

COMETA polarisation study

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Agenda

- Agree on the YODA format
- LO results (tree level and loop-induced)
- Spotted issues
- Next step

YODA format

- we should agree on the **format** in **all details**
- complete content must be included: **scale variations** (now somewhat missing)
- format should be described in some brief documentation: input from **Mareen, Frank**
- for **fixed-order** calculations & comparison we stick to the **“basic”** format

#	drpp	0.0	0.2	0.03366140917517741	0.00018901621063600914	0.041177364219372105	0.042025848389118076	0.032981799508479466	0.03366140917517741	0.033808848627155046	0.027593458128667894	0.027714319508044274
1	0.0	0.2	0.03366140917517741	0.00018901621063600914	0.041177364219372105	0.042025848389118076	0.032981799508479466	0.03366140917517741	0.033808848627155046	0.027593458128667894	0.027714319508044274	
2	0.2	0.4	0.10740598228153844	0.00034082497775796757	0.13140910396376818	0.13409502567042375	0.10525464178406327	0.10740598228153844	0.10786191714716475	0.08804451588555477	0.08841826196251665	
3	0.4	0.6	0.17437250991830475	0.00042919978402626926	0.21341407569862253	0.2177018979484838	0.1709380964619299	0.17437250991830475	0.1750631621480169	0.14293936793262976	0.14350552020756657	
4	0.6	0.8	0.236886597554931	0.0005076138277969747	0.29007473442420395	0.2957499545681256	0.23234092114991725	0.236886597554931	0.2377273010631353	0.19418439605003116	0.19486980373531868	
5	0.8	1.0	0.29334006089803516	0.00055289929210769	0.3594690802246423	0.36623139755081185	0.2879236531581551	0.29334006089803516	0.2941951802797915	0.24046131419298394	0.24116228606057055	
6	1.0	1.2	0.3447960280128414	0.0005943201253109428	0.4228839264033251	0.4304735289906782	0.33871699027862534	0.3447960280128414	0.3455570489301742	0.28264160636860974	0.2832654423675233	
7	1.2	1.4	0.3910852432034445	0.0006275683213738394	0.48014431438210675	0.48826503526801035	0.38458079608302254	0.3910852432034445	0.391618294856776	0.32058652764401285	0.32102348910334666	
8	1.4	1.6	0.43293803217780896	0.00065860787006766	0.5321805044099084	0.540517718895896	0.42626018035690294	0.43293803217780896	0.4330876278563072	0.3548947520597266	0.3550173809749222	
9	1.6	1.8	0.4758416419848543	0.0006807280851049996	0.5855677443517895	0.59408233919188	0.46982171396773973	0.4758416419848543	0.4755713539412088	0.3900643718040691	0.3894280705181557	
10	1.8	2.0	0.5201120367955319	0.0006926924661350885	0.6409239480275863	0.649353734720398	0.5133603274797869	0.5201120367955319	0.5192313840793084	0.4263543939840931	0.4256324915312332	
11	2.0	2.2	0.5676240530875181	0.0007142510797968876	0.7005240025384049	0.708671531632292	0.5610981334188568	0.5676240530875181	0.5659658071846742	0.46530168895143	0.46394236561919655	

LO results (tree level): integrated

code	OS approx.	full	unpol.	LL	LT	TL	TT
MoCANLO	DPA	11.336(1)	11.242(1)	0.6574(1)	1.3332(2)	1.3370(2)	7.7874(8)
STRIPPER	DPA	11.3357(4)	11.2451(2)	0.6560(0)	1.3326(0)	1.3365(0)	7.7925(1)
MULBOS	DPA	–	11.2393(3)	0.6572(0)	1.3329(1)	1.3366(1)	7.7846(2)
BBMC	DPA	11.3372(4)	11.2424(3)	0.6574(0)	1.3333(1)	1.3372(1)	7.7872(2)
SHERPA	NWA	11.363(6)	12.135(5)	0.7112(5)	1.4444(8)	1.4396(8)	8.3821(37)
MADGRAPH	NWA	10.62(4)	10.52(4)	0.604(2)	1.237(5)	1.228(4)	7.3760(269)
POWHEG	DPA	11.448(1)					

Table 3. Integrated cross sections at LO (tree level).

- **Sherpa**: systematic shift of +8% for all pol/unpol modes (+0.1% for full), **cuts? NWA?**
- **MadGraph**: shift between -5% (TT) and -8% (LL) for all results, **cuts? NWA?**
- **DPA** results agree by less than 3 STDs
- **PowHeg**: runs on the way
- **photon-photon** (only in full) below 0.02% of the total

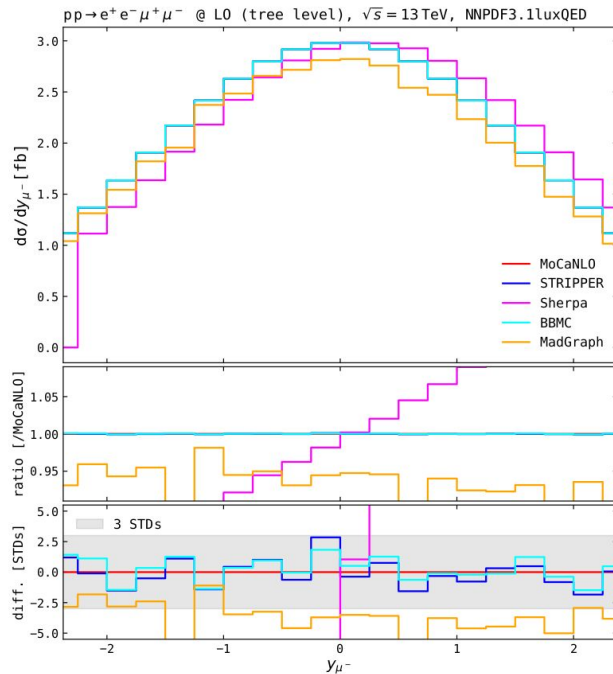
LO results (loop ind.): integrated

code	OS approx.	full	unpol.	LL	LT	TL	TT
MoCANLO	DPA	1.6968(6)	1.6978(6)	0.0914(0)	0.0360(0)	0.0356(0)	1.5360(5)
STRIPPER	DPA	1.682(7)	1.700(2)	0.0912(1)	0.0360(0)	0.0357(0)	1.538(2)
MULBOS	DPA	–	1.6981(9)	0.0913(1)	0.0360(0)	0.0357(0)	1.5363(8)
MADGRAPH	NWA	1.699(6)	1.697(6)	0.0902(3)	0.0355(1)	0.0359(1)	1.539(6)

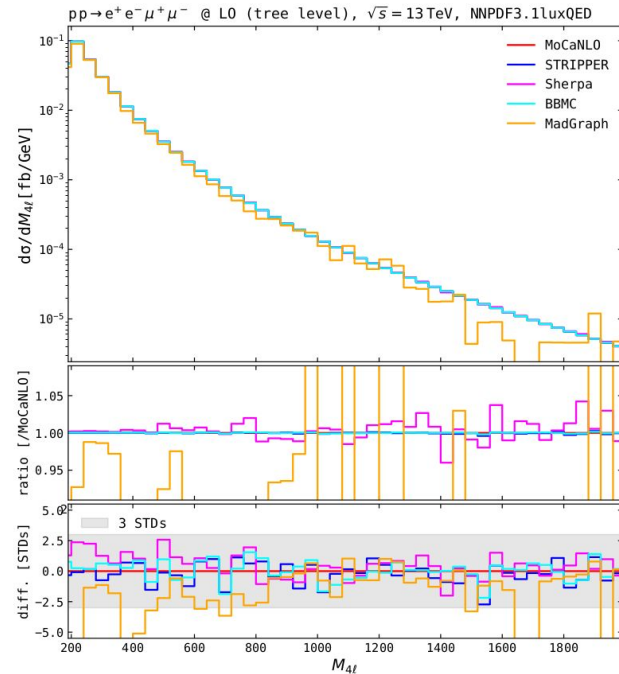
Table 4. Integrated cross sections at LO in the gg loop-induced channel.

- **DPA** results agree by less than 2 STDs for pol/unpol and full
- **MadGraph** agrees well with DPA ones for full/unpol, slight discrepancy for LL

LO results (tree level): full off-shell

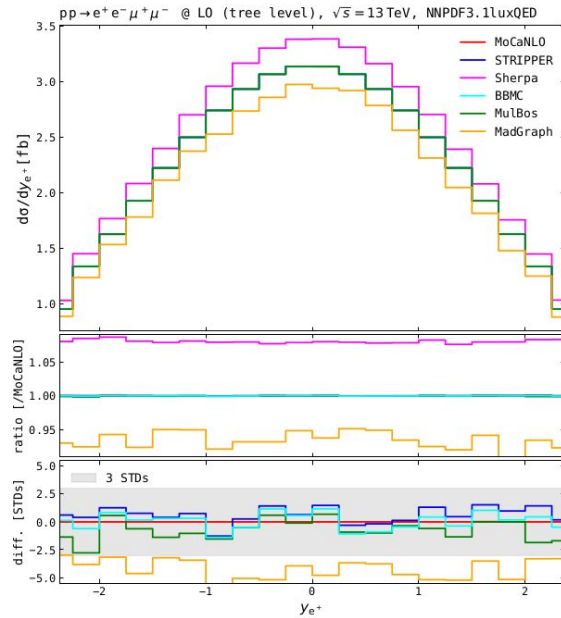


- **MadGraph** overall shift
- asymmetric-shape issue with **Sherpa** distribution in $y(\mu^-)$

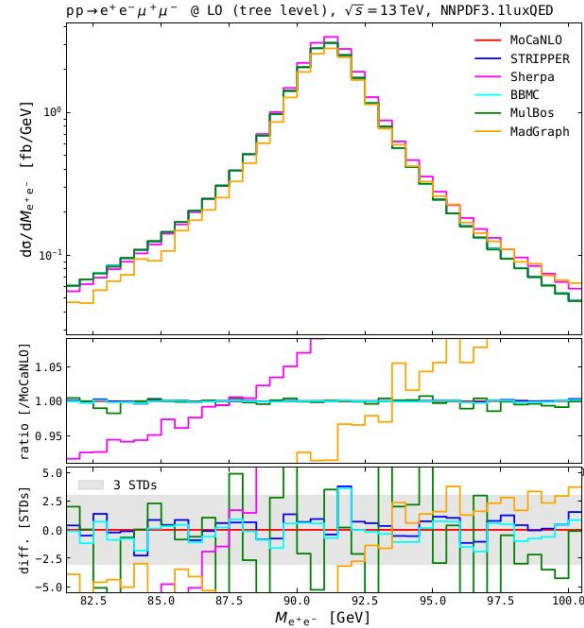


- **Sherpa** agrees with DPA in other distributions, e.g. $M(4l)$

LO results (tree level): unpolarised

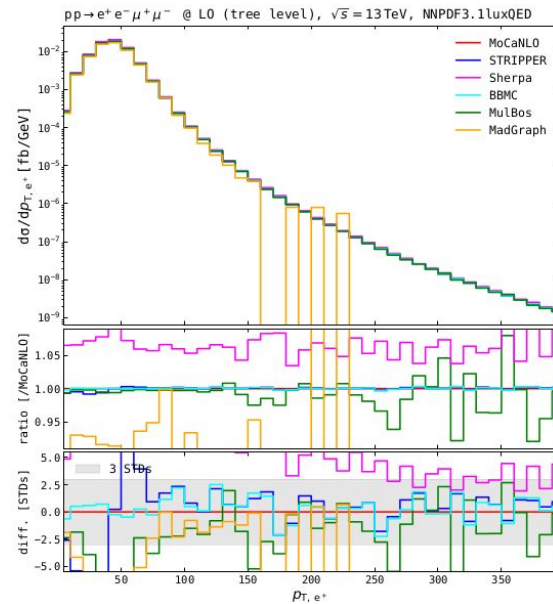
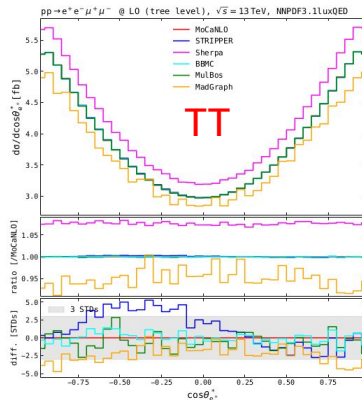
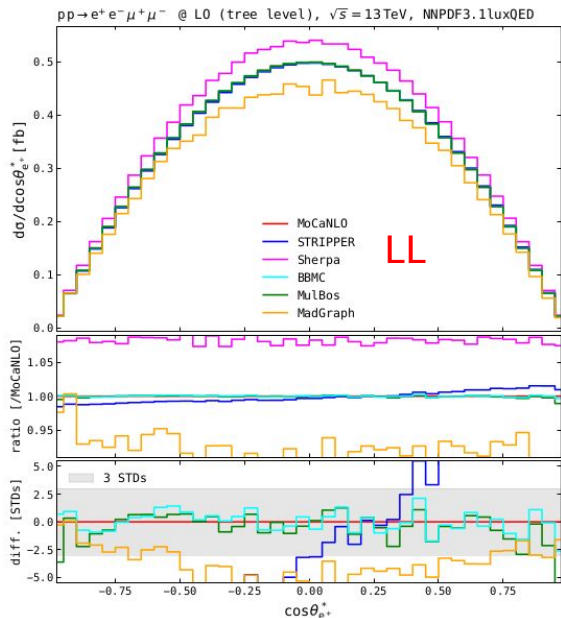


→ **MadGraph** and **Sherpa** overall shifts



→ **NWA vs DPA**: different **M(e+e-)** shapes, but first need to fix normalisation issues

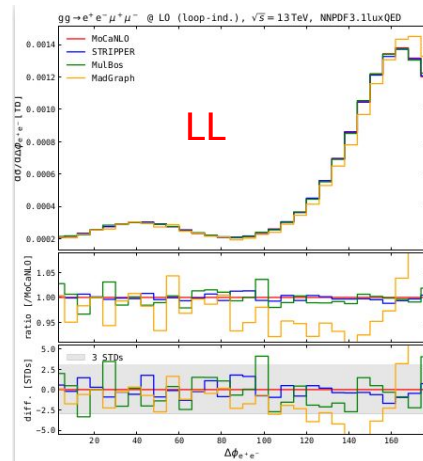
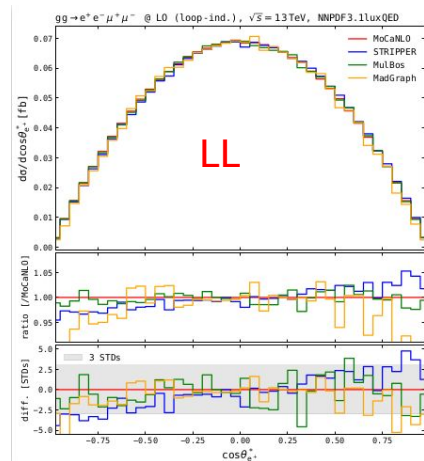
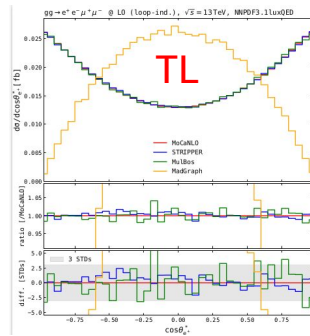
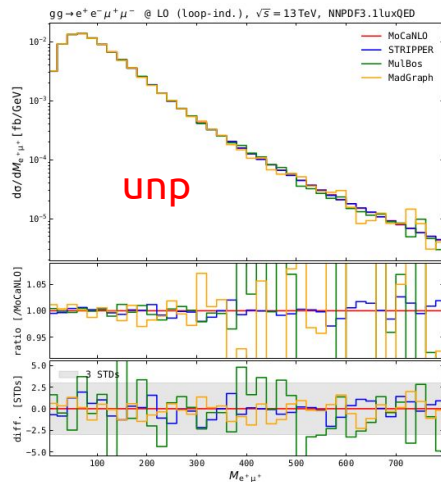
LO results (tree level): polarised



- **shape-wise** agreement in decay angles, apart from **asymmetry** in STRIPPER
- similar effects in TL/LT and for $\Delta\phi$ and other variables, reduced but still present in TT

- **discrep.** at low pT's, but also large stat. oscillations
- MadGraph results with poor stat. already at moderate pT's

LO results (loop ind.): differential



→ good agreement for unpolarised (both angular and pT/mass)

- asymmetry in STRIPPER LL in decay angle reduced but still present
- deviation of MadGraph close to $\Delta\phi(e+e)=\pi$, for LL (not for TT/TL!), not present in $\Delta\phi(e+\mu+)$ instead
- TL and LT swap in MadGraph: check

Technical issues and remarks

- in MoCaNLO wrong definition in $\cos\theta(e+\mu+)$ and $M(3l)$: re-running ongoing
- $\cos\Delta\theta(e+\mu+)$ problem in BBMC only for TT mode at LO

- understand overall shifts in MadGraph and Sherpa
- understand asymmetric longitudinal shape distortions in STRIPPER

- **notation** (raised by Richard): L/T or 0/T for **longitudinal**/transverse?

Next steps

- analysis script and output plots will be pushed soon to the git repo
- please have a look at the LO results: **we should all give feedback** and understand discrepancies in LO results which do not come from “trivial” mistakes

- improve statistics in the pT tails where possible already at LO
- assess compatibility of **scale uncertainties** at LO
- **NLO QCD** runs (fixed order!)

- next meeting end before summer break: **Wed. 17th of July at 3pm CERN time?**