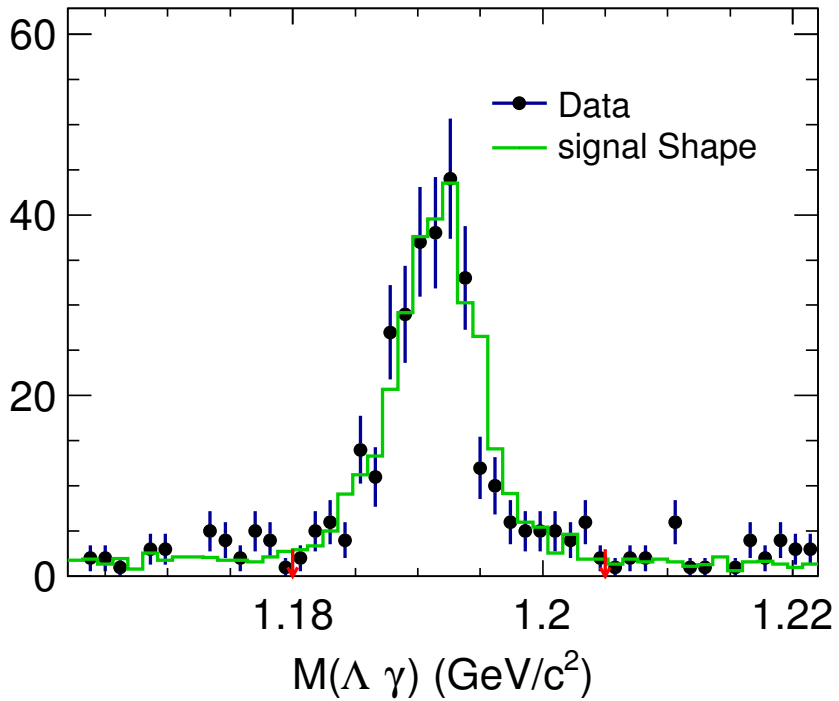


Requirement on Kenimatic Fit

✓ $\chi^2 < 50$



Requirement on $M(\Lambda\gamma)$



Signal

✓ Total signal: 84 ± 9.2

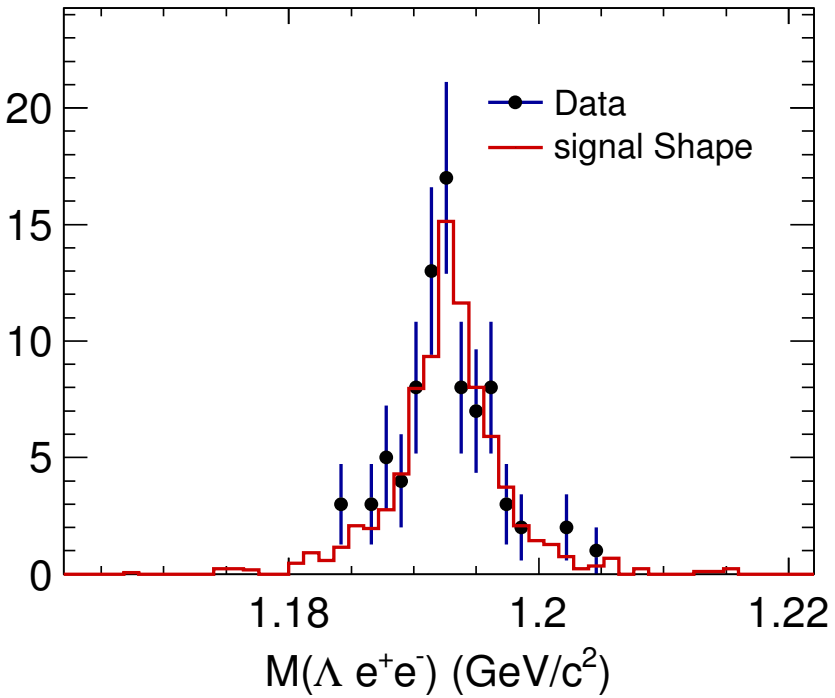


Figure:

$\mathcal{B}(\Sigma \to \Lambda e^+ e^-)$

$$BF = \frac{n^{yield}}{N_{J/\psi} \cdot B(J/\psi \to \Sigma^0 \bar{\Sigma}^0) \cdot \epsilon} \tag{1}$$

$N_{J/\psi}$	$(1.310 \pm 0.007) \times 10^9$
ϵ	1.47%

- ✓ $BF = 0.0037 \pm 0.0004$
- ✓ Theory: 0.00545

Next to

A) Adopt DTag method to obtain the absolute fraction.

B) Analysis new J/ψ data collected during 2017-2018 to improve the measurement.