DM-tchannel studies

F3C_uR model

Disha Bhatia, Indian Association for the Cultivation of Science

F3C_uR model NLO cross-section

mX	mY	cross-section[pb]			
		(xx)	(xy)	(yy-qcd)	(yy-t)
1	100	161.6	2843	7607	306.1
75	100	34.79	1423	7622	133.4
1	500	1.212	5.158	2.805	0.881
200	500	0.3222	3.328	2.824	0.597
400	500	0.07851	1.662	2.822	0.355

Commands used:

1) The prescription followed is as per Benjamin's description.
2) Mass grid is taken as per the suggestion of Benedikt.

   (for this presentation considered some of the points)

3) **There are some points in the grid where the mediator is lighter than the dark matter particle.**
4) Since for uR models, we are considering only one decay mode of mediator i.e. yy > dm u, for a particular value of mY mass, mX cannot be greater than mY, if we are generating processes using exclusive commands like p p > yy dm i.e. the xy mode or pp > yy yy.
5) **Ques:** For such mass points perhaps should stick to the inclusive generation??

Generation of events as per commands suggested by Benedikt

mX	mY	cross-section(pb)		
		xxj	yy(qcd)	yy(t-channel)
1	100	122.2	5104	259.8
75	100	4.18		111
1	500	3.506	2.005	0.7595
200	500	2.12		0.529
400	500	0.4808		0.2958

k-factor

1) To do that, I compare the LO cross-section with NLO cross-section.
2) Since NLO diagrams has both vertex correction and bremsstrahlung corrections, to compute k factor, for LO, I compute cross-section with the diagrams without any extra radiation.
3) NLO command:

   p p > dm dm [QCD]

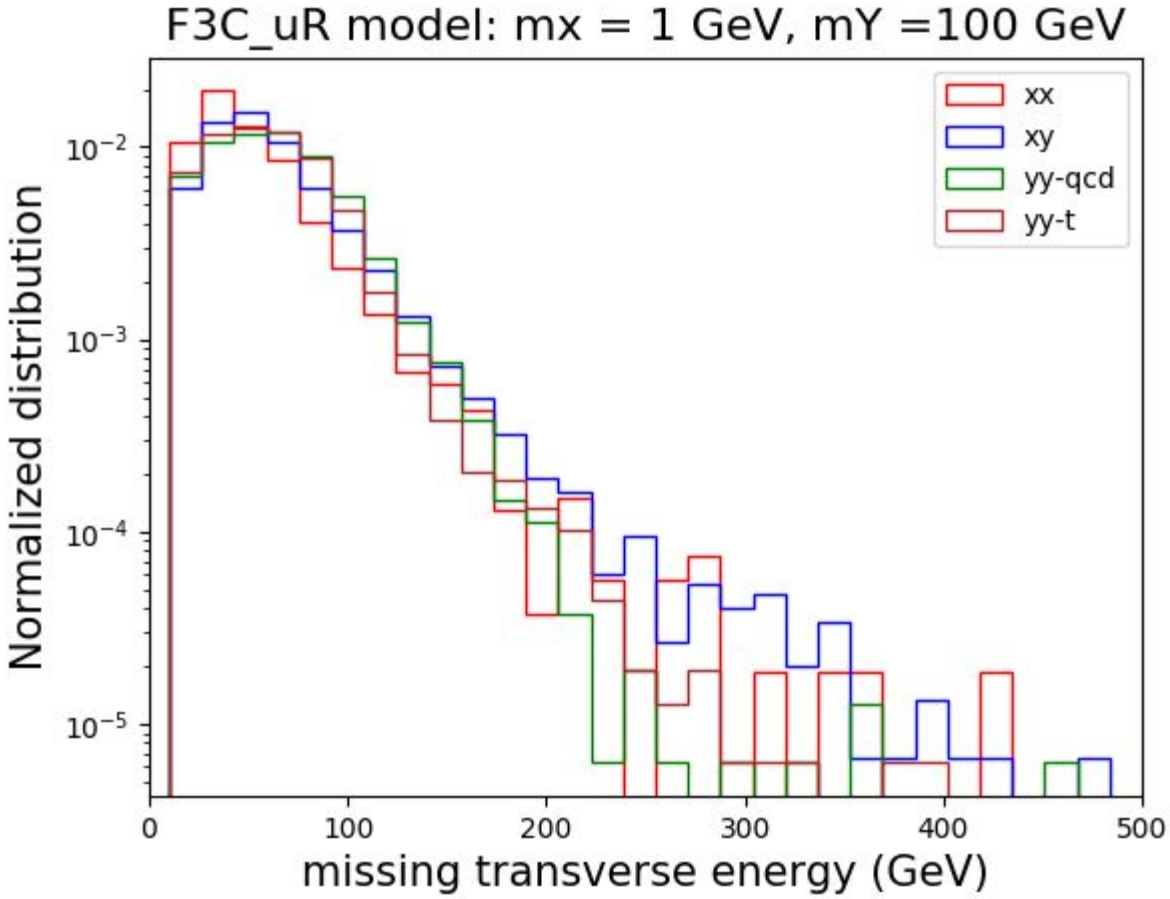
   For LO cross-section computation, I simply use p p > dm dm

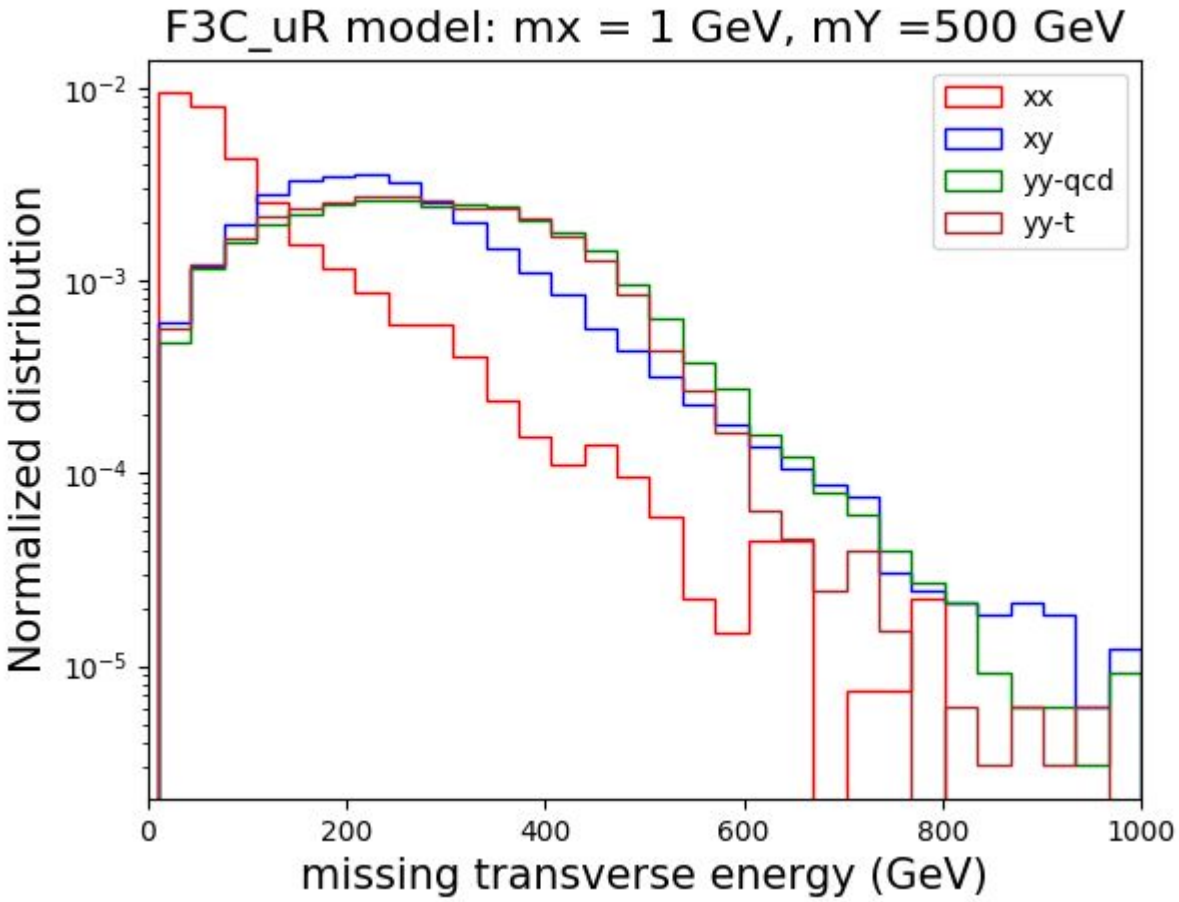
   (For getting distributions, I merge this with the process p p > dm dm j)

mX	mY	k(xx)	k(xy)	k(yy-qcd)	k(yy-tchannel)
1	100	1.02	1.37	1.50	1.178
75	100	1.25	1.41	1.50	1.21
1	500	0.964	1.39	1.39	1.15
200	500	1.15	1.39	1.40	1.13
400	500	1.265	1.42	1.41	1.20

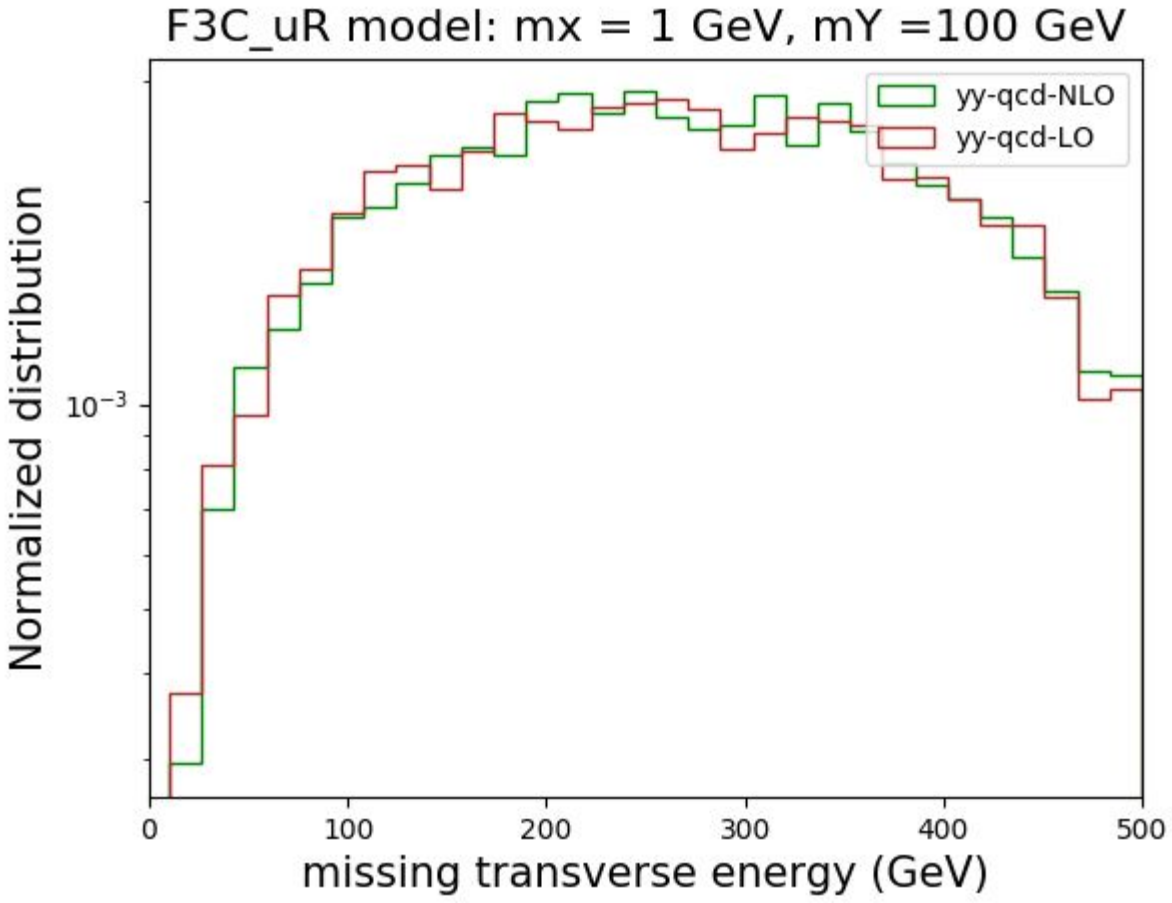
K-factors roughly similar a particular channel over the chosen values of mass range for the mediator and dark matter particle, however slightly different between xx and xy (say).

Distributions:




F3C_uR model: mx = 1 GeV, mY =500 GeV
Normalized distribution
missing transverse energy (GeV)
xx
xy
yy-qcd
yy-t
10^{-2}
10^{-3}
10^{-4}
10^{-5}
0
200
400
600
800
1000

NLO vs LO for yy-qcd

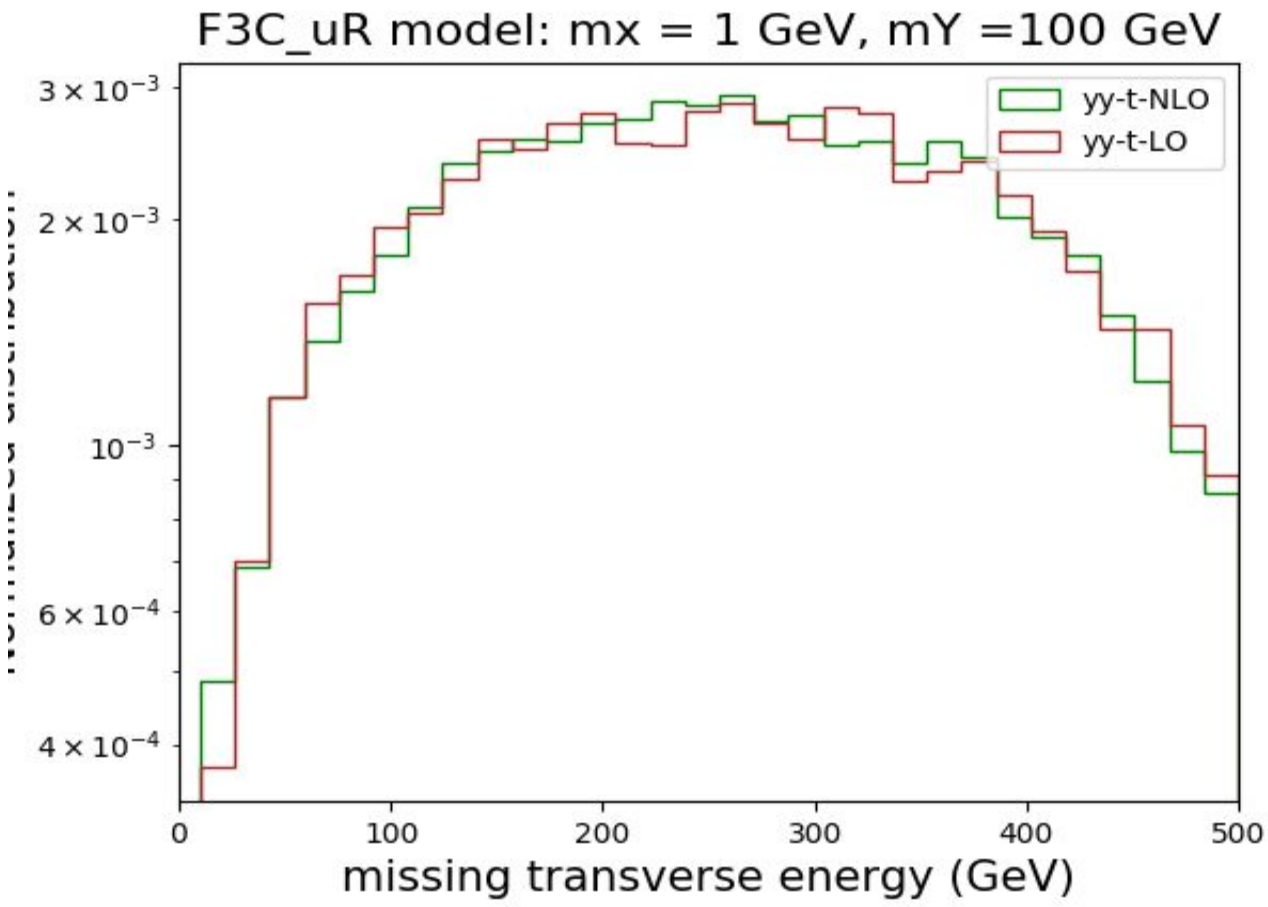


LO distribution using :

p p > dm dm
add process p p > dm dm j

NLO:

p p > dm dm [QCD]


F3C_uR model: mx = 1 GeV, mY =100 GeV
yy-t-NLO
yy-t-LO
3×10^{-3}
2×10^{-3}
10^{-3}
6×10^{-4}
4×10^{-4}
0
100
200
300
400
500
missing transverse energy (GeV)

Summary:

1) From the distributions perspective, there is a rough match between LO and NLO
2) I agree with Benedikt, that LO for distributions would be faster and better

and k-factor can be determined separately.

Further we have to compare distributions for different spin cases, shall do that part soon.

Further suggestions?