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Measurement of $e^+e^- \to K^+K^-$ Cross Section via an untagged ISR Photon

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Group Meeting

Sep. 11th, 2024

Resolution

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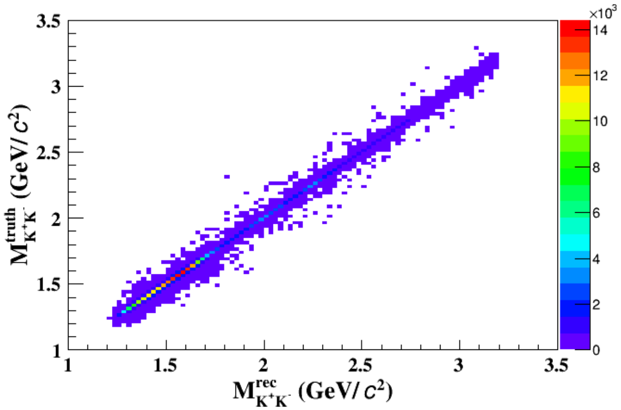
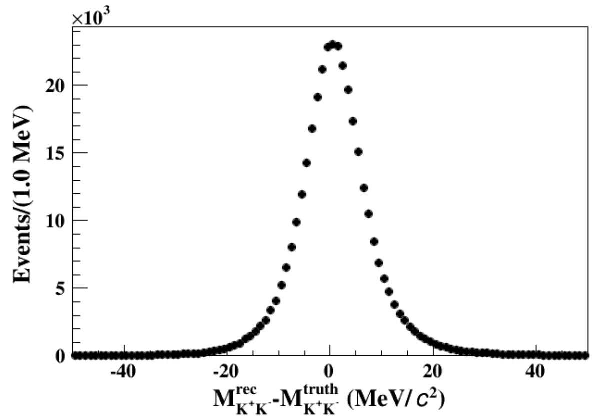
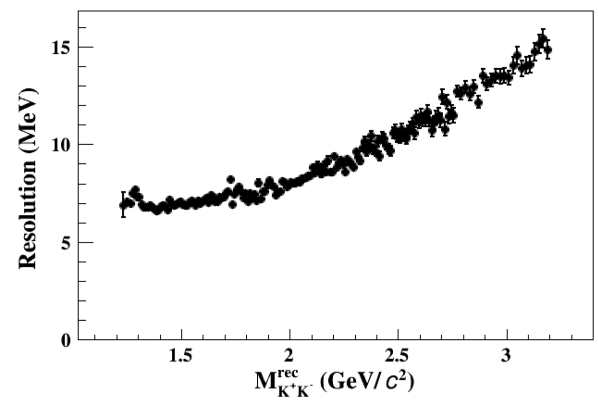
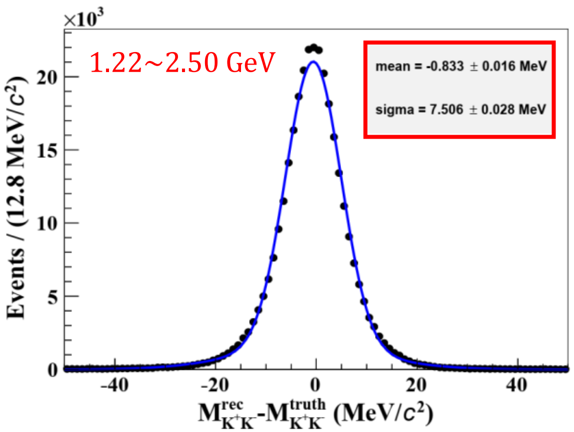
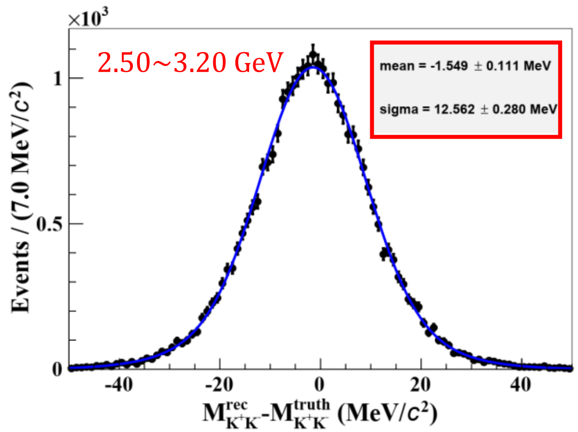
- Resolution of $M(K^+K^-)$:











Bin Width for this plot:
- 1.22-1.26: 20MeV
- 1.26-2.76: 10MeV
- 2.76-3.20: 20MeV

Signal MC

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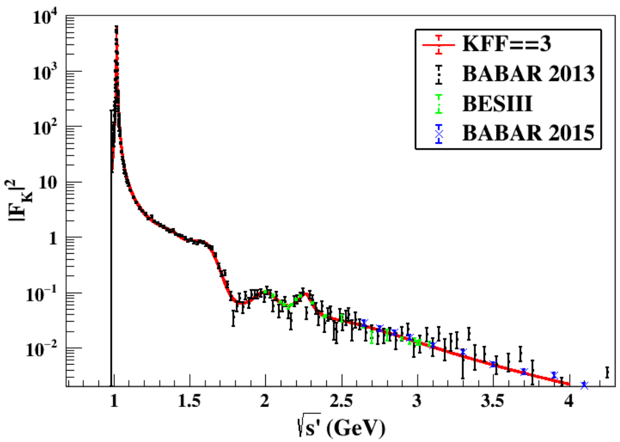
- ϕ width: $$\Gamma_\phi(s) = \Gamma_\phi\Big[\mathcal{B}(\phi\to K^+K^-)\frac{\Gamma_{\phi\to K^+K^-}(s,m_\phi,\Gamma_\phi)}{\Gamma_{\phi\to K^+K^-}(m_\phi^2,m_\phi,\Gamma_\phi)} + \mathcal{B}(\phi\to K^0\bar{K}^0)\frac{\Gamma_{\phi\to K^0\bar{K}^0}(s,m_\phi,\Gamma_\phi)}{\Gamma_{\phi\to K^0\bar{K}^0}(m_\phi^2,m_\phi,\Gamma_\phi)} + 1 - \mathcal{B}(\phi\to K^+K^-) - \mathcal{B}(\phi\to K^0\bar{K}^0)\Big]$$
- ρ width: $$\Gamma_\rho(s) = \Gamma_\rho\frac{s}{m_\rho^2}\left(\frac{\beta(s,m_\pi)}{\beta(m_\rho^2,m_\pi)}\right)^3 \qquad \beta(s,m) = \sqrt{1-4m^2/s}.$$
- BW: $$BW(s,m,\Gamma) = \frac{m^2}{m^2 - s - i\sqrt{s}\Gamma(s)}$$



Resonance	mass	width	coefficient
ϕ	1.019	0.004	0.999
	1.680	0.150	0.069
	2.265	0.100	-0.068
ω	0.783	0.008	2.986
	1.420	0.200	-0.240
	1.670	0.315	-2.250
	2.412	1.097	0.504
ρ	0.775	0.149	0.547
	1.465	0.400	0.105
	1.720	0.250	0.289
	2.005	0.206	0.059

Cross Section

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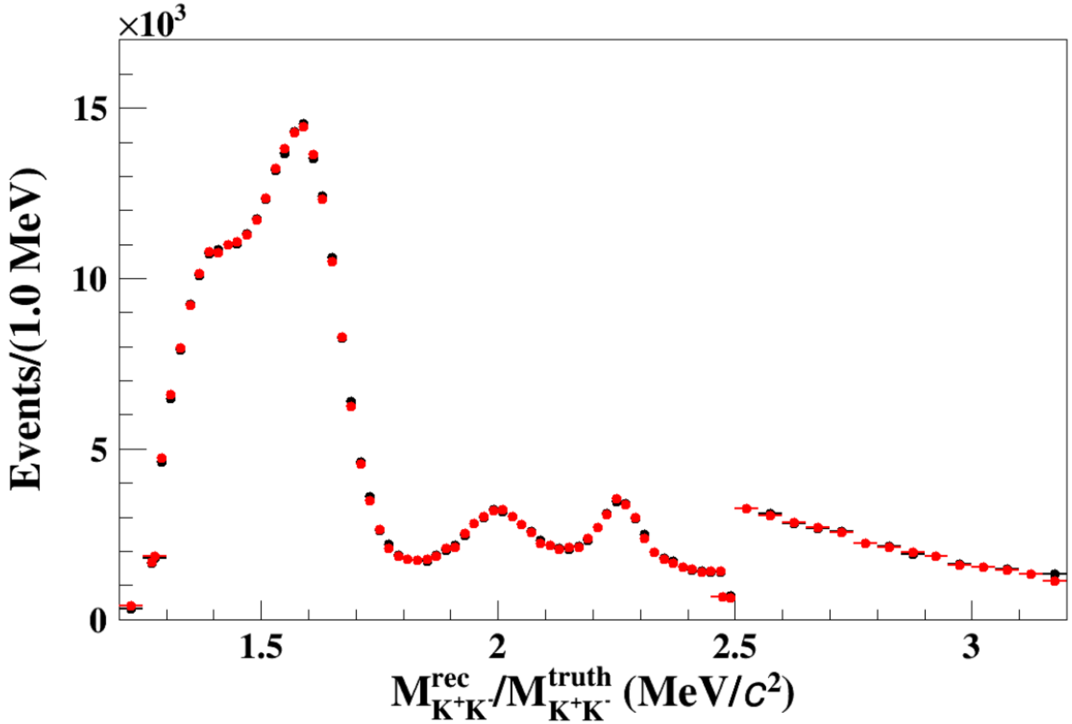
➢ According to $M(K^+K^-)$ resolution and $M(K^+K^-)$ distribution of data from 1.22 GeV to 3.2 GeV:

- From 1.22 to 1.27 GeV, interval size is 50 MeV
- From 1.27 to 2.49 GeV, interval size is 20 MeV
- From 2.49 to 3.19 GeV, interval size is 50MeV

➢ The comparison between MC and MC truth:



Unfolding

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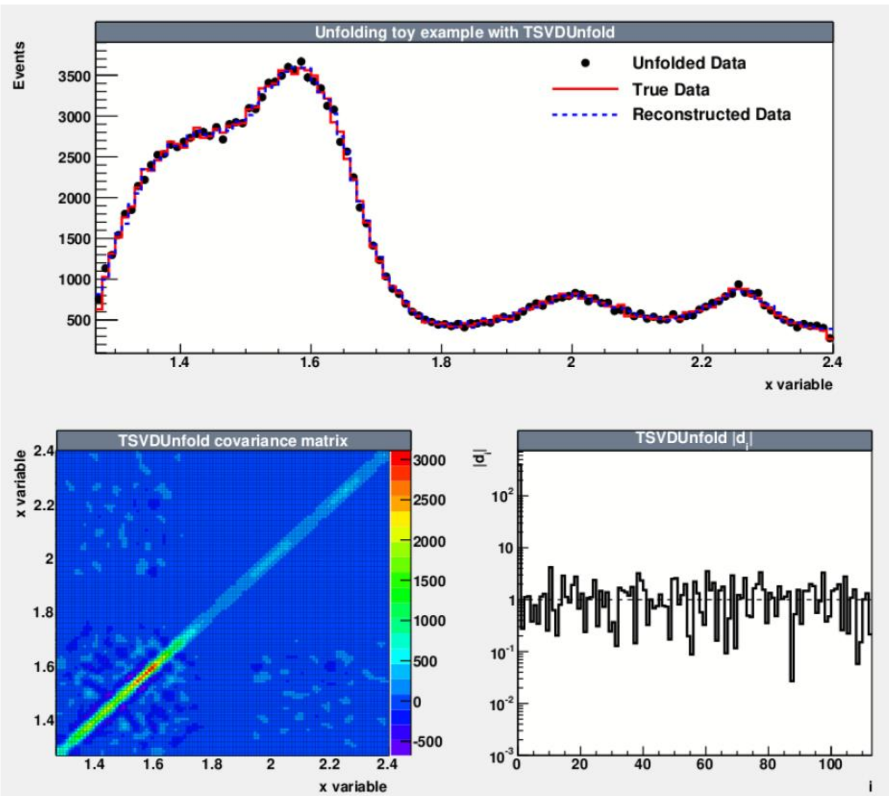
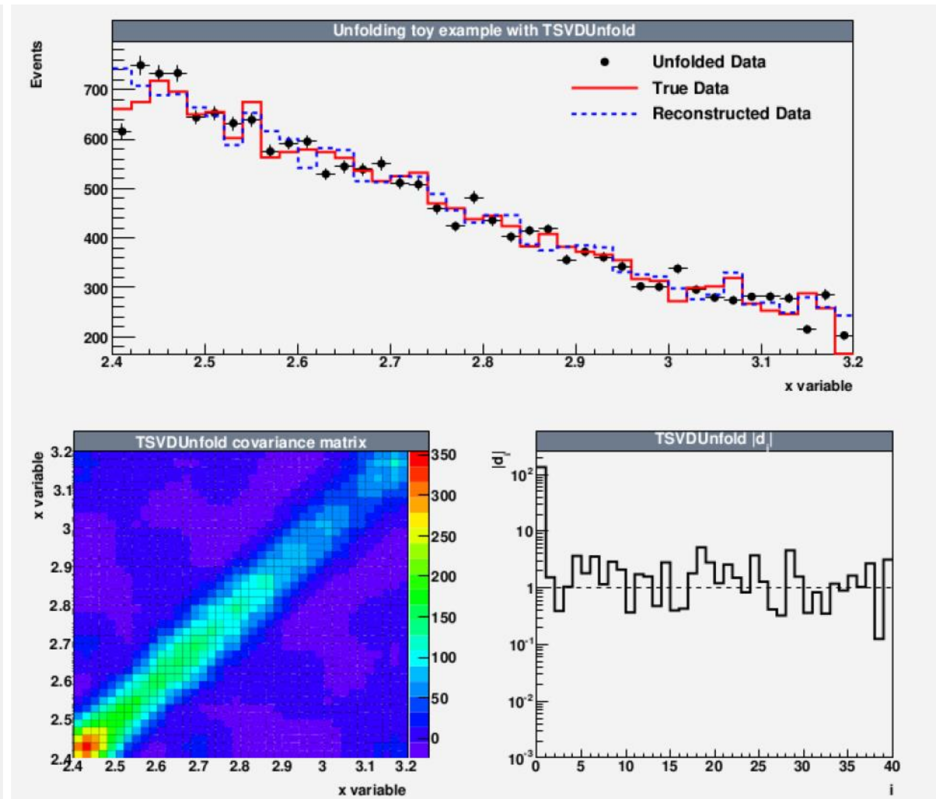
- Advice to unfolders:
  - Three things contribute to the solution: the response matrix, data statistics, and binning.
  - Choose binning wisely: large variations in data may be avoided by using variable bin widths. Size of bin-to-bin error correlations may also be affected.
  - Rescaling is important: only unfold the equations once they have equal "weights".
  - The Monte Carlo sample(s) used for building the response matrix should have as high statistics, and should be as close to the real experiment, as possible.
  - Monte Carlo samples used for testing should have the same statistics as the real data; use of larger or smaller samples can be misleading.
  - To assess unfolding systematics, vary the matrix within its tolerances, and study the effects on the singular values.
  - Even if you are using a different algorithm for unfolding your data, try applying SVD: it will help identify the bottlenecks, and assess any benefits of performing unfolding in the first place.
  - It's wise not to expect any miraculous solutions to unfolding problems.

- The bin width in unfolding (the statistics in each bin and physical requirements):
  - From 1.22 to 1.27 GeV, interval size is 50 MeV
  - From 1.27 to 2.40 GeV, interval size is 10 MeV
  - From 2.40 to 3.20 GeV, interval size is 20MeV

Unfolding

- Try: Kreg = 30; Kreg = 7. Learning and comparison part: 176024





After: $\chi^2 = 56.3278$
Before: $\chi^2 = 64.5769$

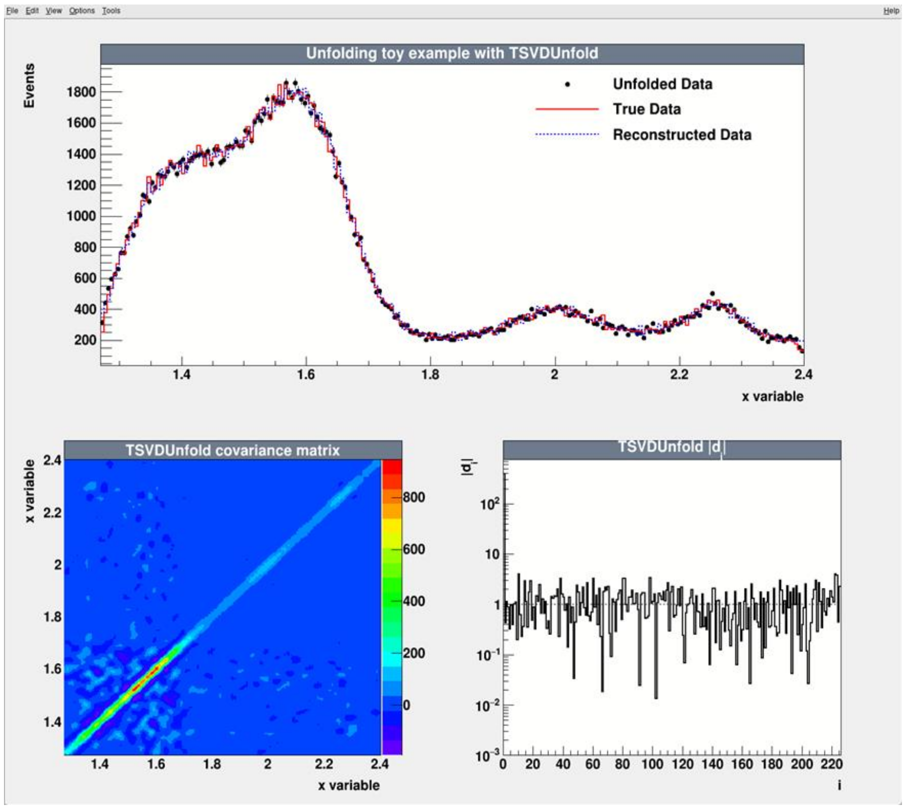
After: $\chi^2 = 26.9952$
Before: $\chi^2 = 31.7286$

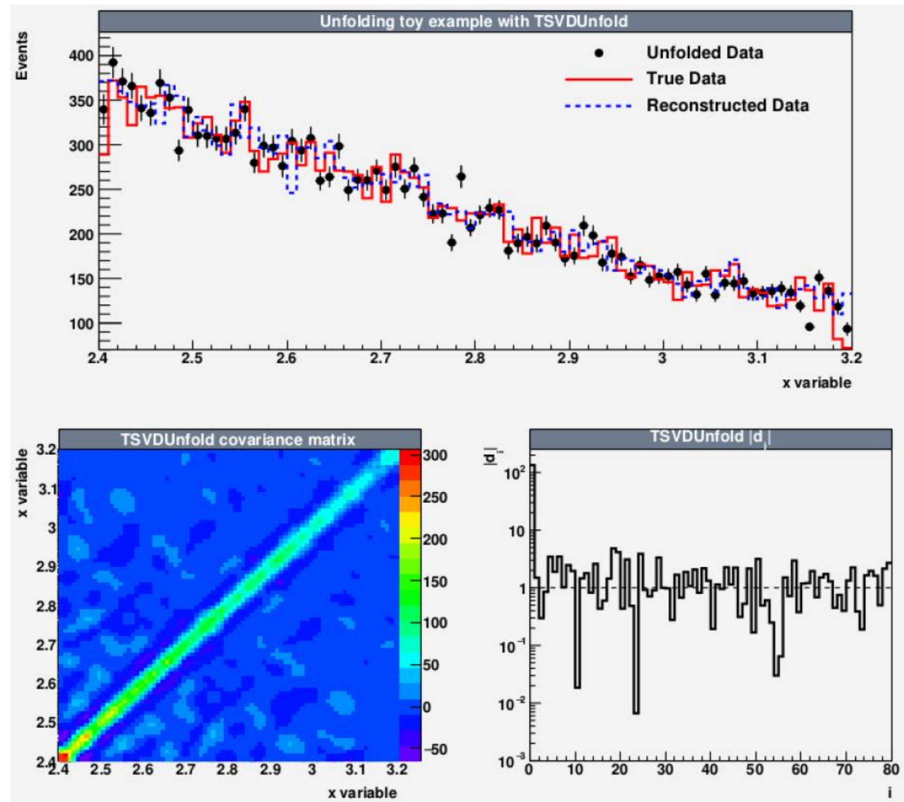
Unfolding

- The bin width in unfolding (the statistics in each bin and physical requirements):
  - From 1.22 to 1.27 GeV, interval size is 50 MeV
  - From 1.27 to 2.40 GeV, interval size is 5 MeV
  - From 2.40 to 3.20 GeV, interval size is 10MeV

Unfolding

- Try: Kreg = 36; Kreg = 19. Learning and comparison part: 176024





After: $\chi^2 = 64.4294$
Before: $\chi^2 = 68.8679$

After: $\chi^2 = 24.8312$
Before: $\chi^2 = 33.9323$