MC@NLO parton density library

MC@NLO has a self-contained library[1] of proton parton densities, which features many of the sets supported by PDFLIB, but also more modern sets, not included in the most recent (and last) version of PDFLIB (8.04). The full listing of the PDF sets supported by the MC@NLO library is given in tables 1, 2 and 3.

MC@NLO PDF library is fully compatible with PDFLIB, and the parton densities are accessed in the same way as in PDFLIB. Namely, one must first initialize the set of interest, through

```
CALL PDFSET(PARM,VALUE)
```

where `PARM` and `VALUE` are defined in the PDFLIB manual (see page 20) – for example, to use the default set of the MRST 1999 release, one has simply to set (see table 1)

```
PARM(1)='MRS'
VALUE(1)=89
```

Having done that, the actual PDF values are obtained by calling

```
CALL STRUCTM(X,SCALE,UPV,DNV,USEA,DSEA,STR,CHM,BOT,TOP,GL)
```

or

```
CALL PFTOPDG(X,SCALE,DXPDF)
```

(see pages 22 and 23 of the PDFLIB manual).

Clearly, the MC@NLO PDF library can be used within any package which uses PDFLIB format to compute parton densities. In order to do so, the user will simply have to replace the linking to PDFLIB with the linking to the following files:

```
mcatnlo_pdftomlm.f
mcatnlo_libofpdf.f
mcatnlo_str.f
dummies.f
```

which can be downloaded from the MC@NLO web page. Since the majority of the original codes for parton densities (which we take from the authors and embed in our package without modifications) need to read grid files for initialization, these files must be present in the directory where the executable obtained from the fortran files above is stored. As a viable alternative, the user can store all these files in a given directory, and then define logical links to them (with `ln -ns`).

Typically, a given PDF set is associated with a value of $\alpha_{\rm S}(M_Z)$. In tables 1, 2 and 3 this is presented as $\Lambda_{\rm QCD}^{(5)}$, the value of $\Lambda_{\rm QCD}$ for five light flavours, in the $\overline{\rm MS}$ scheme at two loops. This holds regardless of the nominal accuracy of the PDF set chosen (i.e., also for LO or NNLO sets), since in the MC@NLO package $\alpha_{\rm S}$ at two loops is always used. Consistently with PDFLIB conventions, the value of $\Lambda_{\rm QCD}^{(5)}$, and the corresponding value with four light flavours, are stored in the common block

```
common/w50512/xpdflam4,xpdflam5
```

[1] The present library is based on a package developed over many years, mainly in connection with the work of refs. [1, 2].

When PDFLIB is linked rather than the MC@NLO PDF library, the user is urged not to trust the value of $\Lambda_{\rm QCD}$ returned by the code, since PDFLIB is affected by notorious bugs in this respect. The correct values can be read from the tables presented in this report.

References

[1] M. L. Mangano, P. Nason and G. Ridolfi, Nucl. Phys. B **373** (1992) 295.

[2] S. Frixione, M. L. Mangano, P. Nason and G. Ridolfi, Nucl. Phys. B **412** (1994) 225 [arXiv:hep-ph/9306337].

Group name	Group number	Set number	Set name	$\Lambda_{\rm QCD}^{(5)}$ (MeV)	Scheme
MRS	3	15	HMRS B	122	$\overline{\rm MS}$
MRS	3	18	KMRS B	122	$\overline{\rm MS}$
MRS	3	22	MRS B0 135	83	$\overline{\rm MS}$
MRS	3	23	MRS B0 160	101	$\overline{\rm MS}$
MRS	3	24	MRS B0 200	130	$\overline{\rm MS}$
MRS	3	25	MRS B0 235	155	$\overline{\rm MS}$
MRS	3	26	MRS S0	140	$\overline{\rm MS}$
MRS	3	27	MRS D0	140	$\overline{\rm MS}$
MRS	3	28	MRS D-	140	$\overline{\rm MS}$
MRS	3	37	MRSA	151	$\overline{\rm MS}$
MRS	3	39	MRSA$'$	152	$\overline{\rm MS}$
MRS	3	41	MRSG	170	$\overline{\rm MS}$
MRS	3	45	MRS 105	99	$\overline{\rm MS}$
MRS	3	46	MRS 110	140	$\overline{\rm MS}$
MRS	3	47	MRS 115	190	$\overline{\rm MS}$
MRS	3	48	MRS 120	253	$\overline{\rm MS}$
MRS	3	49	MRS 125	328	$\overline{\rm MS}$
MRS	3	50	MRS 130	416	$\overline{\rm MS}$
MRS	3	53	MRS R1	159	$\overline{\rm MS}$
MRS	3	54	MRS R2	237	$\overline{\rm MS}$
MRS	3	55	MRS R3	159	$\overline{\rm MS}$
MRS	3	56	MRS R4	237	$\overline{\rm MS}$
MRS	3	67	MRST (98)	220	$\overline{\rm MS}$
MRS	3	68	MRST h-g	220	$\overline{\rm MS}$
MRS	3	69	MRST l-g	220	$\overline{\rm MS}$
MRS	3	70	MRST l-$\alpha_{\rm S}$	164	$\overline{\rm MS}$
MRS	3	71	MRST h-$\alpha_{\rm S}$	288	$\overline{\rm MS}$
MRS	3	89	MRST (99)	220	$\overline{\rm MS}$
MRS	3	90	MRST h-g	220	$\overline{\rm MS}$
MRS	3	91	MRST l-g	220	$\overline{\rm MS}$
MRS	3	92	MRST l-$\alpha_{\rm S}$	164	$\overline{\rm MS}$
MRS	3	93	MRST h-$\alpha_{\rm S}$	288	$\overline{\rm MS}$
MRS	3	94	MRST q-up	224	$\overline{\rm MS}$
MRS	3	95	MRST q-down	215	$\overline{\rm MS}$
MRS	3	96	MRST s-up	220	$\overline{\rm MS}$
MRS	3	97	MRST s-down	220	$\overline{\rm MS}$
MRS	3	98	MRST c-up	220	$\overline{\rm MS}$
MRS	3	99	MRST c-down	220	$\overline{\rm MS}$
MRS	3	100	MRST large d/u	220	$\overline{\rm MS}$
MRS	3	101	MRST NNLO (01)	196	$\overline{\rm MS}$
MRS	3	102	MRST NNLO fast	196	$\overline{\rm MS}$
MRS	3	103	MRST NNLO slow	196	$\overline{\rm MS}$
MRS	3	104	MRST NNLO jet	226	$\overline{\rm MS}$
MRS	3	105	MRST (01)	239	$\overline{\rm MS}$
MRS	3	106	MRST l-$\alpha_{\rm S}$	214	$\overline{\rm MS}$
MRS	3	107	MRST h-$\alpha_{\rm S}$	267	$\overline{\rm MS}$
MRS	3	108	MRST jet	267	$\overline{\rm MS}$
MRS	3	109	MRST LO	416	
MRS	3	110	MRST (02)	249	$\overline{\rm MS}$
MRS	3	111	MRST NNLO (02)	195	$\overline{\rm MS}$
MRS	3	112–142	MRST Err (01)	239	$\overline{\rm MS}$

Table 1: Codes for PDF sets implemented in MC@NLO

Group name	Group number	Set number	Set name	$\Lambda_{\mathrm{QCD}}^{(5)}$ (MeV)	Scheme
CTEQ	4	1	MT S1	138	DIS
CTEQ	4	2	MT B1	125	DIS
CTEQ	4	3	MT B2	123	DIS
CTEQ	4	4	MT E1	97	DIS
CTEQ	4	5	MT 6 (1/2s)	156	DIS
CTEQ	4	6	MT S1	138	$\overline{\mathrm{MS}}$
CTEQ	4	10	MT 6 (1/2s)	156	$\overline{\mathrm{MS}}$
CTEQ	4	11	MT LO	245	
CTEQ	4	12	CTEQ 1L	249	
CTEQ	4	13	CTEQ 1M	152	$\overline{\mathrm{MS}}$
CTEQ	4	14	CTEQ 1MS	152	$\overline{\mathrm{MS}}$
CTEQ	4	15	CTEQ 1ML	220	$\overline{\mathrm{MS}}$
CTEQ	4	16	CTEQ 1D	164	DIS
CTEQ	4	29	CTEQ 3L	263	
CTEQ	4	30	CTEQ 3M	158	$\overline{\mathrm{MS}}$
CTEQ	4	31	CTEQ 3D	164	DIS
CTEQ	4	32	CTEQ 4L	202	
CTEQ	4	33	CTEQ 4D	202	DIS
CTEQ	4	34	CTEQ 4M	202	$\overline{\mathrm{MS}}$
CTEQ	4	35	CTEQ 4A1	140	$\overline{\mathrm{MS}}$
CTEQ	4	36	CTEQ 4A2	169	$\overline{\mathrm{MS}}$
CTEQ	4	38	CTEQ 4A4	239	$\overline{\mathrm{MS}}$
CTEQ	4	39	CTEQ 4A5	281	$\overline{\mathrm{MS}}$
CTEQ	4	40	CTEQ 4HJ	202	$\overline{\mathrm{MS}}$
CTEQ	4	41	CTEQ 4LQ	179	$\overline{\mathrm{MS}}$
CTEQ	4	46	CTEQ 5L	359	
CTEQ	4	47	CTEQ 5D	226	DIS
CTEQ	4	48	CTEQ 5M	226	$\overline{\mathrm{MS}}$
CTEQ	4	49	CTEQ 5HJ	226	$\overline{\mathrm{MS}}$
CTEQ	4	50	CTEQ 5HQ	226	$\overline{\mathrm{MS}}$
CTEQ	4	51	CTEQ 5F3	$\alpha_{\mathrm{S}} = 0.106$	$N_f = 3$
CTEQ	4	52	CTEQ 5F4	$\alpha_{\mathrm{S}} = 0.112$	$N_f = 4$
CTEQ	4	53	CTEQ 5M1	226	$\overline{\mathrm{MS}}$
CTEQ	4	54	CTEQ 5HQ1	226	$\overline{\mathrm{MS}}$
CTEQ	4	55	CTEQ 5M1 (par)	226	$\overline{\mathrm{MS}}$
CTEQ	4	56	CTEQ 6M	226	$\overline{\mathrm{MS}}$
CTEQ	4	57	CTEQ 6D	226	DIS
CTEQ	4	58	CTEQ 6L	226	
CTEQ	4	59–98	CTEQ6 Err	226	$\overline{\mathrm{MS}}$
DO	1	6	DO set 1	340	
DO	1	7	DO set 2	680	
DO	1	8	EHLQ set 1	340	
DO	1	9	EHLQ set 2	490	
DFLM	2	7	DFLM 160	101	DIS
DFLM	2	8	DFLM 260	173	DIS
DFLM	2	9	DFLM 360	250	DIS

Table 2: Codes for PDF sets implemented in MC@NLO

Group name	Group number	Set number	Set name	$\Lambda^{(5)}_{\rm QCD}$ (MeV)	Scheme
ALEKHIN	10	1	LO ffn	418	
ALEKHIN	10	2	LO vfn	418	
ALEKHIN	10	3	LO $m_c = 1.75$ ffn	418	
ALEKHIN	10	4	LO $m_c = 1.75$ vfn	418	
ALEKHIN	10	5	LO ss ffn	418	
ALEKHIN	10	6	LO ss vfn	418	
ALEKHIN	10	7	NLO ffn	215	$\overline{\rm MS}$
ALEKHIN	10	8	NLO vfn	215	$\overline{\rm MS}$
ALEKHIN	10	9	NLO $m_c = 1.75$ ffn	215	$\overline{\rm MS}$
ALEKHIN	10	10	NLO $m_c = 1.75$ vfn	215	$\overline{\rm MS}$
ALEKHIN	10	11	NLO ss ffn	215	$\overline{\rm MS}$
ALEKHIN	10	12	NLO ss vfn	215	$\overline{\rm MS}$
ALEKHIN	10	13	NNLO ffn	182	$\overline{\rm MS}$
ALEKHIN	10	14	NNLO vfn	182	$\overline{\rm MS}$
ALEKHIN	10	15	NNLO $m_c = 1.75$ ffn	182	$\overline{\rm MS}$
ALEKHIN	10	16	NNLO $m_c = 1.75$ vfn	182	$\overline{\rm MS}$
ALEKHIN	10	17	NNLO ss ffn	182	$\overline{\rm MS}$
ALEKHIN	10	18	NNLO ss vfn	182	$\overline{\rm MS}$
ALEKHIN	10	19	NNLO slow ffn	182	$\overline{\rm MS}$
ALEKHIN	10	20	NNLO slow vfn	182	$\overline{\rm MS}$

Table 3: Codes for PDF sets implemented in MC@NLO