Summarizing results for F3C-uR t-channel dark matter mediated model

Disha Bhatia

May 31, 2020

Introduction

- I am working with the scalar dark matter model i.e. f3c-uR.
- The coupling between dark matter, mediator and up-quark is chosen to be 1.
- The cross-sections for a fixed dark matter mass, and varying mediator mass are presented.
- The analysis is done at the NLO level accuracy and comparison between LO and NLO is presented.

Preliminary cross-sections for $M_\xi = 100$ GeV at NLO

M_ϕ (GeV)	XX [pb]	XY [pb]	YY(QCD) [pb]	YY(t-channel) [pb]	YY(int) [pb]
100	$20.3^{+2.9\%}_{-2.6\%} \pm 2\%$	$1042^{+5.9\%}_{-5.6\%} \pm 1.4\%$	$7165^{+10.1\%}_{-10.3\%} \pm 1.8\%$	$86.8^{+1.2\%}_{-1.7\%} \pm 1.9\%$	$5023.5^{+25\%}_{-19\%} \pm 1.69\%$
200	$6.4^{+2.1\%}_{-1.8\%} \pm 1.9\%$	$142.1^{+5.7\%}_{-5.5\%} \pm 1.2\%$	$293.1^{+9.6\%}_{-11.2\%} \pm 1.9\%$	$17.84^{+1.6\%}_{-1.0\%} \pm 1.8\%$	$210.18^{+27\%}_{-31\%} \pm 3.6\%$
300	$2.4^{+1.3\%}_{-1.0\%} \pm 1.9\%$	$34.92^{+5.5\%}_{-5.7\%} \pm 1.1\%$	$38.08.1^{+10.2\%}_{-11.9\%} \pm 2.5\%$	$5.25^{+1.3\%}_{-1.1\%} \pm 2\%$	$26.41^{+33\%}_{-23.3\%} \pm 2.48\%$
400	$1.3^{+1.0\%}_{-0.6\%} \pm 1.9\%$	$11.49^{+5.4\%}_{-6.0\%} \pm 1.1\%$	$8.42^{+10.1\%}_{-12.1\%} \pm 3.1\%$	$1.9^{+1.8\%}_{-1.8\%} \pm 2.3\%$	$5.36^{+35\%}_{-24.4\%} \pm 3.3\%$
500	$0.7^{+0.6\%}_{-0.2\%} \pm 2\%$	$4.503^{+5.6\%}_{-6.3\%} \pm 1.0\%$	$2.94^{+8.5\%}_{-11.0\%} \pm 2.9\%$	$0.78^{+1.8\%}_{-1.8\%} \pm 2.3\%$	$1.40^{+37.1\%}_{-25.5\%} \pm 4.34\%$
1000	$0.08^{+4.6\%}_{-4.2\%} \pm 2\%$	$0.16^{+5.7\%}_{-7.1\%} \pm 1.4\%$	$0.933^{+4.2\%}_{-7.1\%} \pm 2.1\%$	$0.027^{+2.7\%}_{-3.1\%} \pm 3.6\%$	$0.008^{+50.5\%}_{-33\%} \pm 14\%$

Figure: The cross-sections are calculated for F3C-uR restrictions at NLO accuracy. This case corresponds to the scalar dark matter with a fermionic mediator. The dark matter mass is chosen to be 100 GeV. The coupling λ is chosen to be 1.

k-factor for YY[QCD] process

M_ϕ (GeV)	YY-QCD [LO] (pb)	YY-QCD [NLO] (pb)	k-factor
100	7165	5112	1.40
200	293.1	226.19	1.30
300	38.08	31.05	1.23
400	8.425	7.01	1.20
500	2.947	2.082	1.41

Figure: The k-factors are calculated for different mediator masses. The dark matter mass is fixed at 100 GeV and the coupling λ is chosen to be 1.

Distribution 1:

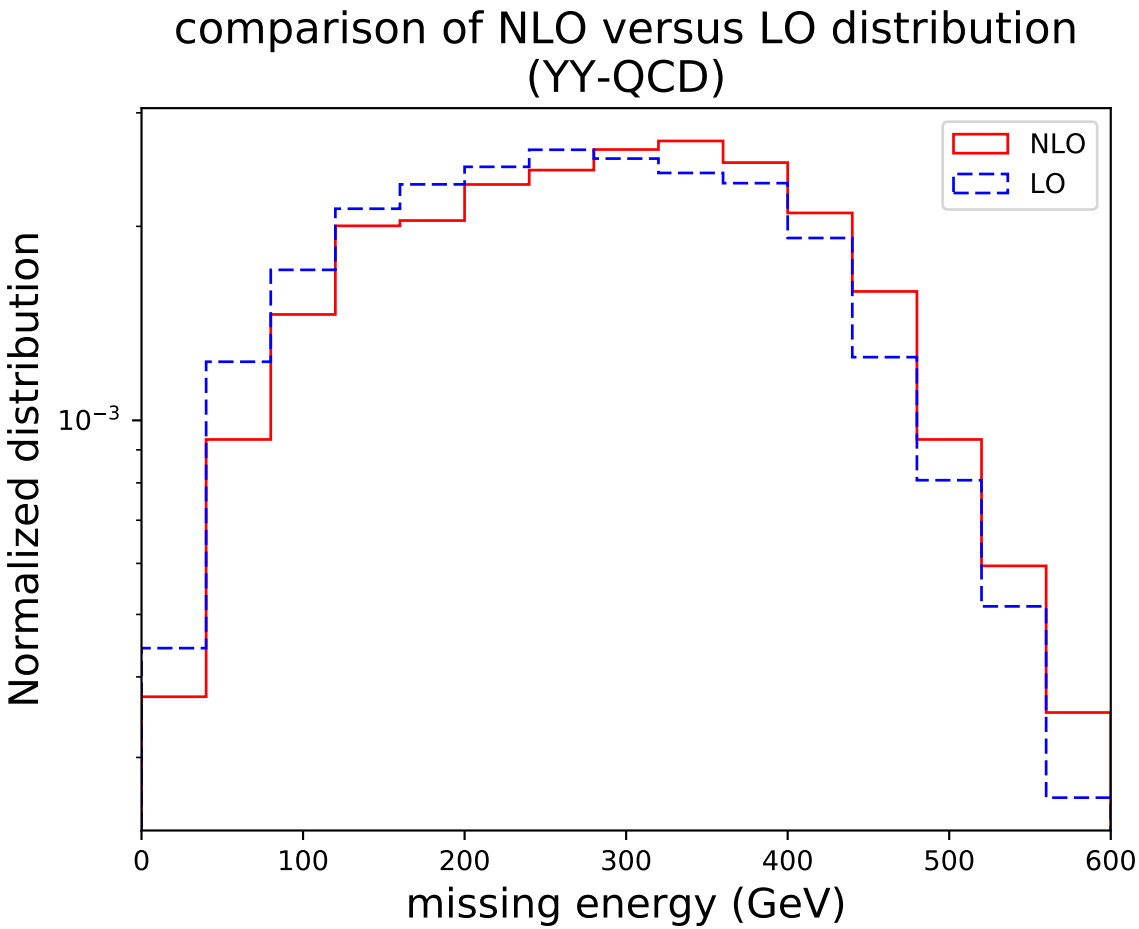

Figure: The figure compares the leading order and next-to-leading order differential distribution of the cross-section for YY(QCD) case. The dark matter mass and the mediator mass are chosen to be 100 and 500 GeV respectively.

Distribution 2:

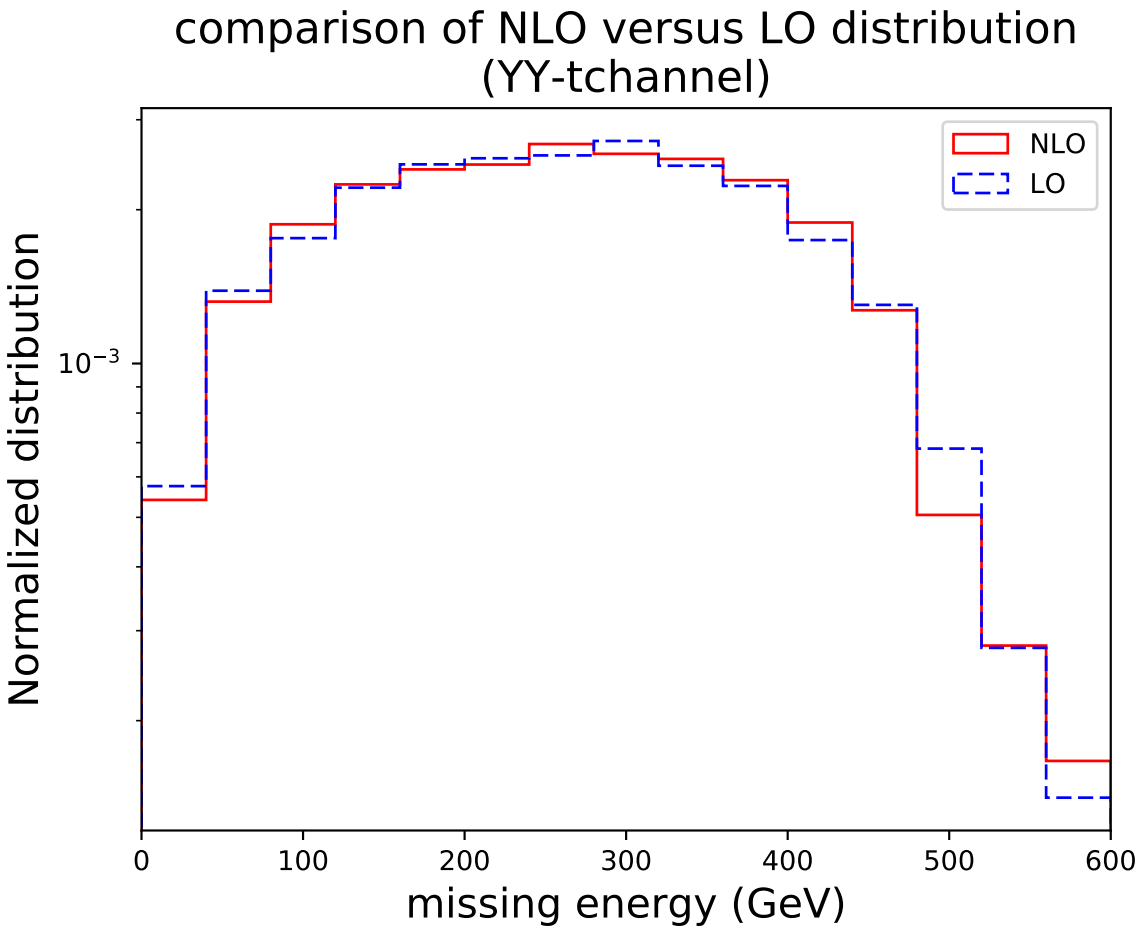

Figure: The figure compares the leading order and next-to-leading order differential distribution of the cross-section for YY-tchannel case. The dark matter mass and the mediator mass are chosen to be 100 and 500 GeV respectively.

Distribution 3:

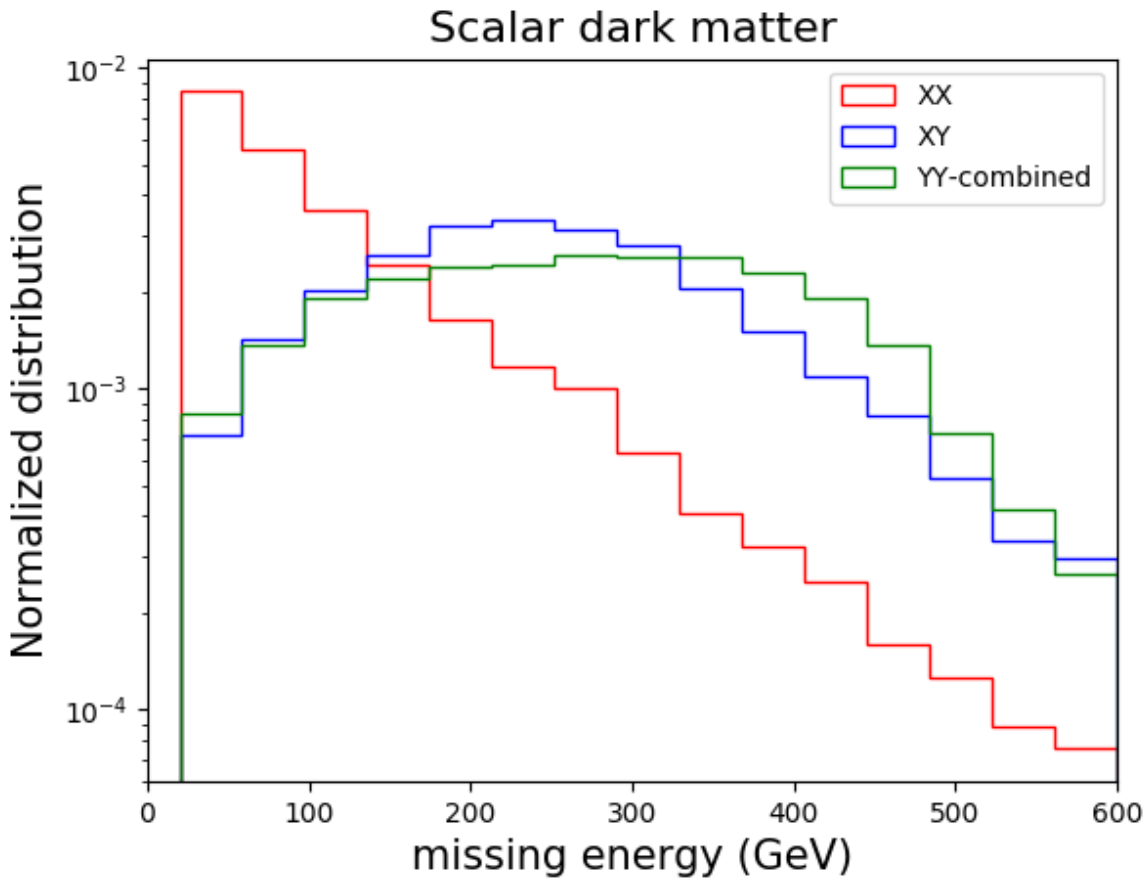

Figure: The figure compares differential distributions from the various segregated processes i.e XX, XY and YY.

Concluding remarks and work ahead

- k-factors in general are not flat.
- The analysis for evaluating efficiency needs to be done, with an extension towards other mass points and couplings respectively.