# $Wb\bar{b}$ production in POWHEG

Carlo Oleari
Università di Milano-Bicocca, Milan

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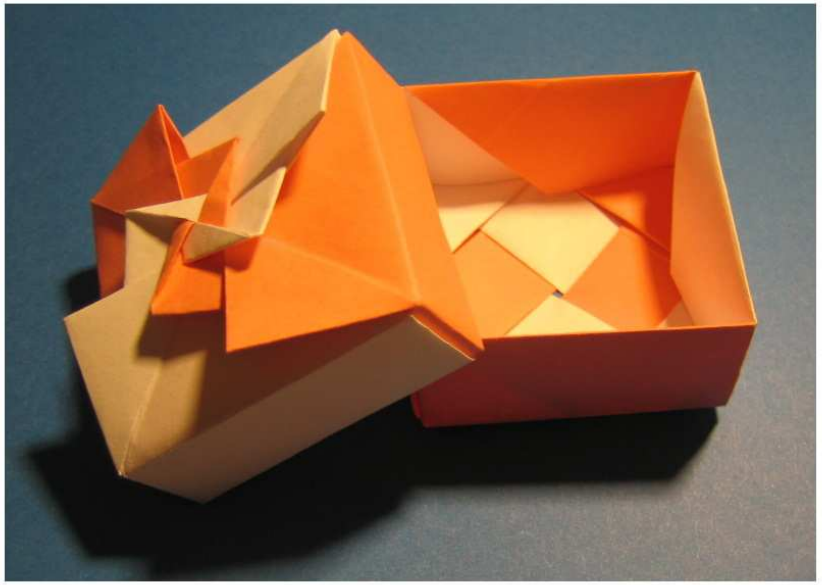
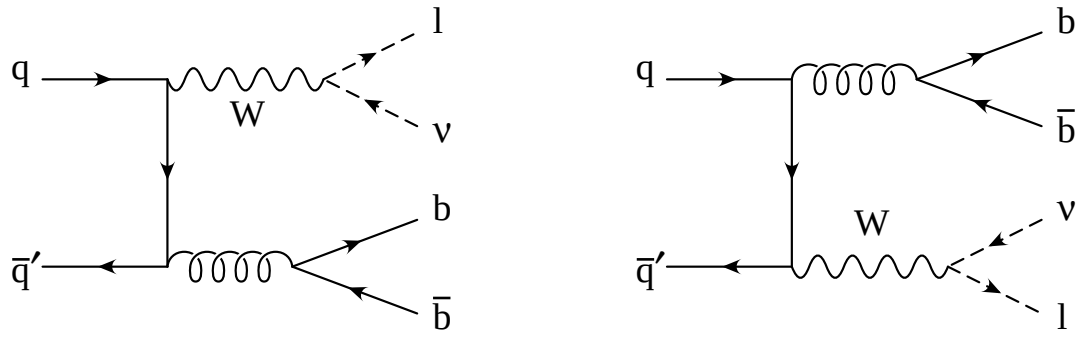


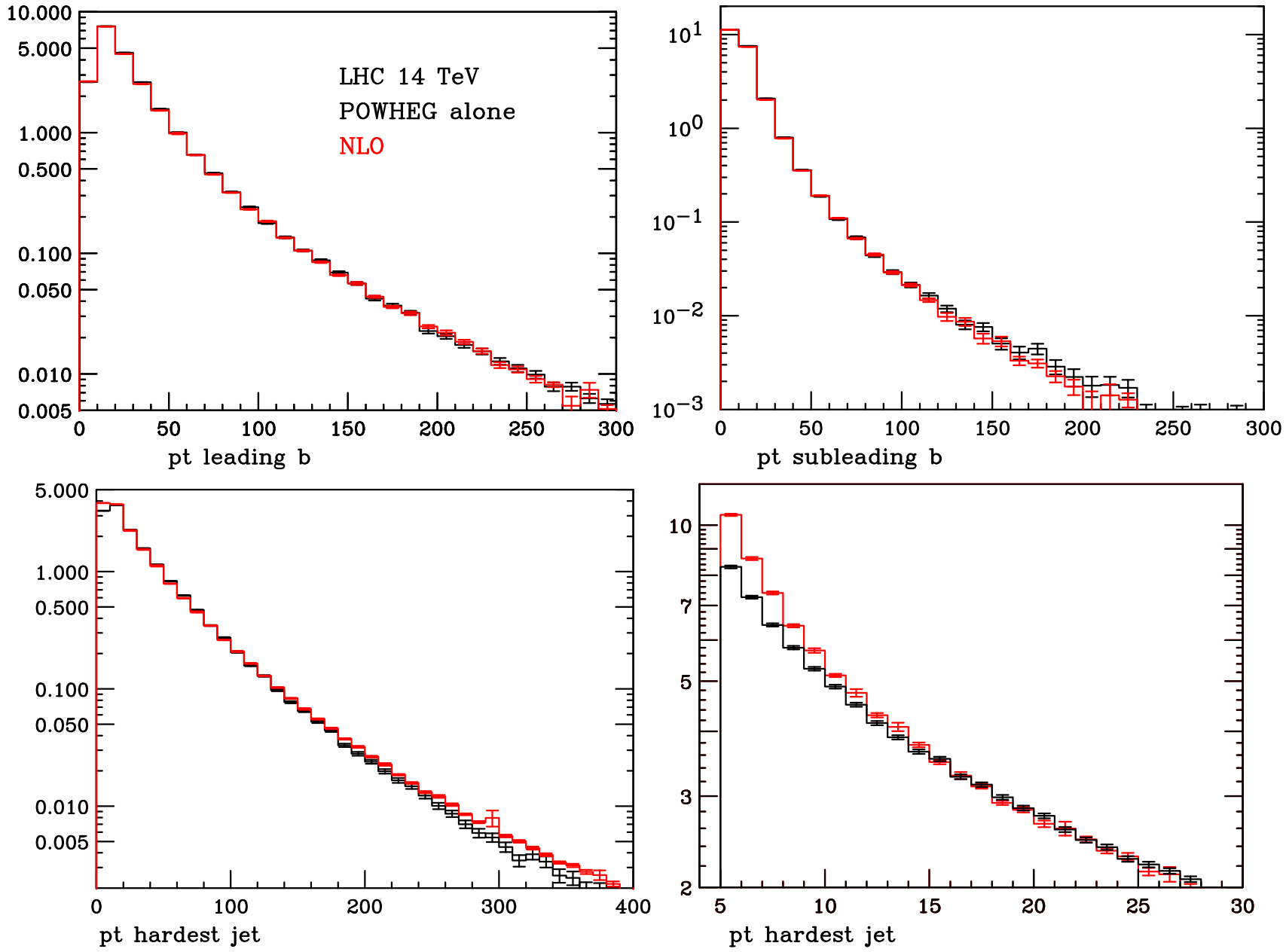
- Introduction to $Wb\bar{b}$
- Running the code

# Introduction to $Wb\bar{b}$

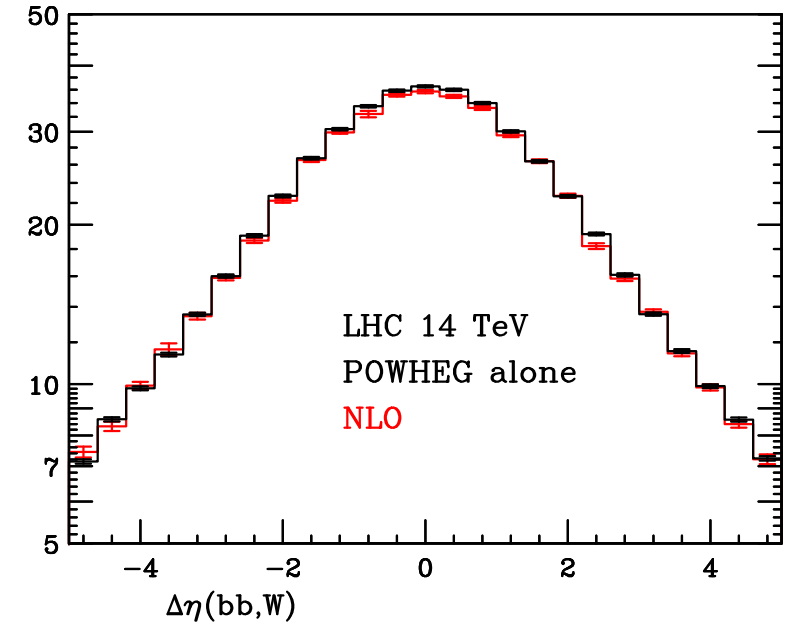
$Wb\bar{b}$ is an irreducible background to $pp \to WH \to Wb\bar{b}$

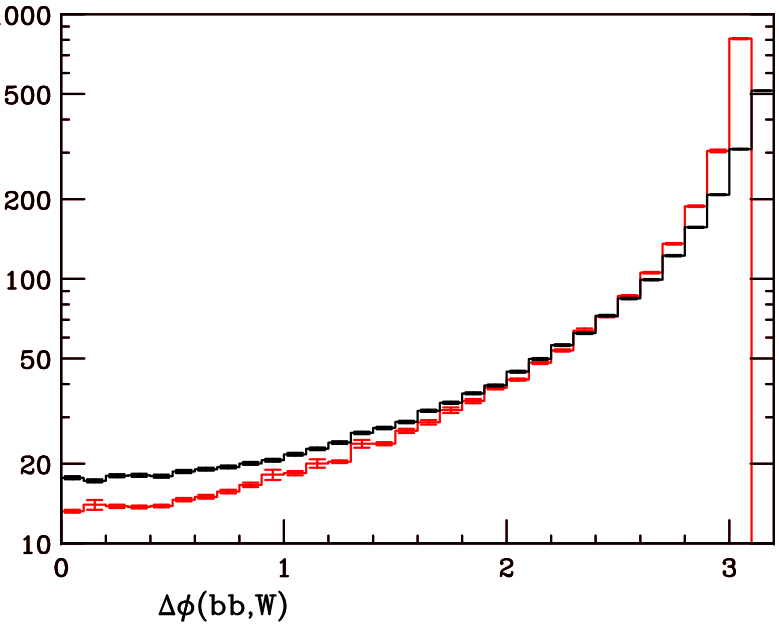


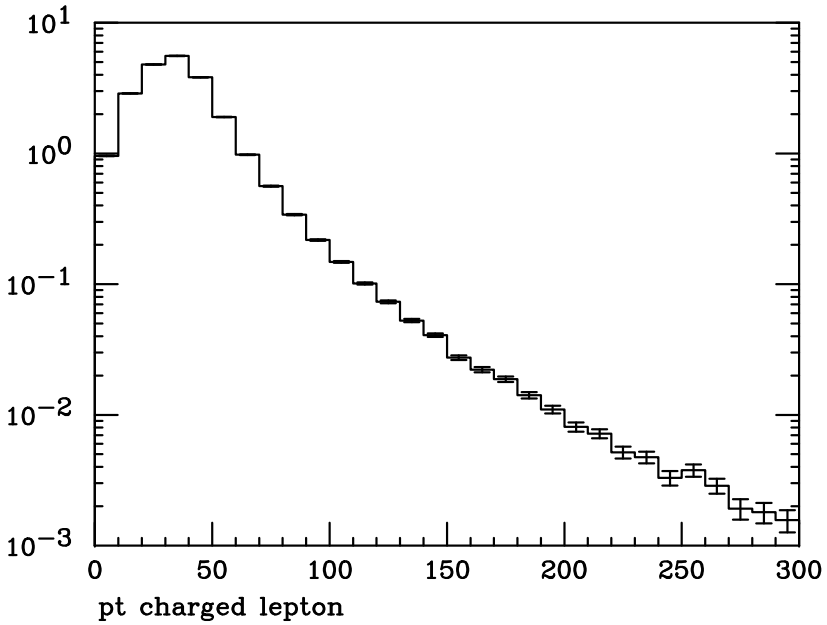

- $b$ quark massive (NLO code from Laura Reina et al.)
- the $W \to l\nu$ decay implemented in an approximated way, with a method similar to the one used by [Frixione, Laenen, Motylinski, and Webber, hep-ph/0702198].
  We expect this to be a good approximation of the exact result.

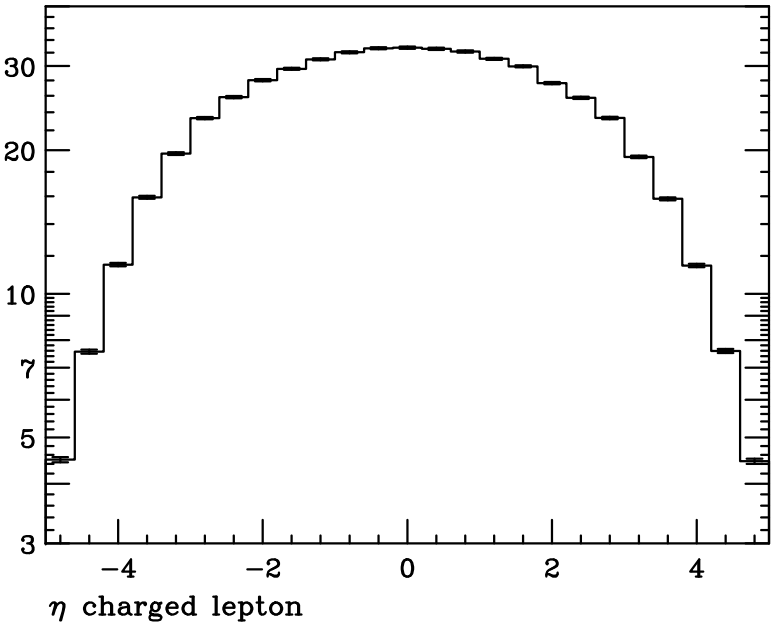



Jet defined using the anti-$k_T$ algo with $p_{\mathrm{T}\,\mathrm{min}} = 5$ GeV, $R = 0.4$


LHC 14 TeV
POWHEG alone
NLO
Δη(bb,W)


Δφ(bb,W)


pt charged lepton


η charged lepton

# Running the code

The POWHEG BOX code can be downloaded from

http://powhegbox.mib.infn.it

- To download the code, you have to give the command (one single line)
  `svn checkout --username anonymous --password anonymous`
  `svn://powhegbox.mib.infn.it/trunk/POWHEG-BOX`
- Under POWHEG-BOX/Docs you can find the POWHEG BOX manual. Under POWHEG-BOX/***process-name***/Docs you can find the manual specific for each subprocess.
- To install $Wb\bar{b}$, enter the main POWHEG-BOX directory and untar the Wbb.tgz file: `tar zxvf Wbb.tgz`. This version is still private and can be obtained via email.
- Enter the Wbb directory, fix the Makefile and then compile the main code by giving: `make pwhg_main`. Right now you need to have installed the LHAPDF and fastjet packages. If you do not have the fastjet package installed, then rename the pwhg_analysis_dummy.f analysis file to be pwhg_analysis.f
- Enter the template directory testrun-lhc and give `../pwhg_main`. In this dir, you can find the powheg.input file that controls the POWHEG BOX running

# powheg.input file

```
numevts  100000   ! number of events to be generated
ih1   1           ! hadron 1 (1 for protons, -1 for antiprotons)
ih2   1           ! hadron 2 (1 for protons, -1 for antiprotons)
ebeam1 7000d0     ! energy of beam 1
ebeam2 7000d0     ! energy of beam 2

! Vector boson parameters
idvecbos  -24  ! PDG code for vector boson to be produced ( W+:24 W-:-24 )
vdecaymode  2  ! 1: electronic decay; 2: muonic decay

! To be set only if using internal (mlm) pdfs
! 131 cteq4m
!  83 cteq4l
! ndns1 131         ! pdf set for hadron 1 (mlm numbering)
! ndns2 131         ! pdf set for hadron 2 (mlm numbering)
! To be set only if using LHA pdfs
! 10550 cteq66
lhans1  10550         ! pdf set for hadron 1 (LHA numbering)
lhans2  10550         ! pdf set for hadron 2 (LHA numbering)
```

# powheg.input file

```
! Parameters to allow or not the use of stored data
use-old-grid    1 ! if 1 use old grid if file pwggrids.dat is present
                  ! (<> 1 regenerate)
use-old-ubound  1 ! if 1 use norm of upper bounding function stored
                  ! in pwgubound.dat, if present; <> 1 regenerate

ncall1 1000000    ! number of calls for initializing the integration grid
itmx1    10       ! number of iterations for initializing the integration grid
ncall2 1000000    ! number of calls for computing the integral and finding
                  !   upper bound
itmx2    10       ! number of iterations for computing the integral and
                  !   finding upper bound
foldcsi   1       ! number of folds on csi integration
foldy     1       ! number of folds on  y  integration
foldphi   1       ! number of folds on phi integration
nubound 1000000   ! number of calls to set up the upper bounding norms
                  !   for radiation
```

# powheg.input file

```
! OPTIONAL PARAMETERS

#flg_debug    1    ! activate the printing of extra info on the LHE file

withnegweights 1   ! (default 0) if on (1) use negative weights

#renscfact  1d0    ! (default 1d0) ren scale factor: muren  = muref * renscfact
#facscfact  1d0    ! (default 1d0) fac scale factor: mufact = muref * facscfact

#bornonly   1      ! (default 0) if 1 do Born only

#testplots  1      ! (default 0) if 1 plot NLO and POWHEG-alone distributions

#xupbound 2d0      ! increase upper bound for radiation generation
```

# powheg.input file

```
#iseed    5437      !  Start the random number generator with seed iseed
#rand1     0        !  skipping  rand2*100000000+rand1 numbers.
#rand2     0        !  (see RM48 short writeup in CERNLIB)

#manyseeds 1        ! Used to perform multiple runs with different random
                    ! seeds in the same directory.
                    ! If set to 1, the program asks for an integer j;
                    ! The file pwgseeds.dat at line j is read, and the
                    ! integer at line j is used to initialize the random
                    ! sequence for the generation of the event.
                    ! The event file is called pwgevents-'j'.lhe
```

# Comments

In the POWHEG-BOX/Wbb/init_couplings.f file you can set the values of the physical parameters that enter this process: $m_W$, $m_b$, $\sin^2\theta_W \ldots$

There are several output files. Among them:

- pwgstat.dat In general, the total cross section written in this file is NOT the true total cross section. It is the total cross section for $Wb\bar{b}$.
  Check the
  negative weight fraction : ...
  in that file too. If you want only positive-weight events, then comment the corresponding line in the poweg.input file

  ```
  #  withnegweights 1    ! (default 0) if on (1) use negative weights
  ```

  and increase csi, y, phi folding to reduce the fraction of negative-weight events.
- Several topdrawer files that contain POWHEG BOX info and the user-defined histograms produced by the pwhg_analysis.f file
- pwgevents.lhe: the event file

## Comments

Now the event file `pwgevents.lhe` is ready to be processed

- If you are interested in plotting the results from `POWHEG` alone, with no subsequent shower, then compile the `lhef_analysis` file and run it in the directory where the file of the events is
- If you want to study the results after the shower done by PYTHIA or HERWIG, then you may compile and run `main-PYTHIA-lhef` or `main-HERWIG-lhef`

# The End