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Measurements of Born Cross Section of $e^+e^- \to D_sD_{s1}(2460)$ and $e^+e^- \to D_s^*D_{s1}(2460)$

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July 10, 2018

Question 1: New KKMC version

Using KKMC 00-00-60, and BesEvtGen 00-03-97, the data is updated. The compare of $(1+\delta)^{ISR}$ and efficiency are shown below.

	old			new		
$\sqrt{s}$	ε	$(1+\delta)^{ISR}$	$\varepsilon\times(1+\delta^{ISR})$	ε	$(1+\delta)^{ISR}$	$\varepsilon\times(1+\delta^{ISR})$
4.467	37.4%	1.035	0.387	38.7%	1.028	0.398
4.527	36.4%	0.687	0.250	38.2%	0.686	0.262
4.575	38.6%	0.715	0.276	38.0%	0.708	0.269
4.600	35.3%	1.053	0.372	38.6%	1.061	0.409

Table: for $e^+e^- \to D_s D_{s1}(2460)$

Question 1: New KKMC version

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$\sqrt{s}$	ε	$(1+\delta)^{ISR}$	$\varepsilon\times(1+\delta^{ISR})$	ε	$(1+\delta)^{ISR}$	$\varepsilon\times(1+\delta^{ISR})$
4.575	19.7%	0.709	0.139	21.5%	0.708	0.152
4.600	15.8%	1.060	0.167	15.6%	1.066	0.166

Table: for $e^+e^- \to D_s^* D_{s1}(2460)$

Question 2: Plot the $MM(D_s)$ spectrum only with D_s mass window cut

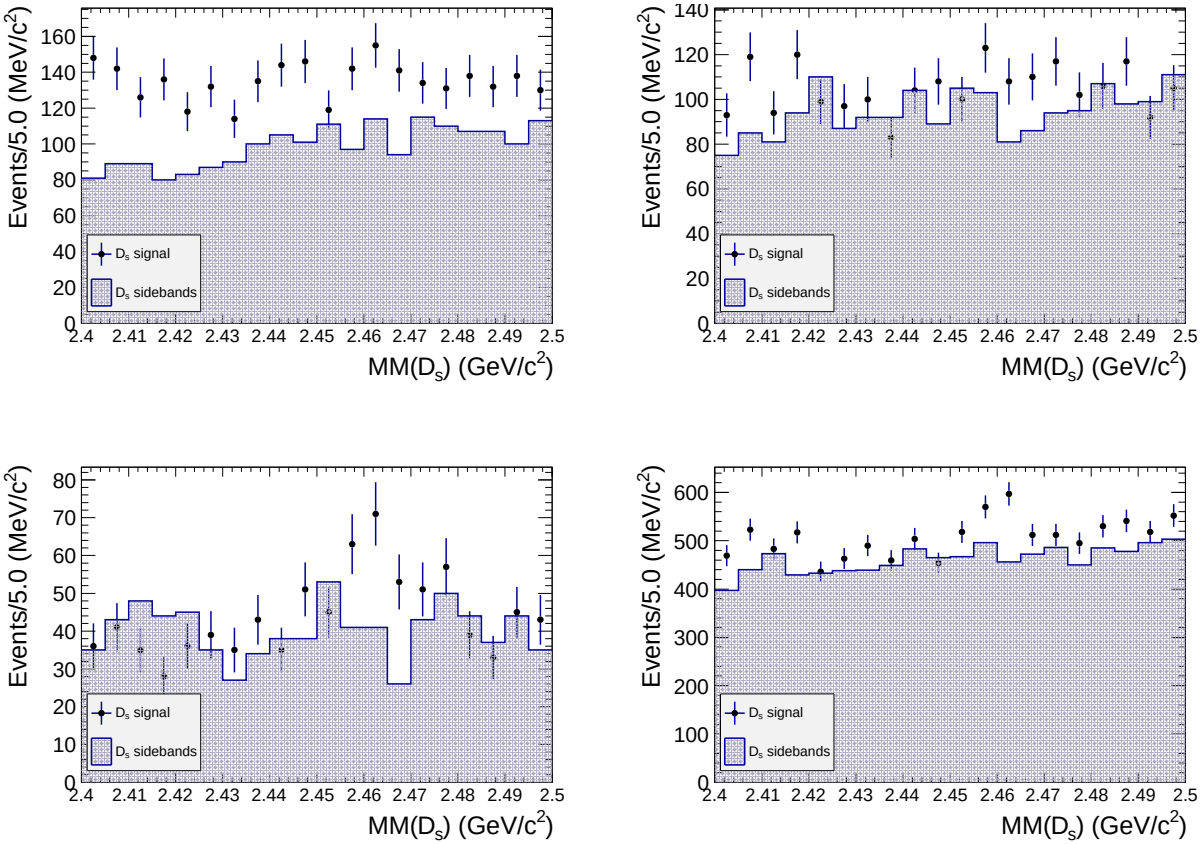


Figure: The D_s recoil mass spectrum only with D_s mass window cut, along with D_s sidebands, for data at 4.467 GeV(upper left), 4.527 GeV(upper right), 4.575 GeV(lower left) and 4.600 GeV(lower right)

Question 2: Plot the $MM(D_s)$ spectrum only with D_s mass window cut

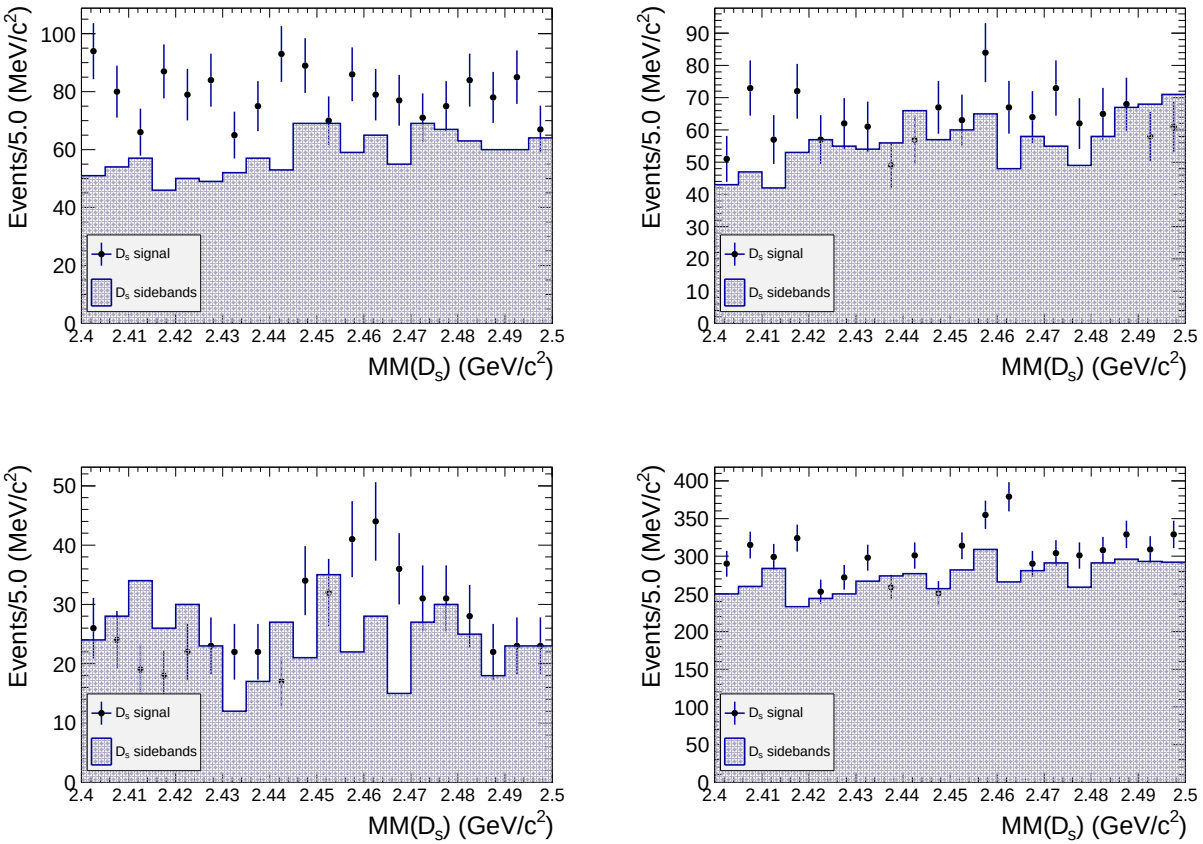
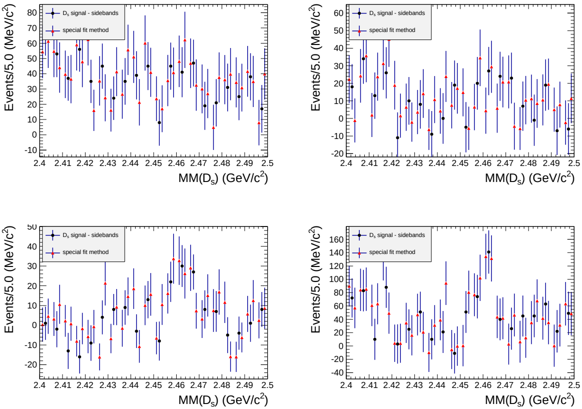


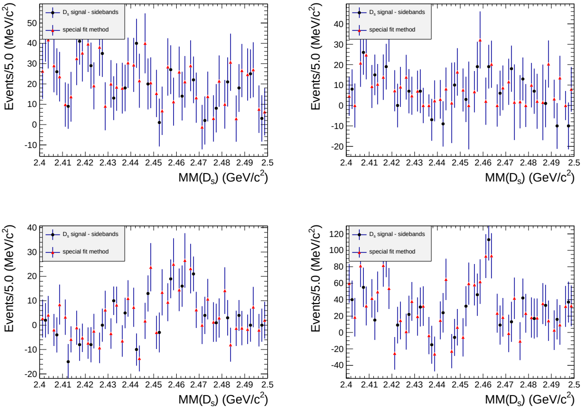
Figure: The D_s recoil mass spectrum only with D_s mass window cut, along with D_s sidebands, with π^0 tag, for data at 4.467 GeV(upper left), 4.527 GeV(upper right), 4.575 GeV(lower left) and 4.600 GeV(lower right)

Question 2: Plot the $MM(D_s)$ spectrum only with D_s mass window cut

And also, compare the ”signal - sidebands” with the binning fit method:



Question 2: Plot the $MM(D_s)$ spectrum only with D_s mass window cut



Question 3: Check for background comes from $e^+e^- \to D_s^* D_{s1}(2460)$ in the $e^+e^- \to D_s D_{s1}(2460)$ analysis, and also the reverse.

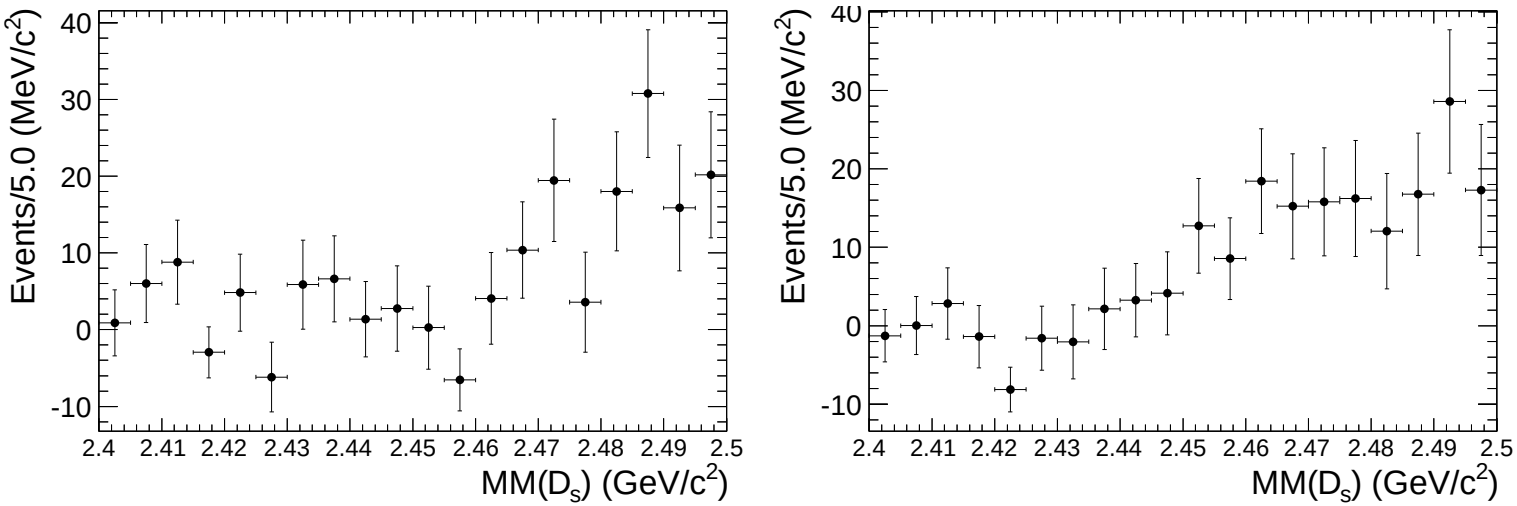


Figure: Divide the D_s recoil mass spectrum into bins, fit D_s invariant mass spectrum in each bin to get the real D_s event count, and then form a D_s recoil mass spectrum, for $e^+e^- \to D_s^* D_{s1}(2460)$ background in the $e^+e^- \to D_s D_{s1}(2460)$ analysis at 4.575 GeV(left) and 4.600 GeV(right).

Question 3: Check for background comes from $e^+e^- \to D_s^* D_{s1}(2460)$ in the $e^+e^- \to D_s D_{s1}(2460)$ analysis, and also the reverse.

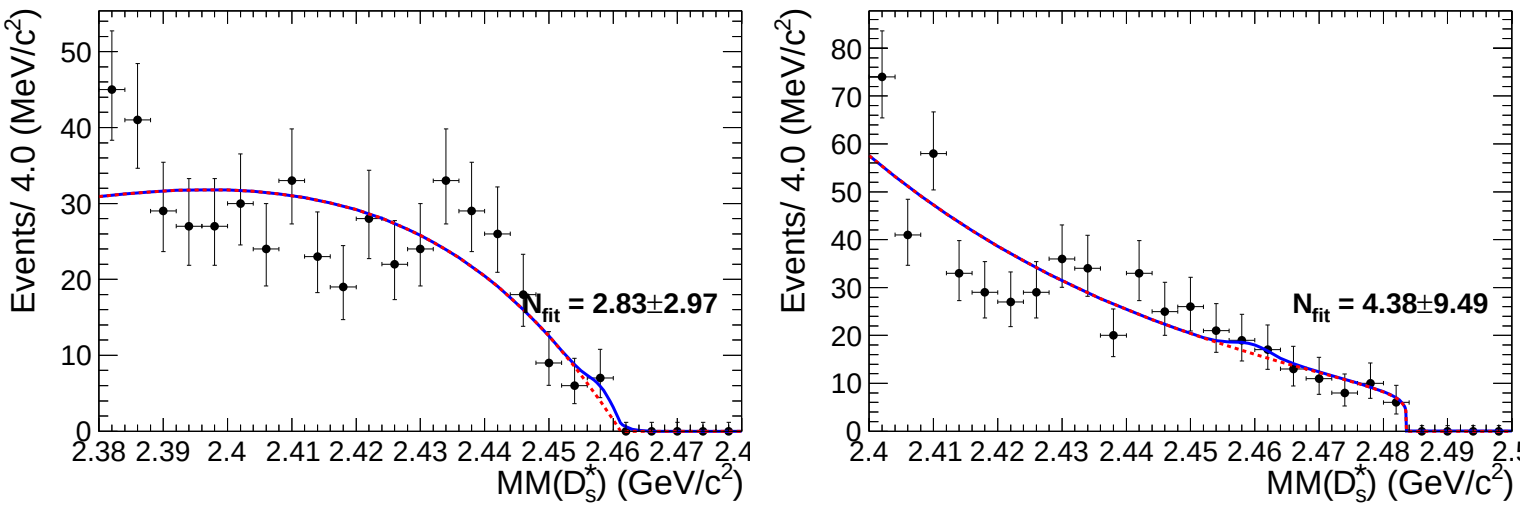


Figure: Analysis $e^+e^- \to D_s D_{s1}(2460)$ MC sample to check for mixing background in the $e^+e^- \to D_s^* D_{s1}(2460)$ analysis, at 4.575 GeV(left) and 4.6 GeV(right).

There's no peaking background in the latter fit result, and there seems to be no peaking background in the former figure. Perform a fit on that figure will fail because there are many data points around zero.

Question 4: Check for some fit in $MM(D_s)$ bins that has very small error bars.

I incorrectly fixed the N_{event} to be positive. The correct result is shown along with Question 5.

Question 5: Expand the $\sqrt{s} = 4.6$ GeV fit zone to the right.

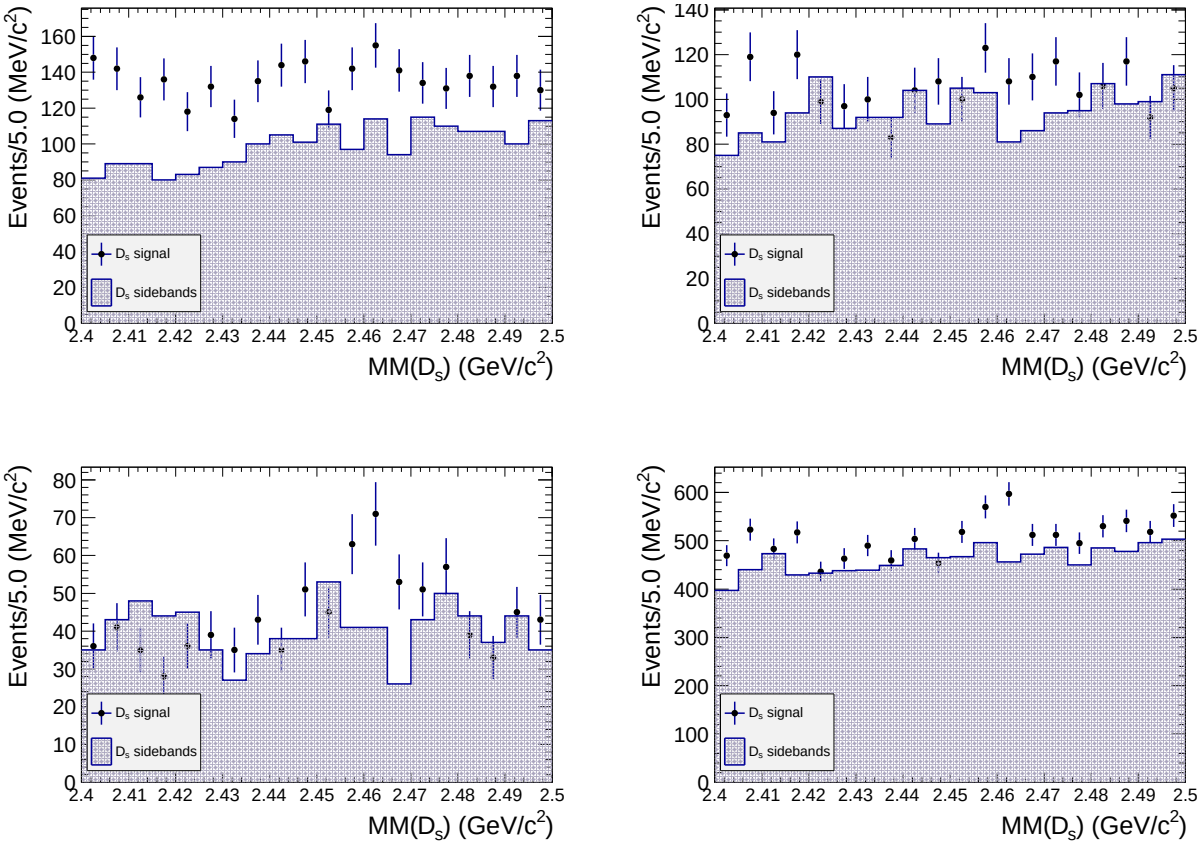


Figure: Divide the D_s recoil mass spectrum into bins, fit D_s invariant mass spectrum in each bin to get the real D_s event count, and then fit the D_s recoil mass spectrum, for data at 4.467 GeV(upper left), 4.527 GeV(upper right), 4.575 GeV(lower left) and 4.600 GeV(lower right)

Question 5: Expand the $\sqrt{s} = 4.6$ GeV fit zone to the right.

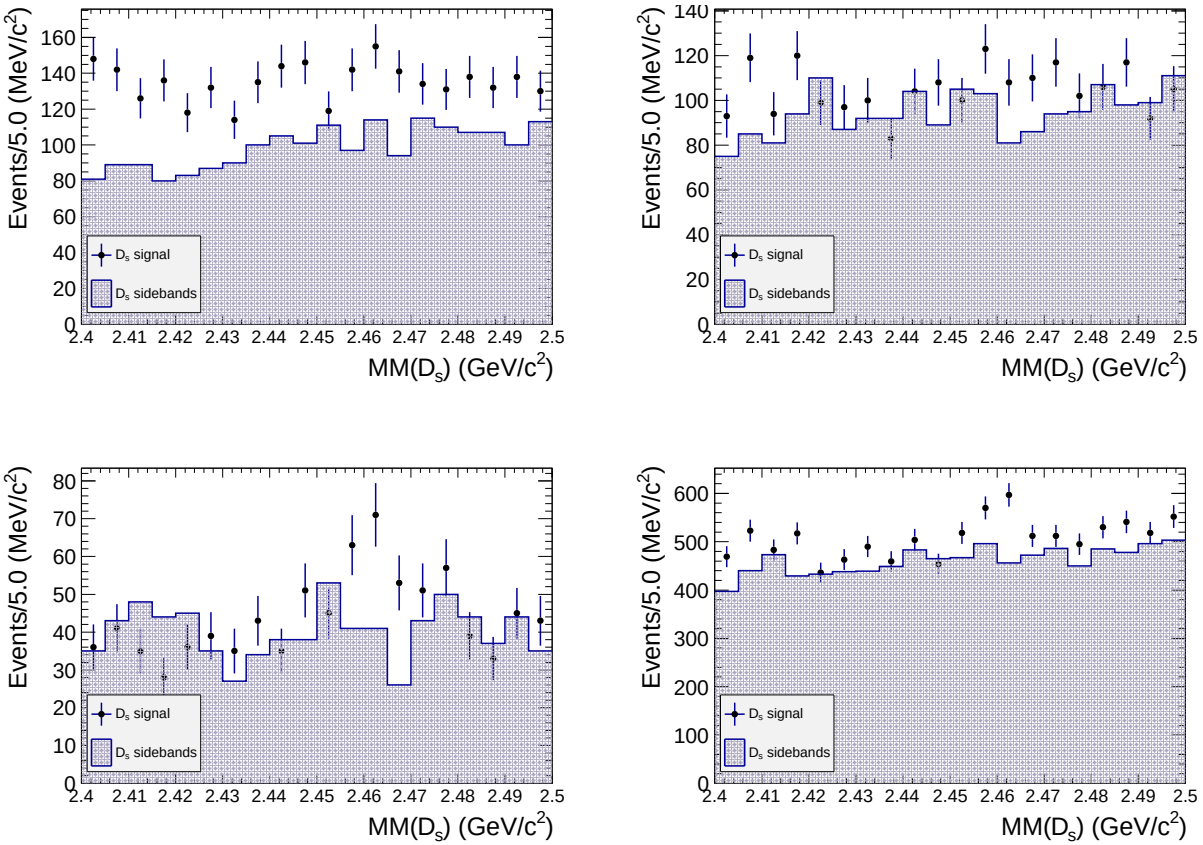


Figure: Divide the D_s recoil mass spectrum into bins, fit D_s invariant mass spectrum in each bin to get the real D_s event count, and then fit the D_s recoil mass spectrum, with π^0 tag for data at 4.467 GeV(upper left), 4.527 GeV(upper right), 4.575 GeV(lower left) and 4.600 GeV(lower

Question 6: Give the upper limit for 4.467 and 4.527 GeV samples.

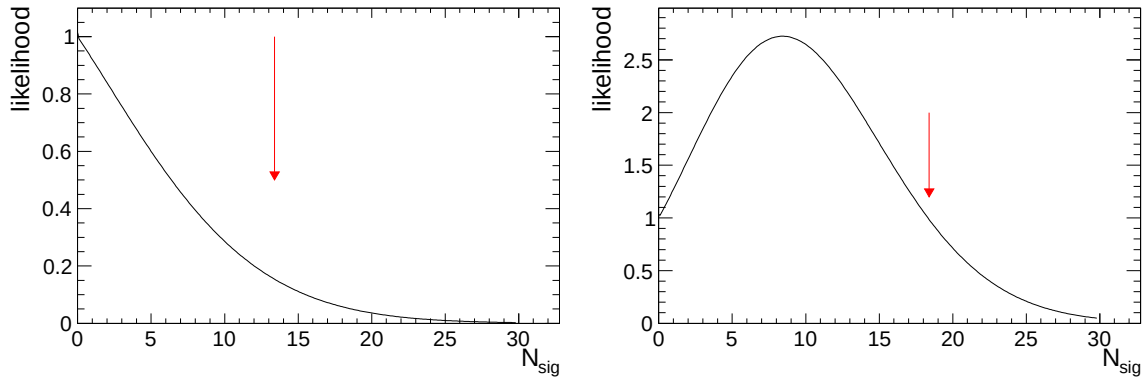


Figure: Likelihood curve to determine upper limit(90%), at 4.467 GeV(left) and 4.527 GeV(right).

energy point	σ	upper limit(90%)
4.467	-2.7 ± 3.5pb	5.3pb
4.527	5.0 ± 3.8pb	10.9pb
4.575	92.5 ± 13.2pb	—
4.600	13.1 ± 1.6pb	—

Table: Born cross section of $e^+e^- \to D_s D_{s1}(2460)$ calculated at four energy point

Question 6: Give the upper limit for 4.467 and 4.527 GeV samples.

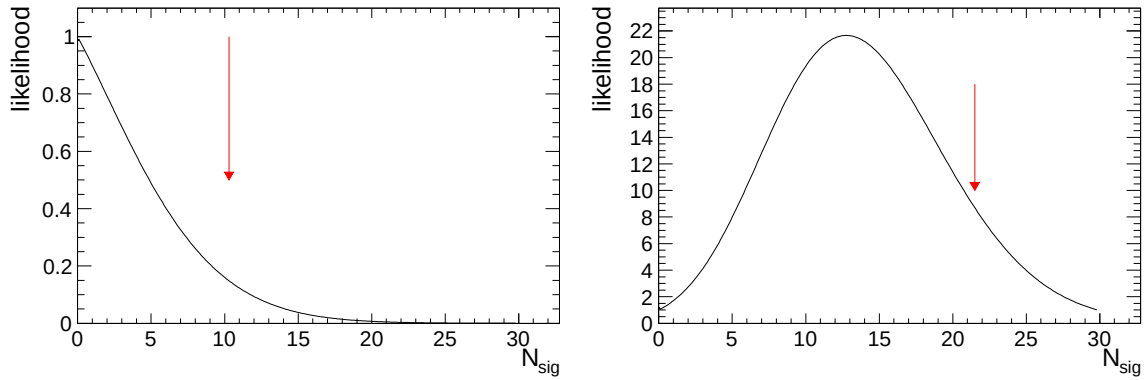


Figure: Likelihood curve to determine upper limit(90%), at 4.467 GeV(left) and 4.527 GeV(right).

energy point	σ	upper limit(90%)
4.467	-1.7 ± 2.5pb	4.0pb
4.527	7.6 ± 3.5pb	12.6pb
4.575	96.3 ± 14.4pb	—
4.600	8.5 ± 1.3pb	—

Table: Born cross section of $e^+e^- \to D_s D_{s1}(2460)$, $D_{s1}(2460) \to \pi^0 + anything$ calculated at

Final Result

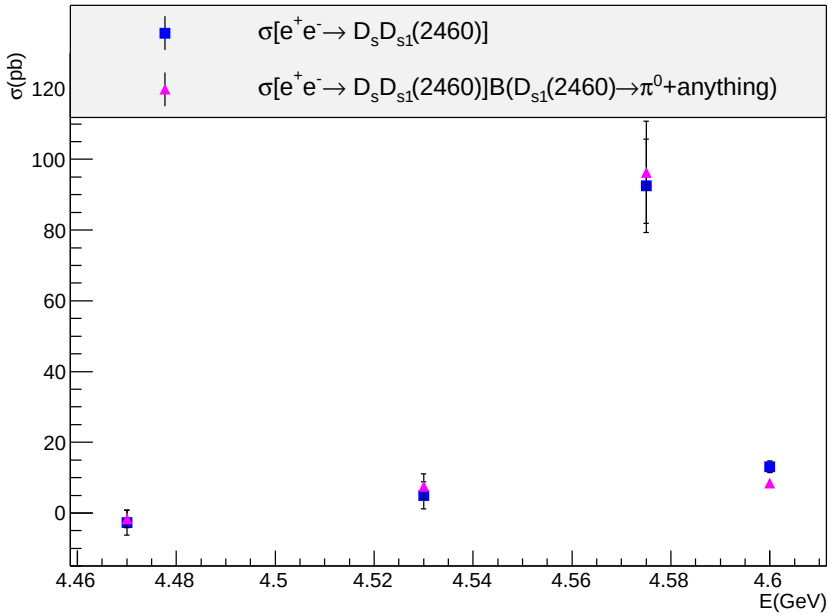


Figure: Born cross section of $e^+e^- \to D_sD_{s1}(2460)$ with and without $D_{s1}(2460) \to \pi^0 + anything$

Final Result

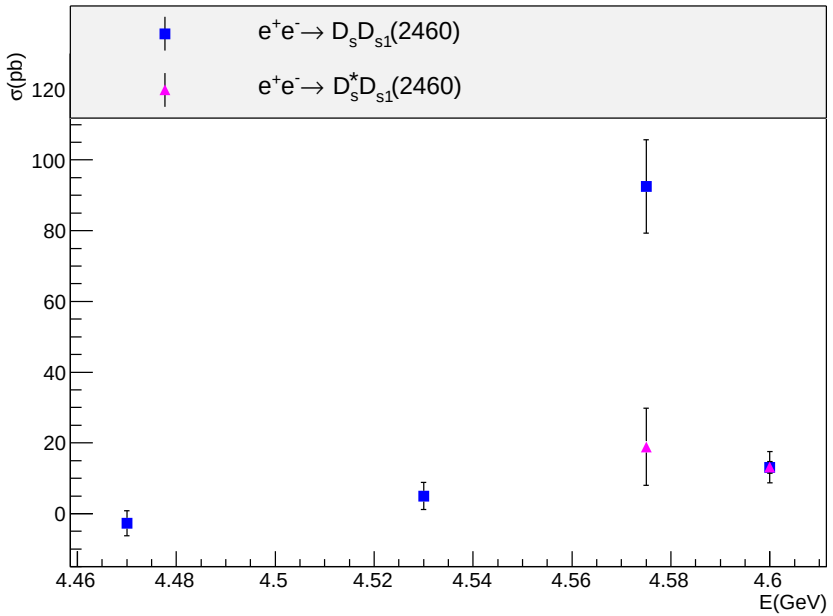


Figure: Born cross section of $e^+e^- \to D_sD_{s1}(2460)$ and $e^+e^- \to D_s^*D_{s1}(2460)$