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NLO-NNLL higgsino-like N2N1 cross sections

The following cross sections are for higgsino-like neutralino-neutralino pair production. They have been calculated for $\sqrt{s} = 13$ TeV at NLO-NNLL using Resummino 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 $\alpha_s(m_Z^2) = 0.118$. 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 $m_{\tilde{\chi}_i}$. 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 $\tilde{\chi}_{i2}$, $\tilde{\chi}_{i1}$, and $\tilde{\chi}_{i1}$ 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

Resummino:

```
@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",
  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",
```

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```
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",
  number      = "132",
  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",
  number      = "023001",
  pages       = "023001",
  doi         = "10.1088/0954-3899/43/2/023001",
  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,
```

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```

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}",
  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("N1N2", "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 $\tilde{\chi}_1^0 \tilde{\chi}_2^0$ production at sqrt(s) = 13 TeV

m [GeV]	[fb]	uncertainty [fb]
50	1.2223e+05	199.1
75	10461	12.82
100	3264.7	3.711
125	1408.8	1.522
150	717.76	0.7476
175	405.85	0.4159
200	246.76	0.2498
225	158.28	0.1564
250	105.82	0.1042

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275	73.121	0.07055
300	51.905	0.04916
325	37.68	0.0351
350	27.87	0.02474
375	20.955	0.01838
400	15.978	0.01385
425	12.333	0.01058
450	9.6234	0.008317
475	7.5812	0.00649
500	6.0233	0.005111
525	4.8224	0.004057
550	3.888	0.003245
575	3.1543	0.002613
600	2.5726	0.002087
625	2.1099	0.0017
650	1.7389	0.001393
675	1.4394	0.001147
700	1.1961	0.0009468
725	0.99831	0.0007894
750	0.83633	0.0006588
775	0.70241	0.0005506
800	0.59153	0.0004616
825	0.49996	0.0003904
850	0.42323	0.0003291
875	0.35933	0.0002785
900	0.30575	0.0002361
925	0.26064	0.0002018
950	0.22267	0.0001718
975	0.19061	0.0001468
1000	0.16347	0.0001258
1025	0.14044	0.0001082
1050	0.12085	9.351e-05
1075	0.10414	8.132e-05
1100	0.089904	7.174e-05
1125	0.077722	6.376e-05

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1150	0.067281	5.718e-05
1175	0.058325	5.24e-05
1200	0.050696	5.062e-05
1225	0.044146	5.176e-05
1250	0.038521	5.812e-05
1275	0.032878	2.52e-05
1300	0.028614	2.198e-05
1325	0.024923	1.916e-05
1350	0.021743	1.782e-05
1375	0.018988	1.656e-05
1400	0.016577	1.573e-05
1425	0.014512	1.521e-05
1450	0.012654	9.264e-06
1475	0.011092	1.555e-05
1500	0.0097317	1.819e-05
1525	0.0092517	7.1e-05
1550	0.0074287	5.385e-06
1575	0.0065112	4.708e-06
1600	0.0057299	1.195e-05
1625	0.0050089	3.688e-06
1650	0.0043972	3.29e-06
1675	0.0039186	1.532e-05
1700	0.0033933	1.057e-05
1725	0.0029732	2.27e-06
1750	0.0026138	1.983e-06
1775	0.0023005	1.68e-06
1800	0.002061	2.657e-06
1825	0.0017791	1.297e-06
1850	0.001565	1.141e-06
1875	0.0015481	4.631e-05
1900	0.0021449	0.0001167
1925	0.0010637	8.6e-07
1950	0.00099779	2.464e-05
1975	0.00082394	6.556e-07
2000	0.00072909	5.498e-07

-- BasilSchneider - 2018-11-14

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