Further consideration on scan above 4.6 GeV

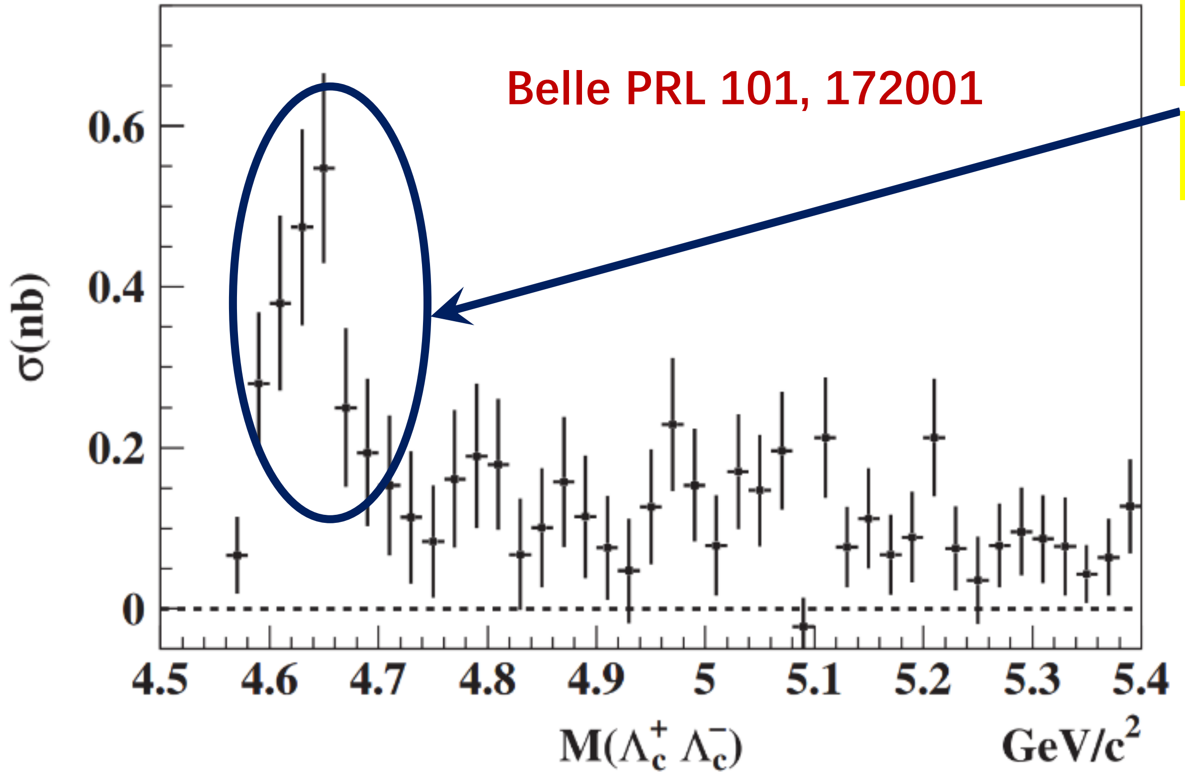
Weiping Wang[1,2], Guangshun Huang[1,2], R. Baldini Ferrodi[3,4]
1. University of Science and Technology of China, Hefei, China
2. State Key Laboratory of Particle Detection and Electronics, Beijing, Hefei, China
3. IHEP, Beijing, China
4. INFN-LNF, Frascati, Italy

Outline

- **Motivation**
- **Fits on Expected $e^+e^- \rightarrow \Lambda_c^+\bar{\Lambda}_c^-$ Cross Section**
- **Conclusion**

Motivation

Belle collaboration measured the $e^+e^- \rightarrow \Lambda_c^+\bar{\Lambda}_c^-$, a peak was determined as:



$M = 4634^{+8}_{-7}(\text{stat.})^{+5}_{-8}(\text{syst.})\ \text{MeV/c}^2$

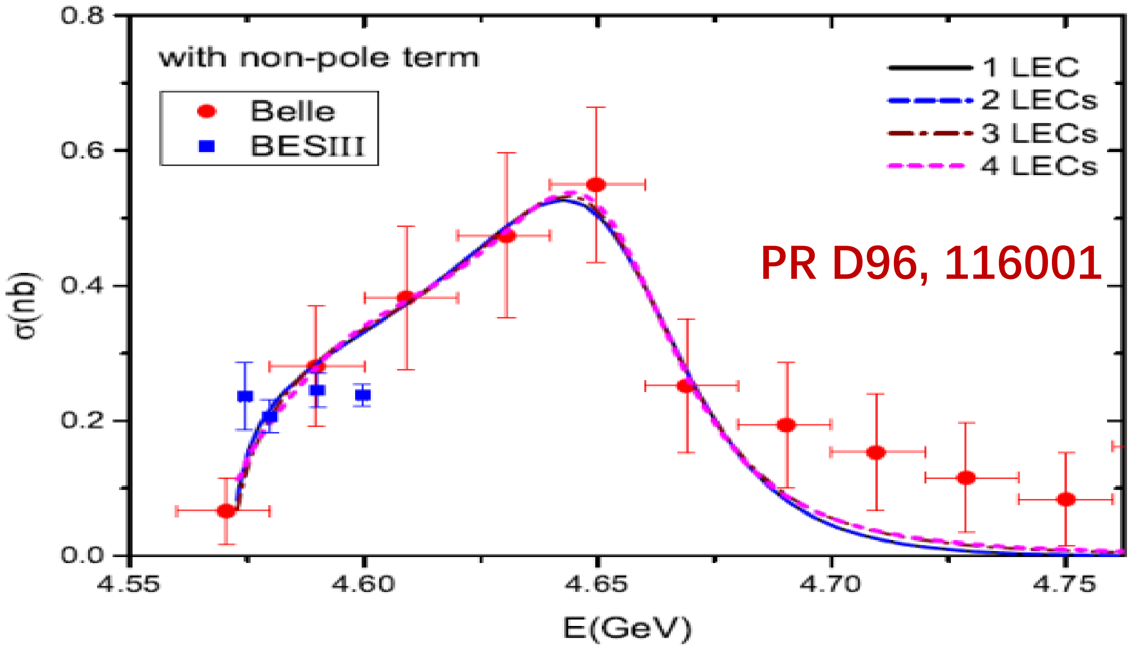
$\Gamma = 92^{+40}_{-24}(\text{stat.})^{+10}_{-21}(\text{syst.})\ \text{MeV}$

This resonance is firstly observed in $\pi^+\pi^-\psi(2S)$ line-shape and named by Y(4660), with higher mass: 4664 ± 12 MeV/c^2 and narrow width: 48 ± 15 MeV

Belle PRL 99, 142002

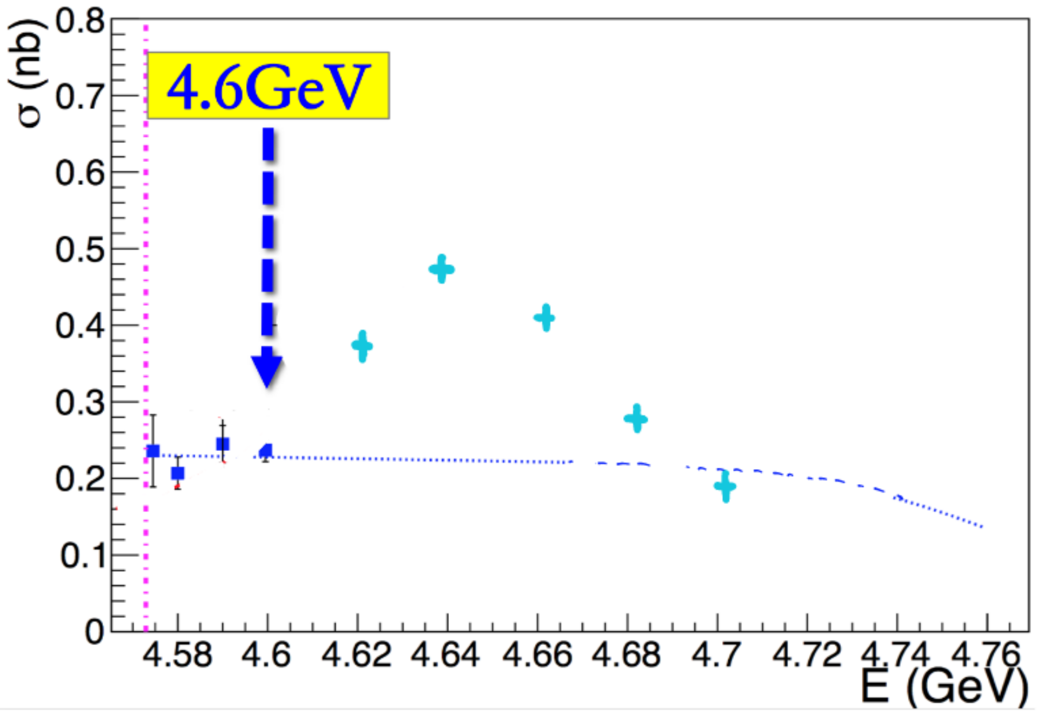
Motivation

Different trends between the measurement of BESIII and Belle collaboration:



BESIII will take data above 4.6 GeV, to precisely establish this resonance and reliably incorporate threshold effect and Y(4660) contribution, more discussion on the data-taking plan is needed.

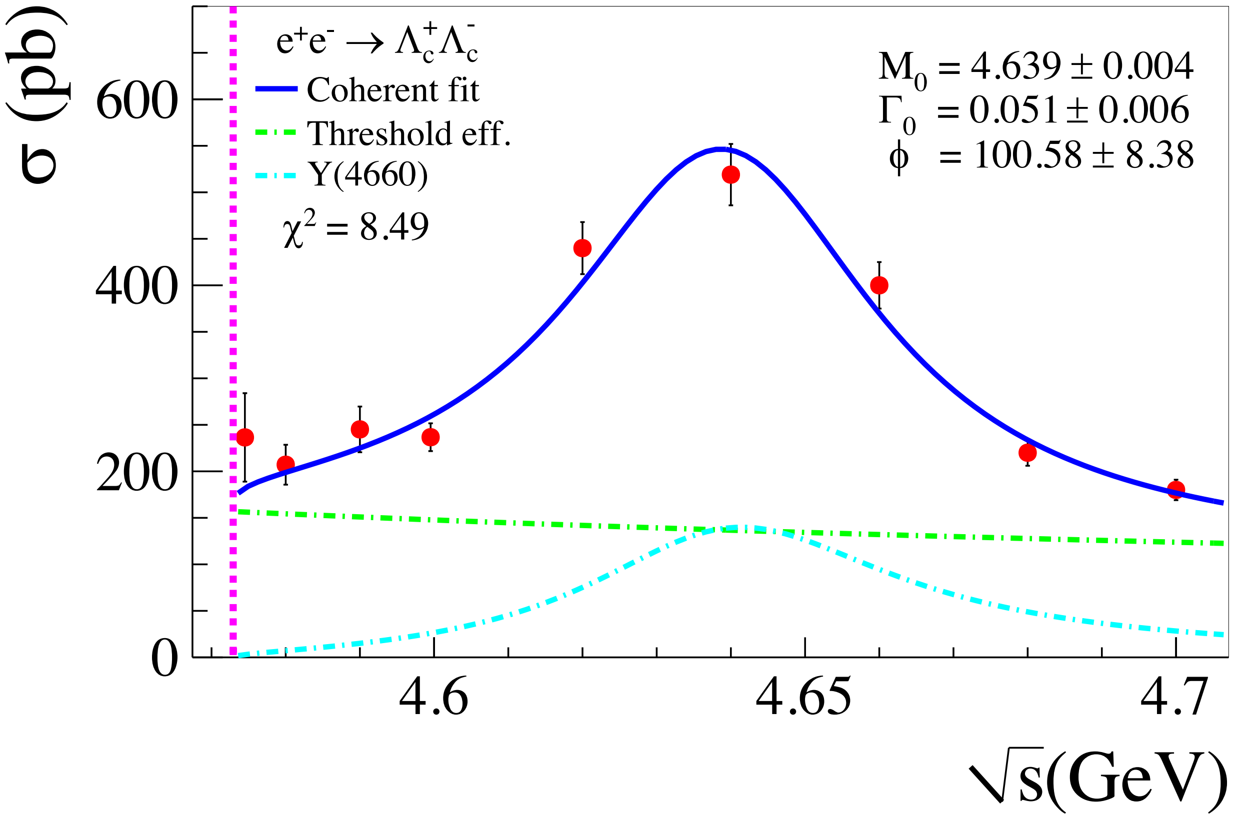
Current data-taking plan



500 pb^{-1} at 4.62, 4.64, 4.66, 4.68 and 4.70 GeV, respectively

Fit the expected line-shape

Assuming decreasing $|G_E/G_M|$ from threshold:



Data above 4.6 GeV is obtained from the interpolation of Belle's results, total uncertainty is about 6.3%

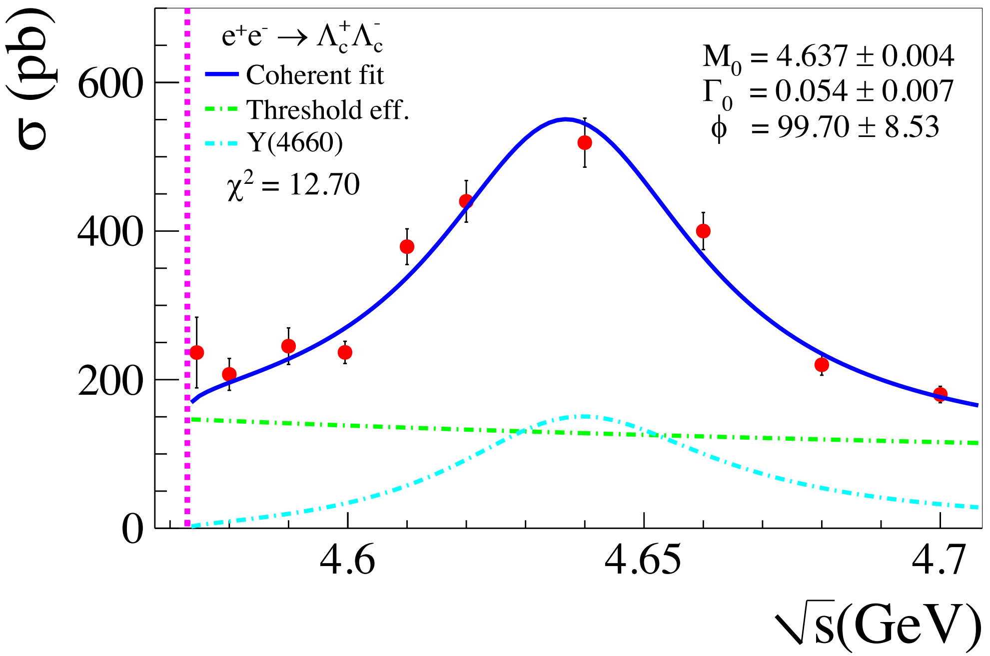
$$\sigma(s) = |a_1 \cdot \sqrt{\sigma_{th}(s)} + a_2 \cdot \mathrm{BW}(s) \cdot e^{i\phi}|^2$$

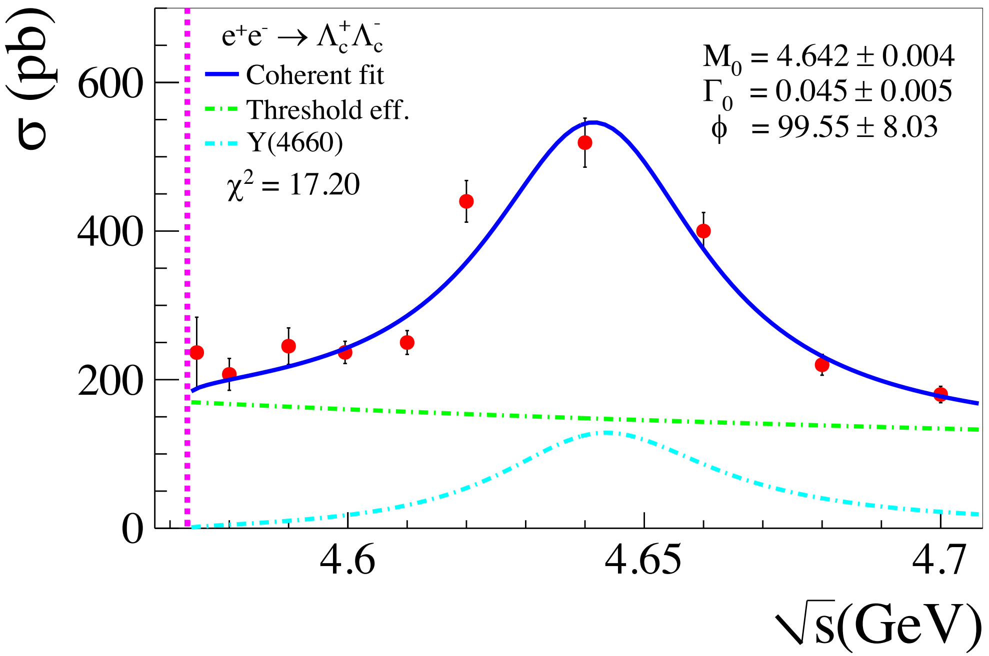
$$\sigma_{th}(s) = \frac{4\pi\alpha^2 C\beta}{3s}|G_M|^2\left(1 + \frac{2m_B^2c^4}{s}\left|\frac{G_E}{G_M}\right|^2\right)$$

$$\mathrm{BW}(s) = (\beta\sqrt{s})^{1/2} \cdot \frac{s - M_0^2 - iM_0\Gamma_0}{(s-M_0^2)^2 + M_0^2\Gamma_0^2}$$

Fit the expected line-shape

Assuming decreasing $|G_E/G_M|$ from threshold:

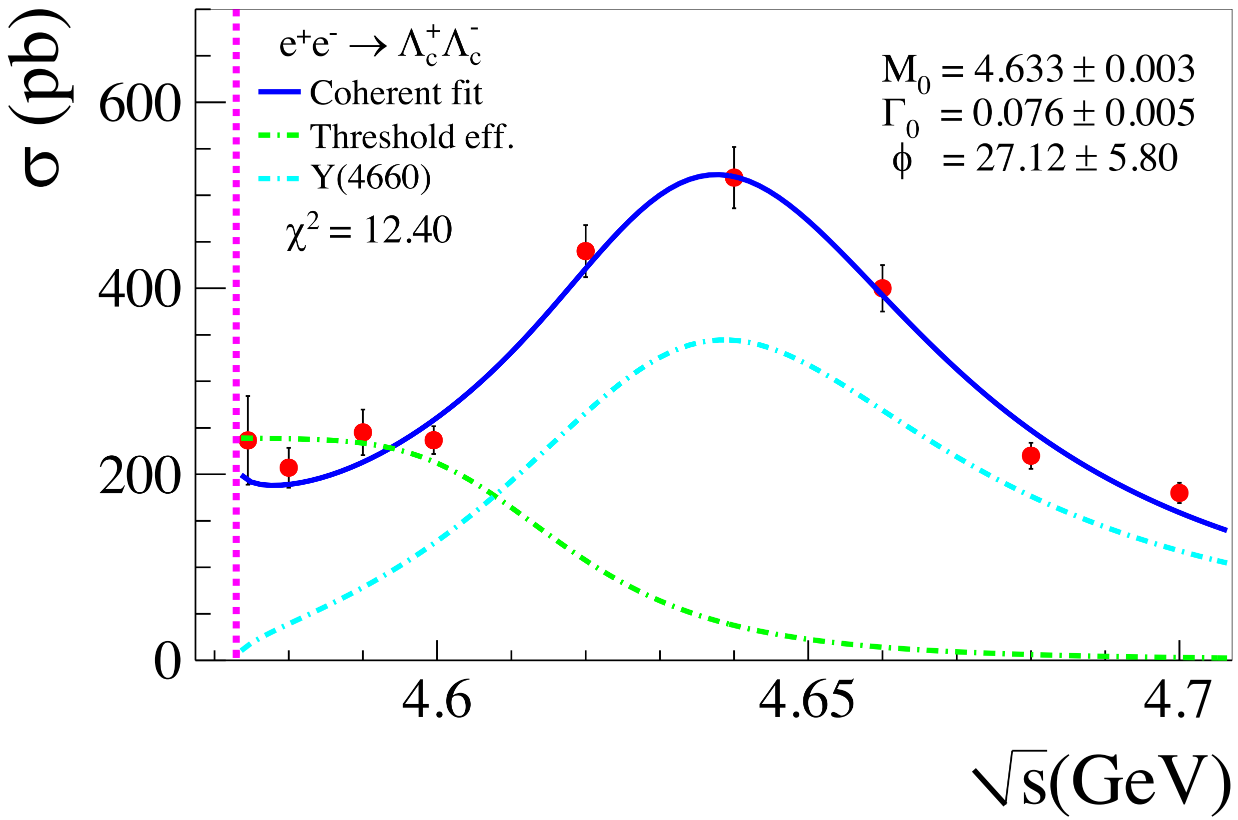




Different cross section results at 4.61 GeV will change the fitted value of M_0 and Γ_0

Fit the expected line-shape

Assuming decreasing contribution from threshold effect:



Data above 4.6 GeV is obtained from the interpolation of Belle's results, total uncertainty is about 6.3%

$$\sigma(s) = |a_1 \cdot \sqrt{\sigma_{\text{th}}(s)} + a_2 \cdot \text{BW}(s) \cdot e^{i\phi}|^2$$

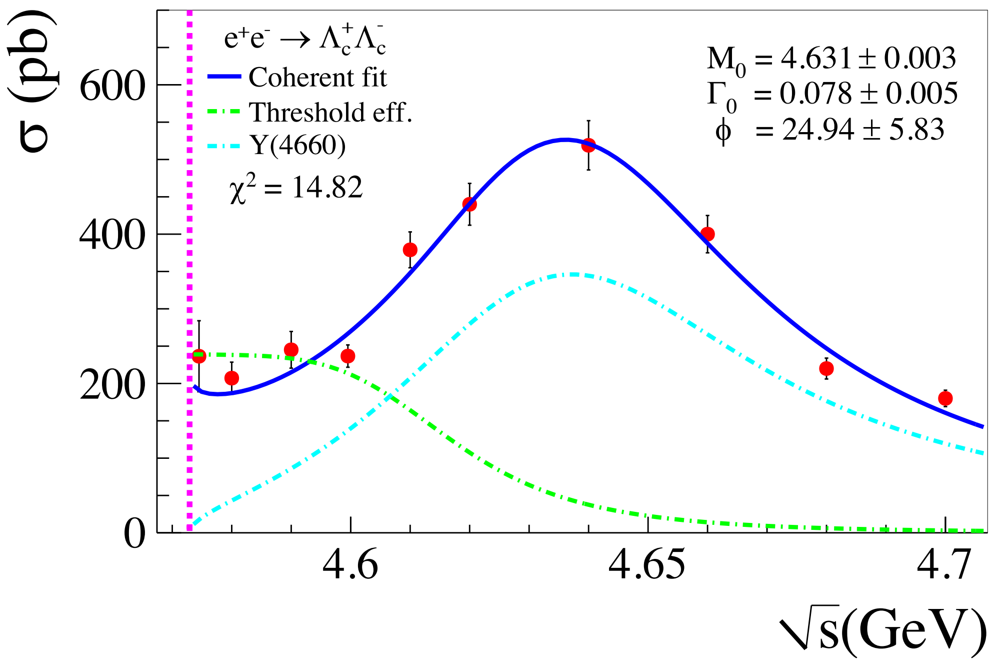
$$\sigma_{\text{th}}(s) = \frac{1}{s\left(1 - e^{-\frac{\pi\alpha_s(s)}{\beta}}\right)\left[1 + \left(\frac{\sqrt{s} - 2m_B}{a_3}\right)^{a_4}\right]}$$

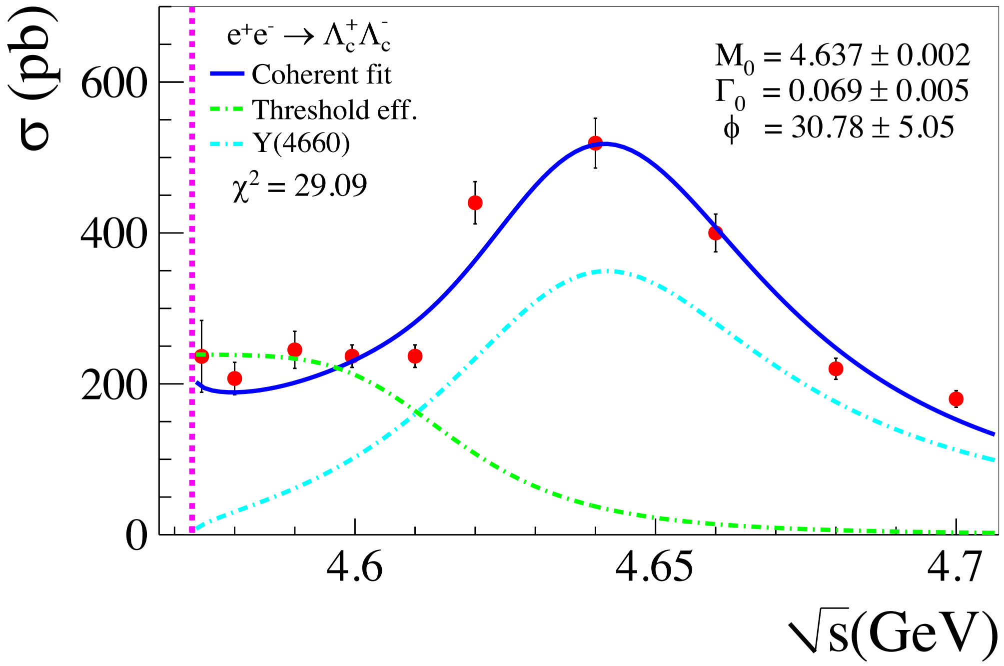
$$\text{BW}(s) = (\beta\sqrt{s})^{1/2} \cdot \frac{s - M_0^2 - iM_0\Gamma_0}{(s - M_0^2)^2 + M_0^2\Gamma_0^2}$$

a_3 and a_4 are fixed during the fit

Fit the expected line-shape

Assuming decreasing contribution from threshold effect:





Different cross section results at 4.61 GeV will change the fitted value of M_0 and Γ_0

Conclusion

- Fits on expected $e^+e^- \to \Lambda_c^+\bar{\Lambda}_c^-$ cross sections are performed
- More reasonable models are needed to describe the threshold effects above 4.6 GeV and incorporate it with Y(4660) state
- More data between 4.60-4.62 GeV, e.g. 10 pb^{-1} at 4.61 GeV, may impose more strict constraints on possible fit models

Thanks for your attention!