Comparison of ZGRAD2 with MCSANC and POWHEG_ew: An update

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Comparison with MCSANC and POWHEG_ew

- MCSANC and POWHEG_ew results as presented at the April 21, 2020 meeting.
- ZGRAD2 (as implemented in WZGRAD) results have been obtained with the agreed setup.
- Change since the talk given at the Februray 26, 2020 meeting: *mstw*2008*nlo*.00.*dat* $\rightarrow$ *MSTW*2008*nlo*68*cl*_0000.*dat* (LHAPDF)

Setup

(masses,width in GeV)

$$\alpha(0) = 0.007297353;\ G_f = 1.1663787 \cdot 10^{-5};\ \alpha_s(m_z^2) = 0.1201789;\ conhc = 389379323$$

pole masses:

$$m_w = 80.35797;\ m_z = 91.15348;\ m_h = 125$$

pole width:

$$\Gamma_z = 2.494266$$

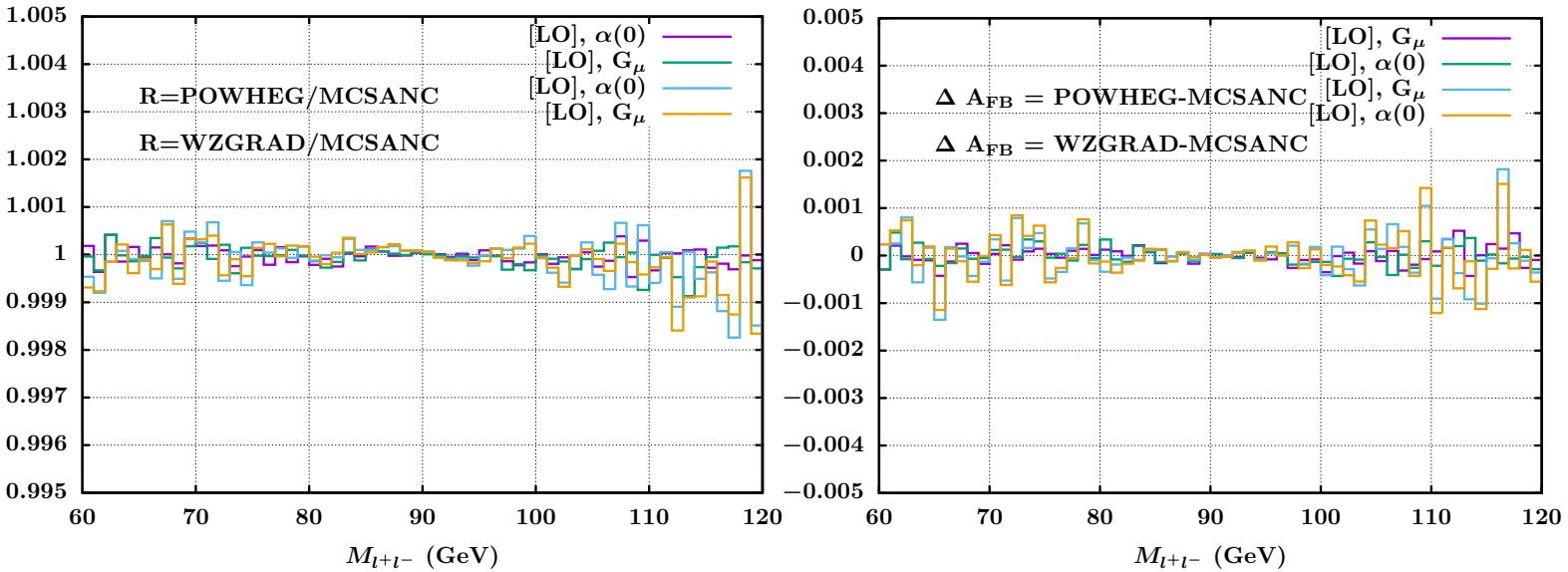
fermion masses:

$$m_e = 5.1099907d-4;\ m_\mu = 0.1056583;\ m_\tau = 1.77705;\ m_d = 0.06983;\ m_u = 0.06984;\ m_s = 0.15;$$

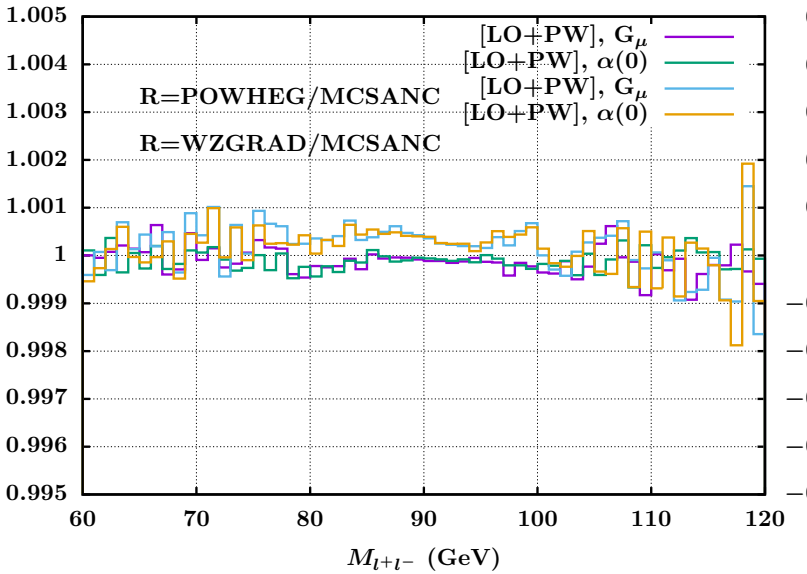
$$m_c = 1.2;\ m_b = 4.7;\ m_t = 173$$

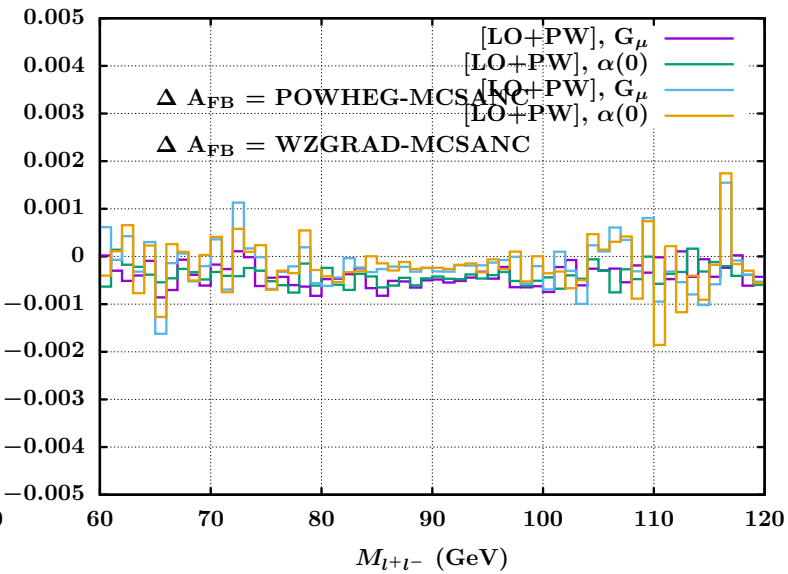
Masses were chosen to reproduce:
$\Delta\alpha$ (91.153480619182758) = (5.8976056714606255OE-002,-1.6216302798205847 1E-002 (POWHEG_ew);
5.8975530055977214E-002 (MCSANC); 5.8975530126199806E-002 (WZGRAD, no top loop)
$1/\alpha$(91.153480619182758) = (128.95414861873800,2.2222171242374937) (POWHEG_ew);
128.95422078992519 (MCSANC); 128.95422078030214 (WZGRAD, no top loop)
Δr = (2.9763267269731868 3E-002,-2.8976782351719614 8E-002) (POWHEG_ew);
2.9762759543028511E-002 (MCSANC); 2.9762761199628920E-002 (WZGRAD)
Final-state: bare muons; EW-schemes: $\alpha(0), G_\mu$; fact/ren scale = m_{ll}; PDF: MSTW2008nlo68cl, Fixed-width scheme
Cuts: no p_T, η, $m_{ll} = [60, 150]$ GeV with binsize=1 GeV
Observables: x-section, forward-, backward-x-sections for QED(ISR,IFI), pure weak (PW), higher order (HO)

$m_{\mu^+\mu^-}$ and $A_{\mathrm{FB}}(m_{\mu^+\mu^-})$ distributions at leading order (LO)

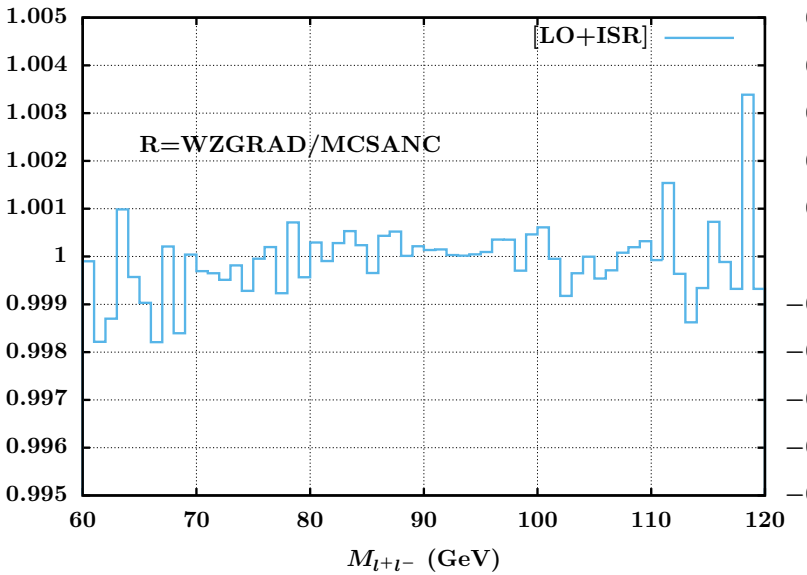


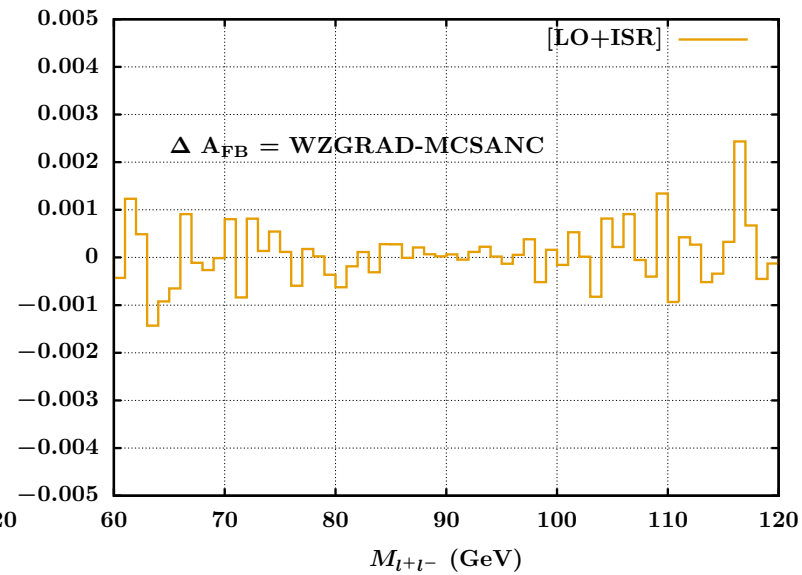
$m_{\mu^+\mu^-}$ and $A_{\mathrm{FB}}(m_{\mu^+\mu^-})$ distributions at LO+pure weak (PW) corrections



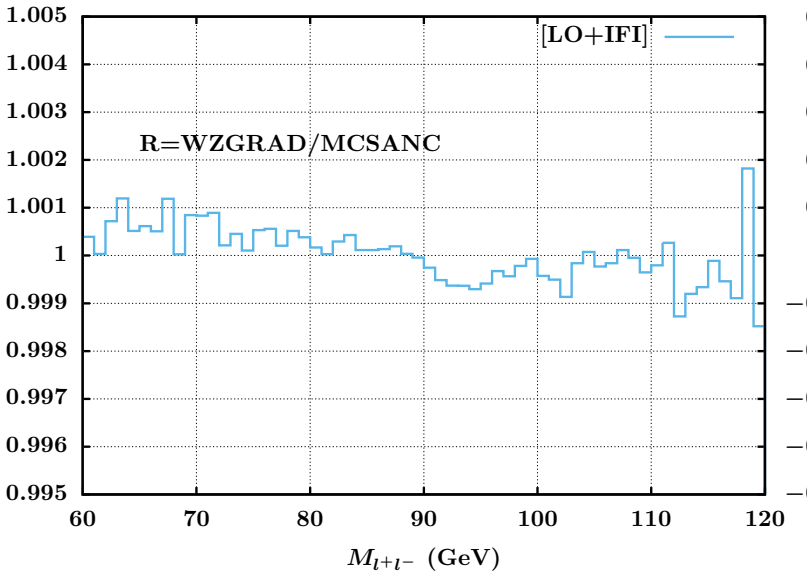


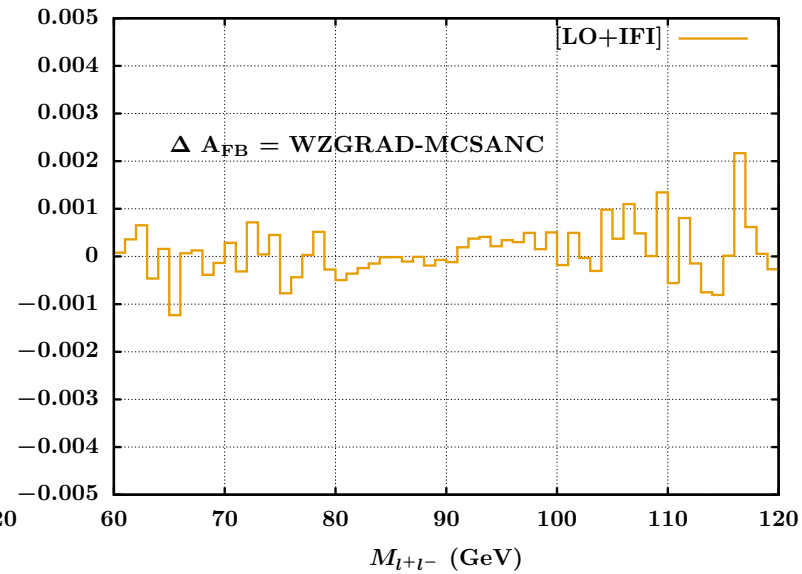
$m_{\mu^+\mu^-}$ and $A_{\rm FB}(m_{\mu^+\mu^-})$ distributions at LO+ISR QED corrections





$m_{\mu^+\mu^-}$ and $A_{\rm FB}(m_{\mu^+\mu^-})$ distributions at LO+IFI QED corrections





σ and A_{FB} at the 8 TeV LHC

Calculated from distributions: $m_{\mu^+\mu^-} = [60 - 120]$ GeV; G_μ EW scheme

x-section [pb]	Ratio	A_{rmFB}	Difference
MCSANC [LO] 951.76(1)		0.03683(1)	
POWHEG [LO] 951.74(1)	0.99998(1)	0.03682(1)	$1(1) \cdot 10^{-5}$
WZGRAD [LO] 951.74(1)	0.99998(1)	0.03683(1)	$0(1) \cdot 10^{-5}$
MCSANC [PW] -5.94(1)		-0.01684(1)	
POWHEG [PW] -6.03(1)	1.02(1)	-0.01733(1)	$-4.9(1) \cdot 10^{-4}$
WZGRAD [PW] -5.63(1)	0.95(1)	-0.01710(1)	$-2.6(1) \cdot 10^{-4}$
MCSANC [ISR] 3.53(1)		-0.00005(2)	
WZGRAD [ISR] 3.65(1)	1.03(1)	0.00000(1)	$5(2) \cdot 10^{-5}$
MCSANC [IFI] 0.18(1)		-0.00031(1)	
WZGRAD [IFI] -0.08(1)	-0.47(1)	-0.00023(1)	$8(1) \cdot 10^{-5}$

Next steps

- Continue to participate in the tuned comparison/benchmarking with `POWHEG`, `MCSANC`, `RADY` and `DIZET`, and explore reasons for observed differences.
- Implement "new" parametrization of A_{FB} in terms of $\sin^2\theta^l_{eff}$ of arXiv:1906.11569 [hep-ph]