



Monte Carlo Studies at Aachen Illa







(C. Zeidler)

Aachen IIIA Analysis Activities

• SUSY / BSM Analyses

- leptonic SUSY searches (H. Pieta, D. Teyssier, A. Meyer)
- parameter scan, ~g and ~s masses
- heavy gauge bosons: W'
- Unparticles / ADD
- Top Physics
 - ttbar (J. Steggemann, A. Hinzmann, O. Actis,
 - T. Klimkovich, G. Müller)

(W. Bender, K. Hoepfner)

(H. Jansen, M. Ata, A. Meyer)

Model-Independent Searches

- "MUSIC"

(C. Hof, P. Biallass, S. Schmitz)





Aachen IIIA MC Activities

SHERPA

(MM with M. Niegel and A. Cakir (KA))*

- integration into and interface to CMS framework
- framework for mass production
- validation / comparison to other generators
- Cosmic Generator (P. Biallass, K. Hoepfner, T. Hebbeker, L. Sonnenschein)
 - included in CMS framework
 - ongoing comparisons to cosmic data

* with lots of support from S. Hoeche, F. Siegert, T. Gleisberg, F. Krauss





Leptonic SUSY Searches





- cut-based / BDT analysis of SUSY in "muon+Jets+MET" channel
- background dominated by EWK processes





SUSY Masses - Parameter Scan







W' Searches



- current lower mass limit at ~1 TeV
- requires precise knowledge of highmT tails of bgrd.
- both, high-mT W background and W' signal done with PYTHIA6

⁽https://twiki.cern.ch/twiki/bin/view/CMS/PhysicsResults)



Model-Independent Searches - MUSiC



- relies on solid MC background predictions
 - CSA07 SM cocktail
 - high-pt tails

- study leptonic events (using 300-400 event classes)
- CMS Physics Result: EXO-08-005 (https://twiki.cern.ch/twiki/bin/view/CMS/PhysicsResults)





Unparticles / Extra Dimensions (ADD)

- Unparticle Studies
 - PYTHIA8 + unparticle add-on by S. Ask (Manchester/CERN)
 - channel: q qbar \rightarrow Z + U (Dileptons + MET)
 - further ideas by M. Strassler, but no MC generator available yet (MadGraph???)
 - channel: DY (Z,gamma,U) or Z' coupling to U
- Extradimension Studies
 - Sherpa ADD vs. SM in DY (+jets) channel





Sherpa - Studies

- generation of W/Z + up to N jets
 - time (days) & memory (GBytes) consuming for N > 3
 - number of graphs can be significantly reduced when constraining order of EWK processes ⇒ cross sections?
- generation of SUSY (+X) events with Sherpa
 - Problem #1 (solved) : no sparticle containers available
 ⇒ requires explicit specification of all production channels (>400 for inclusive SUSY production)
 - Problem #2 (unsolved): fragmentation of colored sparticles not possible in present Sherpa versions (1.1.x)

 \rightarrow however, it is still possible to study SUSY cross sections...





Sherpa – W/Z + Jets (@ 10 TeV)

Process	0j	1j	2ј	Зј					
	σ [pb]	σ [pb]	σ [pb]	σ [pb]					
Order electroweak : unconstrained									
W> e- nub	3551	1221	677	341					
W> mu- nub	3551	1218	681	340					
W+ -> e+ nu	5114	1770	1046	549					
W+ -> mu+ nu	5116	1772	1041	549					
Z -> e+ e-	784	303	172	87					
Z -> mu+ mu-	784	304	172	87					
Order electroweak : 1									
W> e- nub	3551	1221	649	308					
W> mu- nub	3551	1218	649	308					
W+ -> e+ nu	5114	1771	993	504					
W+ -> mu+ nu	5113	1774	991	504					
Z -> e+ e-	784	303	169	85					
Z -> mu+ mu-	784	304	169	84					



	Difference	Oj	1j	2 j	Зј	
	Process	diff [%]	diff [%]	diff [%]	diff [%]	
	W> e- nub	0,0	0,0	-4,2	-9,6	
	W> mu- nub	0,0	0,0	-4,6	-9,4	
	W+ -> e+ nu	0,0	0,1	-5,1	-8,2	
	W+ -> mu+ nu	-0,1	0,2	-4,8	-8,3	
	Z -> e+ e-	0,0	0,0	-2,2	-3,0	
	Z -> mu+ mu-	0,0	0,0	-2,1	-3,4	

- W/Z+ up to 3 jets possible with O(EWK) up to 4
- ~10% loss in cross section of 3-jet bin at O(EWK)=1 (!)





Sherpa - SUSY (@ 14 TeV)







Cosmic Muon Generator

- Why?
 - improve reconstruction algorithms, alignment
 - cosmic muons might obscure rare processes
- Developed and maintained by Aachen IIIA
 - modeling cosmic muon flux and angular distribution (based on parameterizations of differential muon flux obtained from CORSIKA)
 - p_muon = 5..3000 GeV, incident angle from 0 to 80 degree



We still have quite some time for cosmic MC studies...



Summary



- We at Aachen IIIA are mainly MC consumers, HOWEVER
- There also is a growing variety of MC activities
 - Sherpa, Unparticles
 - Cosmic MC for CMS
- Future Plans:
 - inclusive SUSY (+X) production with Sherpa (strong interest also from Aachen IB, +SUSY from MadGraph)
 - tests of the new ME generator (COMIX) in Sherpa
 - tests of other unparticle models





Backup

21.11.08





CMS SUSY Benchmark Points







Softsusy Masses

Masses [GeV]												
Class	Particle	LM 1	LM 2	LM 3	LM 4	LM 5	LM 6	LM 7	LM 8	LM 9	LM 10	LM 11
Gluino (g)	~g	603,5	826,8	597,5	687,4	851,0	931,9	636,5	738,4	487,7	1260,3	776,0
	~d_L	559,7	776,9	625,6	660,1	807,1	856,6	2997,0	816,9	1477,9	3119,4	747,7
	~d_R	536,1	745,7	607,0	635,1	775,5	819,9	2999,9	796,2	1476,9	3112,1	719,7
	~u_L	552,1	770,2	618,6	653,1	800,4	849,8	2989,9	811,0	1474,4	3111,5	741,0
	~u_R	540,1	752,2	610,0	639,9	782,2	827,8	2999,4	800,2	1476,5	3114,0	725,3
(anti-)	~s_L	559,7	776,9	625,6	660,1	807,1	856,6	2997,0	816,9	1477,9	3119,4	747,7
Squarks	~s_R	536,1	745,7	607,0	635,1	775,5	819,9	2999,9	796,2	1476,9	3112,1	719,7
(S)	~c_L	552,1	770,2	618,6	653,1	800,4	849,8	2989,9	811,0	1474,4	3111,5	741,0
	~c_R	540,1	752,2	610,0	639,9	782,2	827,8	2999,4	800,2	1476,5	3114,0	725,3
	~b_1	510,2	671,2	548,3	598,1	734,0	784,7	2448,3	710,2	1008,3	2576,7	642,4
	~b_2	535,6	724,0	596,1	632,2	771,2	816,0	2976,5	789,4	1124,3	3086,9	695,2
	~t_1	407,3	580,0	444,5	481,2	599,5	646,7	1787,6	544,2	881,7	1918,2	551,4
	~t_2	580,3	748,0	606,5	658,0	787,2	838,7	2452,8	759,5	1023,7	2582,2	716,5
	~e_L	186,4	304,1	369,6	288,7	337,8	287,4	2994,3	539,4	1450,5	3008,9	335,7
	~e_R	119,9	231,1	344,4	239,5	270,1	178,2	2997,7	513,7	1450,2	3002,4	281,4
(anti-) Sleptons (I)	~mu_L	186,4	304,1	369,6	288,7	337,8	287,4	2994,3	539,4	1450,5	3008,9	335,7
	∼mu_R	119,9	231,1	344,4	239,5	270,1	178,2	2997,7	513,7	1450,2	3002,4	281,4
	~tau_1	110,8	155,7	323,5	233,3	263,9	170,7	2973,0	505,8	1054,2	2977,6	212,8
	∼tau_2	190,3	314,1	370,1	290,6	339,0	289,4	2981,8	538,9	1266,9	2996,4	339,3
	∼nu_eL	167,4	292,0	359,9	276,4	326,8	274,5	2992,0	532,7	1447,4	3006,3	324,8
	∼nu_muL	167,4	292,0	359,9	276,4	326,8	274,5	2992,0	532,7	1447,4	3006,3	324,8
	∼nu_tauL	166,9	278,9	353,7	275,3	325,6	273,7	2979,6	530,0	1265,3	2994,0	308,6
	~chi_10	96,4	140,5	93,8	111,9	144,1	160,6	93,9	120,4	64,7	209,4	130,2
Neutralinos	~chi_20	177,9	264,3	173,3	208,2	270,6	302,6	176,7	227,8	110,3	359,4	244,1
+	~chi_30	-344,1	-455,4	-329,6	-387,5	-475,3	-521,2	-348,3	-457,8	-184,1	-421,3	-426,3
(anti-)	~chi_40	362,9	468,2	347,1	404,9	490,1	534,8	365,9	470,3	224,6	481,4	439,9
Charginos	~chi_1+	178,5	266,6	174,1	209,8	273,1	305,3	179,3	230,2	107,4	359,9	246,2
(n)	~chi_2+	360,2	465,2	345,4	401,9	486,7	531,1	363,6	467,5	223,1	478,8	437,2





MC Generators in CMS

AlpgenInterface/ CommonInterface/ CosmicMuonGenerator/ ExhumeInterface/ HydjetInterface/ MCatNLOInterface/ MuEnrichInterface/ PyquenInterface/ Pythia8Interface/ ThePEGInterface/

BeamHaloGenerator/ ComphepInterface/ EvtGenInterface/ Herwig6Interface/ I HFInterface/ MadGraphInterface/ PomwigInterface/ Pythia6Interface/ SherpaInterface/ TopRexInterface/

 most commonly used for mass production

- Pythia 6
- Alpgen
- Madgraph
- (Pythia 8, Herwig++)





CSA07 Production

- yielded 150M events (SM cocktail), ~ 100pb-1 of LHC data (https://twiki.cern.ch/twiki/bin/view/CMS/GeneratorProduction2007CSA07)
 - ALPGEN: W/Z+(0-5)jets, ttbar+(0-4)jets
 - PYTHIA: QCD, photon+jets, DY, "Onia"
- signal samples: (https://twiki.cern.ch/twiki/bin/view/CMS/GeneratorProduction2007CSA07Signal)
 - PYTHIA: Higgs, EWK, Diboson, DY, SUSY(BSM),
 - MC@NLO: EWK, Top
 - ALPGEN: Diboson+(0-3)jets, W/Z+(0-5)jets (high-pt tails)





Summer 08 Production

generation of ~ 200M events with full simulation

https://twiki.cern.ch/twiki/bin/view/CMS/ProductionSummer2008

- PYTHIA6: MinBias, QCD, JEC, ttbar, photon+jets, e.m.-/muenriched QCD, bbbar, Onia, Z+jets
- PYTHIA8: photon+jets
- MADGRAPH: QCD, ttbar, single-t, W/Z+QQ, W/DY+jets, Dibosons,
- HERWIG++: QCD