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NLO-NLL higgsino-like N2C1 cross sections

The following cross sections are for higgsino-like chargino-neutralino pair production (sum of $\chi_1^+ \chi_2^0$ and $\chi_1^- \chi_2^0$, and also for each subprocess individually). They have been calculated for $\sqrt{s} = 27$ TeV at NLO-NLL using Resumino 2.0.1 from B. Fuks et al. The Monte Carlo PDF set with 100 replicas PDF4LHC15_mc is used, which is a statistical combination of CT14, MMHT14 and NNPDF3.0, all using $s(m_Z^2) = 0.118$. The use of this combination of PDF sets is recommended for searches for new Physics by the PDF4LHC Working Group. See <https://arxiv.org/abs/1510.03865> for more details.

The cross sections are computed for degenerate charginos and neutralinos. The mass is denoted as m . The following sentence describes all the assumptions in the cross section calculations and is suitable to be included in the description of the interpretation of your results:

The production cross sections are computed at NLO plus next-to-next-to-leading-log (NNLL) precision in a limit of mass-degenerate higgsino $\chi_{1,2}$, $\chi_{1,2}$, and $\chi_{1,2}$ with all the other sparticles assumed to be heavy and decoupled.

When using these cross sections, some references have to be cited. They can be found below in bibtex format. The references can also be downloaded from this Twiki, see attachments at the bottom

Show References Hide References

Resumino:

```
@article{Debove:2010kf,
  author      = "Debove, Jonathan and Fuks, Benjamin and Klasen, Michael",
  title       = "{Threshold resummation for gaugino pair production at hadron colliders}",
  journal     = "Nucl. Phys. B",
  volume      = "842",
  year        = "2011",
  pages       = "51-85",
  doi         = "10.1016/j.nuclphysb.2010.08.016",
  eprint      = "1005.2909",
  archivePrefix = "arXiv",
  primaryClass = "hep-ph",
  reportNumber = "IPHC-PHENO-10-02, LPSC-10-050",
  SLACcitation = "%CITATION = ARXIV:1005.2909;%"
}
@article{Fuks:2012qx,
  author      = "Fuks, Benjamin and Klasen, Michael and Lamprea, David R. and Rothering, Marcel",
  title       = "{Gaugino production in proton-proton collisions at a center-of-mass energy of 8 TeV}",
  journal     = "JHEP",
  volume      = "10",
  pages       = "081",
  doi         = "10.1007/JHEP10(2012)081",
  year        = "2012",
  eprint      = "1207.2159",
  archivePrefix = "arXiv",
  primaryClass = "hep-ph",
  reportNumber = "IPHC-PHENO-12-07, MS-TP-12-05",
}
```

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```

SLACcitation = "%CITATION = ARXIV:1207.2159;%",
}
@article{Fuks:2013vua,
  author      = "Fuks, Benjamin and Klasen, Michael and Lamprea, David R.
                and Rothering, Marcel",
  title       = "{Precision predictions for electroweak superpartner
                production at hadron colliders with {\sc Resummino}}",
  journal     = "Eur. Phys. J. C",
  volume      = "73",
  pages       = "2480",
  doi         = "10.1140/epjc/s10052-013-2480-0",
  year        = "2013",
  eprint      = "1304.0790",
  archivePrefix = "arXiv",
  primaryClass = "hep-ph",
  reportNumber = "CERN-PH-TH-2013-064, IPHC-PHENO-13-02, MS-TP-13-06",
  SLACcitation = "%CITATION = ARXIV:1304.0790;%",
}
@article{Fiaschi:2018hgm,
  author      = "Fiaschi, Juri and Klasen, Michael",
  title       = "{Neutralino-chargino pair production at NLO+NLL with
                resummation-improved parton density functions for LHC Run
                II}",
  journal     = "Phys. Rev. D",
  volume      = "98",
  year        = "2018",
  number      = "5",
  pages       = "055014",
  doi         = "10.1103/PhysRevD.98.055014",
  eprint      = "1805.11322",
  archivePrefix = "arXiv",
  primaryClass = "hep-ph",
  reportNumber = "MS-TP-18-19",
  SLACcitation = "%CITATION = ARXIV:1805.11322;%"
}

```

LHAPDF:

```

@article{Buckley:2014ana,
  author      = "Buckley, Andy and Ferrando, James and Lloyd, Stephen and
                Nordström, Karl and Page, Ben and Rüfenacht, Martin and
                Schönherr, Marek and Watt, Graeme",
  title       = "{LHAPDF6: parton density access in the LHC precision
                era}",
  journal     = "Eur. Phys. J.",
  volume      = "C75",
  year        = "2015",
  pages       = "132",
  doi         = "10.1140/epjc/s10052-015-3318-8",
  eprint      = "1412.7420",
  archivePrefix = "arXiv",
  primaryClass = "hep-ph",
  reportNumber = "GLAS-PPE-2014-05, MCNET-14-29, IPPP-14-111, DCPT-14-222",
  SLACcitation = "%CITATION = ARXIV:1412.7420;%"
}

```

PDF4LHC:

```

@article{Butterworth:2015oua,
  author      = "Butterworth, Jon and others",
  title       = "{PDF4LHC recommendations for LHC Run II}",
  journal     = "J. Phys.",
  volume      = "G43",
  year        = "2016",
  pages       = "023001",
  doi         = "10.1088/0954-3899/43/2/023001",
}

```

SUSYNNLLCROSSSECTIONS27TeVHI NON2C1 < LHCPHYSICS < TWKI

```

eprint          = "1510.03865",
archivePrefix   = "arXiv",
primaryClass    = "hep-ph",
reportNumber    = "OUTP-15-17P, SMU-HEP-15-12, TIF-UNIMI-2015-14,
                  LCTS-2015-27, CERN-PH-TH-2015-249",
SLACcitation    = "%%CITATION = ARXIV:1510.03865;%"
}
@article{Carrazza:2015hva,
  author        = "Carrazza, Stefano and Latorre, José I. and Rojo, Juan
                  and Watt, Graeme",
  title         = "{A compression algorithm for the combination of PDF
                  sets}",
  journal       = "Eur. Phys. J.",
  volume        = "C75",
  year          = "2015",
  pages         = "474",
  doi           = "10.1140/epjc/s10052-015-3703-3",
  eprint        = "1504.06469",
  archivePrefix = "arXiv",
  primaryClass  = "hep-ph",
  reportNumber  = "TIF-UNIMI-2015-2, OUTP-15-01P, IPPP-15-22, DCPT-15-44",
  SLACcitation  = "%%CITATION = ARXIV:1504.06469;%"
}
@article{Watt:2012tq,
  author        = "Watt, G. and Thorne, R. S.",
  title         = "{Study of Monte Carlo approach to experimental
                  uncertainty propagation with MSTW 2008 PDFs}",
  journal       = "JHEP",
  volume        = "08",
  year          = "2012",
  pages         = "052",
  doi           = "10.1007/JHEP08(2012)052",
  eprint        = "1205.4024",
  archivePrefix = "arXiv",
  primaryClass  = "hep-ph",
  reportNumber  = "CERN-PH-TH-2012-132, LCTS-2012-11",
  SLACcitation  = "%%CITATION = ARXIV:1205.4024;%"
}

```

CT14:

```

@article{Dulat:2015mca,
  author        = "Dulat, Sayipjamal and Hou, Tie-Jiun and Gao, Jun and
                  Guzzi, Marco and Huston, Joey and Nadolsky, Pavel and
                  Pumplin, Jon and Schmidt, Carl and Stump, Daniel and Yuan,
                  C. P.",
  title         = "{New parton distribution functions from a global analysis
                  of quantum chromodynamics}",
  journal       = "Phys. Rev.",
  volume        = "D93",
  year          = "2016",
  number        = "3",
  pages         = "033006",
  doi           = "10.1103/PhysRevD.93.033006",
  eprint        = "1506.07443",
  archivePrefix = "arXiv",
  primaryClass  = "hep-ph",
  SLACcitation  = "%%CITATION = ARXIV:1506.07443;%"
}

```

MMHT14:

```

@article{Harland-Lang:2014zoa,
  author        = "Harland-Lang, L. A. and Martin, A. D. and Motylinski, P.
                  and Thorne, R. S.",
  title         = "{Parton distributions in the LHC era: MMHT 2014 PDFs}",

```

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```

journal      = "Eur. Phys. J.",
volume      = "C75",
year        = "2015",
number      = "5",
pages       = "204",
doi         = "10.1140/epjc/s10052-015-3397-6",
eprint      = "1412.3989",
archivePrefix = "arXiv",
primaryClass = "hep-ph",
reportNumber = "LCTS-2014-47, IPPP-14-97, DCPT-14-194",
SLACcitation = "%%CITATION = ARXIV:1412.3989;%%"
}

```

NNPDF:

```

@article{Ball:2014uwa,
  author      = "Ball, Richard D. and others",
  title       = "{Parton distributions for the LHC Run II}",
  collaboration = "NNPDF",
  journal     = "JHEP",
  volume      = "04",
  year        = "2015",
  pages       = "040",
  doi         = "10.1007/JHEP04(2015)040",
  eprint      = "1410.8849",
  archivePrefix = "arXiv",
  primaryClass = "hep-ph",
  reportNumber = "EDINBURGH-2014-15, IFUM-1034-FT, CERN-PH-TH-2013-253,
    OUTP-14-11P, CAVENDISH-HEP-14-11",
  SLACcitation = "%%CITATION = ARXIV:1410.8849;%%"
}

```

To calculate these cross sections, this repository [can be used](#). The SLHA files can be found there as well: [wino.in](#) and [hino.in](#).

Should cross section information be needed for a mass that is not tabulated below, one can obtain it by using the ROOT macros provided under:

```
/afs/cern.ch/user/a/amete/public/EWKGauginoCrossSections_13TeV
```

For this specific grid one needs to do:

```
root -l 'get_gaugino.C("C1N2", "hino", mass)'
```

where mass is the mass of the sparticle in GeV. The result of the interpolation can be seen here.

NLO+NNLL Higgsino cross sections for combined $\tilde{g}^0 \tilde{g}^+$ and $\tilde{g}^0 \tilde{g}^-$ production at $\sqrt{s} = 27$ TeV

m [GeV]	[fb]	uncertainty [fb]
50	248000	372
75	38748	50.4
100	13687.1	16.893
125	6358.6	7.569

SUSY NLO+NNLL Cross Sections 27 TeV Higgs no χ^0 $\chi^{\pm 1}$ production < LHC Physics < TWiki

150	3428.3	3.966
175	2034.98	2.3011
200	1292.74	1.4437
225	864.28	0.9468
250	601.26	0.6465
275	431.87	0.4609
300	318.47	0.3344
325	240.051	0.24967
350	184.35	0.18924
375	143.873	0.14732
400	113.865	0.11576
425	91.231	0.09168
450	73.896	0.07345
475	60.438	0.05945
500	49.853	0.04919
525	41.463	0.04023
550	34.724	0.03338
575	29.2685	0.027895
600	24.8164	0.023453
625	21.1554	0.019842
650	18.1247	0.016864
675	15.5975	0.014031
700	13.4826	0.012051
725	11.7005	0.010394
750	10.1915	0.009002
775	8.9078	0.007824
800	7.8109	0.006824
825	6.8697	0.005972
850	6.0596	0.005284
875	5.3589	0.004649
900	4.7513	0.004122
925	4.2225	0.003647
950	3.7608	0.0032334
975	3.3568	0.0028737
1000	3.00214	0.002559

SUSYLNLO+NNLL Cross Sections 27TeV Higgs no N2C1 < LHC Physics < TWiki

1025	2.69019	0.0022841
1050	2.41499	0.0020423
1075	2.17147	0.0018294
1100	1.9554	0.0016408
1125	1.76392	0.0014754
1150	1.59401	0.0013151
1175	1.4421	0.0011861
1200	1.30651	0.0010713
1225	1.18467	0.0009682
1250	1.07592	0.0008769
1275	0.97832	0.0007952
1300	0.89057	0.000722
1325	0.81158	0.0006562
1350	0.74036	0.0005972
1375	0.67607	0.0005441
1400	0.61785	0.000496
1425	0.56524	0.0004527
1450	0.51816	0.0004147
1475	0.47495	0.00038048
1500	0.4357	0.00034852
1525	0.40002	0.00031948
1550	0.367563	0.00029329
1575	0.337986	0.00026948
1600	0.310934	0.00024803
1625	0.286227	0.00022766
1650	0.263666	0.00021048
1675	0.243063	0.00019374
1700	0.224209	0.0001785
1725	0.206933	0.00016452
1750	0.191093	0.00015234
1775	0.17657	0.0001402
1800	0.163251	0.00012953
1825	0.150992	0.00011976
1850	0.139724	0.00011094
1875	0.129355	0.00010305

SUSY NLO+NNLL Cross Sections 27 TeV Higgs \rightarrow WZ \rightarrow LHC Physics \rightarrow TWiki

675	10.546	0.009698
700	9.1492	0.008356
725	7.9679	0.00723
750	6.9641	0.006281
775	6.1072	0.005475
800	5.3726	0.004789
825	4.7401	0.004203
850	4.1941	0.003742
875	3.7202	0.003301
900	3.308	0.002921
925	2.9482	0.002591
950	2.6332	0.002303
975	2.3567	0.002052
1000	2.1133	0.001832
1025	1.8986	0.001639
1050	1.7087	0.001469
1075	1.5402	0.001319
1100	1.3902	0.001186
1125	1.257	0.001069
1150	1.1386	0.000956
1175	1.0324	0.0008641
1200	0.93739	0.0007822
1225	0.85168	0.0007086
1250	0.77511	0.0006431
1275	0.70623	0.0005844
1300	0.64416	0.0005317
1325	0.58816	0.0004842
1350	0.53756	0.0004415
1375	0.49179	0.000403
1400	0.45022	0.0003681
1425	0.41261	0.0003366
1450	0.37905	0.000309
1475	0.34805	0.0002843
1500	0.31983	0.0002609
1525	0.29413	0.0002396

SUSYLNLL Cross Sections 27TeV Higgs $\gamma\gamma$ production $\sigma_{\text{Higgs}} < \text{TW ki}$

1550	0.27071	0.0002204
1575	0.24933	0.0002029
1600	0.22972	0.0001868
1625	0.21177	0.0001718
1650	0.19535	0.0001591
1675	0.18034	0.0001467
1700	0.16658	0.0001354
1725	0.15395	0.000125
1750	0.14236	0.0001156
1775	0.1317	0.0001069
1800	0.12192	9.893e-05
1825	0.1129	9.163e-05
1850	0.1046	8.489e-05
1875	0.096946	7.908e-05
1900	0.089877	7.324e-05
1925	0.08335	6.783e-05
1950	0.07733	6.286e-05
1975	0.071777	5.832e-05
2000	0.066652	5.415e-05

NLO+NNLL Higgsino cross sections for $\gamma\gamma$ production at $\sqrt{s} = 27 \text{ TeV}$

m [GeV]	[fb]	uncertainty [fb]
50	1.0711e+05	156.8
75	16328	20.43
100	5657.2	6.673
125	2583.8	2.929
150	1371.7	1.508
175	802.58	0.8591
200	503.08	0.527
225	332.06	0.3412
250	228.21	0.2305
275	162.02	0.161
300	118.13	0.1157

NLO+NNLL Higgsino cross sections for $\gamma\gamma$ production at $\sqrt{s} = 27 \text{ TeV}$

SUSY NLO+NNLL Cross Sections for $t\bar{t}$ production at $\sqrt{s} = 270$ TeV

325	88.081	0.08627
350	66.94	0.06474
375	51.714	0.04943
400	40.527	0.03888
425	32.161	0.03053
450	25.807	0.02425
475	20.916	0.01946
500	17.103	0.01577
525	14.099	0.01311
550	11.707	0.01079
575	9.7855	0.008945
600	8.2294	0.007463
625	6.9594	0.006262
650	5.9157	0.005284
675	5.0515	0.004333
700	4.3334	0.003695
725	3.7326	0.003164
750	3.2274	0.002721
775	2.8006	0.002349
800	2.4383	0.002035
825	2.1296	0.001769
850	1.8655	0.001542
875	1.6387	0.001348
900	1.4433	0.001201
925	1.2743	0.001056
950	1.1276	0.0009304
975	1.0001	0.0008217
1000	0.88884	0.000727
1025	0.79159	0.0006451
1050	0.70629	0.0005733
1075	0.63127	0.0005104
1100	0.5652	0.0004548
1125	0.50692	0.0004064
1150	0.45541	0.0003591
1175	0.4097	0.000322

SUSY NLO+NNLL Cross Sections 27TeV $H \rightarrow b\bar{b}$ $\sigma_{\text{NLO+NNLL}} < \sigma_{\text{LHC Physics}} < \text{TW ki}$

1200	0.36912	0.0002891
1225	0.33299	0.0002596
1250	0.30081	0.0002338
1275	0.27209	0.0002108
1300	0.24641	0.0001903
1325	0.22342	0.000172
1350	0.2028	0.0001557
1375	0.18428	0.0001411
1400	0.16763	0.0001279
1425	0.15263	0.0001161
1450	0.13911	0.0001057
1475	0.1269	9.618e-05
1500	0.11587	8.762e-05
1525	0.10589	7.988e-05
1550	0.096853	7.289e-05
1575	0.088656	6.658e-05
1600	0.081214	6.123e-05
1625	0.074457	5.586e-05
1650	0.068316	5.138e-05
1675	0.062723	4.704e-05
1700	0.057629	4.31e-05
1725	0.052983	3.952e-05
1750	0.048733	3.674e-05
1775	0.04487	3.33e-05
1800	0.041331	3.06e-05
1825	0.038092	2.813e-05
1850	0.035124	2.605e-05
1875	0.032409	2.397e-05
1900	0.02992	2.207e-05
1925	0.027637	2.032e-05
1950	0.025541	1.872e-05
1975	0.023615	1.727e-05
2000	0.021845	1.594e-05

-- Basil Schneider - 2018-11-14

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Topic revision: r3 - 2019-01-23 - BasilSchneider



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