

WIMP and Dark Matter Searches

We omit papers on CHAMP's, millicharged particles, and other exotic particles.

GALACTIC WIMP SEARCHES

These limits are for weakly-interacting stable particles that may constitute the invisible mass in the galaxy. Unless otherwise noted, a local mass density of $0.3 \text{ GeV}/\text{cm}^3$ is assumed; see each paper for velocity distribution assumptions. In the papers the limit is given as a function of the X^0 mass. Here we list limits only for typical mass values of sub-GeV, GeV, 20 GeV, 100 GeV, and 1 TeV. Specific limits on supersymmetric dark matter particles may be found in the Supersymmetry section.

Spin-Independent Cross Section Limits for Dark Matter Particle (X^0) on Nucleon

For m_{X^0} in GeV range

We provide here limits for $m_{X^0} < 5 \text{ GeV}$

VALUE (pb)	CL%	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$<1 \times 10^{-2}$	90	¹ ABDELHAME..19A	CRES	CaWO ₄
$<5.4 \times 10^{-6}$	90	² AGNESE 19A	SCDM	GeV-scale WIMPs on Ge
<1	90	³ AKERIB 19	LUX	light DM on Xe via Migdal/brem effect
$<1 \times 10^{-6}$	90	⁴ AMOLE 19	PICO	C ₃ F ₈
$<1.6 \times 10^{-3}$	90	⁵ APRILE 19C	XE1T	DM on Xe
$<1 \times 10^{-7}$	90	⁶ APRILE 19D	XE1T	DM on Xe
<0.1	90	⁷ ARMENGAUD 19	EDEL	GeV-scale WIMPs on Ge
$<1.6 \times 10^3$	90	⁸ KOBAYASHI 19	XMAS	annual modulation Xe
$<7 \times 10^2$	90	⁹ LIU 19B	CDEX	GeV; sub-GeV DM via Migdal
$<7 \times 10^{-7}$	90	¹⁰ AGNES 18	DS50	GeV-scale WIMPs on Ar
$<1.5 \times 10^{-5}$	95	¹¹ AGNESE 18	SCDM	GeV-scale WIMPs on Ge
$<2 \times 10^{-8}$	90	¹² APRILE 18	XE1T	Xe, SI
$<4.5 \times 10^{-3}$	90	¹³ ARNAUD 18	NEWS	low mass WIMP, Ne
$<8 \times 10^{-6}$	90	¹⁴ JIANG 18	CDEX	GeV-scale WIMPs on Ge
$<3 \times 10^{-5}$	90	¹⁵ YANG 18	CDEX	WIMPs on Ge
$<1 \times 10^{-6}$	90	¹⁶ AKERIB 17	LUX	Xe
$<1 \times 10^2$	90	¹⁷ ANGLOHER 17A	CRES	GeV-scale WIMPs
$<7 \times 10^{-5}$	90	¹⁸ ANGLOHER 16	CRES	CaWO ₄
$<3 \times 10^{-5}$	90	¹⁹ APRILE 16	X100	Xe
$<4.3 \times 10^{-4}$	90	²⁰ ARMENGAUD 16	EDE3	GeV-scale WIMPs on Ge
$<7 \times 10^{-5}$	90	²¹ HEHN 16	EDE3	SI WIMP on Ge
$<6 \times 10^{-5}$	90	²² ZHAO 16	CDEX	GeV-scale WIMPs on Ge
$<1 \times 10^{-4}$	90	²³ AMOLE 15	PICO	C ₃ F ₈
$<8 \times 10^{-5}$	90	²⁴ XIAO 15	PNDX	WIMPs on Xe
$<3 \times 10^{-5}$	90	²⁵ AGNESE 14	SCDM	GeV-scale WIMPs
$<1 \times 10^{-3}$	90	²⁶ AKERIB 14	LUX	WIMP on Xe
$<9 \times 10^{-4}$	90	²⁷ LI 13B	TEXO	WIMPs on Ge

$<3 \times 10^{-4}$	90	28	ARCHAMBAU..12	PICA	C_4F_{10}
$<2 \times 10^{-4}$	90	29	AALSETH	11	CGNT GeV WIMPs on Ge
$<5 \times 10^{-4}$	90	30	AHMED	11B	CDM2 GeV-scale WIMPs on Ge
$<8 \times 10^{-5}$	90	31	ANGLE	11	XE10 Xe
$<5 \times 10^{-4}$	90	32	AKERIB	10	CDM2 WIMPs on Ge/Si

- ¹ ABDELHAMEED 19A search for GeV scale dark matter SI scatter on $CaWO_4$; no signal, limits placed in σ vs. mass plane for $m(\text{DM}) \sim 0.1\text{--}10$ GeV. The listed limit is for $m(\text{DM}) = 1$ GeV.
- ² AGNESE 19A search for 1.5–10 GeV WIMP scatter on Ge in CDMSlite dataset. Limits set in a likelihood analysis. No signal was observed. Limit reported for $m(\chi) = 5$ GeV.
- ³ AKERIB 19 search for 0.4–5 GeV DM using bremsstrahlung photons and "Migdal" electrons; 1.4×10^4 kg d exposure of liquid Xe; constraint $\sigma^{SI}(\chi N) < 1$ pb for $m(\chi) = 5$ GeV in light scalar mediator model.
- ⁴ AMOLE 19 search for SI WIMP scatter on C_3F_8 in PICO-60 bubble chamber; no signal: set limit for spin independent coupling $\sigma^{SI}(\chi N) < 1 \times 10^{-6}$ pb for $m(\chi) = 5$ GeV.
- ⁵ APRILE 19C search for light DM scatter on Xe via atomic excitation, ionization (Migdal effect) or bremsstrahlung; no signal, limits placed in σ vs. $m(\text{DM})$ plane for $m(\text{DM}) \sim 0.085\text{--}2$ GeV. The listed limit is for $m(\text{DM}) = 1$ GeV.
- ⁶ APRILE 19D search for light DM scatter on Xe via ionization to probe SI, SD, and χe cross sections; with 22 t d exposure, limits placed in various σ vs. $m(\text{DM})$ planes. Quoted limit is for $m(\text{DM}) = 5$ GeV.
- ⁷ ARMENGAUD 19 search for GeV scale WIMP scatter on Ge; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 0.045\text{--}10$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- ⁸ KOBAYASHI 19 search for sub-GeV WIMP annual modulation in Xe via brems; no signal; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m \sim 0.3\text{--}1$ GeV; quoted limit is for $m(\chi) = 0.5$ GeV.
- ⁹ LIU 19B search for sub-GeV DM using Migdal effect on Ge at CDEX-IB; no signal, require $\sigma^{SI}(\chi N) < 7 \times 10^2$ pb for $m(\chi) = 0.1$ GeV.
- ¹⁰ AGNES 18 search for 1.8–20 GeV WIMP SI scatter on Ar; quoted limit is for $m(\chi) = 5$ GeV.
- ¹¹ AGNESE 18 search for GeV scale WIMPs using CDMSlite; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m \sim 1.5\text{--}20$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- ¹² APRILE 18 search for WIMP scatter on 1 t yr Xe; no signal, limits set in $\sigma(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 6\text{--}1000$ GeV; quoted limit is for $m = 6$ GeV.
- ¹³ ARNAUD 18 search for low mass WIMP scatter on Ne via SPC at NEWS-G; limits set in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m \sim 0.5\text{--}20$ GeV; quoted limit is for $m = 5$ GeV.
- ¹⁴ JIANG 18 search for GeV scale WIMP scatter on Ge; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 3\text{--}10$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- ¹⁵ YANG 18 search for WIMP scatter on Ge; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 2\text{--}10$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- ¹⁶ AKERIB 17 search for WIMP scatter on Xe; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5\text{--}1 \times 10^5$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- ¹⁷ ANGLOHER 17A search for GeV scale WIMP scatter on Al_2O_3 crystal; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 0.15\text{--}10$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- ¹⁸ ANGLOHER 16 search for GeV scale WIMP scatter on $CaWO_4$; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 0.5\text{--}30$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- ¹⁹ APRILE 16 search for low mass WIMPs via ionization at XENON100; limits placed in $\sigma^{SI}(\chi N)$ vs $m(\chi)$ plane for $m \sim 3.5\text{--}20$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- ²⁰ ARMENGAUD 16 search for GeV scale WIMP scatter on Ge; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}30$ GeV; quoted limit is for $m(\chi) = 5$ GeV.

- 21 HEHN 16 search for low mass WIMPs via SI scatter on Ge target using profile likelihood analysis; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}30$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- 22 ZHAO 16 search for GeV-scale WIMP scatter on Ge; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}30$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- 23 AMOLE 15 search for WIMP scatter on C_3F_8 in PICO-2L; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}25$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- 24 XIAO 15 search for WIMP scatter on Xe with PandaX-I; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5\text{--}100$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- 25 AGNESE 14 search for GeV scale WIMPs SI scatter at SuperCDMS; no signal, limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 3.5\text{--}30$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- 26 AKERIB 14 search for WIMP scatter on Xe; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5\text{--}5000$ GeV. Limit given for $m(\chi) = 5$ GeV.
- 27 LI 13B search for WIMP scatter on Ge; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}100$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- 28 ARCHAMBAULT 12 search for low mass WIMP scatter on C_4F_{10} ; limits set in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m \sim 4\text{--}12$ GeV; quoted limit is for $m = 5$ GeV.
- 29 AALSETH 11 search for GeV-scale SI WIMP scatter on Ge; limits placed on $\sigma^{SI}(\chi N)$ for $m(\chi) \sim 3.5\text{--}100$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- 30 AHMED 11B search for GeV scale WIMP scatter on Ge in CDMS II; limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m \sim 4\text{--}12$ GeV.
- 31 ANGLE 11 search for GeV scale WIMPs in Xenon-10; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}20$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- 32 AKERIB 10 search for WIMP scatter on Ge/Si in CDMS2; limits place in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for m 3-100 GeV . Limit given for $m(DM)=5$ GeV

For $m_{\chi^0} = 20$ GeV

For limits from X^0 annihilation in the Sun, the assumed annihilation final state is shown in parenthesis in the comment.

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● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
<7 $\times 10^{-5}$	90	1 ANGLOHER	19 CRES	CaWO ₄
<3 $\times 10^{-7}$	90	2 KIM	19A KIMS	Nal
		3 KOBAYASHI	19 XMAS	SI WIMP on Xe
		4 SEONG	19 BELL	$\gamma \rightarrow \gamma A, A \rightarrow \chi\chi$
<3.5 $\times 10^{-5}$	90	5 YANG	19 CDEX	annual modulation Ge
<2 $\times 10^{-7}$	90	6 ABE	18C XMAS	X^0 -Xe modulation
<1.44 $\times 10^{-5}$	90	7 ADHIKARI	18 C100	Nal
<3 $\times 10^{-7}$	90	8 AGNES	18 DS50	X^0 -Ar
<5 $\times 10^{-6}$	95	9 AGNESE	18 SCDM	Ge
<4 $\times 10^{-8}$	90	10 AGNESE	18A SCDM	Ge
<6 $\times 10^{-11}$	90	11 APRILE	18 XE1T	Xe, SI
<4.5 $\times 10^{-3}$	90	12 ARNAUD	18 NEWS	GeV WIMPs on Ne
<2 $\times 10^{-6}$	90	13 AARTSEN	17 ICCB	ν , earth
<2 $\times 10^{-10}$	90	14 AKERIB	17 LUX	Xe
<1 $\times 10^{-3}$	90	15 BARBOSA-D...	17 ICCB	Nal

$<1.7 \times 10^{-10}$	90	16 CUI	17A PNDX	WIMPs on Xe
$<7.3 \times 10^{-7}$	90	AGNES	16 DS50	Ar
$<1 \times 10^{-5}$	90	17 AGNESE	16 CDMS	Ge
$<2 \times 10^{-4}$	90	18 AGUILAR-AR...	16 DMIC	Si CCDs
$<4.5 \times 10^{-5}$	90	19 ANGLOHER	16 CRES	CaWO ₄
$<2 \times 10^{-6}$	90	20 APRILE	16 X100	Xe
$<9.4 \times 10^{-8}$	90	21 ARMENGAUD	16 EDE3	Ge
$<1.0 \times 10^{-7}$	90	22 HEHN	16 EDE3	Ge
$<5 \times 10^{-6}$	90	23 ZHAO	16 CDEX	Ge
$<1 \times 10^{-5}$	90	AGNES	15 DS50	Ar
$<1.5 \times 10^{-6}$	90	24 AGNESE	15A CDM2	Ge
$<1.5 \times 10^{-7}$	90	25 AGNESE	15B CDM2	Ge
$<2 \times 10^{-6}$	90	26 AMOLE	15 PICO	C ₃ F ₈
$<1.2 \times 10^{-5}$	90	CHOI	15 SKAM	H, solar ν ($b\bar{b}$)
$<1.19 \times 10^{-6}$	90	CHOI	15 SKAM	H, solar ν ($\tau^+ \tau^-$)
$<2 \times 10^{-8}$	90	27 XIAO	15 PNDX	Xe
$<2.0 \times 10^{-7}$	90	28 AGNESE	14 SCDM	Ge
$<3.7 \times 10^{-5}$	90	29 AGNESE	14A SCDM	Ge
$<1 \times 10^{-9}$	90	30 AKERIB	14 LUX	Xe
$<2 \times 10^{-6}$	90	31 ANGLOHER	14 CRES	CaWO ₄
$<5 \times 10^{-6}$	90	FELIZARDO	14 SMPL	C ₂ ClF ₅
$<8 \times 10^{-6}$	90	32 LEE	14A KIMS	CsI
$<2 \times 10^{-4}$	90	33 LIU	14A CDEX	Ge
$<1 \times 10^{-5}$	90	34 YUE	14 CDEX	Ge
$<1.08 \times 10^{-4}$	90	35 AARTSEN	13 ICCB	H, solar ν ($\tau^+ \tau^-$)
$<1.5 \times 10^{-5}$	90	36 ABE	13B XMAS	Xe
$<3.1 \times 10^{-6}$	90	37 AGNESE	13 CDM2	Si
$<3.4 \times 10^{-6}$	90	38 AGNESE	13A CDM2	Si
$<2.2 \times 10^{-6}$	90	39 AGNESE	13A CDM2	Si
		40 BERNABEI	13A DAMA	Nal modulation
$<1.2 \times 10^{-4}$	90	41 LI	13B TEXO	Ge
		42 ZHAO	13 CDEX	Ge
$<1.2 \times 10^{-7}$	90	AKIMOV	12 ZEP3	Xe
		43 ANGLOHER	12 CRES	CaWO ₄
$<8 \times 10^{-6}$	90	44 ANGLOHER	12 CRES	CaWO ₄
$<7 \times 10^{-9}$	90	45 APRILE	12 X100	Xe
$<7 \times 10^{-7}$	90	46 ARMENGAUD	12 EDE2	Ge
		47 BARRETO	12 DMIC	CCD
$<2 \times 10^{-6}$	90	BEHNKE	12 COUP	CF ₃ I
$<7 \times 10^{-6}$		48 FELIZARDO	12 SMPL	C ₂ ClF ₅
$<1.5 \times 10^{-6}$	90	KIM	12 KIMS	CsI
$<5 \times 10^{-5}$	90	49 AALSETH	11 CGNT	Ge
		50 AALSETH	11A CGNT	Ge
$<5 \times 10^{-7}$	90	51 AHMED	11 CDM2	Ge, inelastic
$<2.7 \times 10^{-7}$	90	52 AHMED	11A RVUE	Ge
$<3 \times 10^{-6}$	90	53 ANGLE	11 XE10	Xe
$<7 \times 10^{-8}$	90	54 APRILE	11 X100	Xe
		55 APRILE	11A X100	Xe, inelastic
$<2 \times 10^{-8}$	90	45 APRILE	11B X100	Xe

			56	HORN	11	ZEP3	Xe
<2	$\times 10^{-7}$	90		AHMED	10	CDM2	Ge
<1	$\times 10^{-5}$	90	57	AKERIB	10	CDM2	Si, Ge, low threshold
<1	$\times 10^{-7}$	90		APRILE	10	X100	Xe
<2	$\times 10^{-6}$	90		ARMENGAUD	10	EDE2	Ge
<4	$\times 10^{-5}$	90		FELIZARDO	10	SMPL	C ₂ ClF ₃
<1.5	$\times 10^{-7}$	90	58	AHMED	09	CDM2	Ge
<2	$\times 10^{-4}$	90	59	LIN	09	TEXO	Ge
			60	AALSETH	08	CGNT	Ge

- ¹ ANGLOHER 19 search for low mass WIMP scatter on CaWO₄; no signal; limits placed on Wilson coefficients for $m(\chi) = 0.6\text{--}60$ GeV.
- ² KIM 19A search for WIMP scatter in NaI KIMS experiment; no signal: require $\sigma^{SI}(\chi n) < 7 \times 10^{-5}$ pb for $m(\chi) = 20$ GeV.
- ³ KOBAYASHI 19 search for WIMP scatter in XMASS single-phase liquid Xe detector; no signal; require $\sigma^{SI}(\chi N) < 3 \times 10^{-7}$ pb for $m(\chi) = 20$ GeV.
- ⁴ SEONG 19 search for $\mathcal{T} \rightarrow \gamma A$, $A \rightarrow \chi\chi$ via CP-odd Higgs; no signal; limits on BF set; model dependent conversion to WIMP-nucleon scattering cross section limits $\sigma^{SI} < 10^{-36}$ cm² for $m(\chi) = 0.01\text{--}1$ GeV.
- ⁵ YANG 19 search for low mass wimps via annual modulation in Ge; no signal; require $\sigma^{SI}(\chi N) < 3.5 \times 10^{-5}$ pb for $m(\chi) = 20$ GeV.
- ⁶ ABE 18C search for WIMP annual modulation signal for $m(\text{WIMP})$: 6–20 GeV; limits set on SI WIMP-nucleon cross section: see Fig. 6.
- ⁷ ADHIKARI 18 search for WIMP scatter on NaI; no signal; require $\sigma^{SI} < 1.44 \times 10^{-5}$ pb for $m(\text{WIMP}) = 20$ GeV; inconsistent with DAMA/LIBRA result.
- ⁸ AGNES 18 search low mass $m(\text{WIMP})$: 1.8–20 GeV scatter on Ar; limits on SI WIMP-nucleon cross section set in Fig. 8.
- ⁹ AGNESE 18 give limits for $\sigma^{SI}(\chi N)$ for $m(\text{WIMP})$ between 1.5 and 20 GeV using CDMSlite mode data.
- ¹⁰ AGNESE 18A search for WIMP scatter on Ge at SuperCDMS; 1 event, consistent with expected background; set limit in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m \sim 10\text{--}250$ GeV.
- ¹¹ APRILE 18 search for WIMP scatter on 1 t yr Xe; no signal, limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 6\text{--}1000$ GeV.
- ¹² ARNAUD 18 search for low mass WIMP scatter on Ne via SPC at NEWS-G; limits set in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m \sim 0.5\text{--}20$ GeV.
- ¹³ AARTSEN 17 obtain $\sigma(\text{SI}) < 6 \times 10^{-6}$ pb for $m(\text{wimp}) = 20$ GeV from ν from earth.
- ¹⁴ AKERIB 17 search for WIMP scatter on Xe; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5\text{--}1 \times 10^5$ GeV.
- ¹⁵ BARBOSA-DE-SOUZA 17 search for annual modulation of WIMP scatter on NaI using an exposure of 61 kg yr of DM-Ice17 for recoil energy in the 4–20 keV range (DAMA found modulation for recoil energy < 5 keV). No modulation seen. Sensitivity insufficient to distinguish DAMA signal from null.
- ¹⁶ CUI 17A search for SI WIMP scatter; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m \sim 10\text{--}1 \times 10^4$ GeV using 54 ton-day exposure of Xe.
- ¹⁷ AGNESE 16 CDMSlite excludes low mass WIMPs 1.6–5.5 GeV and SI scattering cross section depending on $m(\text{WIMP})$; see Fig. 4.
- ¹⁸ AGUILAR-AREVALO 16 search low mass 1–10 GeV WIMP scatter on Si CCDs; set limits Fig. 11.
- ¹⁹ ANGLOHER 16 search for GeV scale WIMP scatter on CaWO₄; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 0.5\text{--}30$ GeV.
- ²⁰ APRILE 16 search for low mass WIMPs via ionization at XENON100; limits placed in $\sigma^{SI}(\chi N)$ vs $m(\chi)$ plane for $m \sim 3.5\text{--}20$ GeV.

- 21 ARMENGAUD 16 search for GeV scale WIMP scatter on Ge; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}30$ GeV.
- 22 HEHN 16 search for low mass WIMPs via SI scatter on Ge target using profile likelihood analysis; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}30$ GeV.
- 23 ZHAO 16 search for GeV-scale WIMP scatter on Ge; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}30$ GeV.
- 24 AGNESE 15A reanalyse AHMED 11B low threshold data. See their Fig. 12 (left) for improved limits extending down to 5 GeV.
- 25 AGNESE 15B reanalyse AHMED 10 data.
- 26 See their Fig. 7 for limits extending down to 4 GeV.
- 27 XIAO 15 search for WIMP scatter on Xe with PandaX-I; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5\text{--}100$ GeV.
- 28 This limit value is provided by the authors. See their Fig. 4 for limits extending down to $m_{\chi^0} = 3.5$ GeV.
- 29 This limit value is provided by the authors. AGNESE 14A result is from CDMSlite mode operation with enhanced sensitivity to low mass m_{χ^0} . See their Fig. 3 for limits extending down to $m_{\chi^0} = 3.5$ GeV (see also Fig. 4 in AGNESE 14).
- 30 See their Fig. 5 for limits extending down to $m_{\chi^0} = 5.5$ GeV.
- 31 See their Fig. 5 for limits extending down to $m_{\chi^0} = 1$ GeV.
- 32 See their Fig. 5 for limits extending down to $m_{\chi^0} = 5$ GeV.
- 33 LIU 14A result is based on prototype CDEX-0 detector. See their Fig. 13 for limits extending down to $m_{\chi^0} = 2$ GeV.
- 34 See their Fig. 4 for limits extending down to $m_{\chi^0} = 4.5$ GeV.
- 35 AARTSEN 13 search for neutrinos from the Sun arising from the pair annihilation of χ^0 trapped by the sun in data taken between June 2010 and May 2011.
- 36 See their Fig. 8 for limits extending down to $m_{\chi^0} = 7$ GeV.
- 37 This limit value is provided by the authors. AGNESE 13 use data taken between Oct. 2006 and July 2007. See their Fig. 4 for limits extending down to $m_{\chi^0} = 7$ GeV.
- 38 This limit value is provided by the authors. AGNESE 13A use data taken between July 2007 and Sep. 2008. Three candidate events are seen. Assuming these events are real, the best fit parameters are $m_{\chi^0} = 8.6$ GeV and $\sigma = 1.9 \times 10^{-5}$ pb.
- 39 This limit value is provided by the authors. Limit from combined data of AGNESE 13 and AGNESE 13A. See their Fig. 4 for limits extending down to $m_{\chi^0} = 5.5$ GeV.
- 40 BERNABEI 13A search for annual modulation of counting rate in the 2–6 keV recoil energy interval, in a 14 yr live time exposure of 1.33 t yr. Find a modulation of 0.0112 ± 0.0012 counts/(day kg keV) with 9.3 sigma C.L. Find period and phase in agreement with expectations from DM particles.
- 41 LI 13B search for WIMP scatter on Ge; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}100$ GeV.
- 42 See their Fig. 5 for limits for $m_{\chi^0} = 4\text{--}12$ GeV.
- 43 ANGLOHER 12 observe excess events above the expected background which are consistent with χ^0 with mass ~ 25 GeV (or 12 GeV) and spin-independent χ^0 -nucleon cross section of 2×10^{-6} pb (or 4×10^{-5} pb).
- 44 Reanalysis of ANGLOHER 09 data with all three nuclides. See also BROWN 12.
- 45 See also APRILE 14A.
- 46 See their Fig. 4 for limits extending down to $m_{\chi^0} = 7$ GeV.
- 47 See their Fig. 13 for cross section limits for m_{χ^0} between 1.2 and 10 GeV.
- 48 See also DAHL 12 for a criticism.
- 49 See their Fig. 4 for limits extending to $m_{\chi^0} = 3.5$ GeV.

- 50 AALSETH 11A find indications of annual modulation of the data, the energy spectrum being compatible with X^0 mass around 8 GeV. See also AALSETH 13.
- 51 AHMED 11 search for X^0 inelastic scattering. See their Fig. 8–10 for limits. The inelastic cross section reduces to the elastic cross section at the limit of zero mass splitting (Fig. 8, left).
- 52 AHMED 11A combine CDMS II and EDELWEISS data.
- 53 ANGLE 11 show limits down to $m_{X^0} = 4$ GeV on Fig. 3.
- 54 APRILE 11 reanalyze APRILE 10 data.
- 55 APRILE 11A search for X^0 inelastic scattering. See their Fig. 2 and 3 for limits. See also APRILE 14A.
- 56 HORN 11 perform detector calibration by neutrons. Earlier results are only marginally affected.
- 57 See their Fig. 10 and 12 for limits extending to X^0 mass of 1 GeV.
- 58 Superseded by AHMED 10.
- 59 See their Fig. 6(a) for cross section limits for m_{X^0} extending down to 2 GeV.
- 60 See their Fig. 2 for cross section limits for m_{X^0} between 4 and 10 GeV.

For $m_{X^0} = 100$ GeV

For limits from X^0 annihilation in the Sun, the assumed annihilation final state is shown in parenthesis in the comment.

VALUE (pb)	CL%	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
<4 × 10 ⁻⁸	90	1 ABE	19 XMAS	Xe
<3.9 × 10 ⁻⁹	90	2 AJAJ	19 DEAP	Ar
<2.3 × 10 ⁻⁶	90	3 ADHIKARI	18 C100	Nal
<1.14 × 10 ⁻⁸	90	4 AGNES	18A DS50	Ar
<2 × 10 ⁻⁸	90	5 AGNESE	18A CDMS	Ge
<1.2 × 10 ⁻⁸	90	6 AMAUDRUZ	18 DEAP	Ar
<9.12 × 10 ⁻¹¹	90	7 APRILE	18 XE1T	Xe
		8 REN	18 PNDX	SIDM at PDX-II
<1.7 × 10 ⁻¹⁰	90	9 AKERIB	17 LUX	Xe
<1.2 × 10 ⁻¹⁰	90	10 APRILE	17G XE1T	Xe
<1.2 × 10 ⁻¹⁰	90	11 CUI	17A PNDX	Xe
<2.0 × 10 ⁻⁸	90	AGNES	16 DS50	Ar
<1 × 10 ⁻⁹	90	12 AKERIB	16 LUX	Xe
<1 × 10 ⁻⁹	90	13 APRILE	16B X100	Xe
<2 × 10 ⁻⁸	90	14 TAN	16 PNDX	Xe
<4 × 10 ⁻¹⁰	90	15 TAN	16B PNDX	Xe
<6 × 10 ⁻⁸	90	AGNES	15 DS50	Ar
<4 × 10 ⁻⁸	90	16 AGNESE	15B CDM2	Ge
<7.13 × 10 ⁻⁶	90	CHOI	15 SKAM	H, solar ν ($b\bar{b}$)
<6.26 × 10 ⁻⁷	90	CHOI	15 SKAM	H, solar ν (W^+W^-)
<2.76 × 10 ⁻⁷	90	CHOI	15 SKAM	H, solar ν ($\tau^+\tau^-$)
<1.5 × 10 ⁻⁸	90	17 XIAO	15 PNDX	Xe
<1 × 10 ⁻⁹	90	AKERIB	14 LUX	Xe
<4.0 × 10 ⁻⁶	90	18 AVRORIN	14 BAIK	H, solar ν (W^+W^-)
<1.0 × 10 ⁻⁴	90	18 AVRORIN	14 BAIK	H, solar ν ($b\bar{b}$)
<1.6 × 10 ⁻⁶	90	18 AVRORIN	14 BAIK	H, solar ν ($\tau^+\tau^-$)
<5 × 10 ⁻⁶	90	FELIZARDO	14 SMPL	C ₂ ClF ₅
<6.01 × 10 ⁻⁷	90	19 AARTSEN	13 ICCB	H, solar ν (W^+W^-)
<3.30 × 10 ⁻⁵	90	19 AARTSEN	13 ICCB	H, solar ν ($b\bar{b}$)

$<1.9 \times 10^{-6}$	90	20	ADRIAN-MAR..13	ANTR	H, solar ν ($W^+ W^-$)
$<1.2 \times 10^{-4}$	90	20	ADRIAN-MAR..13	ANTR	H, solar ν ($b\bar{b}$)
$<7.6 \times 10^{-7}$	90	20	ADRIAN-MAR..13	ANTR	H, solar ν ($\tau^+ \tau^-$)
$<2 \times 10^{-6}$	90	21	AGNESE	13	CDM2 Si
$<1.6 \times 10^{-6}$	90	22	BOLIEV	13	BAKS H, solar ν ($W^+ W^-$)
$<1.9 \times 10^{-5}$	90	22	BOLIEV	13	BAKS H, solar ν ($b\bar{b}$)
$<7.1 \times 10^{-7}$	90	22	BOLIEV	13	BAKS H, solar ν ($\tau^+ \tau^-$)
$<3.2 \times 10^{-4}$	90	23	LI	13B	TEXO WIMPs on Ge
$<1.67 \times 10^{-6}$	90	24	ABBASI	12	ICCB H, solar ν ($W^+ W^-$)
$<1.07 \times 10^{-4}$	90	24	ABBASI	12	ICCB H, solar ν ($b\bar{b}$)
$<4 \times 10^{-8}$	90		AKIMOV	12	ZEP3 Xe
$<1.4 \times 10^{-6}$	90	25	ANGLOHER	12	CRES CaWO_4
$<3 \times 10^{-9}$	90	26	APRILE	12	X100 Xe
$<3 \times 10^{-7}$	90		BEHNKE	12	COUP CF_3I
$<7 \times 10^{-6}$			FELIZARDO	12	SMPL C_2ClF_5
$<2.5 \times 10^{-7}$	90	27	KIM	12	KIMS CsI
$<2 \times 10^{-4}$	90		AALSETH	11	CGNT Ge
		28	AHMED	11	CDM2 Ge, inelastic
$<3.3 \times 10^{-8}$	90	29	AHMED	11A	RVUE Ge
		30	AJELLO	11	FLAT
$<3 \times 10^{-8}$	90	31	APRILE	11	X100 Xe
		32	APRILE	11A	X100 Xe, inelastic
$<1 \times 10^{-8}$	90	26	APRILE	11B	X100 Xe
$<5 \times 10^{-8}$	90	33	ARMENGAUD	11	EDE2 Ge
		34	HORN	11	ZEP3 Xe
$<4 \times 10^{-8}$	90		AHMED	10	CDM2 Ge
$<9 \times 10^{-6}$	90		AKERIB	10	CDM2 Si, Ge, low threshold
		35	AKIMOV	10	ZEP3 Xe, inelastic
$<5 \times 10^{-8}$	90		APRILE	10	X100 Xe
$<1 \times 10^{-7}$	90		ARMENGAUD	10	EDE2 Ge
$<3 \times 10^{-5}$	90		FELIZARDO	10	SMPL C_2ClF_3
$<5 \times 10^{-8}$	90	36	AHMED	09	CDM2 Ge
		37	ANGLE	09	XE10 Xe, inelastic
$<3 \times 10^{-4}$	90		LIN	09	TEXO Ge
		38	GIULIANI	05	RVUE

¹ ABE 19 search for SI DD in single phase Xe; no signal; require $\sigma^{SI}(\chi p) < 4 \times 10^{-8}$ pb for $m(\chi) \sim 100$ GeV.

² AJAJ 19 search for SI WIMP-nucleon scatter with 758 tonne day exposure of single phase liquid Ar; no signal: require $\sigma^{SI}(\chi N) < 3.9 \times 10^{-9}$ pb for $m(\chi) = 100$ GeV.

³ ADHIKARI 18 search for WIMP scatter on NaI; limit set $\sigma^{SI}(\chi p) < 2.3 \times 10^{-6}$ pb for $m(\chi) = 100$ GeV.

⁴ AGNES 18A search for WIMP scatter on 46.4 kg Ar; no signal; require $\sigma^{SI}(\chi N) < 1.14 \times 10^{-8}$ pb for $m(\chi) = 100$ GeV.

⁵ AGNESE 18A set limit $\sigma^{SI}(\chi N) < 2 \times 10^{-8}$ pb for $m(\text{WIMP}) = 100$ GeV.

⁶ AMAUDRUZ 18 search for WIMP scatter on Ar with DEAP-3600; limits set: $\sigma^{SI}(\chi p) < 1.2 \times 10^{-8}$ pb for $m(\text{WIMP}) = 100$ GeV.

⁷ APRILE 18 search for WIMP scatter on 1.3 t liquid Xe; no signal; require $\sigma^{SI}(\chi p) < 9.12 \times 10^{-11}$ pb for $m(\chi) = 100$ GeV.

⁸ REN 18 search for self-interacting DM at Panda-X-II with a total exposure of 54 ton day; limits set in $m(\text{DM})$ vs. $m(\text{mediator})$ plane.

- 9 AKERIB 17 exclude SI cross section $> 1.7 \times 10^{-10}$ pb for $m(\text{WIMP}) = 100$ GeV. Uses complete LUX data set.
- 10 APRILE 17G set limit $\sigma^{SI}(\chi p) < 1.2 \times 10^{-10}$ pb for $m(\text{WIMP}) = 100$ GeV using 1 ton fiducial mass Xe TPC. Exposure is 34.2 live days.
- 11 CUI 17A search for SI WIMP scatter; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m \sim 10\text{--}1 \times 10^4$ GeV using 54 ton-day exposure of Xe.
- 12 AKERIB 16 re-analysis of 2013 data exclude SI cross section $> 1 \times 10^{-9}$ pb for $m(\text{WIMP}) = 100$ GeV on Xe target.
- 13 APRILE 16B combined 447 live days using Xe target exclude $\sigma(\text{SI}) > 1.1 \times 10^{-9}$ pb for $m(\text{WIMP}) = 50$ GeV.
- 14 TAN 16 search for WIMP scatter off Xe target; see SI exclusion plot Fig. 6.
- 15 TAN 16B search for WIMP- p scatter off Xe target; see Fig. 5 for SI exclusion.
- 16 AGNESE 15B reanalyse AHMED 10 data.
- 17 XIAO 15 search for WIMP scatter on Xe with PandaX-I; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5\text{--}100$ GeV.
- 18 AVRORIN 14 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the Sun in data taken between 1998 and 2003. See their Table 1 for limits assuming annihilation into neutrino pairs.
- 19 AARTSEN 13 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the sun in data taken between June 2010 and May 2011.
- 20 ADRIAN-MARTINEZ 13 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the sun in data taken between Jan. 2007 and Dec. 2008.
- 21 AGNESE 13 use data taken between Oct. 2006 and July 2007.
- 22 BOLIEV 13 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the sun in data taken from 1978 to 2009. See also SUVOROVA 13 for an older analysis of the same data.
- 23 LI 13B search for WIMP scatter on Ge; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}100$ GeV.
- 24 ABBASI 12 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the Sun. The amount of X^0 depends on the X^0 -proton cross section.
- 25 Reanalysis of ANGLOHER 09 data with all three nuclides. See also BROWN 12.
- 26 See also APRILE 14A.
- 27 See their Fig. 6 for a limit on inelastically scattering X^0 for $m_{X^0} = 70$ GeV.
- 28 AHMED 11 search for X^0 inelastic scattering. See their Fig. 8–10 for limits.
- 29 AHMED 11A combine CDMS and EDELWEISS data.
- 30 AJELLO 11 search for e^\pm flux from X^0 annihilations in the Sun. Models in which X^0 annihilates into an intermediate long-lived weakly interacting particles or X^0 scatters inelastically are constrained. See their Fig. 6–8 for limits.
- 31 APRILE 11 reanalyze APRILE 10 data.
- 32 APRILE 11A search for X^0 inelastic scattering. See their Fig. 2 and 3 for limits. See also APRILE 14A.
- 33 Supersedes ARMENGAUD 10. A limit on inelastic cross section is also given.
- 34 HORN 11 perform detector calibration by neutrons. Earlier results are only marginally affected.
- 35 AKIMOV 10 give cross section limits for inelastically scattering dark matter. See their Fig. 4.
- 36 Superseded by AHMED 10.
- 37 ANGLE 09 search for X^0 inelastic scattering. See their Fig. 4 for limits.
- 38 GIULIANI 05 analyzes the spin-independent X^0 -nucleon cross section limits with both isoscalar and isovector couplings. See their Fig. 3 and 4 for limits on the couplings.

For $m_{\chi^0} = 1$ TeV

For limits from χ^0 annihilation in the Sun, the assumed annihilation final state is shown in parenthesis in the comment.

VALUE (pb)	CL%	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$<3 \times 10^{-6}$	90	1 YAGUNA	19	Ar; I-spin viol DM
$<3.8 \times 10^{-8}$	90	2 AGNES	18A	DS50 Ar
$<8.24 \times 10^{-10}$	90	3 APRILE	18	XE1T Xe
$<2 \times 10^{-9}$	90	4 AKERIB	17	LUX Xe
<0.3	90	5 CHEN	17E	PNDX $\chi N \rightarrow \chi^* \rightarrow \chi\gamma$
$<1.2 \times 10^{-9}$	90	6 CUI	17A	PNDX SI WIMPs on Xe
$<8.6 \times 10^{-8}$	90	AGNES	16	DS50 Ar
$<2 \times 10^{-7}$	90	AGNES	15	DS50 Ar
$<2 \times 10^{-7}$	90	7 AGNESE	15B	CDM2 Ge
$<1 \times 10^{-8}$	90	AKERIB	14	LUX Xe
$<2.2 \times 10^{-6}$	90	8 AVRORIN	14	BAIK H, solar ν ($W^+ W^-$)
$<5.5 \times 10^{-5}$	90	8 AVRORIN	14	BAIK H, solar ν ($b\bar{b}$)
$<6.8 \times 10^{-7}$	90	8 AVRORIN	14	BAIK H, solar ν ($\tau^+ \tau^-$)
$<3.46 \times 10^{-7}$	90	9 AARTSEN	13	ICCB H, solar ν ($W^+ W^-$)
$<7.75 \times 10^{-6}$	90	9 AARTSEN	13	ICCB H, solar ν ($b\bar{b}$)
$<6.9 \times 10^{-7}$	90	10 ADRIAN-MAR..13	ANTR	H, solar ν ($W^+ W^-$)
$<1.5 \times 10^{-5}$	90	10 ADRIAN-MAR..13	ANTR	H, solar ν ($b\bar{b}$)
$<1.8 \times 10^{-7}$	90	10 ADRIAN-MAR..13	ANTR	H, solar ν ($\tau^+ \tau^-$)
$<4.3 \times 10^{-6}$	90	11 BOLIEV	13	BAKS H, solar ν ($W^+ W^-$)
$<3.4 \times 10^{-5}$	90	11 BOLIEV	13	BAKS H, solar ν ($b\bar{b}$)
$<1.2 \times 10^{-6}$	90	11 BOLIEV	13	BAKS H, solar ν ($\tau^+ \tau^-$)
$<2.12 \times 10^{-7}$	90	12 ABBASI	12	ICCB H, solar ν ($W^+ W^-$)
$<6.56 \times 10^{-6}$	90	12 ABBASI	12	ICCB H, solar ν ($b\bar{b}$)
$<4 \times 10^{-7}$	90	AKIMOV	12	ZEP3 Xe
$<1.1 \times 10^{-5}$	90	13 ANGLOHER	12	CRES CaWO_4
$<2 \times 10^{-8}$	90	14 APRILE	12	X100 Xe
$<2 \times 10^{-6}$	90	BEHNKE	12	COUP CF_3I
$<4 \times 10^{-6}$		FELIZARDO	12	SMPL C_2ClF_5
$<1.5 \times 10^{-6}$	90	KIM	12	KIMS CsI
		15 AHMED	11	CDM2 Ge, inelastic
$<1.5 \times 10^{-7}$	90	16 AHMED	11A	RVUE Ge
$<2 \times 10^{-7}$	90	17 APRILE	11	X100 Xe
$<8 \times 10^{-8}$	90	14 APRILE	11B	X100 Xe
$<2 \times 10^{-7}$	90	18 ARMENGAUD	11	EDE2 Ge
		19 HORN	11	ZEP3 Xe
$<2 \times 10^{-7}$	90	AHMED	10	CDM2 Ge
$<4 \times 10^{-7}$	90	APRILE	10	X100 Xe
$<6 \times 10^{-7}$	90	ARMENGAUD	10	EDE2 Ge
$<3.5 \times 10^{-7}$	90	20 AHMED	09	CDM2 Ge

¹ YAGUNA 19 recasts DEAP-3600 single-phase liquid argon results in limit for isospin violating DM; for $f_n/f_p = -0.69$, requires $\sigma^{SI}(\chi p) < 3 \times 10^{-6}$ pb for $m(\chi) = 1$ TeV.

² AGNES 18A search for WIMP scatter on 46.4 kg Ar; no signal; require $\sigma^{SI}(\chi N) < 3.8 \times 10^{-8}$ pb for $m(\chi) = 1$ TeV.

- ³ APRILE 18 search for WIMP scatter on 1.3 t Xe; no signal seen; require $\sigma^{SI}(\chi p) < 8.24 \times 10^{-10}$ pb for $m(\chi) = 1$ TeV.
- ⁴ AKERIB 17 search for WIMP scatter on Xe using complete LUX data set; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5\text{--}1 \times 10^5$ GeV.
- ⁵ CHEN 17E search for inelastic WIMP scatter on Xe; require $\sigma^{SI}(\chi N) < 0.3$ pb for $m(\chi) = 1$ TeV and (mass difference) = 300 keV.
- ⁶ CUI 17A search for WIMP scatter using 54 ton-day exposure of Xe; limits placed in $\sigma^{SI}(\chi N)$ vs. $m(\chi)$ plane for $m \sim 10\text{--}1 \times 10^4$ GeV.
- ⁷ AGNESE 15B reanalyse AHMED 10 data.
- ⁸ AVRORIN 14 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the Sun in data taken between 1998 and 2003. See their Table 1 for limits assuming annihilation into neutrino pairs.
- ⁹ AARTSEN 13 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the sun in data taken between June 2010 and May 2011.
- ¹⁰ ADRIAN-MARTINEZ 13 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the sun in data taken between Jan. 2007 and Dec. 2008.
- ¹¹ BOLIEV 13 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the sun in data taken from 1978 to 2009. See also SUVOROVA 13 for an older analysis of the same data.
- ¹² ABBASI 12 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the Sun. The amount of X^0 depends on the X^0 -proton cross section.
- ¹³ Reanalysis of ANGLOHER 09 data with all three nuclides. See also BROWN 12.
- ¹⁴ See also APRILE 14A.
- ¹⁵ AHMED 11 search for X^0 inelastic scattering. See their Fig. 8–10 for limits.
- ¹⁶ AHMED 11A combine CDMS and EDELWEISS data.
- ¹⁷ APRILE 11 reanalyze APRILE 10 data.
- ¹⁸ Supersedes ARMENGAUD 10. A limit on inelastic cross section is also given.
- ¹⁹ HORN 11 perform detector calibration by neutrons. Earlier results are only marginally affected.
- ²⁰ Superseded by AHMED 10.

———— Spin-Dependent Cross Section Limits ————
 ———— for Dark Matter Particle (X^0) on Proton ————

For m_{X^0} in GeV range

We provide here limits for $m_{X^0} < 5$ GeV

<u>VALUE (pb)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$< 1 \times 10^6$	95	¹ ABDELHAMEE..19	CRES	GeV-scale WIMPs on Li
$< 3 \times 10^{-4}$	90	² AMOLE 19	PICO	C_3F_8
$< 1.7 \times 10^4$	90	³ APRILE 19C	XE1T	light DM on Xe via Migdal/brem effect
$< 8 \times 10^6$	90	⁴ ARMENGAUD 19	EDEL	GeV-scale WIMPs on Ge
< 70	90	⁵ XIA 19A	PNDX	SD WIMP on Xe
< 100	90	⁶ AGNESE 18	SCDM	GeV-scale WIMPs on Ge
< 1	90	⁷ AKERIB 17A	LUX	Xe
< 0.6	90	⁸ FU 17	PNDX	SD WIMP on Xe
< 0.2	90	⁹ AMOLE 15	PICO	C_3F_8
$< 1.6 \times 10^{-1}$	90	¹⁰ ARCHAMBAU..12	PICA	^{19}F

¹ ABDELHAMEED 19 search for SD WIMP scatter on 7Li ; limits placed on $\sigma^{SD}(\chi p)$ for $m(\chi) \sim 0.8\text{--}20$ GeV; quoted limit is for $m(\chi) = 1$ GeV.

- ² AMOLE 19 search for SD WIMP scatter on C₃F₈ in PICO-60 bubble chamber; no signal: set limit for spin dependent coupling $\sigma^{SD}(\chi p) < 2 \times 10^{-4}$ pb for $m(\chi) = 5$ GeV.
- ³ APRILE 19C search for light DM on Xe via Migdal/brem effect; no signal, require $\sigma^{SD}(\chi p) < 1.7 \times 10^4$ pb for $m(\chi) = 1$ GeV.
- ⁴ ARMENGAUD 19 search for GeV scale WIMP scatter on Ge; limits placed in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m(\chi) \sim 0.5\text{--}10$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- ⁵ XIA 19A search for WIMP scatter on Xe in PandaX-II; limits placed in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5\text{--}1 \times 10^5$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- ⁶ AGNESE 18 search for GeV scale WIMPs with CDMSlite; limits placed in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m(\chi) \sim 1.5\text{--}20$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- ⁷ AKERIB 17A search for SD WIMP scatter on Xe using 129.5 kg yr exposure; limits placed in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m(\chi) \sim 6\text{--}1 \times 10^5$ GeV.
- ⁸ FU 17 search for SD WIMP scatter on Xe; limits set in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}1 \times 10^3$ GeV.; quoted limit is for $m(\chi) = 5$ GeV.
- ⁹ AMOLE 15 search for WIMP scatter on C₃F₈ in PICO-2L; limits placed in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}1 \times 10^4$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- ¹⁰ ARCHAMBAULT 12 search for SD WIMP scatter in ¹⁹F with PICASSO; limits set in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m \sim 4\text{--}500$ GeV; quoted limit is for $m(\chi) = 5$ GeV.

For $m_{\chi 0} = 20$ GeV

For limits from X^0 annihilation in the Sun, the assumed annihilation final state is shown in parenthesis in the comment.

VALUE (pb)	CL%	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
< 3 × 10 ⁵	95	1 ABDELHAME..19	CRES	⁷ Li
< 2.5 × 10 ⁻⁵	90	2 AMOLE 19	PICO	C ₃ F ₈
< 2.5 × 10 ⁻⁴	90	3 APRILE 19A	XE1T	Xe, SD
< 1 × 10 ⁻³	90	4 XIA 19A	PNDX	SD WIMP on Xe
< 30	95	5 AGNESE 18	SCDM	Ge
< 1 × 10 ⁻³	90	6 AKERIB 17A	LUX	Xe
< 1.32 × 10 ⁻²	90	7 BEHNKE 17	PICA	C ₄ F ₁₀
< 2 × 10 ⁻³	90	8 FU 17	PNDX	SD WIMP on Xe
< 5 × 10 ⁻⁴	90	9 AMOLE 16A	PICO	C ₃ F ₈
< 2 × 10 ⁻⁶	90	10 KHACHATRY...16AJ	CMS	8 TeV $pp \rightarrow Z + \cancel{E}_T$; $Z \rightarrow \ell\bar{\ell}$
< 1.2 × 10 ⁻³	90	AMOLE 15	PICO	C ₃ F ₈
< 1.43 × 10 ⁻³	90	CHOI 15	SKAM	H, solar ν ($b\bar{b}$)
< 1.42 × 10 ⁻⁴	90	CHOI 15	SKAM	H, solar ν ($\tau^+ \tau^-$)
< 5 × 10 ⁻³	90	FELIZARDO 14	SMPL	C ₂ ClF ₅
< 1.29 × 10 ⁻²	90	11 AARTSEN 13	ICCB	H, solar ν ($\tau^+ \tau^-$)
< 3.17 × 10 ⁻²	90	12 APRILE 13	X100	Xe
< 3 × 10 ⁻²	90	13 ARCHAMBAU..12	PICA	F (C ₄ F ₁₀)
< 6 × 10 ⁻²	90	BEHNKE 12	COUP	CF ₃ I
< 20	90	DAW 12	DRFT	F (CF ₄)
< 7 × 10 ⁻³		FELIZARDO 12	SMPL	C ₂ ClF ₅
< 0.15	90	KIM 12	KIMS	CsI
< 1 × 10 ⁵	90	14 AHLEN 11	DMTP	F (CF ₄)
< 0.1	90	14 BEHNKE 11	COUP	CF ₃ I

< 1.5 × 10 ⁻²	90	¹⁵ TANAKA	11	SKAM	H, solar ν (<i>b</i> \bar{b})
< 0.2	90	ARCHAMBAU..09		PICA	F
< 4	90	LEBEDENKO	09A	ZEP3	Xe
< 0.6	90	ANGLE	08A	XE10	Xe
<100	90	ALNER	07	ZEP2	Xe
< 1	90	LEE	07A	KIMS	CsI
< 20	90	¹⁶ AKERIB	06	CDMS	⁷³ Ge, ²⁹ Si
< 2	90	SHIMIZU	06A	CNTR	F (CaF ₂)
< 0.5	90	ALNER	05	NAIA	NaI
< 1.5	90	BARNABE-HE..05		PICA	F (C ₄ F ₁₀)
< 1.5	90	GIRARD	05	SMPL	F (C ₂ ClF ₅)
< 35	90	MIUCHI	03	BOLO	LiF
< 30	90	TAKEDA	03	BOLO	NaF

¹ ABDELHAMEED 19 uses Li₂MoO₄ target to set limit for spin dependent coupling $\sigma^{SD}(\chi p) < 3. \times 10^5$ pb for $m(\chi) = 20$ GeV.

² AMOLE 19 search for SD WIMP scatter on C₃F₈ in PICO-60 bubble chamber; no signal: set limit for spin dependent coupling $\sigma^{SD}(\chi p) < 2.5 \times 10^{-5}$ pb for $m(\chi) = 20$ GeV.

³ APRILE 19A search for SD WIMP scatter on 1 t yr Xe; no signal, limits placed in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m \sim 6$ –1000 GeV.

⁴ XIA 19A search for WIMP scatter on Xe in PandaX-II; limits placed in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5$ –1 × 10⁵ GeV.

⁵ AGNESE 18 give limits for $\sigma^{SD}(p\chi)$ for $m(\text{WIMP})$ between 1.5 and 20 GeV using CDMSlite mode data.

⁶ AKERIB 17A search for SD WIMP scatter on Xe using 129.5 kg yr exposure; limits placed in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m(\chi) \sim 6$ –1 × 10⁵ GeV.

⁷ BEHNKE 17 show final Picasso results based on 231.4 kg d exposure at SNOLab for WIMP scatter on C₄F₁₀ search via superheated droplet; require $\sigma(\text{SD}) < 1.32 \times 10^{-2}$ pb for $m(\text{WIMP}) = 20$ GeV.

⁸ FU 17 search for SD WIMP scatter on Xe; limits set in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4$ –1 × 10³ GeV.

⁹ AMOLE 16A require SD WIMP-*p* scattering < 5 × 10⁻⁴ pb for $m(\text{WIMP}) = 20$ GeV; bubbles from C₃F₈ target.

¹⁰ KHACHATRYAN 16AJ require SD WIMP-*p* < 2 × 10⁻⁶ pb for $m(\text{WIMP}) = 20$ GeV from $pp \rightarrow Z + \cancel{E}_T$; $Z \rightarrow \ell\bar{\ell}$ signal.

¹¹ AARTSEN 13 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the sun in data taken between June 2010 and May 2011.

¹² The value has been provided by the authors. APRILE 13 note that the proton limits on Xe are highly sensitive to the theoretical model used. See also APRILE 14A.

¹³ ARCHAMBAULT 12 search for WIMP scatter on C₄F₁₀; limits set in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m \sim 4$ –500 GeV.

¹⁴ Use a direction-sensitive detector.

¹⁵ TANAKA 11 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the Sun. The amount of X^0 depends on the X^0 -proton cross section.

¹⁶ See also AKERIB 05.

For $m_{X^0} = 100$ GeV

For limits from X^0 annihilation in the Sun, the assumed annihilation final state is shown in parenthesis in the comment.

<u>VALUE (pb)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

< 4 × 10 ⁻⁵	90	1 AMOLE	19 PICO	C ₃ F ₈
< 4 × 10 ⁻⁴	90	2 APRILE	19A XE1T	Xe, SD
< 8 × 10 ⁻⁴	90	3 XIA	19A PNDX	SD WIMP on Xe
< 8 × 10 ⁻⁴	90	4 AKERIB	17A LUX	Xe
< 5 × 10 ⁻⁵	90	5 AMOLE	17 PICO	C ₃ F ₈
< 3.3 × 10 ⁻²	90	6 APRILE	17A X100	Xe inelastic
< 2.8 × 10 ⁻¹	90	7 BATTAT	17 DRFT	CS ₂
< 1.5 × 10 ⁻³	90	8 FU	17 PNDX	Xe
< 0.553–0.019	95	9 AABOUD	16D ATLS	$pp \rightarrow j + \cancel{E}_T$
< 1 × 10 ⁻⁵	90	10 AABOUD	16F ATLS	$pp \rightarrow \gamma + \cancel{E}_T$
< 1 × 10 ⁻⁴	90	11 AARTSEN	16C ICCB	solar ν ($W^+ W^-$)
< 2 × 10 ⁻⁴	90	12 ADRIAN-MAR.	16 ANTR	solar ν ($W W, b\bar{b}, \tau\bar{\tau}$)
< 3 × 10 ⁻³	90	13 AKERIB	16A LUX	Xe
< 5 × 10 ⁻⁴	90	14 AMOLE	16 PICO	CF ₃ I
< 1.5 × 10 ⁻³	90	AMOLE	15 PICO	C ₃ F ₈
< 3.19 × 10 ⁻³	90	CHOI	15 SKAM	H, solar ν ($b\bar{b}$)
< 2.80 × 10 ⁻⁴	90	CHOI	15 SKAM	H, solar ν ($W^+ W^-$)
< 1.24 × 10 ⁻⁴	90	CHOI	15 SKAM	H, solar ν ($\tau^+ \tau^-$)
< 8 × 10 ²	90	15 NAKAMURA	15 NAGE	CF ₄
< 1.7 × 10 ⁻³	90	16 AVRORIN	14 BAIK	H, solar ν ($W^+ W^-$)
< 4.5 × 10 ⁻²	90	16 AVRORIN	14 BAIK	H, solar ν ($b\bar{b}$)
< 7.1 × 10 ⁻⁴	90	16 AVRORIN	14 BAIK	H, solar ν ($\tau^+ \tau^-$)
< 6 × 10 ⁻³	90	FELIZARDO	14 SMPL	C ₂ ClF ₅
< 2.68 × 10 ⁻⁴	90	17 AARTSEN	13 ICCB	H, solar ν ($W^+ W^-$)
< 1.47 × 10 ⁻²	90	17 AARTSEN	13 ICCB	H, solar ν ($b\bar{b}$)
< 8.5 × 10 ⁻⁴	90	18 ADRIAN-MAR.	13 ANTR	H, solar ν ($W^+ W^-$)
< 5.5 × 10 ⁻²	90	18 ADRIAN-MAR.	13 ANTR	H, solar ν ($b\bar{b}$)
< 3.4 × 10 ⁻⁴	90	18 ADRIAN-MAR.	13 ANTR	H, solar ν ($\tau^+ \tau^-$)
< 1.00 × 10 ⁻²	90	19 APRILE	13 X100	Xe
< 7.1 × 10 ⁻⁴	90	20 BOLIEV	13 BAKS	H, solar ν ($W^+ W^-$)
< 8.4 × 10 ⁻³	90	20 BOLIEV	13 BAKS	H, solar ν ($b\bar{b}$)
< 3.1 × 10 ⁻⁴	90	20 BOLIEV	13 BAKS	H, solar ν ($\tau^+ \tau^-$)
< 7.07 × 10 ⁻⁴	90	21 ABBASI	12 ICCB	H, solar ν ($W^+ W^-$)
< 4.53 × 10 ⁻²	90	21 ABBASI	12 ICCB	H, solar ν ($b\bar{b}$)
< 7 × 10 ⁻²	90	22 ARCHAMBAU.	12 PICA	F (C ₄ F ₁₀)
< 1 × 10 ⁻²	90	BEHNKE	12 COUP	CF ₃ I
< 1.8	90	DAW	12 DRFT	F (CF ₄)
< 9 × 10 ⁻³		FELIZARDO	12 SMPL	C ₂ ClF ₅
< 2 × 10 ⁻²	90	KIM	12 KIMS	Csl
< 2 × 10 ³	90	15 AHLEN	11 DMTP	F (CF ₄)
< 7 × 10 ⁻²	90	BEHNKE	11 COUP	CF ₃ I
< 2.7 × 10 ⁻⁴	90	23 TANAKA	11 SKAM	H, solar ν ($W^+ W^-$)
< 4.5 × 10 ⁻³	90	23 TANAKA	11 SKAM	H, solar ν ($b\bar{b}$)
		24 FELIZARDO	10 SMPL	C ₂ ClF ₃
< 6 × 10 ³	90	15 MIUCHI	10 NAGE	CF ₄
< 0.4	90	ARCHAMBAU.	09 PICA	F
< 0.8	90	LEBEDENKO	09A ZEP3	Xe
< 1.0	90	ANGLE	08A XE10	Xe
< 15	90	ALNER	07 ZEP2	Xe

< 0.2	90	LEE	07A	KIMS	CsI
< 1 × 10 ⁴	90	¹⁵ MIUCHI	07	NAGE	F (CF ₄)
< 5	90	²⁵ AKERIB	06	CDMS	⁷³ Ge, ²⁹ Si
< 2	90	SHIMIZU	06A	CNTR	F (CaF ₂)
< 0.3	90	ALNER	05	NAIA	NaI
< 2	90	BARNABE-HE.	05	PICA	F (C ₄ F ₁₀)
< 100	90	BENOIT	05	EDEL	⁷³ Ge
< 1.5	90	GIRARD	05	SMPL	F (C ₂ ClF ₅)
< 0.7		²⁶ GIULIANI	05A	RVUE	
		²⁷ GIULIANI	04	RVUE	
		²⁸ GIULIANI	04A	RVUE	
< 35	90	MIUCHI	03	BOLO	LiF
< 40	90	TAKEDA	03	BOLO	NaF

¹ AMOLE 19 search for SD WIMP scatter on C₃F₈ in PICO-60 bubble chamber; no signal: set limit for spin dependent coupling $\sigma^{SD}(\chi p) < 4 \times 10^{-5}$ pb for $m(\chi) = 100$ GeV.

² APRILE 19A search for SD WIMP scatter on 1 t yr Xe; no signal, limits placed in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m \sim 6\text{--}1000$ GeV.

³ XIA 19A search for WIMP scatter on Xe in PandaX-II; limits placed in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5\text{--}1 \times 10^5$ GeV.

⁴ AKERIB 17A search for SD WIMP scatter on Xe using 129.5 kg yr exposure; limits placed in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m(\chi) \sim 6\text{--}1 \times 10^5$ GeV.

⁵ AMOLE 17 require $\sigma(\text{WIMP-}p)^{SD} < 5 \times 10^{-5}$ pb for $m(\text{WIMP}) = 100$ GeV using PICO-60 1167 kg-days exposure at SNOLab.

⁶ APRILE 17A require require $\sigma(\text{WIMP-}p)(\text{inelastic})^{SD} < 3.3 \times 10^{-2}$ pb for $m(\text{WIMP}) = 100$ GeV, based on 7640 kg day exposure at LNGS.

⁷ BATTAT 17 use directional detection of CS₂ ions to require $\sigma(\text{SD}) < 2.8 \times 10^{-1}$ pb for 100 GeV WIMP with a 55 days exposure at the Boulby Underground Science Facility.

⁸ FU 17 from a 33000 kg d exposure at CJPL, PANDAX II derive for $m(\text{DM}) = 100$ GeV, $\sigma^{SD}(\text{WIMP-}p) < 2 \times 10^{-3}$ pb.

⁹ AABOUD 16D use ATLAS 13 TeV 3.2 fb⁻¹ of data to search for monojet plus missing E_T ; agree with SM rates; present limits on large extra dimensions, compressed SUSY spectra and wimp pair production.

¹⁰ AABOUD 16F search for monophoton plus missing E_T events at ATLAS with 13 TeV and 3.2 fb⁻¹; signal agrees with SM background; place limits on SD WIMP-proton scattering vs. mediator mass and large extra dimension models.

¹¹ AARTSEN 16C search for high energy ν s from WIMP annihilation in solar core; limits set on SD WIMP- p scattering (Fig. 8).

¹² ADRIAN-MARTINEZ 16 search for WIMP annihilation into ν s from solar core; exclude SD cross section $< \text{few } 10^{-4}$ depending on $m(\text{WIMP})$.

¹³ AKERIB 16A using 2013 data exclude SD WIMP-proton scattering $> 3 \times 10^{-3}$ pb for $m(\text{WIMP}) = 100$ GeV.

¹⁴ AMOLE 16 use bubble technique on CF₃I target to exclude SD WIMP- p scattering $> 5 \times 10^{-4}$ pb for $m(\text{WIMP}) = 100$ GeV.

¹⁵ Use a direction-sensitive detector.

¹⁶ AVRORIN 14 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the Sun in data taken between 1998 and 2003. See their Table 1 for limits assuming annihilation into neutrino pairs.

¹⁷ AARTSEN 13 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the sun in data taken between June 2010 and May 2011.

¹⁸ ADRIAN-MARTINEZ 13 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the sun in data taken between Jan. 2007 and Dec. 2008.

- ¹⁹ The value has been provided by the authors. APRILE 13 note that the proton limits on Xe are highly sensitive to the theoretical model used. See also APRILE 14A.
- ²⁰ BOLIEV 13 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the sun in data taken from 1978 to 2009. See also SUVOROVA 13 for an older analysis of the same data.
- ²¹ ABBASI 12 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the Sun. The amount of X^0 depends on the X^0 -proton cross section.
- ²² ARCHAMBAULT 12 search for WIMP scatter on C_4F_{10} ; limits set in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m \sim 4\text{--}500$ GeV.
- ²³ TANAKA 11 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the Sun. The amount of X^0 depends on the X^0 -proton cross section.
- ²⁴ See their Fig. 3 for limits on spin-dependent proton couplings for X^0 mass of 50 GeV.
- ²⁵ See also AKERIB 05.
- ²⁶ GIULIANI 05A analyze available data and give combined limits.
- ²⁷ GIULIANI 04 reanalyze COLLAR 00 data and give limits for spin-dependent X^0 -proton coupling.
- ²⁸ GIULIANI 04A give limits for spin-dependent X^0 -proton couplings from existing data.

For $m_{X^0} = 1$ TeV

For limits from X^0 annihilation in the Sun, the assumed annihilation final state is shown in parenthesis in the comment.

VALUE (pb)	CL%	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$< 3 \times 10^{-4}$	90	¹ AMOLE	19	PICO C_3F_8
$< 4 \times 10^{-3}$	90	² APRILE	19A	XE1T Xe, SD
$< 5 \times 10^{-3}$	90	³ XIA	19A	PNDX SD WIMP on Xe
		⁴ ALBERT	18C	HAWC DM annihilation in Sun to long-lived mediator
$< 2.05 \times 10^{-5}$	90	⁵ AARTSEN	17A	ICCB ν , sun
$< 7 \times 10^{-3}$	90	⁶ AKERIB	17A	LUX Xe
$< 2 \times 10^{-2}$	90	⁷ FU	17	PNDX SD WIMP on Xe
		⁸ ADRIAN-MAR..16B	ANTR	solar μ from WIMP annih.
$< 1 \times 10^{-2}$	90	AMOLE	15	PICO C_3F_8
$< 1.5 \times 10^3$	90	NAKAMURA	15	NAGE CF_4
$< 2.7 \times 10^{-3}$	90	⁹ AVRORIN	14	BAIK H, solar $\nu (W^+ W^-)$
$< 6.9 \times 10^{-2}$	90	⁹ AVRORIN	14	BAIK H, solar $\nu (b\bar{b})$
$< 8.4 \times 10^{-4}$	90	⁹ AVRORIN	14	BAIK H, solar $\nu (\tau^+ \tau^-)$
$< 4.48 \times 10^{-4}$	90	¹⁰ AARTSEN	13	ICCB H, solar $\nu (W^+ W^-)$
$< 1.00 \times 10^{-2}$	90	¹⁰ AARTSEN	13	ICCB H, solar $\nu (b\bar{b})$
$< 8.9 \times 10^{-4}$	90	¹¹ ADRIAN-MAR..13	ANTR	H, solar $\nu (W^+ W^-)$
$< 2.0 \times 10^{-2}$	90	¹¹ ADRIAN-MAR..13	ANTR	H, solar $\nu (b\bar{b})$
$< 2.3 \times 10^{-4}$	90	¹¹ ADRIAN-MAR..13	ANTR	H, solar $\nu (\tau^+ \tau^-)$
$< 7.57 \times 10^{-2}$	90	¹² APRILE	13	X100 Xe
$< 5.4 \times 10^{-3}$	90	¹³ BOLIEV	13	BAKS H, solar $\nu (W^+ W^-)$
$< 4.2 \times 10^{-2}$	90	¹³ BOLIEV	13	BAKS H, solar $\nu (b\bar{b})$
$< 1.5 \times 10^{-3}$	90	¹³ BOLIEV	13	BAKS H, solar $\nu (\tau^+ \tau^-)$
$< 2.50 \times 10^{-4}$	90	¹⁴ ABBASI	12	ICCB H, solar $\nu (W^+ W^-)$
$< 7.86 \times 10^{-3}$	90	¹⁴ ABBASI	12	ICCB H, solar $\nu (b\bar{b})$
$< 8 \times 10^{-2}$	90	BEHNKE	12	COUP CF_3I

< 8	90	DAW	12	DRFT	F (CF ₄)
< 6 × 10 ⁻²		FELIZARDO	12	SMPL	C ₂ ClF ₅
< 8 × 10 ⁻²	90	KIM	12	KIMS	Csl
< 8 × 10 ³	90	¹⁵ AHLEN	11	DMTP	F (CF ₄)
< 0.4	90	BEHNKE	11	COUP	CF ₃ I
< 2 × 10 ⁻³	90	¹⁶ TANAKA	11	SKAM	H, solar ν (<i>b</i> \bar{b})
< 2 × 10 ⁻²	90	¹⁶ TANAKA	11	SKAM	H, solar ν (<i>W</i> ⁺ <i>W</i> ⁻)
< 1 × 10 ⁻³	90	¹⁷ ABBASI	10	ICCB	KK dark matter
< 2 × 10 ⁴	90	¹⁵ MIUCHI	10	NAGE	CF ₄
< 8.7 × 10 ⁻⁴	90	ABBASI	09B	ICCB	H, solar ν (<i>W</i> ⁺ <i>W</i> ⁻)
< 2.2 × 10 ⁻²	90	ABBASI	09B	ICCB	H, solar ν (<i>b</i> \bar{b})
< 3	90	ARCHAMBAU..09		PICA	F
< 6	90	LEBEDENKO	09A	ZEP3	Xe
< 9	90	ANGLE	08A	XE10	Xe
<100	90	ALNER	07	ZEP2	Xe
< 0.8	90	LEE	07A	KIMS	Csl
< 4 × 10 ⁴	90	¹⁵ MIUCHI	07	NAGE	F (CF ₄)
< 30	90	¹⁸ AKERIB	06	CDMS	⁷³ Ge, ²⁹ Si
< 1.5	90	ALNER	05	NAIA	NaI
< 15	90	BARNABE-HE.05		PICA	F (C ₄ F ₁₀)
<600	90	BENOIT	05	EDEL	⁷³ Ge
< 10	90	GIRARD	05	SMPL	F (C ₂ ClF ₅)
<260	90	MIUCHI	03	BOLO	LiF
<150	90	TAKEDA	03	BOLO	NaF

¹ AMOLE 19 search for SD WIMP scatter on C₃F₈ in PICO-60 bubble chamber; no signal: set limit for spin dependent coupling $\sigma^{SD}(\chi p) < 3 \times 10^{-4}$ pb for $m(\chi) = 1000$ GeV.

² APRILE 19A search for SD WIMP scatter on 1 t yr Xe; no signal, limits placed in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m \sim 6$ –1000 GeV.

³ XIA 19A search for WIMP scatter on Xe in PandaX-II; limits placed in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5$ – 1×10^5 GeV.

⁴ ALBERT 18C search for DM annihilation in Sun to long-lived mediator (LLM) which decays outside Sun, for DM masses above 1 TeV; assuming LLM, limits set on $\sigma^{SD}(\chi p)$.

⁵ AARTSEN 17A search for neutrinos from solar WIMP annihilation into $\tau^+ \tau^-$ in 532 days of live time.

⁶ AKERIB 17A search for SD WIMP scatter on Xe using 129.5 kg yr exposure; limits placed in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m(\chi) \sim 6$ – 1×10^5 GeV.

⁷ FU 17 search for SD WIMP scatter on Xe; limits set in $\sigma^{SD}(\chi p)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4$ – 1×10^3 GeV.

⁸ ADRIAN-MARTINEZ 16B search for secluded DM via WIMP annihilation in solar core into light mediator which later decays to μ or ν s; limits presented in Figures 3 and 4.

⁹ AVRORIN 14 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the Sun in data taken between 1998 and 2003. See their Table 1 for limits assuming annihilation into neutrino pairs.

¹⁰ AARTSEN 13 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the sun in data taken between June 2010 and May 2011.

¹¹ ADRIAN-MARTINEZ 13 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the sun in data taken between Jan. 2007 and Dec. 2008.

¹² The value has been provided by the authors. APRILE 13 note that the proton limits on Xe are highly sensitive to the theoretical model used. See also APRILE 14A.

- ¹³ BOLIEV 13 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the sun in data taken from 1978 to 2009. See also SUVOROVA 13 for an older analysis of the same data.
- ¹⁴ ABBASI 12 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the Sun. The amount of X^0 depends on the X^0 -proton cross section.
- ¹⁵ Use a direction-sensitive detector.
- ¹⁶ TANAKA 11 search for neutrinos from the Sun arising from the pair annihilation of X^0 trapped by the Sun. The amount of X^0 depends on the X^0 -proton cross section.
- ¹⁷ ABBASI 10 search for ν_μ from annihilations of Kaluza-Klein photon dark matter in the Sun.
- ¹⁸ See also AKERIB 05.

————— Spin-Dependent Cross Section Limits —————
 ————— for Dark Matter Particle (X^0) on Neutron —————

For m_{X^0} in GeV range

We provide here limits for $m_{X^0} < 5$ GeV

VALUE (pb)	CL%	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$< 1 \times 10^{10}$	95	¹ ABDELHAME..19	CRES	SD low mass DM on Li
$< 2.3 \times 10^2$	90	² APRILE	19C	XE1T light DM on Xe via Migdal/brem effect
$< 1 \times 10^{-2}$	90	³ APRILE	19D	XE1T light DM on Xe via ionization
$< 4 \times 10^4$	90	⁴ ARMENGAUD	19	EDEL GeV-scale WIMPs on Ge
$< 8 \times 10^{-2}$	90	⁵ XIA	19A	PNDX SD WIMP on Xe
< 3	90	⁶ AGNESE	18	SCDM GeV-scale WIMPs on Ge
< 3	90	⁷ JIANG	18	CDEX GeV-scale WIMPs on Ge
< 10	90	⁸ YANG	18	CDEX WIMPs on Ge
$< 1 \times 10^{-1}$	90	⁹ AKERIB	17A	LUX Xe
< 0.1	90	¹⁰ FU	17	PNDX SD WIMP on Xe
< 20	90	¹¹ ZHAO	16	CDEX GeV-scale WIMPs on Ge
< 150	90	¹² AHMED	11B	CDM2 GeV-scale WIMPs on Ge

¹ ABDELHAMEED 19 search for GeV-scale WIMP SD scatter on ^7Li crystal; set limit $\sigma^{SD}(\chi n)$ for $m(\chi) \sim 0.8\text{--}20$ GeV; quoted limit for $m(\chi) = 1$ GeV.

² APRILE 19C search for light DM on Xe via Migdal/bremsstrahlung effect; no signal, require $\sigma^{SD}(\chi n) < 230$ pb for $m(\chi) = 1$ GeV.

³ APRILE 19D search for light DM scatter on Xe via ionization; no signal, limits placed in σ vs. $m(\text{DM}) \sim 3\text{--}6$ GeV; quoted limit is for $m(\text{DM}) = 5$ GeV.

⁴ ARMENGAUD 19 search for GeV scale WIMP scatter on Ge; limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 0.5\text{--}10$ GeV; quoted limit is for $m(\chi) = 5$ GeV.

⁵ XIA 19A search for WIMP scatter on Xe in PandaX-II; limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5\text{--}1 \times 10^5$ GeV; quoted limit is for $m(\chi) = 5$ GeV.

⁶ AGNESE 18 search for GeV scale WIMPs scatter at CDMSlite; limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m \sim 1.5\text{--}20$ GeV; quoted limit is for $m(\chi) = 5$ GeV.

⁷ JIANG 18 search for GeV scale WIMP scatter on Ge; limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 3\text{--}10$ GeV; quoted limit is for $m(\chi) = 5$ GeV.

⁸ YANG 18 search for WIMP scatter on Ge; limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 2\text{--}10$ GeV; quoted limit is for $m(\chi) = 5$ GeV.

⁹ AKERIB 17A search for SD WIMP scatter on Xe with 129.5 kg yr exposure; limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5\text{--}1 \times 10^5$ GeV; quoted limit is for $m(\chi) = 5$ GeV.

- ¹⁰ FU 17 search for SD WIMP scatter on Xe; limits set in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}1 \times 10^3$ GeV.; quoted limit is for $m(\chi) = 5$ GeV.
- ¹¹ ZHAO 16 search for GeV-scale WIMP scatter on Ge; limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}30$ GeV; quoted limit is for $m(\chi) = 5$ GeV.
- ¹² AHMED 11B search for GeV scale WIMP scatter on Ge in CDMS II; limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m \sim 4\text{--}12$ GeV. Limit given for $m(\chi) = 5$ GeV.

For $m_{\chi 0} = 20$ GeV

VALUE (pb)	CL%	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
< 8 × 10 ⁻⁶	90	¹ APRILE	19A XE1T	Xe, SD
< 3 × 10 ⁻⁵	90	² XIA	19A PNDX	SD WIMP on Xe
< 1.5	95	³ AGNESE	18 SCDM	Ge
< 2.5 × 10 ⁻⁵	90	⁴ AKERIB	17A LUX	Xe
< 7 × 10 ⁻⁵	90	⁵ FU	17 PNDX	SD WIMP on Xe
< 2	90	⁶ ZHAO	16 CDEX	GeV-scale WIMPs on Ge
< 0.09	90	FELIZARDO	14 SMPL	C ₂ ClF ₅
< 8	90	⁷ UCHIDA	14 XMAS	¹²⁹ Xe, inelastic
< 1.13 × 10 ⁻³	90	⁸ APRILE	13 X100	Xe
< 0.02	90	AKIMOV	12 ZEP3	Xe
< 0.06	90	AHMED	09 CDM2	Ge
< 0.04	90	LEBEDENKO	09A ZEP3	Xe
< 50		⁹ LIN	09 TEXO	Ge
< 6 × 10 ⁻³	90	ANGLE	08A XE10	Xe
< 0.5	90	ALNER	07 ZEP2	Xe
< 25	90	LEE	07A KIMS	CsI
< 0.3	90	¹⁰ AKERIB	06 CDMS	⁷³ Ge, ²⁹ Si
< 30	90	SHIMIZU	06A CNTR	F (CaF ₂)
< 60	90	ALNER	05 NAIA	NaI
< 20	90	BARNABE-HE.	05 PICA	F (C ₄ F ₁₀)
< 10	90	BENOIT	05 EDEL	⁷³ Ge
< 4	90	KLAPDOR-K...	05 HDMS	⁷³ Ge (enriched)
< 600	90	TAKEDA	03 BOLO	NaF

¹ APRILE 19A search for SD WIMP scatter on 1 t yr Xe; no signal: limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m \sim 6\text{--}1000$ GeV.

² XIA 19A search for WIMP scatter on Xe in PandaX-II; limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5\text{--}1 \times 10^5$ GeV.

³ AGNESE 18 give limits for $\sigma^{SD}(n\chi)$ for $m(\text{WIMP})$ between 1.5 and 20 GeV using CDMSlite mode data.

⁴ AKERIB 17A search for SD WIMP scatter on Xe with 129.5 kg yr exposure; limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5\text{--}1 \times 10^5$ GeV.

⁵ FU 17 search for SD WIMP scatter on Xe; limits set in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}1 \times 10^3$ GeV.

⁶ ZHAO 16 search for GeV-scale WIMP scatter on Ge; limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}30$ GeV.

⁷ Derived limit from search for inelastic scattering $X^0 + {}^{129}\text{Xe} \rightarrow X^0 + {}^{129}\text{Xe}^*$ (39.58 keV).

⁸ The value has been provided by the authors. See also APRILE 14A.

⁹ See their Fig. 6(b) for cross section limits for $m_{\chi 0}$ extending down to 2 GeV.

¹⁰ See also AKERIB 05.

For $m_{\chi^0} = 100$ GeV

<u>VALUE (pb)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
< 1.5×10^{-5}	90	1 APRILE	19A	XE1T Xe, SD
< 4×10^{-3}	90	2 SUZUKI	19	XMAS ^{129}Xe , inelastic
< 2×10^{-5}	90	3 XIA	19A	PNDX SD WIMP on Xe
< 2.5×10^{-5}	90	4 AKERIB	17A	LUX Xe
< 7×10^{-5}	90	5 FU	17	PNDX SD WIMP on Xe
< 0.1	90	FELIZARDO	14	SMPL C_2ClF_5
< 0.05	90	6 UCHIDA	14	XMAS ^{129}Xe , inelastic
< 4.68×10^{-4}	90	7 APRILE	13	X100 Xe
< 0.01	90	AKIMOV	12	ZEP3 Xe
		8 FELIZARDO	10	SMPL C_2ClF_3
< 0.02	90	AHMED	09	CDM2 Ge
< 0.01	90	LEBEDENKO	09A	ZEP3 Xe
<100	90	LIN	09	TEXO Ge
< 0.01	90	ANGLE	08A	XE10 Xe
< 0.05	90	9 BEDNYAKOV	08	RVUE Ge
< 0.08	90	ALNER	07	ZEP2 Xe
< 6	90	LEE	07A	KIMS CsI
< 0.07	90	10 AKERIB	06	CDMS ^{73}Ge , ^{29}Si
< 30	90	SHIMIZU	06A	CNTR F (CaF_2)
< 10	90	ALNER	05	NAIA NaI
< 30	90	BARNABE-HE.	05	PICA F (C_4F_{10})
< 0.7	90	BENOIT	05	EDEL ^{73}Ge
< 0.2		11 GIULIANI	05A	RVUE
< 1.5	90	KLAPDOR-K...	05	HDMS ^{73}Ge (enriched)
		12 GIULIANI	04	RVUE
		13 GIULIANI	04A	RVUE
		14 MIUCHI	03	BOLO LiF
<800	90	TAKEDA	03	BOLO NaF

¹ APRILE 19A search for SD WIMP scatter on 1 t yr Xe; no signal, limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m \sim 6\text{--}1000$ GeV.

² SUZUKI 19 search in single phase liquid xenon detector for inelastic scattering $X^0 + ^{129}\text{Xe} \rightarrow X^0 + ^{129}\text{Xe}^*$ (39.58 keV); no signal: require $\sigma(\chi n)^{SD} < 4 \times 10^{-3}$ pb for $m(\chi) = 100$ GeV.

³ XIA 19A search for WIMP scatter on Xe in PandaX-II; limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5\text{--}1 \times 10^5$ GeV.

⁴ AKERIB 17A search for SD WIMP scatter on Xe with 129.5 kg yr exposure; limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5\text{--}1 \times 10^5$ GeV.

⁵ FU 17 search for SD WIMP scatter on Xe; limits set in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4\text{--}1 \times 10^3$ GeV.

⁶ UCHIDA 14 derived limit from search for inelastic scattering $X^0 + ^{129}\text{Xe} \rightarrow X^0 + ^{129}\text{Xe}(39.58 \text{ keV})$.

⁷ The value has been provided by the authors. See also APRILE 14A.

⁸ See their Fig. 3 for limits on spin-dependent neutron couplings for X^0 mass of 50 GeV.

⁹ BEDNYAKOV 08 reanalyze KLAPDOR-KLEINGROTHAUS 05 and BAUDIS 01 data.

¹⁰ See also AKERIB 05.

¹¹ GIULIANI 05A analyze available data and give combined limits.

- ¹² GIULIANI 04 reanalyze COLLAR 00 data and give limits for spin-dependent X^0 -neutron coupling.
¹³ GIULIANI 04A give limits for spin-dependent X^0 -neutron couplings from existing data.
¹⁴ MIUCHI 03 give model-independent limit for spin-dependent X^0 -proton and neutron cross sections. See their Fig. 5.

For $m_{X^0} = 1$ TeV

VALUE (pb)	CL%	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
< 1.2×10^{-4}	90	¹ APRILE	19A	XE1T Xe, SD
< 2×10^{-4}	90	² XIA	19A	PNDX Xe
< 2.5×10^{-4}	90	³ AKERIB	17A	LUX Xe
< 4×10^{-4}	90	⁴ FU	17	PNDX SD WIMP on Xe
< 0.07	90	FELIZARDO	14	SMPL C_2ClF_5
< 0.2	90	⁵ UCHIDA	14	XMAS ^{129}Xe , inelastic
< 3.64×10^{-3}	90	⁶ APRILE	13	X100 Xe
< 0.08	90	AKIMOV	12	ZEP3 Xe
< 0.2	90	AHMED	09	CDM2 Ge
< 0.1	90	LEBEDENKO	09A	ZEP3 Xe
< 0.1	90	ANGLE	08A	XE10 Xe
< 0.25	90	⁷ BEDNYAKOV	08	RVUE Ge
< 0.6	90	ALNER	07	ZEP2 Xe
< 30	90	LEE	07A	KIMS CsI
< 0.5	90	⁸ AKERIB	06	CDMS ^{73}Ge , ^{29}Si
< 40	90	ALNER	05	NAIA NaI
< 200	90	BARNABE-HE.	05	PICA F (C_4F_{10})
< 4	90	BENOIT	05	EDEL ^{73}Ge
< 10	90	KLAPDOR-K...	05	HDMS ^{73}Ge (enriched)
< 4×10^3	90	TAKEDA	03	BOLO NaF

¹ APRILE 19A search for SD WIMP scatter on 1 t yr Xe; no signal, limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m \sim 6-1000$ GeV.

² XIA 19A search for WIMP scatter on Xe in PandaX-II; limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5-1 \times 10^5$ GeV.

³ AKERIB 17A search for SD WIMP scatter on Xe with 129.5 kg yr exposure; limits placed in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 5-1 \times 10^5$ GeV.

⁴ FU 17 search for SD WIMP scatter on Xe; limits set in $\sigma^{SD}(\chi n)$ vs. $m(\chi)$ plane for $m(\chi) \sim 4-1 \times 10^3$ GeV.

⁵ Derived limit from search for inelastic scattering $X^0 + ^{129}Xe^* \rightarrow X^0 + ^{129}Xe^*$ (39.58 keV).

⁶ The value has been provided by the authors. See also APRILE 14A.

⁷ BEDNYAKOV 08 reanalyze KLAPDOR-KLEINGROTHAUS 05 and BAUDIS 01 data.

⁸ See also AKERIB 05.

Cross-Section Limits for Dark Matter Particles (X^0) on electron

For m_{χ^0} in GeV rangeWe provide here limits for $m_{\chi^0} < 5$ GeV

VALUE (pb)	CL%	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$< 2 \times 10^6$	90	¹ AKERIB 20	LUX	mirror DM with Xe
		² ABRAMOFF 19	SENS	WIMP-e scatter on Si
		³ AGUILAR-AR...19A	DMIC	MeV scale DM scatter on e in Si
$< 1 \times 10^{-4}$	90	⁴ APRILE 19D	XE1T	light DM on Xe via ionization
$< 9 \times 10^{-3}$	90	⁵ AGNES 18B	DS50	Ar
$< 1 \times 10^4$	90	⁶ AGNESE 18B	SCDM	$e\chi$ scatter
$< 5 \times 10^3$	90	⁷ CRISLER 18	SENS	Si CCD
		⁸ APRILE 17	X100	Xe, annual modulation

¹ AKERIB 20 search for mirror DM with LUX 95 d \times 118 kg data for mirror e scatter from Xe; no signal, limits placed in kinetic mixing parameter vs. mirror e temperature $T \sim 0.1$ – 0.9 keV plane.

² ABRAMOFF 19 search for MeV-scale WIMP scatter from Si skipper-CCD; limits placed on $\sigma(\chi e)$ for $m(\chi) \sim 0.5$ – 100 MeV depending on DM form factors. Limit given for $m(\text{DM}) = 1$ MeV.

³ AGUILAR-AREVALO 19A search for MeV scale DM scatter from e in Si CCDs at SNO-LAB; no signal, limits placed in $\sigma(e)$ vs. $m(\text{DM})$ plane for $m(\text{DM}) \sim 0.6$ – 100 MeV.

⁴ APRILE 19D search for light DM scatter on Xe via ionization; no signal, limits placed in σ on nucleus vs. $m(\text{DM})$ plane for $m(\text{DM}) \sim 0.02$ – 10 GeV; quoted limit is for $m(\text{DM}) = 0.2$ GeV.

⁵ AGNES 18B search for MeV scale WIMP scatter from e in Ar; no signal, limits set in σ_e vs. $m(\chi)$ plane for $m \sim 20$ – 1000 MeV and two choices of form factor $F(\text{DM})$; quoted limit for $m(\chi) = 100$ MeV and $F = 1$.

⁶ AGNESE 18B search for $e\chi$ scatter in SuperCDMS; limits placed in $\sigma(e\chi)$ vs. $m(\chi)$ plane for $m \sim 0.3$ – 1×10^4 MeV for two assumed form factors and also in $m(\text{dark photon})$ vs. kinetic mixing plane. Limit given for $m(\chi) = 1$ GeV and $F=1$.

⁷ CRISLER 18 search for $\chi e \rightarrow \chi e$ scatter in Si CCD; place limits on MeV DM in σ_e vs. $m(\chi)$ plane for $m \sim 0.5$ – 1000 MeV for different form factors; quoted limit is for $F(\text{DM}) = 1$ and $m(\chi) = 10$ MeV.

⁸ APRILE 17 search for WIMP- e annual modulation signal for recoil energy in the 2.0 – 5.8 keV interval using 4 years data with Xe. No significant effect seen.

Cross-Section Limits for Dark Matter Particles (χ^0) on Nuclei**For m_{χ^0} in GeV range**We provide here limits for $m_{\chi^0} < 5$ GeV**For $m_{\chi^0} = 20$ GeV**

VALUE (nb)	CL%	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
< 0.03	90	¹ UCHIDA 14	XMAS	^{129}Xe , inelastic
< 0.08	90	² ANGLOHER 02	CRES	Al
		³ BENOIT 00	EDEL	Ge
< 0.04	95	⁴ KLIMENKO 98	CNTR	^{73}Ge , inel.
< 0.8		ALESSAND... 96	CNTR	O
< 6	90	ALESSAND... 96	CNTR	Te
< 0.02		⁵ BELLI 96	CNTR	^{129}Xe , inel.
		⁶ BELLI 96C	CNTR	^{129}Xe

< 4 × 10 ⁻³	90	7	BERNABEI	96	CNTR	Na
< 0.3	90	7	BERNABEI	96	CNTR	I
< 0.2	95	8	SARSA	96	CNTR	Na
< 0.015	90	9	SMITH	96	CNTR	Na
< 0.05	95	10	GARCIA	95	CNTR	Natural Ge
< 0.1	95		QUENBY	95	CNTR	Na
< 90	90	11	SNOWDEN-...	95	MICA	¹⁶ O
< 4 × 10 ³	90	11	SNOWDEN-...	95	MICA	³⁹ K
< 0.7	90		BACCI	92	CNTR	Na
< 0.12	90	12	REUSSER	91	CNTR	Natural Ge
< 0.06	95		CALDWELL	88	CNTR	Natural Ge

¹ UCHIDA 14 limit is for inelastic scattering $X^0 + {}^{129}\text{Xe}^* \rightarrow X^0 + {}^{129}\text{Xe}^*$ (39.58 keV).

² ANGLOHER 02 limit is for spin-dependent WIMP-Aluminum cross section.

³ BENOIT 00 find four event categories in Ge detectors and suggest that low-energy surface nuclear recoils can explain anomalous events reported by UKDMC and Saclay NaI experiments.

⁴ KLIMENKO 98 limit is for inelastic scattering $X^0 {}^{73}\text{Ge} \rightarrow X^0 {}^{73}\text{Ge}^*$ (13.26 keV).

⁵ BELLI 96 limit for inelastic scattering $X^0 {}^{129}\text{Xe} \rightarrow X^0 {}^{129}\text{Xe}^*$ (39.58 keV).

⁶ BELLI 96C use background subtraction and obtain $\sigma < 150 \text{ pb}$ ($< 1.5 \text{ fb}$) (90% CL) for spin-dependent (independent) X^0 -proton cross section. The confidence level is from R. Bernabei, private communication, May 20, 1999.

⁷ BERNABEI 96 use pulse shape discrimination to enhance the possible signal. The limit here is from R. Bernabei, private communication, September 19, 1997.

⁸ SARSA 96 search for annual modulation of WIMP signal. See SARSA 97 for details of the analysis. The limit here is from M.L. Sarsa, private communication, May 26, 1997.

⁹ SMITH 96 use pulse shape discrimination to enhance the possible signal. A dark matter density of 0.4 GeV cm^{-3} is assumed.

¹⁰ GARCIA 95 limit is from the event rate. A weaker limit is obtained from searches for diurnal and annual modulation.

¹¹ SNOWDEN-IFFT 95 look for recoil tracks in an ancient mica crystal. Similar limits are also given for ²⁷Al and ²⁸Si. See COLLAR 96 and SNOWDEN-IFFT 96 for discussion on potential backgrounds.

¹² REUSSER 91 limit here is changed from published (0.04) after reanalysis by authors. J.L. Vuilleumier, private communication, March 29, 1996.

For $m_{X^0} = 100 \text{ GeV}$

VALUE (nb)	CL%	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
< 3 × 10 ⁻³	90	1 UCHIDA	14	XMAS ¹²⁹ Xe, inelastic
< 0.3	90	2 ANGLOHER	02	CRES Al
		3 BELLI	02	RVUE
		4 BERNABEI	02C	DAMA
		5 GREEN	02	RVUE
		6 ULLIO	01	RVUE
		7 BENOIT	00	EDEL Ge
< 4 × 10 ⁻³	90	8 BERNABEI	00D	¹²⁹ Xe, inel.
		9 AMBROSIO	99	MCRO
		10 BRHLIK	99	RVUE
< 8 × 10 ⁻³	95	11 KLIMENKO	98	CNTR ⁷³ Ge, inel.
< 0.08	95	12 KLIMENKO	98	CNTR ⁷³ Ge, inel.
< 4		ALESSAND...	96	CNTR O

<25			ALESSAND...	96	CNTR	Te
< 6 × 10 ⁻³	90	13	BELLI	96	CNTR	¹²⁹ Xe, inel.
		14	BELLI	96C	CNTR	¹²⁹ Xe
< 1 × 10 ⁻³	90	15	BERNABEI	96	CNTR	Na
< 0.3	90	15	BERNABEI	96	CNTR	I
< 0.7	95	16	SARSA	96	CNTR	Na
< 0.03	90	17	SMITH	96	CNTR	Na
< 0.8	90	17	SMITH	96	CNTR	I
< 0.35	95	18	GARCIA	95	CNTR	Natural Ge
< 0.6	95		QUENBY	95	CNTR	Na
< 3	95		QUENBY	95	CNTR	I
< 1.5 × 10 ²	90	19	SNOWDEN-...	95	MICA	¹⁶ O
< 4 × 10 ²	90	19	SNOWDEN-...	95	MICA	³⁹ K
< 0.08	90	20	BECK	94	CNTR	⁷⁶ Ge
< 2.5	90		BACCI	92	CNTR	Na
< 3	90		BACCI	92	CNTR	I
< 0.9	90	21	REUSSER	91	CNTR	Natural Ge
< 0.7	95		CALDWELL	88	CNTR	Natural Ge

¹ UCHIDA 14 limit is for inelastic scattering $X^0 + {}^{129}\text{Xe}^* \rightarrow X^0 + {}^{129}\text{Xe}^*$ (39.58 keV).

² ANGLOHER 02 limit is for spin-dependent WIMP-Aluminum cross section.

³ BELLI 02 discuss dependence of the extracted WIMP cross section on the assumptions of the galactic halo structure.

⁴ BERNABEI 02C analyze the DAMA data in the scenario in which X^0 scatters into a slightly heavier state as discussed by SMITH 01.

⁵ GREEN 02 discusses dependence of extracted WIMP cross section limits on the assumptions of the galactic halo structure.

⁶ ULLIO 01 disfavor the possibility that the BERNABEI 99 signal is due to spin-dependent WIMP coupling.

⁷ BENOIT 00 find four event categories in Ge detectors and suggest that low-energy surface nuclear recoils can explain anomalous events reported by UKDMC and Saclay NaI experiments.

⁸ BERNABEI 00D limit is for inelastic scattering $X^0 {}^{129}\text{Xe} \rightarrow X^0 {}^{129}\text{Xe}$ (39.58 keV).

⁹ AMBROSIO 99 search for upgoing muon events induced by neutrinos originating from WIMP annihilations in the Sun and Earth.

¹⁰ BRHLIK 99 discuss the effect of astrophysical uncertainties on the WIMP interpretation of the BERNABEI 99 signal.

¹¹ KLIMENKO 98 limit is for inelastic scattering $X^0 {}^{73}\text{Ge} \rightarrow X^0 {}^{73}\text{Ge}^*$ (13.26 keV).

¹² KLIMENKO 98 limit is for inelastic scattering $X^0 {}^{73}\text{Ge} \rightarrow X^0 {}^{73}\text{Ge}^*$ (66.73 keV).

¹³ BELLI 96 limit for inelastic scattering $X^0 {}^{129}\text{Xe} \rightarrow X^0 {}^{129}\text{Xe}^*$ (39.58 keV).

¹⁴ BELLI 96C use background subtraction and obtain $\sigma < 0.35$ pb (< 0.15 fb) (90% CL) for spin-dependent (independent) X^0 -proton cross section. The confidence level is from R. Bernabei, private communication, May 20, 1999.

¹⁵ BERNABEI 96 use pulse shape discrimination to enhance the possible signal. The limit here is from R. Bernabei, private communication, September 19, 1997.

¹⁶ SARSA 96 search for annual modulation of WIMP signal. See SARSA 97 for details of the analysis. The limit here is from M.L. Sarsa, private communication, May 26, 1997.

¹⁷ SMITH 96 use pulse shape discrimination to enhance the possible signal. A dark matter density of 0.4 GeV cm^{-3} is assumed.

¹⁸ GARCIA 95 limit is from the event rate. A weaker limit is obtained from searches for diurnal and annual modulation.

¹⁹ SNOWDEN-IFFT 95 look for recoil tracks in an ancient mica crystal. Similar limits are also given for ²⁷Al and ²⁸Si. See COLLAR 96 and SNOWDEN-IFFT 96 for discussion on potential backgrounds.

²⁰ BECK 94 uses enriched ⁷⁶Ge (86% purity).

²¹ REUSSER 91 limit here is changed from published (0.3) after reanalysis by authors. J.L. Vuilleumier, private communication, March 29, 1996.

For $m_{\chi^0} = 1$ TeV

<u>VALUE (nb)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
< 0.03	90	1 UCHIDA	14 XMAS	¹²⁹ Xe, inelastic
< 3	90	2 ANGLOHER	02 CRES	Al
		3 BENOIT	00 EDEL	Ge
		4 BERNABEI	99D CNTR	SIMP
		5 DERBIN	99 CNTR	SIMP
< 0.06	95	6 KLIMENKO	98 CNTR	⁷³ Ge, inel.
< 0.4	95	7 KLIMENKO	98 CNTR	⁷³ Ge, inel.
< 40		ALESSAND...	96 CNTR	O
<700		ALESSAND...	96 CNTR	Te
< 0.05	90	8 BELLI	96 CNTR	¹²⁹ Xe, inel.
< 1.5	90	9 BELLI	96 CNTR	¹²⁹ Xe, inel.
		10 BELLI	96C CNTR	¹²⁹ Xe
< 0.01	90	11 BERNABEI	96 CNTR	Na
< 9	90	11 BERNABEI	96 CNTR	I
< 7	95	12 SARSA	96 CNTR	Na
< 0.3	90	13 SMITH	96 CNTR	Na
< 6	90	13 SMITH	96 CNTR	I
< 6	95	14 GARCIA	95 CNTR	Natural Ge
< 8	95	QUENBY	95 CNTR	Na
< 50	95	QUENBY	95 CNTR	I
<700	90	15 SNOWDEN-...	95 MICA	¹⁶ O
< 1 × 10 ³	90	15 SNOWDEN-...	95 MICA	³⁹ K
< 0.8	90	16 BECK	94 CNTR	⁷⁶ Ge
< 30	90	BACCI	92 CNTR	Na
< 30	90	BACCI	92 CNTR	I
< 15	90	17 REUSSER	91 CNTR	Natural Ge
< 6	95	CALDWELL	88 CNTR	Natural Ge

¹ UCHIDA 14 limit is for inelastic scattering $\chi^0 + {}^{129}\text{Xe}^* \rightarrow \chi^0 + {}^{129}\text{Xe}^*$ (39.58 keV).

² ANGLOHER 02 limit is for spin-dependent WIMP-Aluminum cross section.

³ BENOIT 00 find four event categories in Ge detectors and suggest that low-energy surface nuclear recoils can explain anomalous events reported by UKDMC and Saclay NaI experiments.

⁴ BERNABEI 99D search for SIMPs (Strongly Interacting Massive Particles) in the mass range 10^3 – 10^{16} GeV. See their Fig. 3 for cross-section limits.

⁵ DERBIN 99 search for SIMPs (Strongly Interacting Massive Particles) in the mass range 10^2 – 10^{14} GeV. See their Fig. 3 for cross-section limits.

⁶ KLIMENKO 98 limit is for inelastic scattering $\chi^0 {}^{73}\text{Ge} \rightarrow \chi^0 {}^{73}\text{Ge}^*$ (13.26 keV).

⁷ KLIMENKO 98 limit is for inelastic scattering $\chi^0 {}^{73}\text{Ge} \rightarrow \chi^0 {}^{73}\text{Ge}^*$ (66.73 keV).

⁸ BELLI 96 limit for inelastic scattering $\chi^0 {}^{129}\text{Xe} \rightarrow \chi^0 {}^{129}\text{Xe}^*$ (39.58 keV).

- ⁹ BELLI 96 limit for inelastic scattering $\chi^0 129\text{Xe} \rightarrow \chi^0 129\text{Xe}^*(236.14 \text{ keV})$.
- ¹⁰ BELLI 96C use background subtraction and obtain $\sigma < 0.7 \text{ pb}$ ($< 0.7 \text{ fb}$) (90% CL) for spin-dependent (independent) χ^0 -proton cross section. The confidence level is from R. Bernabei, private communication, May 20, 1999.
- ¹¹ BERNABEI 96 use pulse shape discrimination to enhance the possible signal. The limit here is from R. Bernabei, private communication, September 19, 1997.
- ¹² SARSA 96 search for annual modulation of WIMP signal. See SARSA 97 for details of the analysis. The limit here is from M.L. Sarsa, private communication, May 26, 1997.
- ¹³ SMITH 96 use pulse shape discrimination to enhance the possible signal. A dark matter density of 0.4 GeV cm^{-3} is assumed.
- ¹⁴ GARCIA 95 limit is from the event rate. A weaker limit is obtained from searches for diurnal and annual modulation.
- ¹⁵ SNOWDEN-IFFT 95 look for recoil tracks in an ancient mica crystal. Similar limits are also given for ^{27}Al and ^{28}Si . See COLLAR 96 and SNOWDEN-IFFT 96 for discussion on potential backgrounds.
- ¹⁶ BECK 94 uses enriched ^{76}Ge (86% purity).
- ¹⁷ REUSSER 91 limit here is changed from published (5) after reanalysis by authors. J.L. Vuilleumier, private communication, March 29, 1996.

Miscellaneous Results from Underground Dark Matter Searches

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$<6.4 \times 10^{-10}$	90	¹ ABRAMOFF 19	SENS	MeV DM e-Si; dark photon Si absorption
		² ADHIKARI 19	C100	annual modulation NaI
		³ AMARE 19	ANAI	annual modulation NaI
		⁴ APRILE 19	XE1T	π (Xe)
		⁵ BRINGMANN 19		cosmic ray DM
		⁶ BRUNE 19		Majoran DM
		⁷ CHOI 19	THEO	290 TeV IceCube ν
		⁸ HA 19	C100	inelastic boosted dark γ
		⁹ KLOPF 19		$n \rightarrow \chi e^+ e^-$
		¹⁰ AARTSEN 18D	ICCB	relic WIMP $\chi \rightarrow \nu X$
		¹¹ ABE 18F	XMAS	$A' e \rightarrow A' e$
		¹² AGNES 18B	DS50	Ar
		¹³ AGNESE 18B	SCDM	MeV DM e-Si; dark photon Si absorption
$<1 \times 10^{-12}$	90	¹⁴ AKERIB 18A	LUX	Xe
		¹⁵ ARMENGAUD 18	EDE3	Ge
		¹⁶ KACHULIS 18	SKAM	boosted DM on e
		¹⁷ AGUILAR-AR... 17	DMIC	γ' on Si
		¹⁸ APRILE 17	X100	Xe
		¹⁹ APRILE 17D	X100	Xe
$<4 \times 10^{-3}$	90	²⁰ APRILE 17H	X100	keV bosonic DM search
		²¹ APRILE 17K	X100	$\chi N \rightarrow \chi^* \rightarrow \chi \gamma$
		²² ANGLOHER 16A	CRES	CaWO_4
		²³ APRILE 15	X100	Event rate modulation
		²⁴ APRILE 15A	X100	Electron scattering

¹ ABRAMOFF 19 search for MeV scale DM via DM–e scattering and dark photon DM via absorption in Si; limits set in coupling vs. $m(\chi)$ plane and on dark photon in $m(A)$ vs. kinetic mixing parameter plane.

- 2 ADHIKARI 19 search for annual modulation signal from WIMP scatter on NaI with 1.7 yr exposure; result consistent with both DAMA/LIBRA and null hypothesis.
- 3 AMARE 19 is ANAIS-112 search for WIMP scatter annual modulation on NaI; 157.55 kg yr exposure; result compatible with null hypothesis; confirm goal of reaching sensitivity at 3σ to DAMA/LIBRA result in 5 years.
- 4 APRILE 19 search for WIMP-pion scattering in Xe; no signal: require $\sigma(\chi\pi) < 6.4 \times 10^{-10}$ pb for $m(\chi) = 30$ GeV.
- 5 BRINGMANN 19 derive theoretically limits on GeV and sub-GeV mass dark matter, in its high energy component generated by interaction with cosmic rays; place limits on σ^{SI} and $\sigma^{SD} < 10^5$ pb.
- 6 BRUNE 19 examine possibility of Majoron dark matter; limits placed on Majoron mass vs. coupling from SN1987a and ν -less double beta decay.
- 7 CHOI 19 from multimessenger observation finds limit on $\sigma(\nu\chi)/m(\text{DM}) < 5.1 \times 10^{-23}$ cm²/GeV based on 290 TeV IceCube neutrino event.
- 8 HA 19 search for inelastic boosted MeV scale dark photon using COSINE-100 data; limits placed in m vs. ϵ plane for various mediators.
- 9 KLOPF 19 search for DM via $n \rightarrow \chi e^+ e^-$; no signal: limits placed in branching fraction vs. $m(e^+ e^-)$ plane.
- 10 AARTSEN 18D search for long-lived DM particles decaying $\chi \rightarrow \nu X$; no excess seen; for DM masses above 10 TeV, excluding lifetimes shorter than 10^{28} s.
- 11 ABE 18F search for keV mass ALPs and hidden photons (HP) scatter on electrons; limits set on mass vs. coupling.
- 12 AGNES 18B search for MeV-scale DM scatter on electrons in Ar; no signal; require $\sigma(\chi e) < 9 \times 10^{-3}$ pb for DM form factor $F(\text{DM}) = 1$ and < 300 pb for $F(\text{DM})$ proportional to $1/q^2$ for $m(\chi) = 100$ MeV.
- 13 AGNESE 18B search for MeV scale DM via DM-e scattering and dark photon DM via absorption in Si; limits set on MeV DM in coupling vs. $m(\chi)$ plane and on dark photon in $m(A')$ vs. kinetic mixing plane.
- 14 AKERIB 18A search for annual and diurnal modulation of DM scattering rate on electrons for recoil energy between 2 and 6 keVee; no signal found.
- 15 ARMENGAUD 18 search for ALP from the Sun and galactic bosonic DM, interacting in Ge; no signal; limits set for 0.8–500 keV DM particles.
- 16 KACHULIS 18 search for an excess of elastically scattered electrons above the atmospheric neutrino background in Super-K; limits placed for simple annihilation or decay in the Sun or galactic center producing "boosted" dark matter.
- 17 AGUILAR-AREVALO 17 search for hidden photon DM scatter on Si target CCD; limit kinetic mixing $\kappa < 1 \times 10^{-12}$ for $m = 10$ eV.
- 18 APRILE 17 search for WIMP-e annual modulation signal for recoil energy in the 2.0–5.8 keV interval using 4 years data with Xe. No significant effect seen.
- 19 APRILE 17D set limits on 14 WIMP-nucleon different interaction operators. No deviations found using 225 live days in the 6.6–240 keV recoil energy range.
- 20 APRILE 17H search for keV bosonic DM via $e\chi \rightarrow e$, looking for electronic recoils with 224.6 live days of data and 34 kg of LXe. Limits set on $\chi e e$ coupling for $m(\chi) = 8$ –125 keV.
- 21 APRILE 17K search for magnetic inelastic DM via $\chi N \rightarrow \chi^* \rightarrow \chi\gamma$. Limits set in DM magnetic moment vs. mass splitting plane for two DM masses corresponding to the DAMA/LIBRA best fit values.
- 22 ANGLOHER 16A require q^2 dependent scattering $< 8 \times 10^{-3}$ pb for asymmetric DM $m(\text{WIMP}) = 3$ GeV on CaWO₄ target. It uses a local dark matter density of 0.38 GeV/cm³.
- 23 APRILE 15 search for periodic variation of electronic recoil event rate in the data between Feb. 2011 and Mar. 2012. No significant modulation is found for periods up to 500 days.

²⁴ APRILE 15A search for X^0 scattering off electrons. See their Fig. 4 for limits on cross section through axial-vector coupling for m_{X^0} between 0.6 GeV and 1 TeV. For $m_{X^0} = 2$ GeV, $\sigma < 60$ pb (90%CL) is obtained.

————— X^0 Annihilation Cross Section —————

Limits are on σv for X^0 pair annihilation at threshold.

VALUE (cm ³ s ⁻¹)	CL%	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
		1 ABEYSEKARA 19	HAWC	DM annihilation to γ s within galactic substructure
$<0.8 \times 10^{-22}$	95	2 ALBERT 19B	HAWC	annihilation/decay to γ in M31
$<4 \times 10^{-26}$	95	3 CHEUNG 19		$\chi\chi \rightarrow e^+e^-$ and $b\bar{b}$
$<7 \times 10^{-27}$	95	4 DI-MAURO 19	FLAT	Fermi-LAT M31 and M33
		5 JOHNSON 19	FLAT	P -wave DM; Fermi-LAT
$<2 \times 10^{-26}$	95	6 LI 19D	FLAT	$\chi\chi \rightarrow \gamma$
$<1 \times 10^{-32}$		7 NG 19		sterile ν decay/annihilation
		8 QUEIROZ 19		semi-annihilating DM
$<4 \times 10^{-28}$	95	9 ABDALLAH 18	HESS	$X^0 X^0 \rightarrow \gamma X$; galactic halo
$<1 \times 10^{-23}$	95	10 AHNEN 18	MGIC	$X^0 X^0 \rightarrow \gamma X$; Ursa Major II
$<1 \times 10^{-22}$	95	11 ALBERT 18B	HAWC	$X^0 X^0 \rightarrow \gamma X$; Andromeda
$<1 \times 10^{-26}$	95	12 CHANG 18A		$\chi\chi \rightarrow b\bar{b} \rightarrow \gamma$
		13 LISANTI 18	THEO	Fermi, γ ; galaxy groups
		14 MAZZIOTTA 18	FLAT	Fermi-LAT CRE data
$<1.2 \times 10^{-23}$	95	15 AARTSEN 17C	ICCB	$\chi\chi \rightarrow$ neutrinos
$<1 \times 10^{-23}$	90	16 ALBERT 17A	ANTR	ν , DM annihilation
$<1.32 \times 10^{-25}$	95	17 ARCHAMBAU.17	VRTS	γ dwarf galaxies
$<7 \times 10^{-21}$	90	18 AVRORIN 17	BAIK	cosmic ν
$<1 \times 10^{-28}$		19 BOUDAUD 17		MeV DM to e^+e^-
		20 AARTSEN 16D	ICCB	ν , galactic center
$<6 \times 10^{-26}$	95	21 ABDALLAH 16	HESS	Central Galactic Halo
$<1 \times 10^{-27}$	95	22 ABDALLAH 16A	HESS	WIMP+WIMP $\rightarrow \gamma\gamma$; galactic center
$<3 \times 10^{-26}$	95	23 AHNEN 16	MGFL	Satellite galaxy, $m(\text{WIMP})=100$ GeV
$<1.9 \times 10^{-21}$	90	24 AVRORIN 16	BAIK	ν s from galactic center
$<3 \times 10^{-26}$	95	25 CAPUTO 16	FLAT	small Magellanic cloud
$<1 \times 10^{-25}$	95	26 FORNASA 16	FLAT	Fermi-LAT γ -ray anisotropy
$<5 \times 10^{-27}$		27 LEITE 16		WIMP, radio
$<2 \times 10^{-26}$	95	28 LI 16	FLAT	dwarf galaxies
$<1 \times 10^{-25}$	95	29 LI 16A	FLAT	Fermi-LAT; M31
$<1 \times 10^{-26}$		30 LIANG 16	FLAT	Fermi-LAT, gamma line
$<1 \times 10^{-25}$	95	31 LU 16	FLAT	Fermi-LAT and AMS-02
$<1 \times 10^{-23}$	95	32 SHIRASAKI 16	FLAT	extra galactic
		33 AARTSEN 15C	ICCB	ν , Galactic halo
		34 AARTSEN 15E	ICCB	ν , Galactic center
		35 ABRAMOWSKI15	HESS	Galactic center
		36 ACKERMANN 15	FLAT	monochromatic γ
		37 ACKERMANN 15A	FLAT	isotropic γ background
		38 ACKERMANN 15B	FLAT	Satellite galaxy

		39	ADRIAN-MAR..15	ANTR	ν , Galactic center
$<2.90 \times 10^{-26}$	95	40,41	ACKERMANN 14	FLAT	Satellite galaxy, $m = 10$ GeV
$<1.84 \times 10^{-25}$	95	40,42	ACKERMANN 14	FLAT	Satellite galaxy, $m = 100$ GeV
$<1.75 \times 10^{-24}$	95	40,42	ACKERMANN 14	FLAT	Satellite galaxy, $m = 1$ TeV
$<4.52 \times 10^{-24}$	95	43	ALEKSIC 14	MGIC	Segue 1, $m = 1.35$ TeV
		44	AARTSEN 13C	ICCB	Galaxies
		45	ABRAMOWSKI13	HESS	Central Galactic Halo
		46	ACKERMANN 13A	FLAT	Galaxy
		47	ABRAMOWSKI12	HESS	Fornax Cluster
		48	ACKERMANN 12	FLAT	Galaxy
		49	ACKERMANN 12	FLAT	Galaxy
		50	ALIU 12	VRTS	Segue 1
$<1 \times 10^{-22}$	90	51	ABBASI 11C	ICCB	Galactic halo, $m=1$ TeV
$<3 \times 10^{-25}$	95	52	ABRAMOWSKI11	HESS	Near Galactic center, $m=1$ TeV
$<1 \times 10^{-26}$	95	53	ACKERMANN 11	FLAT	Satellite galaxy, $m=10$ GeV
$<1 \times 10^{-25}$	95	53	ACKERMANN 11	FLAT	Satellite galaxy, $m=100$ GeV
$<1 \times 10^{-24}$	95	53	ACKERMANN 11	FLAT	Satellite galaxy, $m=1$ TeV

- ¹ ABEYSEKARA 19 search for γ s from DM annihilation in galactic substructures with HAWC; no signal, limits placed in $J\langle\sigma\cdot v\rangle$ vs. declination plane for $m(\text{DM}) \sim 1\text{--}108$ TeV.
- ² ALBERT 19B search for DM signal from M31 galaxy in μ , τ , t , b , W channels using HAWC for $m(\text{DM}) \sim 1\text{--}100$ TeV; no signal, limits placed in $\langle\sigma\cdot v\rangle$ vs. $m(\text{DM})$ plane.
- ³ CHEUNG 19 derive model-dependent bounds on $\langle\sigma\cdot v\rangle$ from EDGES data: $< 4 \times 10^{-26}$ cm^3/s for e^+e^- and $b\bar{b}$ for $m(\chi) = 100$ GeV (including boost factor).
- ⁴ DI-MAURO 19 place limits on WIMP annihilation via Fermi-LAT observation of M31 and M33 galaxies: $\langle\sigma\cdot v\rangle < 7 \times 10^{-27}$ cm^3/s for $m(\chi) = 20$ GeV from M31.
- ⁵ JOHNSON 19 search for γ -rays, 10–600 GeV energy, from P -wave annihilating DM around SgrA* BH using Fermi-LAT; limits set for various models.
- ⁶ LI 19D search for $\chi\chi \rightarrow \gamma$ in Fermi-LAT data; no signal, require $\langle\sigma\cdot v\rangle < 2 \times 10^{-26}$ cm^3/s for $m(\chi) = 100$ GeV.
- ⁷ NG 19 search for X-ray line from sterile ν decay/annihilation using NuStar M-31; no signal: limits placed in $m(\nu)$ vs mixing angle and $\langle\sigma\cdot v\rangle$ vs $m(\nu)$.
- ⁸ QUEIROZ 19 examine $\chi\chi \rightarrow \chi^{SM}$ semi-annihilation of DM reaction; limits placed for various assumed SM particles in $\langle\sigma\cdot v\rangle$ vs. $m(\chi)$ plane.
- ⁹ ABDALLAH 18 search for WIMP WIMP $\rightarrow \gamma X$ in central galactic halo, 10 years of data; limits placed in $\langle\sigma\cdot v\rangle$ vs. $m(\text{WIMP})$ plane for $m(\text{WIMP}): 0.3\text{--}70$ TeV.
- ¹⁰ AHNEN 18 search for WIMP WIMP $\rightarrow \gamma X$ from Ursa Major II; limits set in $\langle\sigma\cdot v\rangle$ vs. $m(\text{WIMP})$ plane for $b\bar{b}$, W^+W^- , $\tau^+\tau^-$, and $\mu^+\mu^-$ annihilation modes.
- ¹¹ ALBERT 18B search for TeV-scale WIMPs with WIMP WIMP $\rightarrow \gamma X$ in Andromeda galaxy using HAWC Observatory; limits set in $\langle\sigma\cdot v\rangle$ vs $m(\text{WIMP})$ plane.
- ¹² CHANG 18A examine $\chi\chi \rightarrow b\bar{b} \rightarrow \gamma$ using Fermi Pass 8 data; no signal; require $\langle\sigma\cdot v\rangle < 10^{-26}$ cm^3/s for $m(\chi) = 50$ GeV.
- ¹³ LISANTI 18 examine Fermi Pass 8 γ -ray data from galaxy groups; report $m(\text{WIMP}) > 30$ GeV for annihilation in $b\bar{b}$ channel.
- ¹⁴ MAZZIOTTA 18 examine Fermi-LAT electron and positron spectra searching for features originating from DM particles annihilation into e^+e^- pairs, from 45 GeV to 2 TeV; no signal found, limits are obtained.
- ¹⁵ AARTSEN 17C use 1005 days of IceCube data to search for $\chi\chi \rightarrow$ neutrinos via various annihilation channels. Limits set.

- 16 ALBERT 17A search for DM annihilation to νs using ANTARES data from 2007–2015. No signal. Limits set in $\langle\sigma\cdot v\rangle$ vs. $m(\text{DM})$ plane for $m(\text{DM}) \sim 10\text{--}10 \times 10^5$ GeV. The listed limit is for $m(\text{DM}) = 100$ TeV.
- 17 ARCHAMBAULT 17 set limits for WIMP mass between 100 GeV and 1 TeV on $\langle\sigma\cdot v\rangle$ for W^+W^- , ZZ , $b\bar{b}$, $s\bar{s}$, $u\bar{u}$, $d\bar{d}$, $t\bar{t}$, e^+e^- , $g\bar{g}$, $c\bar{c}$, hh , $\gamma\gamma$, $\mu^+\mu^-$, $\tau^+\tau^-$ annihilation channels.
- 18 AVRORIN 17 find upper limits for the annihilation cross section in various channels for DM particle mass between 30 GeV and 10 TeV. Strongest upper limits coming from the two neutrino channel require $\langle\sigma\cdot v\rangle < 6 \times 10^{-20}$ cm³/s in dwarf galaxies and $\langle\sigma\cdot v\rangle < 7 \times 10^{-21}$ cm³/s in LMC for 5 TeV WIMP mass.
- 19 BOUDAUD 17 use data from the spacecraft Voyager 1, beyond the heliopause, and from AMS02 on $\chi\chi \rightarrow e^+e^-$ to require $\langle\sigma\cdot v\rangle < 1. \times 10^{-28}$ cm³/s for $m(\chi) = 10$ MeV.
- 20 AARTSEN 16D search for GeV νs from WIMP annihilation in galaxy; limits set on $\langle\sigma\cdot v\rangle$ in Fig. 6, 7.
- 21 ABDALLAH 16 require $\langle\sigma\cdot v\rangle < 6 \times 10^{-26}$ cm³/s for $m(\text{WIMP}) = 1.5$ TeV from 254 hours observation (WW channel) and $< 2 \times 10^{-26}$ cm³/s for $m(\text{WIMP}) = 1.0$ TeV in $\tau^+\tau^-$ channel.
- 22 ABDALLAH 16A search for line spectra from WIMP + WIMP $\rightarrow \gamma\gamma$ in 18 hr HESS data; rule out previous 130 GeV WIMP hint from Fermi-LAT data.
- 23 AHNEN 16 require $\langle\sigma\cdot v\rangle < 3 \times 10^{-26}$ cm³/s for $m(\text{WIMP}) = 100$ GeV (WW channel).
- 24 AVRORIN 16 require $\langle\sigma\cdot v\rangle < 1.91 \times 10^{-21}$ cm³/s from WIMP annihilation to νs via WW channel for $m(\text{WIMP}) = 1$ TeV.
- 25 CAPUTO 16 place limits on WIMPs from annihilation to gamma rays in Small Magellanic Cloud using Fermi-LaT data: $\langle\sigma\cdot v\rangle < 3 \times 10^{-26}$ cm³/s for $m(\text{WIMP}) = 10$ GeV.
- 26 FORNASE 16 use anisotropies in the γ -ray diffuse emission detected by Fermi-LAT to bound $\langle\sigma\cdot v\rangle < 10^{-25}$ cm³/s for $m(\text{WIMP}) = 100$ GeV in $b\bar{b}$ channel: see Fig. 28. The limit is driven by dark-matter subhalos in the Milky Way and it refers to their Most Constraining Scenario.
- 27 LEITE 16 constrain WIMP annihilation via search for radio emissions from Smith cloud; $\langle\sigma\cdot v\rangle < 5 \times 10^{-27}$ cm³/s in ee channel for $m(\text{WIMP}) = 5$ GeV.
- 28 LI 16 re-analyze Fermi-LAT data on 8 dwarf spheroidals; set limit $\langle\sigma\cdot v\rangle < 2 \times 10^{-26}$ cm³/s for $m(\text{WIMP}) = 100$ GeV in $b\bar{b}$ mode with substructures included.
- 29 LI 16A constrain $\langle\sigma\cdot v\rangle < 10^{-25}$ cm³/s in $b\bar{b}$ channel for $m(\text{WIMP}) = 100$ GeV using Fermi-LAT data from M31; see Fig. 6.
- 30 LIANG 16 search dwarf spheroidal galaxies, Large Magellanic Cloud, and Small Magellanic Cloud for γ -line in Fermi-LAT data.
- 31 LU 16 re-analyze Fermi-LAT and AMS-02 data; require $\langle\sigma\cdot v\rangle < 10^{-25}$ cm³/s for $m_m(\text{WIMP}) = 1$ TeV in $b\bar{b}$ channel.
- 32 SHIRASAKI 16 re-analyze Fermi-LAT extra-galactic data; require $\langle\sigma\cdot v\rangle < 10^{-23}$ cm³/s for $m(\text{WIMP}) = 1$ TeV in $b\bar{b}$ channel; see Fig. 8.
- 33 AARTSEN 15C search for neutrinos from X^0 annihilation in the Galactic halo. See their Figs. 16 and 17, and Table 5 for limits on $\sigma\cdot v$ for X^0 mass between 100 GeV and 100 TeV.
- 34 AARTSEN 15E search for neutrinos from X^0 annihilation in the Galactic center. See their Figs. 7 and 9, and Table 3 for limits on $\sigma\cdot v$ for X^0 mass between 30 GeV and 10 TeV.
- 35 ABRAMOWSKI 15 search for γ from X^0 annihilation in the Galactic center. See their Fig. 4 for limits on $\sigma\cdot v$ for X^0 mass between 250 GeV and 10 TeV.
- 36 ACKERMANN 15 search for monochromatic γ from X^0 annihilation in the Galactic halo. See their Fig. 8 and Tables 2–4 for limits on $\sigma\cdot v$ for X^0 mass between 0.2 GeV and 500 GeV.

- 37 ACKERMANN 15A search for γ from X^0 annihilation (both Galactic and extragalactic) in the isotropic γ background. See their Fig. 7 for limits on $\sigma \cdot v$ for X^0 mass between 10 GeV and 30 TeV.
- 38 ACKERMANN 15B search for γ from X^0 annihilation in 15 dwarf spheroidal satellite galaxies of the Milky Way. See their Figs. 1 and 2 for limits on $\sigma \cdot v$ for X^0 mass between 2 GeV and 10 TeV.
- 39 ADRIAN-MARTINEZ 15 search for neutrinos from X^0 annihilation in the Galactic center. See their Figs. 10 and 11 and Tables 1 and 2 for limits on $\sigma \cdot v$ for X^0 mass between 25 GeV and 10 TeV.
- 40 ACKERMANN 14 search for γ from X^0 annihilation in 25 dwarf spheroidal satellite galaxies of the Milky Way. See their Tables II–VII for limits assuming annihilation into e^+e^- , $\mu^+\mu^-$, $\tau^+\tau^-$, $u\bar{u}$, $b\bar{b}$, and W^+W^- , for X^0 mass ranging from 2 GeV to 10 TeV.
- 41 Limit assuming X^0 pair annihilation into $b\bar{b}$.
- 42 Limit assuming X^0 pair annihilation into W^+W^- .
- 43 ALEKSIC 14 search for γ from X^0 annihilation in the dwarf spheroidal galaxy Segue 1. The listed limit assumes annihilation into W^+W^- . See their Figs. 6, 7, and 16 for limits on $\sigma \cdot v$ for annihilation channels $\mu^+\mu^-$, $\tau^+\tau^-$, $b\bar{b}$, $t\bar{t}$, $\gamma\gamma$, γZ , W^+W^- , ZZ for X^0 mass between 10^2 and 10^4 GeV.
- 44 AARTSEN 13C search for neutrinos from X^0 annihilation in nearby galaxies and galaxy clusters. See their Figs. 5–7 for limits on $\sigma \cdot v$ for $X^0 X^0 \rightarrow \nu\bar{\nu}$, $\mu^+\mu^-$, $\tau^+\tau^-$, and W^+W^- for X^0 mass between 300 GeV and 100 TeV.
- 45 ABRAMOWSKI 13 search for monochromatic γ from X^0 annihilation in the Milky Way halo in the central region. Limit on $\sigma \cdot v$ between 10^{-28} and 10^{-25} $\text{cm}^3 \text{s}^{-1}$ (95% CL) is obtained for X^0 mass between 500 GeV and 20 TeV for $X^0 X^0 \rightarrow \gamma\gamma$. X^0 density distribution in the Galaxy by Einasto is assumed. See their Fig. 4.
- 46 ACKERMANN 13A search for monochromatic γ from X^0 annihilation in the Milky Way. Limit on $\sigma \cdot v$ for the process $X^0 X^0 \rightarrow \gamma\gamma$ in the range 10^{-29} – 10^{-27} $\text{cm}^3 \text{s}^{-1}$ (95% CL) is obtained for X^0 mass between 5 and 300 GeV. The limit depends slightly on the assumed density profile of X^0 in the Galaxy. See their Tables VII–X and Fig.10. Supersedes ACKERMANN 12.
- 47 ABRAMOWSKI 12 search for γ 's from X^0 annihilation in the Fornax galaxy cluster. See their Fig. 7 for limits on $\sigma \cdot v$ for X^0 mass between 0.1 and 100 TeV for the annihilation channels $\tau^+\tau^-$, $b\bar{b}$, and W^+W^- .
- 48 ACKERMANN 12 search for monochromatic γ from X^0 annihilation in the Milky Way. Limit on $\sigma \cdot v$ in the range 10^{-28} – 10^{-26} $\text{cm}^3 \text{s}^{-1}$ (95% CL) is obtained for X^0 mass between 7 and 200 GeV if X^0 annihilates into $\gamma\gamma$. The limit depends slightly on the assumed density profile of X^0 in the Galaxy. See their Table III and Fig. 15.
- 49 ACKERMANN 12 search for γ from X^0 annihilation in the Milky Way in the diffuse γ background. Limit on $\sigma \cdot v$ of 10^{-24} $\text{cm}^3 \text{s}^{-1}$ or larger is obtained for X^0 mass between 5 GeV and 10 TeV for various annihilation channels including W^+W^- , $b\bar{b}$, gg , e^+e^- , $\mu^+\mu^-$, $\tau^+\tau^-$. The limit depends slightly on the assumed density profile of X^0 in the Galaxy. See their Figs. 17–20.
- 50 ALIU 12 search for γ 's from X^0 annihilation in the dwarf spheroidal galaxy Segue 1. Limit on $\sigma \cdot v$ in the range 10^{-24} – 10^{-20} $\text{cm}^3 \text{s}^{-1}$ (95% CL) is obtained for X^0 mass between 10 GeV and 2 TeV for annihilation channels e^+e^- , $\mu^+\mu^-$, $\tau^+\tau^-$, $b\bar{b}$, and W^+W^- . See their Fig. 3.
- 51 ABBASI 11C search for ν_μ from X^0 annihilation in the outer halo of the Milky Way. The limit assumes annihilation into $\nu\nu$. See their Fig. 9 for limits with other annihilation channels.
- 52 ABRAMOWSKI 11 search for γ from X^0 annihilation near the Galactic center. The limit assumes Einasto DM density profile.

⁵³ ACKERMANN 11 search for γ from X^0 annihilation in ten dwarf spheroidal satellite galaxies of the Milky Way. The limit for $m = 10$ GeV assumes annihilation into $b\bar{b}$, the others W^+W^- . See their Fig. 2 for limits with other final states. See also GERINGER-SAMETH 11 for a different analysis of the same data.

Dark Matter Particle (X^0) Production in Hadron Collisions

Searches for X^0 production in association with observable particles (γ , jets, ...) in high energy hadron collisions. If a specific form of effective interaction Lagrangian is assumed, the limits may be translated into limits on X^0 -nucleon scattering cross section.

VALUE	DOCUMENT ID	TECN	COMMENT
• • •	We do not use the following data for averages, fits, limits, etc. • • •		
1	AABOUD	19AA ATLS	multi-channel BSM search
2	AABOUD	19AI ATLS	$H \rightarrow \chi\chi$
3	AABOUD	19AL ATLS	$H \rightarrow \chi\chi$
4	AABOUD	19Q ATLS	single $t + \cancel{E}_T$
5	AABOUD	19V ATLS	review mediator based DM searches
6	BANERJEE	19 NA64	$eN \rightarrow eN + \cancel{E}$
7	SIRUNYAN	19AN CMS	$H\chi\chi \rightarrow b\bar{b} \cancel{E}_T$
8	SIRUNYAN	19BC CMS	$LQ LQ \rightarrow \mu j \cancel{E}_T$
9	SIRUNYAN	19BO CMS	$VV \rightarrow Hqq; H \rightarrow DM$
10	SIRUNYAN	19C CMS	$pp \rightarrow t\bar{t}\chi\chi$
11	SIRUNYAN	19O CMS	$pp \rightarrow \gamma \cancel{E}_T$
12	SIRUNYAN	19X CMS	$pp \rightarrow t\bar{t} + \cancel{p}'_T; pp \rightarrow t(\bar{t}) + \cancel{p}'_T$
13	AABOUD	18 ATLS	$pp \rightarrow Z\chi\chi; Z \rightarrow \ell\ell$
14	AABOUD	18A ATLS	$pp \rightarrow t\bar{t} \cancel{E}_T; pp \rightarrow b\bar{b} \cancel{E}_T$
15	AABOUD	18CA ATLS	$pp \rightarrow V\chi\chi; V \rightarrow jj$
16	AABOUD	18I ATLS	$pp \rightarrow \text{jet}(s) + \cancel{E}_T$
17	AGUILAR-AR...	18B MBNE	$pN \rightarrow \chi\chi, \chi = e, \pi, \text{ or } N$
18	KHACHATRY...	18 CMS	$pp \rightarrow Z(\ell\ell) + \cancel{E}_T$
19	SIRUNYAN	18BF CMS	$pp \rightarrow t \cancel{E}_T$
20	SIRUNYAN	18BO CMS	dijet resonance search
21	SIRUNYAN	18BV CMS	$pp \rightarrow Z \cancel{E}_T$
22	SIRUNYAN	18C CMS	$pp \rightarrow t\bar{t} \cancel{E}_T$
23	SIRUNYAN	18CU CMS	$pp \rightarrow Z \cancel{E}_T$
24	SIRUNYAN	18DH CMS	$pp \rightarrow \chi\chi h; h \rightarrow \gamma\gamma \text{ or } \tau\bar{\tau}$
25	SIRUNYAN	18S CMS	$pp \rightarrow \text{jets} \cancel{E}_T$
26	AABOUD	17A ATLS	$pp (H \rightarrow b\bar{b} + \text{WIMP pair})$
27	AABOUD	17AM ATLS	$pp \rightarrow Z' \rightarrow Ah \rightarrow h(b\bar{b}) + \cancel{E}_T$
28	AABOUD	17AQ ATLS	$pp \rightarrow h(\gamma\gamma) + \cancel{E}_T$
29	AABOUD	17BD ATLS	$pp \rightarrow \text{jet}(s) + \cancel{E}_T$
30	AABOUD	17R ATLS	$pp \rightarrow \gamma \cancel{E}_T$
31	AGUILAR-AR...	17A MBNE	$pN \rightarrow \chi\chi X; \chi N \rightarrow \chi N$
32	BANERJEE	17 NA64	$eN \rightarrow eN\gamma'$
33	KHACHATRY...	17A CMS	forward jets + \cancel{E}_T
34	KHACHATRY...	17F CMS	$H \rightarrow \text{invisibles}$
35	SIRUNYAN	17 CMS	$Z + \cancel{E}_T$
36	SIRUNYAN	17AP CMS	$pp \rightarrow Z' \rightarrow Ah \rightarrow h + \text{MET}$
37	SIRUNYAN	17AQ CMS	$pp \rightarrow \gamma + \text{MET}$

38	SIRUNYAN	17BB	CMS	$pp \rightarrow t\bar{t} + \cancel{E}_T; pp \rightarrow b\bar{b} + \cancel{E}_T$
39	SIRUNYAN	17G	CMS	$pp \rightarrow j + \cancel{E}_T$
40	SIRUNYAN	17U	CMS	$pp \rightarrow Z\chi\chi; Z \rightarrow \ell\bar{\ell}$
41	AABOUD	16AD	ATLS	$(W \text{ or } Z \rightarrow \text{jets}) + \cancel{E}_T$
42	AAD	16AF	ATLS	$VV \rightarrow \text{forward jets} + \cancel{E}_T$
43	AAD	16AG	ATLS	$\ell + \text{jets}$
44	AAD	16M	ATLS	$pp \rightarrow H + \cancel{E}_T, H \rightarrow b\bar{b}$
45	KHACHATRY...16BZ	CMS		$\text{jet(s)} + \cancel{E}_T$
46	KHACHATRY...16CA	CMS		$\text{jets} + \cancel{E}_T$
47	KHACHATRY...16N	CMS		$pp \rightarrow \gamma + \cancel{E}_T$
48	AAD	15AS	ATLS	$b(\bar{b}) + \cancel{E}_T, t\bar{t} + \cancel{E}_T$
49	AAD	15BH	ATLS	$\text{jet} + \cancel{E}_T$
50	AAD	15CF	ATLS	$H^0 + \cancel{E}_T$
51	AAD	15CS	ATLS	$\gamma + \cancel{E}_T$
52	KHACHATRY...15AG	CMS		$t\bar{t} + \cancel{E}_T$
53	KHACHATRY...15AL	CMS		$\text{jet} + \cancel{E}_T$
54	KHACHATRY...15T	CMS		$\ell + \cancel{E}_T$
55	AAD	14AI	ATLS	$W + \cancel{E}_T$
56	AAD	14BK	ATLS	$W, Z + \cancel{E}_T$
57	AAD	14K	ATLS	$Z + \cancel{E}_T$
58	AAD	14O	ATLS	$Z + \cancel{E}_T$
59	AAD	13AD	ATLS	$\text{jet} + \cancel{E}_T$
60	AAD	13C	ATLS	$\gamma + \cancel{E}_T$
61	AALTONEN	12K	CDF	$t + \cancel{E}_T$
62	AALTONEN	12M	CDF	$\text{jet} + \cancel{E}_T$
63	CHATRCHYAN	12AP	CMS	$\text{jet} + \cancel{E}_T$
64	CHATRCHYAN	12T	CMS	$\gamma + \cancel{E}_T$

- ¹ AABOUD 19AA searches for BSM physics in more than 700 event classes with more than 10^5 regions at 13 TeV with 3.2 fb^{-1} ; no significant signal.
- ² AABOUD 19AI searches for vector boson fusion $pp \rightarrow Hqq, H \rightarrow \text{invisible}$ at 13 TeV with 36.1 fb^{-1} ; no signal: require $B(H \rightarrow \text{invisible}) < 0.37$ (0.28 expected).
- ³ AABOUD 19AL perform search in three different channels for $H \rightarrow \chi\chi$ at 7, 8 and 13 TeV; combined result $BF(H \rightarrow \text{invisible}) < 0.26$ (0.17 expected).
- ⁴ AABOUD 19Q search for single $t + \cancel{E}_T$ at 13 TeV with 36.1 fb^{-1} of data; no signal; limits set in σ or coupling vs. mass plane for simplified models.
- ⁵ AABOUD 19V review ATLAS results from 7, 8 and 13 TeV searches for mediator-based DM and DE scalar which couples to gravity; no signal: limits set for large variety of simplified models.
- ⁶ BANERJEE 19 search for dark photon via $eN \rightarrow eN + \cancel{E}$ in NA64; no signal, limits placed in kinetic mixing ϵ vs. $m(\text{DM})$ plane for $m(\text{DM}) \sim 0.001\text{--}1 \text{ GeV}$.
- ⁷ SIRUNYAN 19AN search at 13 TeV with 35.9 fb^{-1} for $pp \rightarrow H\chi\chi \rightarrow b\bar{b} \cancel{E}_T$; no signal: limits set in the context of a 2HDM + pseudoscalar (a) model and a baryonic Z' model.
- ⁸ SIRUNYAN 19BC search for DM via LeptoQuark pair annihilation $LQ LQ \rightarrow \mu j \chi\chi \rightarrow \mu j \cancel{E}_T$ with 77.4 fb^{-1} , 13 TeV; no signal: limits placed in $m(\chi)$ vs. $m(\text{LQ})$ plane. Model dependent limits on DM mass up to 600 GeV depending on $m(\text{LQ})$ placed.
- ⁹ SIRUNYAN 19BO search for vector boson fusion $VV \rightarrow qqH$ with $H \rightarrow \chi\chi$ at 13 TeV with 38.2 fb^{-1} ; no signal: limits placed for several models. Also search for $H \rightarrow \text{invisible}$ at 7, 8, and 13 TeV; no signal: limit placed on $BF < 0.19$.
- ¹⁰ SIRUNYAN 19C search for DM via $pp \rightarrow t\bar{t}\chi\chi$ at 13 TeV, 35.9 fb^{-1} ; no signal; limits placed on coupling vs. mediator mass for various simplified models.

- 11 SIRUNYAN 190 search for $pp \rightarrow \gamma$ at 13 TeV with 35.9 fb^{-1} ; no signal: limits placed on parameters of various models.
- 12 SIRUNYAN 19X search for $pp \rightarrow t\bar{t} \cancel{E}_T$ and $pp \rightarrow t \cancel{E}_T + \dots$ at 13 TeV with 35.9 fb^{-1} ; no signal: limits placed on χ production σ for various simplified models with $m(\chi) = 1 \text{ GeV}$.
- 13 AABOUD 18 search for $pp \rightarrow Z + \cancel{E}_T$ with $Z \rightarrow \ell\ell$ at 13 TeV with 36.1 fb^{-1} of data. Limits set for simplified models.
- 14 AABOUD 18A search for $pp \rightarrow t\bar{t} \cancel{E}_T$ or $pp \rightarrow b\bar{b} \cancel{E}_T$ at 13 TeV, 36.1 fb^{-1} of data. Limits set for simplified models.
- 15 AABOUD 18CA search for $pp \rightarrow V\chi\chi$ with $V \rightarrow jj$ at 13 TeV, 36.1 fb^{-1} ; no signal; limits set in $m(\text{DM})$ vs $m(\text{mediator})$ simplified model plane.
- 16 AABOUD 18I search for $pp \rightarrow j + \cancel{E}_T$ at 13 TeV with 36.1 fb^{-1} of data. Limits set for simplified models with pair-produced weakly interacting dark-matter candidates.
- 17 AGUILAR-AREVALO 18B search for WIMP production in MiniBooNE p beam dump; no signal; limits set for $m(\chi) \sim 5\text{--}50 \text{ MeV}$ in vector portal DM model.
- 18 KHACHATRYAN 18 search for $pp \rightarrow Z(\ell\ell) + \cancel{E}_T$; no signal; limits set on effective dark matter interactions and other exotic physics models.
- 19 SIRUNYAN 18BF search for $pp \rightarrow t \cancel{E}_T$ at 13 TeV and 36 fb^{-1} ; no signal; limits placed on DM models involving a flavor changing neutral current, scalar resonance decaying to top quark and DM.
- 20 SIRUNYAN 18BO search for high mass dijet resonances at 13 TeV and 36 fb^{-1} ; no signal: limits placed on various models, including simplified DM models involving a spin $= 1$ Z' mediator.
- 21 SIRUNYAN 18BV search for $pp \rightarrow Z \cancel{E}_T$ at 13 TeV; no signal, limits placed for various exotic physics models including DM.
- 22 SIRUNYAN 18C search for new physics in $pp \rightarrow$ final states with two oppositely charged leptons at 13 TeV with 35.9 fb^{-1} . Limits placed on $m(\text{mediator})$ and top squark for various simplified models.
- 23 SIRUNYAN 18CU search for $pp \rightarrow Z \cancel{E}_T$ at 13 TeV and 2.3 fb^{-1} ; no signal: limits placed for various exotic models including DM.
- 24 SIRUNYAN 18DH search for $pp \rightarrow \chi\chi h$; $h \rightarrow \gamma\gamma$ or $\tau\bar{\tau}$ at 13 TeV, 35.9 fb^{-1} ; no signal; limits placed on massive boson mediator Z' in the context of $Z'+2\text{HDM}$ and baryonic Z' models. Limits also cast in terms of spin-independent WIMP-nucleon cross section for masses 1–200 GeV.
- 25 SIRUNYAN 18S search for $pp \rightarrow$ jets \cancel{E}_T at 13 TeV; no signal: limits placed on simplified dark matter models, on the branching ratio of the Higgs boson to invisible particles, and on several other exotic physics models including fermion portal DM.
- 26 AABOUD 17A search for $H \rightarrow b\bar{b} + \cancel{E}_T$. See Fig. 4b for limits set on VB mediator vs WIMP mass.
- 27 AABOUD 17AM search for $pp \rightarrow Z' \rightarrow Ah \rightarrow h(b\bar{b}) + \cancel{E}_T$ at 13 TeV. Limits set in $m(Z')$ vs. $m(A)$ plane and on the visible cross section of $h(b\bar{b}) + \cancel{E}_T$ events in bins of \cancel{E}_T .
- 28 AABOUD 17AQ search for WIMP in $pp \rightarrow h(\gamma\gamma) + \cancel{E}_T$ in 36.1 fb^{-1} of data. Limits on the visible cross section are also provided. Model dependent limits on spin independent DM - Nucleon cross-section are also presented, which are more stringent than those from direct searches for DM mass smaller than 2.5 GeV.
- 29 AABOUD 17BD search for $pp \rightarrow \text{jet}(s) + \cancel{E}_T$ at 13 TeV with 3.2 fb^{-1} of data. Limits set for simplified models. Observables corrected for detector effects can be used to constrain other models.
- 30 AABOUD 17R, for an axial vector mediator in the s-channel, excludes $m(\text{mediator}) < 750\text{--}1200 \text{ GeV}$ for $m(\text{DM}) < 230\text{--}480 \text{ GeV}$, depending on the couplings.
- 31 AGUILAR-AREVALO 17A search for DM produced in 8 GeV proton collisions with steel beam dump followed by DM-nucleon scattering in MiniBooNE detector. Limit placed on DM cross section parameter $Y < 2 \times 10^{-8}$ for $\alpha_D = 0.5$ and for $0.01 < m(\text{DM}) < 0.3 \text{ GeV}$.

- 32 BANERJEE 17 search for dark photon invisible decay via eN scattering; exclude $m(\gamma')$ < 100 MeV as an explanation of $(g_\mu - 2)$ muon anomaly.
- 33 KHACHATRYAN 17A search for WIMPs in forward jets + \cancel{E}_T channel with 18.5 fb^{-1} at 8 TeV; limits set in effective theory model, Fig. 3.
- 34 KHACHATRYAN 17F search for $H \rightarrow$ invisibles in pp collisions at 7, 8, and 13 TeV; place limits on Higgs portal DM.
- 35 SIRUNYAN 17 search for $pp \rightarrow Z + \cancel{E}_T$ with 2.3 fb^{-1} at 13 TeV; no signal seen; limits placed on WIMPs and unparticles.
- 36 SIRUNYAN 17AP search for $pp \rightarrow Z' \rightarrow Ah \rightarrow h + \text{MET}$ with $h \rightarrow b\bar{b}$ or $\gamma\gamma$ and $A \rightarrow \chi\chi$ with 2.3 fb^{-1} at 13 TeV. Limits set in $m(Z')$ vs. $m(A)$ plane.
- 37 SIRUNYAN 17AQ search for $pp \rightarrow \gamma + \text{MET}$ at 13 TeV with 12.9 fb^{-1} . Limits derived for simplified DM models, effective electroweak-DM interaction and Extra Dimensions models.
- 38 SIRUNYAN 17BB search for WIMPs via $pp \rightarrow t\bar{t} + \cancel{E}_T$, $pp \rightarrow b\bar{b} + \cancel{E}_T$ at 13 TeV with 2.2 fb^{-1} . Limits derived for various simplified models.
- 39 SIRUNYAN 17G search for $pp \rightarrow j + \cancel{E}_T$ with 12.9 fb^{-1} at 13 TeV; limits placed on WIMP mass/mediators in DM simplified models.
- 40 SIRUNYAN 17U search for WIMPs/unparticles via $pp \rightarrow Z\chi\chi$, $Z \rightarrow \ell\bar{\ell}$ at 13 TeV with 2.3 fb^{-1} . Limits derived for various simplified models.
- 41 AABOUD 16AD place limits on $VVXX$ effective theory via search for hadronic W or Z plus WIMP pair production. See Fig. 5.
- 42 AAD 16AF search for $VV \rightarrow (H \rightarrow \text{WIMP pair}) +$ forward jets with 20.3 fb^{-1} at 8 TeV; set limits in Higgs portal model, Fig. 8.
- 43 AAD 16AG search for lepton jets with 20.3 fb^{-1} of data at 8 TeV; Fig. 13 excludes dark photons around 0.1–1 GeV for kinetic mixing 10^{-6} – 10^{-2} .
- 44 AAD 16M search with 20.3 fb^{-1} of data at 8 TeV pp collisions; limits placed on EFT model (Fig. 7) and simplified Z' model (Fig. 6).
- 45 KHACHATRYAN 16BZ search for jet(s) + \cancel{E}_T in 19.7 fb^{-1} at 8 TeV; limits set for variety of simplified models.
- 46 KHACHATRYAN 16CA search for WIMPs via jet(s) + \cancel{E}_T using razor variable; require mediator scale > 1 TeV for various effective theories.
- 47 KHACHATRYAN 16N search for $\gamma +$ WIMPs in 19.6 fb^{-1} at 8 TeV; limits set on SI and SD WIMP- p scattering in Fig. 3.
- 48 AAD 15AS search for events with one or more bottom quark and missing E_T , and also events with a top quark pair and missing E_T in pp collisions at $E_{\text{cm}} = 8 \text{ TeV}$ with $L = 20.3 \text{ fb}^{-1}$. See their Figs. 5 and 6 for translated limits on X^0 -nucleon cross section for $m = 1$ –700 GeV.
- 49 AAD 15BH search for events with a jet and missing E_T in pp collisions at $E_{\text{cm}} = 8 \text{ TeV}$ with $L = 20.3 \text{ fb}^{-1}$. See their Fig. 12 for translated limits on X^0 -nucleon cross section for $m = 1$ –1200 GeV.
- 50 AAD 15CF search for events with a $H^0 (\rightarrow \gamma\gamma)$ and missing E_T in pp collisions at $E_{\text{cm}} = 8 \text{ TeV}$ with $L = 20.3 \text{ fb}^{-1}$. See paper for limits on the strength of some contact interactions containing X^0 and the Higgs fields.
- 51 AAD 15CS search for events with a photon and missing E_T in pp collisions at $E_{\text{cm}} = 8 \text{ TeV}$ with $L = 20.3 \text{ fb}^{-1}$. See their Fig. 13 (see also erratum) for translated limits on X^0 -nucleon cross section for $m = 1$ –1000 GeV.
- 52 KHACHATRYAN 15AG search for events with a top quark pair and missing E_T in pp collisions at $E_{\text{cm}} = 8 \text{ TeV}$ with $L = 19.7 \text{ fb}^{-1}$. See their Fig. 8 for translated limits on X^0 -nucleon cross section for $m = 1$ –200 GeV.
- 53 KHACHATRYAN 15AL search for events with a jet and missing E_T in pp collisions at $E_{\text{cm}} = 8 \text{ TeV}$ with $L = 19.7 \text{ fb}^{-1}$. See their Fig. 5 and Tables 4–6 for translated limits on X^0 -nucleon cross section for $m = 1$ –1000 GeV.

- 54 KHACHATRYAN 15T search for events with a lepton and missing E_T in pp collisions at $E_{\text{cm}} = 8$ TeV with $L = 19.7 \text{ fb}^{-1}$. See their Fig. 17 for translated limits on X^0 -proton cross section for $m = 1\text{--}1000$ GeV.
- 55 AAD 14AI search for events with a W and missing E_T in pp collisions at $E_{\text{cm}} = 8$ TeV with $L = 20.3 \text{ fb}^{-1}$. See their Fig. 4 for translated limits on X^0 -nucleon cross section for $m = 1\text{--}1500$ GeV.
- 56 AAD 14BK search for hadronically decaying W , Z in association with \cancel{E}_T in 20.3 fb^{-1} at 8 TeV pp collisions. Fig. 5 presents exclusion results for SI and SD scattering cross section. In addition, cross section limits on the anomalous production of W or Z bosons with large missing transverse momentum are also set in two fiducial regions.
- 57 AAD 14K search for events with a Z and missing E_T in pp collisions at $E_{\text{cm}} = 8$ TeV with $L = 20.3 \text{ fb}^{-1}$. See their Fig. 5 and 6 for translated limits on X^0 -nucleon cross section for $m = 1\text{--}10^3$ GeV.
- 58 AAD 14O search for ZH^0 production with H^0 decaying to invisible final states. See their Fig. 4 for translated limits on X^0 -nucleon cross section for $m = 1\text{--}60$ GeV in Higgs-portal X^0 scenario.
- 59 AAD 13AD search for events with a jet and missing E_T in pp collisions at $E_{\text{cm}} = 7$ TeV with $L = 4.7 \text{ fb}^{-1}$. See their Figs. 5 and 6 for translated limits on X^0 -nucleon cross section for $m = 1\text{--}1300$ GeV.
- 60 AAD 13C search for events with a photon and missing E_T in pp collisions at $E_{\text{cm}} = 7$ TeV with $L = 4.6 \text{ fb}^{-1}$. See their Fig. 3 for translated limits on X^0 -nucleon cross section for $m = 1\text{--}1000$ GeV.
- 61 AALTONEN 12K search for events with a top quark and missing E_T in $p\bar{p}$ collisions at $E_{\text{cm}} = 1.96$ TeV with $L = 7.7 \text{ fb}^{-1}$. Upper limits on $\sigma(tX^0)$ in the range 0.4–2 pb (95% CL) is given for $m_{X^0} = 0\text{--}150$ GeV.
- 62 AALTONEN 12M search for events with a jet and missing E_T in $p\bar{p}$ collisions at $E_{\text{cm}} = 1.96$ TeV with $L = 6.7 \text{ fb}^{-1}$. Upper limits on the cross section in the range 2–10 pb (90% CL) is given for $m_{X^0} = 1\text{--}300$ GeV. See their Fig. 2 for translated limits on X^0 -nucleon cross section.
- 63 CHATRCHYAN 12AP search for events with a jet and missing E_T in pp collisions at $E_{\text{cm}} = 7$ TeV with $L = 5.0 \text{ fb}^{-1}$. See their Fig. 4 for translated limits on X^0 -nucleon cross section for $m_{X^0} = 0.1\text{--}1000$ GeV.
- 64 CHATRCHYAN 12T search for events with a photon and missing E_T in pp collisions at $E_{\text{cm}} = 7$ TeV with $L = 5.0 \text{ fb}^{-1}$. Upper limits on the cross section in the range 13–15 fb (90% CL) is given for $m_{X^0} = 1\text{--}1000$ GeV. See their Fig. 2 for translated limits on X^0 -nucleon cross section.

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SIRUNYAN	18S	PR D97 092005	A.M. Sirunyan <i>et al.</i>	(CMS Collab.)
YANG	18	CP C42 023002	L.T. Yang <i>et al.</i>	(CDEX Collab.)
AABOUD	17A	PL B765 11	M. Aaboud <i>et al.</i>	(ATLAS Collab.)
AABOUD	17AM	PRL 119 181804	M. Aaboud <i>et al.</i>	(ATLAS Collab.)
AABOUD	17AQ	PR D96 112004	M. Aaboud <i>et al.</i>	(ATLAS Collab.)
AABOUD	17BD	EPJ C77 765	M. Aaboud <i>et al.</i>	(ATLAS Collab.)
AABOUD	17R	EPJ C77 393	M. Aaboud <i>et al.</i>	(ATLAS Collab.)
AARTSEN	17	EPJ C77 82	M.G. Aartsen <i>et al.</i>	(IceCube Collab.)
AARTSEN	17A	EPJ C77 146	M.G. Aartsen <i>et al.</i>	(IceCube Collab.)
Also		EPJ C79 214 (errat.)	M.G. Aartsen <i>et al.</i>	(IceCube Collab.)
AARTSEN	17C	EPJ C77 627	M.G. Aartsen <i>et al.</i>	(IceCube Collab.)
AGUILAR-AR...	17	PRL 118 141803	A. Aguilar-Arevalo <i>et al.</i>	(DAMIC Collab.)
AGUILAR-AR...	17A	PRL 118 221803	A.A. Aguilar-Arevalo <i>et al.</i>	(MiniBooNE Collab.)
AKERIB	17	PRL 118 021303	D.S. Akerib <i>et al.</i>	(LUX Collab.)
AKERIB	17A	PRL 118 251302	D.S. Akerib <i>et al.</i>	(LUX Collab.)
ALBERT	17A	PL B769 249	A. Albert <i>et al.</i>	(ANTARES Collab.)
Also		PL B796 253 (errat.)	A. Albert <i>et al.</i>	(ANTARES Collab.)
AMOLE	17	PRL 118 251301	C. Amole <i>et al.</i>	(PICO Collab.)
ANGLOHER	17A	EPJ C77 637	G. Angloher <i>et al.</i>	(CRESST Collab.)
APRILE	17	PRL 118 101101	E. Aprile <i>et al.</i>	(XENON100 Collab.)
APRILE	17A	PR D96 022008	E. Aprile <i>et al.</i>	(XENON100 Collab.)
APRILE	17D	PR D96 042004	E. Aprile <i>et al.</i>	(XENON100 Collab.)
APRILE	17G	PRL 119 181301	E. Aprile <i>et al.</i>	(XENON Collab.)
APRILE	17H	PR D96 122002	E. Aprile <i>et al.</i>	(XENON100 Collab.)
APRILE	17K	JCAP 1710 039	E. Aprile <i>et al.</i>	(XENON100 Collab.)
ARCHAMBAU...	17	PR D95 082001	S. Archambault <i>et al.</i>	(VERITAS Collab.)
AVRORIN	17	JETP 125 80	A.D. Avrorin <i>et al.</i>	(BAIKAL Collab.)
BANERJEE	17	PRL 118 011802	D. Banerjee <i>et al.</i>	(NA64 Collab.)
BARBOSA-D...	17	PR D95 032006	E. Barbosa de Souza <i>et al.</i>	(DM17 Collab.)
BATTAT	17	ASP 91 65	J.B.R. Battat <i>et al.</i>	(DRIFT-II Collab.)
BEHNKE	17	ASP 90 85	E. Behnke <i>et al.</i>	(PICASSO Collab.)
BOUDAUD	17	PRL 119 021103	M. Boudaud, J. Lavalle, P. Salati	
CHEN	17E	PR D96 102007	X. Chen <i>et al.</i>	(PandaX-II Collab.)
CUI	17A	PRL 119 181302	X. Cui <i>et al.</i>	(PandaX-II Collab.)
FU	17	PRL 118 071301	C. Fu <i>et al.</i>	(PandaX-II Collab.)
Also		PRL 120 049902 (errat.)	C. Fu <i>et al.</i>	(PandaX-II Collab.)
KHACHATRY...	17A	PRL 118 021802	V. Khachatryan <i>et al.</i>	(CMS Collab.)
KHACHATRY...	17F	JHEP 1702 135	V. Khachatryan <i>et al.</i>	(CMS Collab.)
SIRUNYAN	17	JHEP 1703 061	A.M. Sirunyan <i>et al.</i>	(CMS Collab.)
SIRUNYAN	17AP	JHEP 1710 180	A.M. Sirunyan <i>et al.</i>	(CMS Collab.)
SIRUNYAN	17AQ	JHEP 1710 073	A.M. Sirunyan <i>et al.</i>	(CMS Collab.)
SIRUNYAN	17BB	EPJ C77 845	A.M. Sirunyan <i>et al.</i>	(CMS Collab.)
SIRUNYAN	17G	JHEP 1707 014	A.M. Sirunyan <i>et al.</i>	(CMS Collab.)
SIRUNYAN	17U	JHEP 1709 106	A.M. Sirunyan <i>et al.</i>	(CMS Collab.)
AABOUD	16AD	PL B763 251	M. Aaboud <i>et al.</i>	(ATLAS Collab.)
AABOUD	16D	PR D94 032005	M. Aaboud <i>et al.</i>	(ATLAS Collab.)
AABOUD	16F	JHEP 1606 059	M. Aaboud <i>et al.</i>	(ATLAS Collab.)
AAD	16AF	JHEP 1601 172	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	16AG	JHEP 1602 062	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	16M	PR D93 072007	G. Aad <i>et al.</i>	(ATLAS Collab.)
AARTSEN	16C	JCAP 1604 022	M.G. Aartsen <i>et al.</i>	(IceCube Collab.)
AARTSEN	16D	EPJ C76 531	M.G. Aartsen <i>et al.</i>	(IceCube Collab.)
ABDALLAH	16	PRL 117 111301	H. Abdallah <i>et al.</i>	(H.E.S.S. Collab.)
ABDALLAH	16A	PRL 117 151302	H. Abdallah <i>et al.</i>	(H.E.S.S. Collab.)
ADRIAN-MAR...	16	PL B759 69	S. Adrian-Martinez <i>et al.</i>	(ANTARES Collab.)
ADRIAN-MAR...	16B	JCAP 1605 016	S. Adrian-Martinez <i>et al.</i>	(ANTARES Collab.)
AGNES	16	PR D93 081101	P. Agnes <i>et al.</i>	(DarkSide-50 Collab.)
AGNESE	16	PRL 116 071301	R. Agnese <i>et al.</i>	(SuperCDMS Collab.)
AGUILAR-AR...	16	PR D94 082006	A. Aguilar-Arevalo <i>et al.</i>	(DAMIC Collab.)
AHNEN	16	JCAP 1602 039	M.L. Ahnen <i>et al.</i>	(MAGIC and Fermi-LAT Collab.)
AKERIB	16	PRL 116 161301	D.S. Akerib <i>et al.</i>	(LUX Collab.)
AKERIB	16A	PRL 116 161302	D.S. Akerib <i>et al.</i>	(LUX Collab.)
AMOLE	16	PR D93 052014	C. Amole <i>et al.</i>	(PICO Collab.)
AMOLE	16A	PR D93 061101	C. Amole <i>et al.</i>	(PICO Collab.)
ANGLOHER	16	EPJ C76 25	G. Angloher <i>et al.</i>	(CRESST-II Collab.)
ANGLOHER	16A	PRL 117 021303	G. Angloher <i>et al.</i>	(CRESST-II Collab.)
APRILE	16	PR D94 092001	E. Aprile <i>et al.</i>	(XENON100 Collab.)
APRILE	16B	PR D94 122001	E. Aprile <i>et al.</i>	(XENON100 Collab.)
ARMENGAUD	16	JCAP 1605 019	E. Armengaud <i>et al.</i>	(EDELWEISS-III Collab.)

AVRORIN	16	ASP 81 12	A.D. Avrorin <i>et al.</i>	(BAIKAL Collab.)
CAPUTO	16	PR D93 062004	R. Caputo <i>et al.</i>	
FORNASA	16	PR D94 123005	M. Fornasa <i>et al.</i>	(Fermi-LAT Collab.)
HEHN	16	EPJ C76 548	L. Hehn <i>et al.</i>	(EDELWEISS-III Collab.)
KHACHATRY...	16AJ	PR D93 052011	V. Khachatryan <i>et al.</i>	(CMS Collab.)
KHACHATRY...	16BZ	JHEP 1612 083	V. Khachatryan <i>et al.</i>	(CMS Collab.)
Also		JHEP 1708 035 (errat.)	V. Khachatryan <i>et al.</i>	(CMS Collab.)
KHACHATRY...	16CA	JHEP 1612 088	V. Khachatryan <i>et al.</i>	(CMS Collab.)
KHACHATRY...	16N	PL B755 102	V. Khachatryan <i>et al.</i>	(CMS Collab.)
LEITE	16	JCAP 1611 021	N. Leite <i>et al.</i>	
LI	16	PR D93 043518	S. Li <i>et al.</i>	
LI	16A	JCAP 1612 028	Z. Li <i>et al.</i>	
LIANG	16	PR D94 103502	Y.-F. Liang <i>et al.</i>	
LU	16	PR D93 103517	B.-Q. Lu, H.-S. Zong	
SHIRASAKI	16	PR D94 063522	M. Shirasaki <i>et al.</i>	
TAN	16	PR D93 122009	T.H. Tan <i>et al.</i>	(PandaX Collab.)
TAN	16B	PRL 117 121303	A. Tan <i>et al.</i>	(PandaX Collab.)
ZHAO	16	PR D93 092003	W. Zhao <i>et al.</i>	(CDEX Collab.)
AAD	15AS	EPJ C75 92	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	15BH	EPJ C75 299	G. Aad <i>et al.</i>	(ATLAS Collab.)
Also		EPJ C75 408 (errat.)	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	15CF	PRL 115 131801	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	15CS	PR D91 012008	G. Aad <i>et al.</i>	(ATLAS Collab.)
Also		PR D92 059903 (errat.)	G. Aad <i>et al.</i>	(ATLAS Collab.)
AARTSEN	15C	EPJ C75 20	M.G. Aartsen <i>et al.</i>	(IceCube Collab.)
AARTSEN	15E	EPJ C75 492	M.G. Aartsen <i>et al.</i>	(IceCube Collab.)
ABRAMOWSKI	15	PRL 114 081301	A. Abramowski <i>et al.</i>	(H.E.S.S. Collab.)
ACKERMANN	15	PR D91 122002	M. Ackermann <i>et al.</i>	(Fermi-LAT Collab.)
ACKERMANN	15A	JCAP 1509 008	M. Ackermann <i>et al.</i>	(Fermi-LAT Collab.)
ACKERMANN	15B	PRL 115 231301	M. Ackermann <i>et al.</i>	(Fermi-LAT Collab.)
ADRIAN-MAR...	15	JCAP 1510 068	S. Adrian-Martinez <i>et al.</i>	(ANTARES Collab.)
AGNES	15	PL B743 456	P. Agnes <i>et al.</i>	(DarkSide-50 Collab.)
AGNESE	15A	PR D91 052021	R. Agnese <i>et al.</i>	(SuperCDMS Collab.)
AGNESE	15B	PR D92 072003	R. Agnese <i>et al.</i>	(SuperCDMS Collab.)
AMOLE	15	PRL 114 231302	C. Amole <i>et al.</i>	(PICO Collab.)
APRILE	15	PRL 115 091302	E. Aprile <i>et al.</i>	(XENON Collab.)
APRILE	15A	SCI 349 851	E. Aprile <i>et al.</i>	(XENON Collab.)
CHOI	15	PRL 114 141301	K. Choi <i>et al.</i>	(Super-Kamiokande Collab.)
KHACHATRY...	15AG	JHEP 1506 121	V. Khachatryan <i>et al.</i>	(CMS Collab.)
KHACHATRY...	15AL	EPJ C75 235	V. Khachatryan <i>et al.</i>	(CMS Collab.)
KHACHATRY...	15T	PR D91 092005	V. Khachatryan <i>et al.</i>	(CMS Collab.)
NAKAMURA	15	PTEP 2015 4 043F01	K. Nakamura <i>et al.</i>	(NEWAGE Collab.)
XIAO	15	PR D92 052004	X. Xiao <i>et al.</i>	(PandaX Collab.)
AAD	14AI	JHEP 1409 037	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	14BK	PRL 112 041802	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	14K	PR D90 012004	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	14O	PRL 112 201802	G. Aad <i>et al.</i>	(ATLAS Collab.)
ACKERMANN	14	PR D89 042001	M. Ackermann <i>et al.</i>	(Fermi-LAT Collab.)
AGNESE	14	PRL 112 241302	R. Agnese <i>et al.</i>	(SuperCDMS Collab.)
AGNESE	14A	PRL 112 041302	R. Agnese <i>et al.</i>	(SuperCDMS Collab.)
AKERIB	14	PRL 112 091303	D.S. Akerib <i>et al.</i>	(LUX Collab.)
ALEKSIC	14	JCAP 1402 008	J. Aleksic <i>et al.</i>	(MAGIC Collab.)
ANGLOHER	14	EPJ C74 3184	G. Angloher <i>et al.</i>	(CRESST-II Collab.)
APRILE	14A	ASP 54 11	E. Aprile <i>et al.</i>	(XENON100 Collab.)
AVRORIN	14	ASP 62 12	A.D. Avrorin <i>et al.</i>	(BAIKAL Collab.)
FELIZARDO	14	PR D89 072013	M. Felizardo <i>et al.</i>	(SIMPLE Collab.)
LEE	14A	PR D90 052006	H.S. Lee <i>et al.</i>	(KIMS Collab.)
LIU	14A	PR D90 032003	S.K. Liu <i>et al.</i>	(CDEX Collab.)
UCHIDA	14	PTEP 2014 063C01	H. Uchida <i>et al.</i>	(XMASS Collab.)
YUE	14	PR D90 091701	Q. Yue <i>et al.</i>	(CDEX Collab.)
AAD	13AD	JHEP 1304 075	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	13C	PRL 110 011802	G. Aad <i>et al.</i>	(ATLAS Collab.)
AALSETH	13	PR D88 012002	C.E. Aalseth <i>et al.</i>	(CoGeNT Collab.)
AARTSEN	13	PRL 110 131302	M.G. Aartsen <i>et al.</i>	(IceCube Collab.)
AARTSEN	13C	PR D88 122001	M.G. Aartsen <i>et al.</i>	(IceCube Collab.)
ABE	13B	PL B719 78	K. Abe <i>et al.</i>	(XMASS Collab.)
ABRAMOWSKI	13	PRL 110 041301	A. Abramowski <i>et al.</i>	(H.E.S.S. Collab.)
ACKERMANN	13A	PR D88 082002	M. Ackermann <i>et al.</i>	(Fermi-LAT Collab.)
ADRIAN-MAR...	13	JCAP 1311 032	S. Adrian-Martinez <i>et al.</i>	(ANTARES Collab.)
AGNESE	13	PR D88 031104	R. Agnese <i>et al.</i>	(CDMS Collab.)
AGNESE	13A	PRL 111 251301	R. Agnese <i>et al.</i>	(CDMS Collab.)

APRILE	13	PRL 111 021301	E. Aprile <i>et al.</i>	(XENON100 Collab.)
BERNABEI	13A	EPJ C73 2648	R. Bernabei <i>et al.</i>	(DAMA Collab.)
BOLIEV	13	JCAP 1309 019	M. Boliev <i>et al.</i>	
LI	13B	PRL 110 261301	H.B. Li <i>et al.</i>	(TEXONO Collab.)
SUVOROVA	13	PAN 76 1367	O.V. Suvorova <i>et al.</i>	(INRM)
ZHAO	13	PR D88 052004	W. Zhao <i>et al.</i>	(CDEX Collab.)
AALTONEN	12K	PRL 108 201802	T. Aaltonen <i>et al.</i>	(CDF Collab.)
AALTONEN	12M	PRL 108 211804	T. Aaltonen <i>et al.</i>	(CDF Collab.)
ABBASI	12	PR D85 042002	R. Abbasi <i>et al.</i>	(IceCube Collab.)
ABRAMOWSKI	12	APJ 750 123	A. Abramowski <i>et al.</i>	(H.E.S.S. Collab.)
ACKERMANN	12	PR D86 022002	M. Ackermann <i>et al.</i>	(Fermi-LAT Collab.)
AKIMOV	12	PL B709 14	D.Yu. Akimov <i>et al.</i>	(ZEPLIN-III Collab.)
ALIU	12	PR D85 062001	E. Aliu <i>et al.</i>	(VERITAS Collab.)
ANGLOHER	12	EPJ C72 1971	G. Angloher <i>et al.</i>	(CRESST-II Collab.)
APRILE	12	PRL 109 181301	E. Aprile <i>et al.</i>	(XENON100 Collab.)
ARCHAMBAU...	12	PL B711 153	S. Archambault <i>et al.</i>	(PICASSO Collab.)
ARMENGAUD	12	PR D86 051701	E. Armengaud <i>et al.</i>	(EDELWEISS Collab.)
BARRETO	12	PL B711 264	J. Barreto <i>et al.</i>	(DAMIC Collab.)
BEHNKE	12	PR D86 052001	E. Behnke <i>et al.</i>	(COUPP Collab.)
Also		PR D90 079902 (errat.)	E. Behnke <i>et al.</i>	(COUPP Collab.)
BROWN	12	PR D85 021301	A. Brown <i>et al.</i>	(OXF)
CHATRCHYAN	12AP	JHEP 1209 094	S. Chatrchyan <i>et al.</i>	(CMS Collab.)
CHATRCHYAN	12T	PRL 108 261803	S. Chatrchyan <i>et al.</i>	(CMS Collab.)
DAHL	12	PRL 108 259001	C.E. Dahl, J. Hall, W.H. Lippincott	(CHIC, FNAL)
DAW	12	ASP 35 397	E. Daw <i>et al.</i>	(DRIFT-II-d Collab.)
FELIZARDO	12	PRL 108 201302	M. Felizardo <i>et al.</i>	(SIMPLE Collab.)
KIM	12	PRL 108 181301	S.C. Kim <i>et al.</i>	(KIMS Collab.)
AALSETH	11	PRL 106 131301	C.E. Aalseth <i>et al.</i>	(CoGeNT Collab.)
AALSETH	11A	PRL 107 141301	C.E. Aalseth <i>et al.</i>	(CoGeNT Collab.)
ABBASI	11C	PR D84 022004	R. Abbasi <i>et al.</i>	(IceCube Collab.)
ABRAMOWSKI	11	PRL 106 161301	A. Abramowski <i>et al.</i>	(H.E.S.S. Collab.)
ACKERMANN	11	PRL 107 241302	M. Ackermann <i>et al.</i>	(Fermi-LAT Collab.)
AHLEN	11	PL B695 124	S. Ahlen <i>et al.</i>	(DMTPC Collab.)
AHMED	11	PR D83 112002	Z. Ahmed <i>et al.</i>	(CDMS Collab.)
AHMED	11A	PR D84 011102	Z. Ahmed <i>et al.</i>	(CDMS and EDELWEISS Collabs.)
AHMED	11B	PRL 106 131302	Z. Ahmed <i>et al.</i>	(CDMS Collab.)
AJELLO	11	PR D84 032007	M. Ajello <i>et al.</i>	(Fermi-LAT Collab.)
ANGLE	11	PRL 107 051301	J. Angle <i>et al.</i>	(XENON10 Collab.)
Also		PRL 110 249901 (errat.)	J. Angle <i>et al.</i>	(XENON10 Collab.)
APRILE	11	PR D84 052003	E. Aprile <i>et al.</i>	(XENON100 Collab.)
APRILE	11A	PR D84 061101	E. Aprile <i>et al.</i>	(XENON100 Collab.)
APRILE	11B	PRL 107 131302	E. Aprile <i>et al.</i>	(XENON100 Collab.)
ARMENGAUD	11	PL B702 329	E. Armengaud <i>et al.</i>	(EDELWEISS-II Collab.)
BEHNKE	11	PRL 106 021303	E. Behnke <i>et al.</i>	(COUPP Collab.)
GERINGER-SA...	11	PRL 107 241303	A. Geringer-Sameth, S.M. Koushiappas	
HORN	11	PL B705 471	M. Horn <i>et al.</i>	(ZEPLIN-III Collab.)
TANAKA	11	APJ 742 78	T. Tanaka <i>et al.</i>	(Super-Kamiokande Collab.)
ABBASI	10	PR D81 057101	R. Abbasi <i>et al.</i>	(IceCube Collab.)
AHMED	10	SCI 327 1619	Z. Ahmed <i>et al.</i>	(CDMS II Collab.)
AKERIB	10	PR D82 122004	D.S. Akerib <i>et al.</i>	(CDMS II Collab.)
AKIMOV	10	PL B692 180	D.Yu. Akimov <i>et al.</i>	(ZEPLIN-III Collab.)
APRILE	10	PRL 105 131302	E. Aprile <i>et al.</i>	(XENON100 Collab.)
ARMENGAUD	10	PL B687 294	E. Armengaud <i>et al.</i>	(EDELWEISS-II Collab.)
FELIZARDO	10	PRL 105 211301	M. Felizardo <i>et al.</i>	(The SIMPLE Collab.)
MIUCHI	10	PL B686 11	K. Miuchi <i>et al.</i>	(NEWAGE Collab.)
ABBASI	09B	PRL 102 201302	R. Abbasi <i>et al.</i>	(IceCube Collab.)
AHMED	09	PRL 102 011301	Z. Ahmed <i>et al.</i>	(CDMS Collab.)
ANGLE	09	PR D80 115005	J. Angle <i>et al.</i>	(XENON10 Collab.)
ANGLOHER	09	ASP 31 270	G. Angloher <i>et al.</i>	(CRESST Collab.)
ARCHAMBAU...	09	PL B682 185	S. Archambault <i>et al.</i>	(PICASSO Collab.)
LEBEDENKO	09A	PRL 103 151302	V.N. Lebedenko <i>et al.</i>	(ZEPLIN-III Collab.)
LIN	09	PR D79 061101	S.T. Lin <i>et al.</i>	(TEXONO Collab.)
AALSETH	08	PRL 101 251301	C.E. Aalseth <i>et al.</i>	(CoGeNT Collab.)
Also		PRL 102 109903 (errat.)	C.E. Aalseth <i>et al.</i>	(CoGeNT Collab.)
ANGLE	08A	PRL 101 091301	J. Angle <i>et al.</i>	(XENON10 Collab.)
BEDNYAKOV	08	PAN 71 111	V.A. Bednyakov, H.P. Klapdor-Kleingrothaus, I.V. Krivosheina	
		Translated from YAF 71 112.		

ALNER	07	PL B653 161	G.J. Alner <i>et al.</i>	(ZEPLIN-II Collab.)
LEE	07A	PRL 99 091301	H.S. Lee <i>et al.</i>	(KIMS Collab.)
MIUCHI	07	PL B654 58	K. Miuchi <i>et al.</i>	
AKERIB	06	PR D73 011102	D.S. Akerib <i>et al.</i>	(CDMS Collab.)
SHIMIZU	06A	PL B633 195	Y. Shimizu <i>et al.</i>	
AKERIB	05	PR D72 052009	D.S. Akerib <i>et al.</i>	(CDMS Collab.)
ALNER	05	PL B616 17	G.J. Alner <i>et al.</i>	(UK Dark Matter Collab.)
BARNABE-HEIDER	05	PL B624 186	M. Barnabe-Heider <i>et al.</i>	(PICASSO Collab.)
BENOIT	05	PL B616 25	A. Benoit <i>et al.</i>	(EDELWEISS Collab.)
GIRARD	05	PL B621 233	T.A. Girard <i>et al.</i>	(SIMPLE Collab.)
GIULIANI	05	PRL 95 101301	F. Giuliani	
GIULIANI	05A	PR D71 123503	F. Giuliani, T.A. Girard	
KLAPDOR-KLEINGROTHAUS	06	PL B609 226	H.V. Klapdor-Kleingrothaus, I.V. Krivosheina, C. Tomei	
GIULIANI	04	PL B588 151	F. Giuliani, T.A. Girard	
GIULIANI	04A	PRL 93 161301	F. Giuliani	
MIUCHI	03	ASP 19 135	K. Miuchi <i>et al.</i>	
TAKEDA	03	PL B572 145	A. Takeda <i>et al.</i>	
ANGLOHER	02	ASP 18 43	G. Angloher <i>et al.</i>	(CRESST Collab.)
BELLI	02	PR D66 043503	P. Belli <i>et al.</i>	
BERNABEI	02C	EPJ C23 61	R. Bernabei <i>et al.</i>	(DAMA Collab.)
GREEN	02	PR D66 083003	A.M. Green	
BAUDIS	01	PR D63 022001	L. Baudis <i>et al.</i>	(Heidelberg-Moscow Collab.)
SMITH	01	PR D64 043502	D. Smith, N. Weiner	
ULLIO	01	JHEP 0107 044	P. Ullio, M. Kamionkowski, P. Vogel	
BENOIT	00	PL B479 8	A. Benoit <i>et al.</i>	(EDELWEISS Collab.)
BERNABEI	00D	NJP 2 15	R. Bernabei <i>et al.</i>	(DAMA Collab.)
COLLAR	00	PRL 85 3083	J.I. Collar <i>et al.</i>	(SIMPLE Collab.)
AMBROSIO	99	PR D60 082002	M. Ambrosio <i>et al.</i>	(Macro Collab.)
BERNABEI	99	PL B450 448	R. Bernabei <i>et al.</i>	(DAMA Collab.)
BERNABEI	99D	PRL 83 4918	R. Bernabei <i>et al.</i>	(DAMA Collab.)
BRHLIK	99	PL B464 303	M. Brhlik, L. Roszkowski	
DERBIN	99	PAN 62 1886	A.V. Derbin <i>et al.</i>	
KLIMENKO	98	Translated from YAF 62 2034. JETPL 67 875	A.A. Klimenko <i>et al.</i>	
SARSA	97	PR D56 1856	M.L. Sarsa <i>et al.</i>	(ZARA)
ALESSANDRELLO	96	PL B384 316	A. Alessandrello <i>et al.</i>	(MILA, MILAI, SASSO)
BELLI	96	PL B387 222	P. Belli <i>et al.</i>	(DAMA Collab.)
Also		PL B389 783 (erratum)	P. Belli <i>et al.</i>	(DAMA Collab.)
BELLI	96C	NC C19 537	P. Belli <i>et al.</i>	(DAMA Collab.)
BERNABEI	96	PL B389 757	R. Bernabei <i>et al.</i>	(DAMA Collab.)
COLLAR	96	PRL 76 331	J.I. Collar	(SCUC)
SARSA	96	PL B386 458	M.L. Sarsa <i>et al.</i>	(ZARA)
Also		PR D56 1856	M.L. Sarsa <i>et al.</i>	(ZARA)
SMITH	96	PL B379 299	P.F. Smith <i>et al.</i>	(RAL, SHEF, LOIC+)
SNOWDEN-LFFT	96	PRL 76 332	D.P. Snowden-Ifft, E.S. Freeman, P.B. Price	(UCB)
GARCIA	95	PR D51 1458	E. Garcia <i>et al.</i>	(ZARA, SCUC, PNL)
QUENBY	95	PL B351 70	J.J. Quenby <i>et al.</i>	(LOIC, RAL, SHEF+)
SNOWDEN-LFFT	95	PRL 74 4133	D.P. Snowden-Ifft, E.S. Freeman, P.B. Price	(UCB)
Also		PRL 76 331	J.I. Collar	(SCUC)
Also		PRL 76 332	D.P. Snowden-Ifft, E.S. Freeman, P.B. Price	(UCB)
BECK	94	PL B336 141	M. Beck <i>et al.</i>	(MPIH, KIAE, SASSO)
BACCI	92	PL B293 460	C. Bacci <i>et al.</i>	(Beijing-Roma-Saclay Collab.)
REUSSER	91	PL B255 143	D. Reusser <i>et al.</i>	(NEUC, CIT, PSI)
CALDWELL	88	PRL 61 510	D.O. Caldwell <i>et al.</i>	(UCSB, UCB, LBL)