



Status Report on WHIZARD



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([arXiv:0708.4233](https://arxiv.org/abs/0708.4233))

HGF MC Meeting, KIT Karlsruhe, 2009

Status of the WHIZARD Event Generator

- ▶ Monte-Carlo event generator for BSM signals and SM backgrounds
- ▶ Located at: Universities of Freiburg, Siegen, Würzburg
Main Authors: Wolfgang Kilian, Thorsten Ohl, JR
Postdocs: Björn Herrmann, Christian Speckner + 4 PhDs + Master students
- ▶ URL: <http://whizard.event-generator.org>
<http://projects.hepforge.org/whizard>
- ▶ Actual versions:
 - ▶ 1.93 (1.94 update before Christmas), basically for experiment support
 - ▶ **WHIZARD 2.0.0 β released tonight**
- ▶ **Standard Reference** for old + new versions:

[Kilian/Ohl/JR, 0708.4233](#)

[Moretti/Ohl/JR, hep-ph/0102195 \(O'Mega\)](#)

one grand unified package

(incl. VAMP, Circe, Circe 2, WHiZard, O'Mega)

WHIZARD – Overview over BSM Models

MODEL TYPE	with CKM matrix	trivial CKM
QED with e, μ, τ, γ	—	QED
QCD with d, u, s, c, b, t, g	—	QCD
Standard Model	SM_CKM	SM
SM with anomalous gauge couplings	SM_ac_CKM	SM_ac
SM with anomalous top couplings	SMtop_CKM	SMtop
SM with K matrix	—	SM_KM
MSSM	MSSM_CKM	MSSM
MSSM with gravitinos	—	MSSM_Grav
NMSSM	NMSSM_CKM	NMSSM
extended SUSY models	—	PSSSM
Littlest Higgs	—	Littlest
Littlest Higgs with ungauged $U(1)$	—	Littlest_Eta
Littlest Higgs with T parity	—	Littlest_Tpar
Simplest Little Higgs (anomaly-free)	—	Simplest
Simplest Little Higgs (universal)	—	Simplest_univ
3-site model (inoff., soon off.)	—	TSM
UED	—	UED
SUSY Xdim. (inoff.)	—	SED
Noncommutative SM (inoff.)	—	NCSM
SM with Z'	—	Zprime
SM with gravitino and photino	—	GravTest
Augmentable SM template	—	Template

easy to implement new models or FeynRules interface

Features in WHIZARD 2

► Physics

- cascade decays -> inclusive production w/ full correlations
- cuts/trigger, scale setting, matrix element reweighting, histograms: arbitrary expressions possible
- flavor sums initial + final state (e.g. jet = quark:gluon)
- Parton shower (complete ISR/FSR; by Sebastian Schmidt)

► Technics

- WHIZARD as a shared library
- Unified user interface: process configuration, compilation, cuts, integration, simulation
- Methods for user interface: input file, interactive shell, command line, library calls (e.g., from C); GUI foreseen
- Native HepMC support (+ LHEF, StdHEP, HEPEVT, etc.)

► Development

- Under development: Broader physics support, especially QCD
- Underlying event
- Parton shower matching
- Dipole subtraction / NLO (GOLEM interface)

WHIZARD 2.0

New universal input file:

```

model - "NMSSM"
read_slha ("nmssm.slha")

me - 0
mmu - 0

alias lepton = e1:e2:e3:E1:E2:E3
alias neutrino = n1:n2:n3:N1:N2:N3
alias j = u:d:s:c:U:D:S:C:g

process nmssm1 - p, p -> j, j, neu1, neu1

sqrts - 10 TeV
beams - p, p -> lhpdf

scan seed (32 -> 1 // 2) { show (seed_value) }

scan $str ("foo", "bar")
?ok - false
show (?ok)
?ok = mZ > mW
show (?)

$str = "foo"
$str = $str // "bar"
show ($)

alias q = if ?ok then u else d
alias u = d
alias q =
  let alias Q = U:D in (q:d):Q
show (alias u, alias q, alias Q)

scan int i (-1,1,2) {
  if (true) {} else {}
  if (i > 1) {
    $string = "i>1"
  } else if (i > 0) {
    $string = "i>0"
  }
  if (i > 0) {
  } else {
    $string = "i<=0"
  }
}

show ({1}, (mH + mW))
show (?mH > mZ), ?{true})
show (${ "foo" }, ${ "foo" // "bar" })

```

```

compile ("proc") {
  fcflags = "-O3"
}

int ncalls = 15

# Check observables
eta_cut = 5
cuts = all Pt > 100 GeV [lepton] and
  any PDG == 13 [lepton] and
  any M > 100 GeV [combine if cos (Theta) > 0.5
    [lepton, neutrino]] and
  all E <= 200 [collect [neutrino]] and
  any 5 degree < Theta < 175 degree
  [select if abs (Eta) < eta_cut [lepton]]
integrate (nmssm1) { iterations = 1: ncalls }

simulate (qq) {
  luminosity = 1 ifb
  write ("nmssm1.dat") { format = HepMC }
  write ("nmssm1.lhef") { format = LHEF }
}

```

WHIZARD support for the experiments

▶ ATLAS

- ▶ Included inside the ATLAS framework
 - ▶ ATHENA framework + 2.0 validation/support + main coordination: Marcus Rammes (U. Siegen)
 - ▶ Documentation TWiki page: Philipp Anger (TU Dresden)
 - ▶ Additional support: Jan Schumacher (U. Bonn) → Markus Wasinsky (U. Freiburg)
 - ▶ Author contact person: JR

▶ CMS

- ▶ Not yet officially included in the CMS framework
- ▶ Contact with F. Moortgat (CERN), C. Rabbertz (Karlsruhe)
- ▶ Author contact person: JR

▶ ILC/CLIC

- ▶ Update of beamstrahlung and ISR specifications for new ILC/CLIC/muon collider design concepts
- ▶ Important role for detector development (SiD letter of intent, 0911.0006)
- ▶ ILC related work: SLAC, Imperial College London, LAL/Orsay
- ▶ Contact persons in Germany: P. Bechtle (DESY), J. List (DESY)
- ▶ Author contact person: Wolfgang Kilian, JR

WHIZARD Graphical Data Analysis

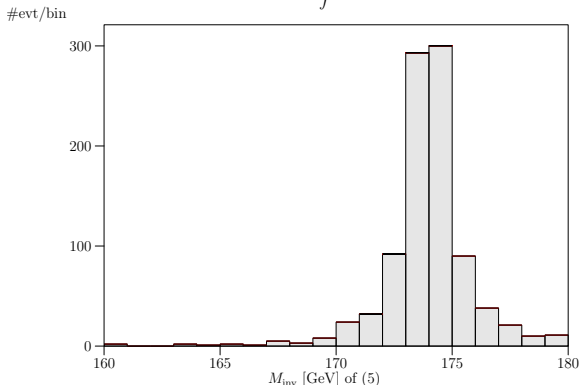
(NOTE: Much refined in version 2.0)

WHIZARD data analysis

March 16, 2007

Process: qttdec ($u\bar{u} \rightarrow b\bar{b}W^+W^-$)

$$\sqrt{s} = 500.0 \text{ GeV} \quad \int \mathcal{L} = 0.2754 \times 10^{-01} \text{ fb}^{-1}$$



$\sigma_{\text{tot}} = 36305. \pm 310. \text{ fb} \quad [\pm 0.85 \%] \quad n_{\text{evt, tot}} = 1000$
 $\sigma_{\text{cut}} = 36305. \pm 0.115 \times 10^{+04} \text{ fb} \quad [\pm 3.16 \%] \quad n_{\text{evt, cut}} = 1000 \quad [100.00 \%]$