The Dark Matter Programme of the Cherenkov Telescope Array

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Dark Matter Search: Targets and Strategies



Spectral Lines

Little or no astrophysical uncertainties, but low sensitivity because of expected small branching ratio

Satellites

Low background and good

source id, but low statistics

Galaxy Clusters Low background, but low statistics

Isotropic" contributions Large statistics, but astrophysics, galactic diffuse background

Dark Matter simulation: Pieri+(2009) arXiv:0908.0195



Classical Dwarf spheroidal galaxies: promising targets for DM detection





CTA DM Detection Strategy

Year	1	2	3	4	5	6	7	8	9	10
Galactic halo	175 h	175 h	175 h							
Best dSph	100 h	100 h	100 h							
				iı	n case o	f detectio	on at GC	, large σ	v	
Best dSph				150 h	150 h	150 h	150 h	150 h	150 h	150 h
Galactic halo				100 h	100 h	100 h	100 h	100 h	100 h	100 h
		in case of detection at GC, small σv								
Galactic halo				100 h	100 h	100 h	100 h	100 h	100 h	100 h
	in case of no detection at GC									
Best Target				100 h	100 h	100 h	100 h	100 h	100 h	100 h

First 3 years

- The principal target is the Galactic Center Halo (most intense diffuse emission regions removed)
- Best dSph as "cleaner" environment for cross-checks and verification (if hint of strong signal)

Next 7 years

- If there is detection in GC halo data set (525h)
 - Strong signal: continue with GC halo in parallel with best dSph to provide robust detection
 - Weak signal: focus on GC focus to increase data set until systematic errors can be kept under control
- If no detection in GC halo data set
 - Focus observation on the best target at that time to produce legacy limits.

Dwarf Spheroidal Galaxies: CTA Sensitivity



There are several of the newly discovered dSph that have a better case for being a promising target, Will choose most promising targets before observations with the latest knowledge. note:the "thermal" cross section is only a reference value. The real cross section can be higher or lower



CTA, HESS, FERMI, PLANK DM upper-limits

Together Fermi and CTA will probe most of the space of WIMP models with thermal relic annihilation cross section

The expectation for CTA is for the Einasto profile and is optimistic as includes only statistical errors. The effect of the Galactic diffuse emission can affect the results by ~ 50%



DM limit improvement estimate in 15 years (2008-2023)



Together Fermi and CTA will probe most of the space of WIMP models with thermal relic annihilation cross section

Complementarity and Searches for Dark Matter in the pMSSM







Dark Matter Searches in Dwarf Spheroidal Galaxies with CTA

In-house calculation of the astrophysical factors for the dSph halos

- Selection of final sample of dSphs
- Derivation of input quantities for Jeans analysis
- Calculation of astrophysical factor profiles and 2D maps



- In-house calculation of astrophysical factors for DM annihilation and decay in dSphs
 - Selection of optimal candidates for both CTA sites made on distance and minimum zenith angle:

D < 100 pc ZAmin < 30^o

- Selected sample:

10 Northern dSphs (Boöl, Boöll, Boöll, CBe, Dral, Lae3, Seg1, Seg2, Trill, Wil1)
11 Southern dSphs (Cetll, Erilll, Grull,

Horl, Indl, Phell, Retll, Sgrl, Sgrll, Scl, Sex) Table 2: Basic properties of the dSphs belonging to the MW subgroup and those of the LG not associated to major galaxies, ranked in alphabetical order. The dSphs from the M31 subgroup are not included. Objects indicated with "cls" are "classical" dSphs, whereas "uft" stands for "ultrafant". Dashes in the cultination columns indicate objects that do not rise above the borizon in the relevant hemisphere. The names of targets within -100 kpc with cultimation zenith angles ZA $\leq 30^\circ$ are highlighted in **boldEace** for the Northern hemisphere and in *italic* for the Southern MSPs.

Name	Abbr.	Туре	R.A. (hh mm ss)	dec. (dd mm ss)	Distance (kpc)	${\rm ZA}_{\rm cutm}{\rm N}({\rm deg})$	ZA _{cutn} S (deg)	Month	Ref.
Andromeda XVIII	AndXVIII	uft	00 02 14.5	+45 05 20	1330 ± 104	14.62	70.00	Sep	1.2
Aquarius	Agr	uft	20 46 51.8	-125053	1030 ± 57	41.54	11.54	Aug	1.3
Bootes I	Bool	uft	14 00 06.0	+143000	65 ± 3	13.85	38.46	Apr	1.4
Boötes II	BooII	uft	13 58 00.0	+12.51.00	39 ± 2	16.15	36.92	Apr	1.5
Bootes III	BoöIII	uft	13 57 12.0	+264800	46 ± 2	1.54	40.77	Apr	1.5
Canes Venatici I	CVnI	uft	13 28 03.5	+33 33 21	216 ± 8	4.62	57.69	Apr	1.4
Canes Venatici II	CVnII	uft	12 57 10.0	+34.19.15	159 ± 8	6.15	59.23	Apr	1.4
Carina	Car	cls	06 41 36.7	-50 57 58	106 ± 1	80.00	26.92	Dec	1.6
Cetus I	CetI	u ft	00.26.11.0	-11.02.40	748 ± 31	30.23	13.85	Sem	1.7
Cetus II	Cetll	uft	01 17 52 8	-17 25 12	30 ± 3	45 38	6.91	Oct	23
Columba I	Coll	uft.	05 31 26 4	-28 01 48	187 + 18	56.15	3.08	Dac	23
Coma Berenicee	CBa	un	12 26 59 0	+23 54 15	42 ± 10	5 38	47.69	Mar	1.8
Drawn I	Deal	ala	17 20 12 4	157 54 55	75 + 4	20.22	93.09	Low	1.0
Dracol	Deall	c is	16 52 47.6	157 34 33	7.5 ± 4	29.23	82.46	Man	2.1
Enidorem II	Draft	un	13 32 47.0	+04 33 33	20 ± 3	34.02	18.40	May	24
Eridanus II	TOTAL D	un	03 44 21.5	-43 31 48	330 ± 10	90.77	18.40	Ow	2.5
Eridanus III	ETHIL	un	02 22 45.5	-52 10 48	95±27	80.17	27.09	Oct	25
Fornax	Por	cis	02 39 39.3	-34 26 57	140 ± 1	03.08	10.00	Oct	1,0
Grus I	Grul	ult	22 56 42.4	-50 09 48	120 ± 17	78.46	25.38	Sep	26
Grus II	Gruff	unt	22 04 04.8	-46 26 24	53±5	15.38	22.31	Aug	- 23
Hercules	Her	uft	16 31 02.0	+12 47 30	137 ± 11	16.15	36.92	May	1,10
Horologium I	HorI	uft	02 55 28.9	-54 06 36	87 ± 13	83.08	29.23	Oct	25
Hydra II	HyaII	uft	12 21 42.1	-31 59 07	134 ± 10	60.77	6.92	Mar	27
Indus I	IndI	uft	21 08 48.1	-51 09 36	69 ± 16	80.00	26.92	Aug	25
Indus II	IndII	uft	20 38 52.8	-46 09 36	214 ± 16	75.38	22.31	Aug	23
Laevens 3	Lac3	uft	21 06 54.3	+14.58.48	67 ± 3	13.85	39.23	Aug	24
Leo I	LeoI	cls	10 08 28.1	+12.18.23	272 ± 10	16.15	35.38	Feb	1,11
Leo II	LeoII	cls	11 13 28.8	+22 09 06	240 ± 9	6.92	46.92	Mar	1,12
Leo IV	LeoIV	uft	11 32 57.0	-00 32 00	151 ± 4	29.23	23.85	Mar	1,13
Leo V	LeoV	uft	11 31 09.6	$+02\ 13\ 12$	169 ± 5	26.15	26.92	Mar	1,13
Leo T	LeoT	uft	09 34 53.4	+170305	377 ± 28	12.31	42.31	Feb	1,14
Phoenix I	PheI	uft	01 51 06.3	-44 26 41	427 ± 31	73.85	20.00	Oct	1,14
Phoenix II	PheII	uft	23 39 57.6	-54 24 36	95 ± 18	83.08	30.00	Sep	25
Pictor I	PicI	uft	04 43 48.0	-501648	126 ± 24	78.46	26.15	Nov	25
Pisces II	PscII	uft	22 58 31.0	+055709	182 ± 13	23.08	30.77	Sep	1.15
Reticulum II	RetII	uft	03 35 40.9	-540300	32 ± 2	83.08	29.23	Nov	25
Reticulum III	RetIII	uft	03 45 26.3	-60 27 00	92 ± 13	88.46	35.38	Nov	23
Sagittarius 1	SerI	uft	18 55 19.5	-303243	31 ± 1	59.23	6.15	Jul	1.16
Sagittarius II	SgrII	uft	19 52 40.5	-22.04.05	67 ± 5	51.54	2.31	Jul	24
Sculptor	Scl	cls	01 00 09 4	-33 42 33	84 + 2	63.08	9.23	Oct	1.17
Segue 1	Seg1	uft	10 07 04 0	+160455	23 ± 2	12.31	40.77	Feb	1.18
Segne 2	Seg2	uft	02 19 16 0	+20.10.31	36 ± 2	8.46	44.62	Oct	1.19
Sertons	Sex	cls	10 13 03 0	-01 36 53	84 ± 3	30.77	23.07	Esh	1.13
Trianonlum II	Trill	10	02 13 17 4	+36 10.42	30 + 2	6.02	60.77	Oct	78
Tucana I	Tuel	uft	22 41 49 6	-64 25 10	855 + 35		40.00	Sam	17
Tucana II	Tuch	uft	22 41 49.0	-58 33 36	58 + 6	86.92	33.85	Sep	25
Tucana III	Tuelly		23 56 35 9	-59 36 00	25 + 2	87.60	34.62	Sam	22
Tucana IV	TuelV	un	23 30 33.9	-60 51 00	48 ± 4	80.23	35.38	Sen	23
Line Maine I	LINA-I	un	10 24 53 8	-00.51.00	105 - 2	32.23	76.15	Mar	1.25
Ursa Major I	UMAR	un	10 54 52.8	+31 33 12	105 ± 2 35 ± 2	23.08	70.15	Diah	1,20
Una Minut	UNIAN	un	15 00 08 5	+03 07 48	33 ± 4	34.02	81.09	Peo Maria	1,21
Orsa Millior	OM	cis	15 09 08.5	+0/13/21	08 ± 2	38.40	75.30	May	1,22
Willman 1	Will	uft	10 49 21.0	+51.03.00	38 ± 7	22.31	75.38	Mar	1,18

References: (1, coordinates enly) [?]; (2-22, distances only) [4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24]; (23-28, both data) [25, 26, 27, 287 ?].



- In-house calculation of astrophysical factors for DM annihilation and decay in dSphs
 - Selection of optimal candidates for both CTA sites made on distance and minimum zenith angle:

D < 100 pc ZAmin < 30^o

– Selected sample:

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Andromeda XVIII uft 00 02 14.5 +45 05 20 1330 ± 104 14 62 70.00 Sep 1.2 Aquarius Aqu uft 100 06.0 +14 10 00 65 ± 3 13 35 35.4 Aquarius Aquarius Aquarius Aug 13 Bootest II Booill uft 13 55 00.0 +12 51 00 9 + 2 16 15 36 92 Apr 15 Canes Venatici I CVall uft 13 28 01.5 +33 32 1 216 ± 8 46 2 57.69 Apr 14 Canes Venatici I CVall uft 12 57 10.0 +33 19 15 159 ± 8 615 59.23 Apr 14 Catina Cell uft 01 25 48 -17 25 12 00 28 + 31 90.01 20.69 2 Dec 16 Coum herenice Bit uft 01 25 48 -17 25 12 04 8 + 31 90.01 23 8 + 28 16 41 24 5 + 34 60 41 04 1 + 32 Coum herenice Bit uft 02 5 4 + 5 + 5 + 5	Name	Abbr.	Туре	R.A. (hh mm ss)	dec. (dd mm ss)	Distance (kpc)	$ZA_{calm}N(deg)$	ZA _{cutn} S (deg)	Month	Ref.
AquatinsAqruft20.65 \$1, 812.50 \$31030 \pm 7741.5411.45AufAqr1.4Bootes IIBoot uft13.80 00.00+12.51 0039 \pm 216.1536.92Apr1.4Bootes IIBootin uft13.87 12.0 \pm 2.64 8:0046 \pm 21.5440.77Apr1.5Cance Nenatici ICVuluft13.28 0.35 \pm 33.32 121.64 \pm 84.6257.69Apr1.4Cance Nenatici IICVuluft13.27 10.00 \pm 33.31 2121.64 \pm 84.61559.23Apr1.4Cance Nenatici IICelluft00.64 13.67 -50.575 810.6 \pm 130.2026.92Dec1.6Cettar ICelluft01.17 22.8 -17.25 11.2 40 ± 1 34.218.040 1Cat21Columa BerenfexeCheuft12.54 9.0 $+2.54$ 11.8 42 ± 2 5.38 4.769Mar1.8Draco IIDrailchi17.20 12.4 $+75$ 54 55 75 ± 4 29.238.308Jun1.9Draco IIDrailuft03.24 22 55 -52 16 4893.6 1672.3118.46Nev25FernaxForchs02.39 59.3 -342 65 77146 \pm 163.0810.00Cot2.5FormaxForchs02.39 59.3 -342 65 77146 \pm 163.0810.00Cot2.5FormaxForchs02.32 55 2.5516.4897.13 <td>Andromeda XVIII</td> <td>AndXVIII</td> <td>uft</td> <td>00 02 14.5</td> <td>+45 05 20</td> <td>1330 ± 104</td> <td>14.62</td> <td>70.00</td> <td>Sep</td> <td>1,2</td>	Andromeda XVIII	AndXVIII	uft	00 02 14.5	+45 05 20	1330 ± 104	14.62	70.00	Sep	1,2
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	Canes Venatici II	CVnII	uft	12 57 10.0	+34 19 15	159 ± 8	6.15	59.23	Apr	1,4
	Carina	Car	cls	06 41 36.7	-50 57 58	106 ± 1	80.00	26.92	Dec	1,6
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	Cetus II	Cetll	uft	01 17 52.8	-17 25 12	30 ± 3	45.38	6.91	Oct	23
	Columba I	Coll	uft	05 31 26.4	-280148	182 ± 18	56.15	3.08	Dec	23
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$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Draco I	DraI	cls	17 20 12.4	+57 54 55	75 ± 4	29.23	83.08	Jun	1,9
	Draco II	DraII	uft	15 52 47.6	+64 33 55	20 ± 3	34.62	88.46	May	24
Erdanus III Erdanus III etal 0.22 245 -52 10 48 95 ± 27 80 77 27.69 Oct 25 Grus I Grul uft 225 6424 -500 948 120 ± 17 78.46 25.518 Sep 26 Grus I Grul uft 225 6424 -500 948 120 ± 17 78.46 25.518 Sep 26 Grus II Grul uft 163 10.20 $+124$ 730 137 ± 11 16.15 36.92 May 1,10 Hercules Her uft 0.25 52.89 -54 06.36 87 ± 13 85.08 29.23 Oct 2.5 Indus II Indi uft 214 2.1 -51 99 36 69 ± 16 80.00 2.69.2 Aug 23 Indus II Indi uft 210 85 2.8 -64 99 36 214 ± 16 75.38 22.31 Aug 23 Leo I LeoII LeoII LeoII 132 8.8 +12 18 23 272 ± 10 16.15 35.38 Feb </td <td>Eridanus II</td> <td>EriII</td> <td>uft</td> <td>03 44 21.5</td> <td>-43 31 48</td> <td>330 ± 16</td> <td>72.31</td> <td>18.46</td> <td>Nov</td> <td>25</td>	Eridanus II	EriII	uft	03 44 21.5	-43 31 48	330 ± 16	72.31	18.46	Nov	25
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Eridanus III	EriIII	uft	02 22 45.5	-52 16 48	95 ± 27	80.77	27.69	Oct	25
Grus I Grul uft 22 56 42.4 $-500 948$ 120 ±17 78.46 25.38 Sep 26 Grun II Grun II Grun II 163 10 2.0 $+12 47 30$ 31 ± 5 75.38 22.31 Ang 21 Hercules Her uft $102 55 289$ $-84 06.36$ 87 ± 11 16.15 36.92 May 25 Indus II Hyal II uft $21 42.1$ $-31 5907$ 134 ± 10 60.77 6.92 Mar 25 Indus II Indil uft $2108 52.8$ $-5109 36$ 69 ± 16 80.00 25.92 Aug 23 Leo I Losi S 52.8 $-4609 36$ 214 ± 16 75.38 22.31 Aug 23 Leo I Leo I Leo I Leo I 138 5 32.33 Aug 24 Leo IV LeoIV u full $132 570$ $-00 32 00$ 151 ± 4 $29 23$ 23.85 Mar $1,13$ Leo V LeoIV LeoIV u full<	Fornax	For	cls	02 39 59.3	-34 26 57	146 ± 1	63.08	10.00	Oct	1,6
$ \begin{array}{c} Grun II & Grul I & uft & 2204043 & -462624 & 53 \pm 5 & 75.88 & 22.31 & Aug & 23 \\ Hercules & Her uft & 163102.0 & +124730 & 137 \pm 11 & 16.15 & 36.92 & May & L10 \\ Homlogium I & Hyal I & uft & 02.552.89 & -5406.36 & 87 \pm 13 & 8308 & 22.23 & Oct & 25 \\ Hydra II & HyalI & uft & 02.552.89 & -5406.36 & 67 \pm 16 & 8000 & 2652 & Aug & 25 \\ Indue I & IndI & uft & 2108.481 & -5199.36 & 69 \pm 16 & 8000 & 2652 & Aug & 25 \\ Indue I & IndI & uft & 20.38.52.8 & -46.99.36 & 214 \pm 16 & 75.38 & 22.31 & Aug & 23 \\ Lacvens J & Lac's & uft & 2106.544 & +145.848 & 67 \pm 1 & 13.55 & 30.33 & Aug & 24 \\ Leo I & LeoI & cls & 10082.81 & \pm 12.823 & 272 \pm 10 & 16.15 & 33.38 & Feb & 1.11 \\ Leo II & LeoII & cls & 11032.88 & \pm 22.906 & 240 \pm 9 & 6.92 & 46.92 & Mar & 1,13 \\ Leo V & LeoV & uft & 11.32.87 & \pm 12.092.50 & 151 \pm 4 & 29.23 & 23.85 & Mar & 1,13 \\ Leo V & LeoV & uft & 11.31.98, & \pm 170.05 & 377 \pm 28 & 12.31 & 42.31 & Feb & 1,44 \\ Phoenix I & Phoelix I & Phoelix & 0.934.534 & \pm 170.05 & 377 \pm 28 & 12.31 & 42.31 & Feb & 1,44 \\ Phoenix I & Phoelix & uft & 23.957.6 & -54.24.36 & 95 \pm 18 & 83.08 & 30.09 & Sep & 25 \\ Pictor I & PicI & uft & 04.43.48.0 & -50.16.48 & 126 \pm 24 & 77.86 & 20.61.5 & Nov & 25 \\ Piccer I & PicI & uft & 0.45.26.3 & -60.270.0 & 0.24 \pm 2 & 83.08 & 30.07 & Sep & 1.55 \\ Pictor I & PicI & uft & 0.45.26.3 & -60.270.0 & 0.24 \pm 2 & 83.08 & 30.17 & Sep & 1.55 \\ Pictor I & PicI & uft & 0.55.26 & -30.22.43 & 31 \pm 1 & 59.23 & 6.15 & Jul & 1.46 \\ Seguitariau I & SepI & uft & 10.35.40 & -30.42.3 & 38.4 \pm 2 & 63.08 & 9.2.3 & Nov & 25 \\ Seguitariau I & SepI & uft & 10.70.40 & +36.0100 & 32 \pm 2 & 23.46 & 9.43 & 30.77 & Sep & 1.15 \\ Segue 2 & Seg2 & uft & 00.70.40 & -33.42.3 & 84 \pm 2 & 63.08 & 9.2.3 & Oct & 1.17 \\ Segue 1 & Seg1 & uft & 10.57.40 & -30.22.40 & 57.55 & 51.54 & 2.31 & Jul & 24 & SepI & 1.55 & 1.54 & 2.31 & Jul & 24 & SepI & -78.53 & 36.55 & 51.54 & 2.31 & Jul & 1.46 & SepI & -78.53 & 36.55 & 55.55 & -78.53 & 6.15 & Jul & 1.16 \\ Segue 1 & Seg1 & uft & 10.30.0 & -61.36 & 85 \pm 5 & -78.400 & Sep & 1.7 \\ Ticana II & Tu$	Grus I	GruI	uft	22 56 42.4	$-50\ 09\ 48$	120 ± 17	78.46	25.38	Sep	26
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Grus II	Grull	uft	22.04.04.8	-46 26 24	53 ± 5	75.38	22.31	Aug	23
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Hercules	Her	uft	16 31 02.0	+12 47 30	137 ± 11	16.15	36.92	May	1,10
$ Hydra II HyaII urft 12 21 42.131 59 07 134 \pm 10 60.77 6.92 Mar 27 model in the interval of the i$	Horologium I	Horl	uft	02 55 28.9	-54 06 36	87 ± 13	83.08		Oct	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Hydra II	HyaII	uft	12 21 42.1	-315907	134 ± 10	60.77	6.92	Mar	27
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Indus I	Indl	uft	21 08 48.1	-51 09 36	69 ± 16	80.00	26.92	Aug	25
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Indus II	IndII	uft	20 38 52.8	-46 09 36	214 ± 16	75.38	22.31	Aug	23
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Laevens 3	Lac3	uft	21.06.54.3	+14.58.48	67 ± 3	13.85	39.23	Aug	24
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Leo I	LeoI	cls	10 08 28.1	$+12\ 18\ 23$	272 ± 10	16.15	35.38	Feb	1,11
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Leo II	LeoII	cls	11 13 28.8	+22 09 06	240 ± 9	6.92	46.92	Mar	1,12
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Leo IV	LeoIV	uft	11 32 57.0	-00 32 00	151 ± 4	29.23	23.85	Mar	1,13
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Leo V	LeoV	uft	11 31 09.6	$+02\ 13\ 12$	169 ± 5	26.15	26.92	Mar	1,13
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Leo T	LeoT	uft	09 34 53.4	+170305	377 ± 28	12.31	42.31	Feb	1,14
Phoenx II Phoell uft 23 39 57.6 $-54 24 36$ 95 ± 18 83 08 30.00 Sep 25 Pictor I Pictor Pic	Phoenix I	PheI	uft	01 51 06.3	-44 26 41	427 ± 31	73.85	20.00	Oct	1,14
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Phoenix II	PheII	uft	23 39 57.6	-54 24 36	95 ± 18	83.08	30.00	Sep	25
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Pictor I	PicI	uft	04 43 48.0	-50 16 48	126 ± 24	78.46	26.15	Nov	25
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Pisces II	PscII	uft	22 58 31.0	+05 57 09	182 ± 13	23.08	30.77	Sep	1,15
Reticulum III RedIII uft 03 45 26.3 -602700 92 ± 13 88.46 35.38 Nov 23 Segitatraira II Segitatraira II Signitaria II Signitaria II Signitaria II 59.23 6.15 Jul 1,16 Segitatraira II Signitaria II Signitaria II 19 52.40.5 -220405 67 ± 5 51.54 2.31 Jul 1.46 Secuptor Sci Sci 1000.09.4 -334233 84 ± 2 63.08 9.23 Oct 1,17 Segue I Seg1 uft 1007.04.0 $+16.0455$ 23 ± 2 12.31 40.77 Feb 1,18 Section I Section I Section I 0.21 19 16.0 $+201033$ 6 ± 2 44.6462 Oct 1,19 Section I Section I Section I Section II Triat 021317.4 $+361042$ 30 ± 2 692 60.77 Oct 28 Tracena II TucIII uft 225 216 17 -583336	Reticulum II	RetII	uft	03 35 40.9	-54 03 00	32 ± 2	83.08	29.23	Nov	25
Sagittaria I Sgrl uft 18 55 19.5 $-303 243$ 31 ± 1 59.23 6.15 Jul 1.16 Sagittaria II Sgrl II uft 19 52 40.5 $-220 40.5$ 67 ± 5 51.54 2.31 Jul 2.4 Scaptor Scl cls 0 10 00.94 $-33 4233$ 84 ± 2 63.08 9.23 Oct 1.17 Segue I Segu I uft 100 70 40 $+160 455$ 23 ± 2 12.31 40.77 Feb 1.18 Segue 2 Seg2 uft 007 04.0 $+201031$ 36 ± 2 8.46 4.462 Oct 1.9 Section S	Reticulum III	RetIII	uft	03 45 26.3	-60 27 00	92 ± 13	88.46	35.38	Nov	23
Sagitariar II Signal uit 19 52 40.5 -220405 67 ± 5 51.54 2.31 Jul 24 Scalptor Scilptor	Sagittarius I	SgrI	uft	18 55 19.5	-30 32 43	31 ± 1	59.23	6.15	Jul	1,16
Sculptor Scl cls 0100094 -334233 84 ± 2 63.08 9.23 Oct 1,17 Segue 1 Segue 1 uft 1007040 +160455 23 ± 2 12.31 40.77 Feb 1,18 Segue 2 Seg2 uft 0219160 +201031 36 ± 2 8.46 44.62 Oct 1,19 Sectant Sectant Sectant Sectant 30.77 23.07 Feb 1,13 Trianguhum II Titl uft 02.1317.4 +36.10.42 30.42 6.92 60.77 Oct 28 Tucana I Tucl uft 22.52.16.7 -65.83.36 58 ± 6 86.92 33.85 Sep 25 Tucana II TucHII uft 02.35.53 -69.51.00 28 ± 2 87.69 34.62 Sep 23 Tucana IV TucHII uft 02.35.53 -69.51.00 48 ± 4 89.23 35.38 Seg 23 Ursa Major I UMAI	Sagittarius II	SgrII	uft	19 52 40.5	-22 04 05	67 ± 5	51.54	2.31	Jul	24
Segue I Seg1 uft 10 07 04 0 $+1604355$ 23 ± 2 12.31 40.77 Feb $1,18$ Segue 2 Seg2 uft 02 19 16.0 $+1604355$ 23 ± 2 12.31 40.77 Feb $1,18$ Sectour Sex cls 10 13 03.0 -013653 84 ± 3 30.77 23.07 Feb $1,13$ Triangulum II Trill uft 02 13 17.4 $+361042$ 30 ± 2 692 60.77 Oct 28 Tucana I Tucl uft 22 41 49.6 -642510 855 ± 55 $ 40.00$ Sec p 25 Tucana II TuclI uft 22 52 16.7 -583336 88 ± 6 86.92 33.485 Sep 25 Tucana II TucIV uft 0255.3 -693600 25 ± 2 87.69 34.62 Sep 23 Ursa Major I UMaI uft 103452.8 $+515512$ 105 ± 2 23.08 76.15	Sculptor	Scl	cls	01 00 09.4	-33 42 33	84 ± 2	63.08	9.23	Oct	1,17
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Segue 1	Seg1	ult	10 07 04.0	+16 04 55	23 ± 2	12.31	40.77	Peb	1,18
Section Sex cls 10 1 0 3 0 0 -01 3 6 5 3 84 ± 3 30.77 23.07 Feb 1,13 Triangulum II Till uft 02 13 17.4 $+36$ 10 42 30 ± 2 692 60.77 Oct 28 Tucana II Tucl uft 22 21 1 3 17.4 $+36$ 10 42 30 ± 2 692 60.77 Oct 28 Tucana II Tucl uft 22 52 16.7 -583 33 6 58 ± 6 8692 33.85 Sep 2.5 Tucana II Tucl uft 22 55 65.9 -59 36 00 25 ± 2 87.69 34.62 Sep 25 Tucana IV TuclV uft 00 02 55.3 -605100 48 ± 4 89.23 35.88 Sep 23 Ursa Major I UMaI uft 10 34 52.8 $+515512$ 105 ± 2 20.87 76.15 Mar 1.20 Ursa Major II UMaI uft $03 450.8$ $+51 512$ 105 ± 2 20.87 76.15	Segue 2	Seg2	uft	02 19 16.0	+20 10 31	36 ± 2	8.46	44.62	Oct	1,19
Transpirum II Init utt 0211174 $+561042$ $30+2$ 692 60.77 Oct 28 Tucana I Tucl utt 2214986 -642510 855 ± 35 $$ 40.00 Sep 1.7 Tucana II TuclII uft 222414986 -642510 855 ± 35 $$ 40.00 Sep 1.7 Tucana II TuclII uft 2252167 883336 88 ± 6 8692 33.85 Sep 25 Tucana II TuclII uft 2252167 583336 88 ± 6 8692 33.85 Sep 25 Tucana IV TuclV uft 000255.3 -605100 48 ± 4 8923 35.38 Sep 23 Ursa Major I UMaI uft 103452.8 $+515512$ 105 ± 2 23.08 76.15 Mar $1,20$ Ursa Minor UMaI uft 103452.8 $+630748$ 35 ± 2 38.46 $$ <	Sextans	Sex	cls	10 13 03.0	-01 36 53	84 ± 3	30.77	23.07	Peb	1,13
Iucana I Iucl ut 224 149.6 $-64 25 10$ 855 ± 35 $$ 40.00 Sep 1,7 Tucana II Tucli uft 225 25 16.7 $-58 33 36$ 58 ± 6 86.92 33.85 Sep 25 Tucana III Tucli uft 225 53.59 $-59 36 00$ 25 ± 2 87.69 34.62 Sep 25 Tucana IV Tucli uft $23 56 35.9$ $-59 36 00$ 25 ± 2 87.69 34.62 Sep 23 Ursa Major I Tucli uft $103 452.8$ $+51 55 12$ 105 ± 2 23.08 76.15 Mar $1,20$ Ursa Major I UMaI uft $103 452.8$ $+51 55 12$ 105 ± 2 23.08 76.15 Mar $1,20$ Ursa Minor UMaI uft $13 00 + 55 + 63 07 48$ 35 ± 2 34.62 87.69 $76 + 62$ 78.46 $$ May $1,20$ Ursa Minor UMaI ck $15 09 08.5$ $+67 13 21$ 68 ± 2 38.4	Triangulum II	Trill	uft	02 13 17.4	+36 10 42	30 ± 2	6.92	60.77	Oct	28
Iucana II Iucit ut 22 22 16.7 -88.33 36 38.6 86.92 33.85 Sep 25 Tucana II Tucil uf $225 63.59$ $-59 36.00$ 25 ± 2 87.69 34.62 Sep 23 Tucana IV TucIV uft 000255.3 -605100 48 ± 4 89.23 35.38 Sep 23 Ursa Major I UMaI uft 103452.8 $+515512$ 105 ± 2 23.08 76.15 Mar $1,20$ Ursa Major II UMaI uft 03452.8 $+515512$ 105 ± 2 34.62 87.69 76.9 76.00 76.15 Mar $1,20$ Ursa Major II UMaI uft 15300.65 $+67.1321$ 68 ± 2 38.46 $$ May 1.22 Ursa Minor UMi cds $160.03.6$ $67.03.03$ 76.23 76.46 $$ May 1.22	Tucana I	Tucl	uft	22 41 49.6	-64 25 10	855 ± 35		40.00	Sep	1,7
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Tucana II	Tuch	un	22 52 16.7	-58 33 36	38 ± 0	80.92	33.85	Sep	25
Internativ Interv unctiv 00 (2.5) (0) (48 ± 4) 89 (2.5) (3.	Tucana III	Tuelli	uft	23 56 35.9	-59 36 00	25 ± 2	87.69	34.62	Sep	23
Ursa Major I UNAI ult 10.54.528 ± 51.55 12 10.5 ± 2 25.08 76.15 Mar 1,20 Ursa Major I UMAI ult 01.64.51.300 ± 51.300 ± 51.57 35.2 10.5 ± 2 34.62 87.69 Feb 1,21 Ursa Minor UMAi cls 15.09.08.5 $\pm 67.13.21$ 68. ± 2 38.46 $-$ May 1,22 William UMAI cls 15.09.08.5 $\pm 67.13.21$ 68. ± 2 38.46 $-$ May 1,22	Lucana IV	TUCIV	un	00 02 55.5	-60.51.00	48±4	89.23	35.38	Sep	1.20
Ursa major ii Umaii un 0851300 +030748 35±2 34.02 87.09 Peb 1,21 Ursa Minor UMi c1s 15.09.08.5 +67.13.21 68±2 38.46 - May 1,22	Ursa Major I	UMal	ult	10 34 52.8	+51 55 12	105 ± 2	23.08	70.15	Mar	1,20
UTA BHIRDT UMI CIS 12.09.08.5 +07.13.21 08.±2 38.40 — May 1.22 Willington 1 W211 04.0.210 (51.02.00 28.±7 20.23) 75.23 1. 75.24	Ursa Major II	UMan	ult	15 00 08 5	+03 07 48	33±2	34.02	87.09	Neo	1,21
	Crsd Blinor	Wall	cis	13 09 08.5	10/13/21	08±2	38.40	75.30	May	1,22

References: (1, coordinates only) [?]; (2–22, distances only) [4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24]; (23–28, both data) [25, 26, 27, 28? ?].



- In-house calculation of astrophysical factors for DM annihilation and decay in dSphs
 - Exclusion of targets without or with too poor brightness/kinematic data available in the literature:

Boöll (only 5 member stars) Cetll (no kinematic data) Erill (no kinematic data) Horl (only 5 member stars) Indl (no kinematic data) Lae3 (no kinematic data) Phell (no kinematic data) Seg2 (no brightness data)

- Surviving sample:

7 Northern dSphs 6 Southern dSphs Table 2: Basic properties of the dSphs belonging to the MW subgroup and those of the LG not associated to major galaxies, ranked in alphabetical order. The dSphs from the M31 subgroup are not included. Objects indicated with "cls" are "classical" dSphs, whereas "ufi" stands for "ultrafant". Dashes in the cultimization columns indicate objects that do not rise above the horizon in the relevant hemisphere. The names of targets within -100 kpc with cultimization zenith angles ZA $\leq 30^\circ$ are highlighted in **holdface** for the Northern hemisphere and in *italic* for the Southern Abrus.

Name	Abbr.	Туре	R.A. (hh mm ss)	dec. (dd mm ss)	Distance (kpc)	ZA _{calm} N (deg)	ZA _{culm} S (deg)	Month	Ref
Andromeda XVIII	AndXVIII	uft	00 02 14.5	+45 05 20	1330 ± 104	14.62	70.00	Sep	1.2
Aquarius	Aar	uft	20 46 51.8	-125053	1030 ± 57	41.54	11.54	Aug	1.3
Boötes I	Bool	uft	14 00 06.0	+143000	65 ± 3	13.85	38.46	Apr	1.4
Boötes II	Boöll	uft	13 58 00.0	+12.51.00	39 ± 2	16.15	36.92	Apr	1.5
Bootes III	BoöIII	uft	13 57 12.0	+264800	46 ± 2	1.54	40.77	Apr	1.5
Canes Venatici I	CVnI	uft	13 28 03 5	+33 33 21	216 ± 8	4.62	57.69	Apr	1.4
Canes Venatici II	CVnII	uft	12 57 10 0	+34 19 15	159 + 8	6.15	59.23	Anr	1.4
Carina Carina	Car	cle	06.41.36.7	-50 57 58	106 ± 1	80.00	26.92	Dec	1.6
Cature I	Cal		00 26 11 0	-11.02.40	748 + 31	30.23	13.85	Sam	1.7
Cetus I	Call	un	01 17 52 8	-17.25.12	748±31	39.23	13.83	Ort	- 22
Columba I	Cell		05 21 26 4	29.01.49	182 / 18	40.00	1.08	Dee	- 2.3
Common I	COL	un	12.26.50.0	-28 01 48	182 ± 18	50.15	3.08	Dec	1.9
Coma berenices	CBe	un	12 26 59.0	+23 54 15	42 ± 2	0.58	47.09	Mar	1,8
Draco I	Drail	CIS	17/20/12.4	+37 34 35	75 ± 4	29.23	8,5.08	Jun	1,9
Draco II	Drall	uft	15 52 47.6	+64 33 55	20 ± 3	34.62	88.46	May	24
Eridanus II	EnII	uft	03 44 21.5	-43 31 48	330 ± 16	72.31	18.46	Nov	- 25
Eridanus III	EriIII	uft	02 22 45.5	-52 16 48	95 ± 27	80.77	27.69	Oct	25
Fornax	For	cls	02 39 59.3	-34 26 57	146 ± 1	63.08	10.00	Oct	1,6
Grus I	GruI	uft	22 56 42.4	$-50\ 09\ 48$	120 ± 17	78.46	25.38	Sep	26
Grui II	GruII	uft	22.04.04.8	-46 26 24	53 ± 5	75.38	22.31	Aug	23
Hercules	Her	uft	16 31 02.0	+12 47 30	137 ± 11	16.15	36.92	May	1,10
Horologium I	HorI	uft	02 55 28.9	-54 06 36	87 ± 13	83.08	29.23	Oct	25
Hydra II	Hyall	uft	12 21 42.1	-315907	134 ± 10	60.77	6.92	Mar	27
Indus I	Indl	uft	21 08 48.1	-51 09 36	69 ± 16	80.00	26.92	Aug	25
Indus II	IndII	uft	20 38 52.8	-46 09 36	214 ± 16	75.38	22.31	Aug	23
Laevens 3	Lac3	uft	21.06.54.3	+14.58.48	67 ± 3	13.85	39.23	Aug	24
Leo I	LeoI	cls	10 08 28.1	+12 18 23	272 ± 10	16.15	35.38	Feb	1.13
Leo II	LeoII	cls	11 13 28.8	+22.09.06	240 ± 9	6.92	46.92	Mar	1.12
Leo IV	LeeIV	uft	11 32 57 0	-00 32 00	151 ± 4	29.23	23.85	Mar	1.13
Leo V	LeoV	uft	11 31 09 6	+02.13.12	169 ± 5	26.15	26.92	Mar	1.12
LeoT	LeoT	uft.	09 34 53 4	+17.03.05	377 ± 28	12.31	42.31	Eab	1.1.
Phoenix I	Phel		01 51 06 3	-44.26.41	427 ± 31	73.85	20.00	Oct	111
Phoenix II	Phot		23 30 57 6	-54 24 36	95 + 18	83.08	30.00	San	7.5
Pictor I	Piel	uit uft	04 43 48 0	-50 16 48	126 + 24	78.46	26.15	New	- 25
Discourt II	D-11	une .	22 59 21 0	05 57 00	103 . 12	22.40	20.15	E.	1.11
Pisces II Rationalum II	Psch	un	22 38 31.0	51.01.00	182 ± 13	23.08	30.77	New	1,1,
Reticulum II	Beelli	un	03 35 40.9	-34 03 00	32 ± 2	83.08	29.23	NOV	2.3
Renculum III	Rettfi	un	03 45 26.5	-60 27 00	92±13	88.40	35.38	NOV	- 23
Sagittarius I	Sgri	un	18 55 19.5	-30 32 43	31±1	59.25	0.15	Jul	1,10
Saginarius 11	sgrii	un	19 52 40.5	-22 04 05	0/±2	51.54	2.31	Jui	24
Sculptor	Scl	cls	01 00 09.4	-33 42 33	84 ± 2	63.08	9.23	Oct	1,1
Segue 1	Seg1	ult	10 07 04.0	+16 04 55	23 ± 2	12.31	40.77	Peb	1,13
Segue 2	Seg2	uft	02 19 16.0	+20 10 31	36 ± 2	8.46	44.62	Oct	1,19
Sextans	Sex	cls	10 13 03.0	-01 36 53	84 ± 3	30.77	23.07	Feb	1,13
Triangulum II	Trill	uft	02 13 17.4	+36 10 42	30 ± 2	6.92	60.77	Oct	28
Tucana I	TucI	uft	22 41 49.6	-64 25 10	855 ± 35	-	40.00	Sep	1,7
Tucana II	TucII	uft	22 52 16.7	-58 33 36	58 ± 6	86.92	33.85	Sep	25
Tucana III	TucIII	uft	23 56 35.9	-59 36 00	25 ± 2	87.69	34.62	Sep	23
Tucana IV	TucIV	uft	00 02 55.3	-60.51.00	48 ± 4	89.23	35.38	Sep	23
Ursa Major I	UMaI	uft	10 34 52.8	+51 55 12	105 ± 2	23.08	76.15	Mar	1,20
Ursa Major II	UMall	uft	08 51 30.0	+630748	35 ± 2	34.62	87.69	Feb	1,2
Ursa Minor	UMi	cls	15 09 08.5	+67 13 21	68 ± 2	38.46		May	1,22
ALCIN	W/SUL		10.40.21.0	151.01.00	20.7	00.01	75.30	24	1.14

References: (1, coordinates only) [?]; (2–22, distances only) [4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24]; (23–28, both data) [25, 26, 27, 28? ?].



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- Surviving sample:

7 Northern dSphs 6 Southern dSphs Table 2: Basic properties of the dSphs belonging to the MW subgroup and those of the LG not associated to major galaxies, ranked in alphabetical order. The dSphs from the M31 subgroup are not included. Objects indicated with "cls" are "classical" dSphs, whereas "uft" stands for "ultrafaint". Dashes in the cultination columns indicate objects that do not rise above the horizon in the relevant hemisphere. The names of targets within -100 kpc with cultimation centith angles ZA $\leq 30^\circ$ are highlighted in **boldface** for the Northern hemisphere and in *italic* for the Southern hemisphere respectively, for a total of 10 Northern and 11 Southern dSphs.

Name	Abbr.	Туре	R.A. (hh mm ss)	dec. (dd mm ss)	Distance (kpc)	${\rm ZA}_{\rm cubn} \: {\rm N} \: ({\rm deg})$	ZA _{culm} S (deg)	Month	Ref.
Andromeda XVIII	AndXVIII	uft	00 02 14.5	+45 05 20	1330 ± 104	14.62	70.00	Sep	1,2
Aquarius	Agr	uft	20 46 51.8	-125053	1030 ± 57	41.54	11.54	Aug	1.3
Boötes I	Boöl	uft	14 00 06.0	+14 30 00	65 ± 3	13.85	38.46	Apr	1,4
Boötes III	BoöIII	uft	13 57 12.0	+26 48 00	46 ± 2	1.54	40.77	Apr	1.5
Canes Venatici I	CVnI	uft	13 28 03.5	+33 33 21	216 ± 8	4.62	57.69	Apr	1,4
Canes Venatici II	CVnII	uft	12 57 10.0	+34 19 15	159 ± 8	6.15	59.23	Apr	1,4
Carina	Car	cls	06 41 36.7	-50 57 58	106 ± 1	80.00	26.92	Dec	1,6
Cetus I	CetI	uft	00 26 11.0	-11 02 40	748 ± 31	39.23	13.85	Sep	1.7
Columba I	Coll	uft	05 31 26.4	-28 01 48	182 ± 18	56.15	3.08	Dec	23
Coma Berenices	CBe	uft	12 26 59.0	+23 54 15	42 ± 2	5.38	47.69	Mar	1,8
Draco I	DraI	cls	17 20 12.4	+57 54 55	75 ± 4	29.23	83.08	Jun	1,9
Draco II	DraII	uft	15 52 47.6	+64 33 55	20 ± 3	34.62	88.46	May	24
Eridanus II	EriII	uft	03 44 21.5	-43 31 48	330 ± 16	72.31	18.46	Nov	25
Fornax	For	cls	02 39 59.3	-34 26 57	146 ± 1	63.08	10.00	Oct	1,6
Grus I	GruI	uft	22 56 42.4	-500948	120 ± 17	78.46	25.38	Sep	26
Gnu II	Grull	uft	22.04.04.8	-46 26 24	53 ± 5	75.38	22.31	Aug	23
Hercules	Her	uft	16 31 02.0	+12 47 30	137 ± 11	16.15	36.92	May	1,10
Hydra II	Hyall	uft	12 21 42.1	-31 59 07	134 ± 10	60.77	6.92	Mar	27
Indus II	IndII	uft	20 38 52.8	-46 09 36	214 ± 16	75.38	22.31	Aug	23
and the l	LanI	ale.	10.08.28.1	+12 18 23	272 ± 10	16.15	15.18	Eab	1.11
no II	LeoII	cls	11 13 28 8	+22.09.06	240 + 9	6.92	46.92	Mar	1.12
Leo IV	LeoIV	uft	11 32 57 0	-00 32 00	151 + 4	29.23	23.85	Mar	1.13
Leo V	LeoV	uft	11 31 09.6	+02 13 12	169 ± 5	26.15	26.92	Mar	1.13
Leo T	LeoT	uft	09 34 53.4	+170305	377 ± 28	12.31	42.31	Feb	1.14
Phoenix I	PheI	uft	01 51 06.3	-44 26 41	427 ± 31	73.85	20.00	Oct	1,14
Pictor I	PicI	uft	04 43 48.0	-50 16 48	126 ± 24	78.46	26.15	Nov	25
Pisces II	PscII	uft	22 58 31.0	+05 57 09	182 ± 13	23.08	30.77	Sep	1.15
Reticulum II	RetII	uft	03 35 40.9	-54.03.00	32 ± 2	83.08	29.23	Nov	25
Reticulum III	RetIII	uft	03 45 26.3	-60 27 00	92 ± 13	88.46	35.38	Nov	23
Sagittarius I	SgrI	uft	18 55 19.5	-30 32 43	31 ± 1	59.23	6.15	Jul	1,16
Sagittarius II	SgrII	uft	19 52 40.5	-22 04 05	67 ± 5	51.54	2.31	Jul	24
Sculptor	Scl	cls	01 00 09.4	-33 42 33	84 ± 2	63.08	9.23	Oct	1,17
Segue 1	Seg1	uft	10 07 04.0	+16 04 55	23 ± 2	12.31	40.77	Feb	1,18
Sextans	Sex	cls	10 13 03.0	-01 36 53	84 ± 3	30.77	23.07	Feb	1,13
Friangulum II	Trill	uft	02 13 17.4	+36 10 42	30 ± 2	6.92	60.77	Oct	28
Tucana I	TucI	uft	22 41 49.6	-64 25 10	855 ± 35		40.00	Sep	1,7
Tucana II	TucII	uft	22 52 16.7	-58 33 36	58 ± 6	86.92	33.85	Sep	25
Tucana III	Tuelli	uft	23 56 35.9	-59 36 00	25 ± 2	87.69	34.62	Sep	23
Incana IV	TUCIV TIM-T	un	10 24 53 8	-60 51 00	48 ± 4	89.23	35.38	Sep	1.20
Ursa Major II	UMal	uft	08 51 30 0	+63 07 48	35 + 2	34.62	87.69	Eeb	1.20
L M	TIM	ala	15 00 09 5	(67 13 31	69.7	20 46	07.07		1.00
UPSa MUROF	5 U M U	10.10	1 2 119 110 2	THE	DA # 2	375 (40)		NIAV	1.2.2

References: (1, coordinates only) [?]; (2-22, distances only) [4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24]; (23-28, both data) [25, 26, 27, 287 ?].





- In-house calculation of astrophysical factors for DM annihilation and decay in dSphs — *IN PROGRESS*
 - Jeans analysis with CLUMPY v3.0.1 (Hütten+ 2019)
 - Input data: dSph surface brightness profile + kinematics of dSph member stars



$$\frac{1}{n^*(r)} \left\{ \frac{d}{dr} \left[n^*(r) \overline{v_r^2} \right] \right\} + \frac{2}{r} \beta_{\text{ani}}(r) \overline{v_r^2} = -\frac{G[M_{\text{DM}}(r) + M_*(r)]}{r^2}$$

$$n^{*}(r) = \frac{n_{\rm s}^{*}}{\left(\frac{r}{r_{\rm s}^{*}}\right)^{\gamma^{*}} \left[1 + \left(\frac{r}{r_{\rm s}^{*}}\right)^{\alpha^{*}}\right]^{\frac{\beta^{*} - \gamma^{*}}{\alpha^{*}}}}$$

$$p_{\text{mem}}(v_i, W_i) = \frac{\exp\left\{-\frac{1}{2}\left[\frac{(v_i - \langle v_{\text{mem}} \rangle)^2}{\sigma_{\text{mem}}^2 + \sigma_i^2} + \frac{(W_i - \langle W_{\text{mem}} \rangle)^2}{\Delta W_{\text{mem}}^2 + \Delta W_i^2}\right]\right\}}{2\pi\sqrt{(\sigma_{\text{mem}}^2 + \sigma_i^2)(\Delta W_{\text{mem}}^2 + \Delta W_i^2)}}$$





- In-house calculation of astrophysical factors for DM annihilation and decay in dSphs — *IN PROGRESS*
 - dSph surface brightness parameters computed for the whole selected sample

	$oldsymbol{ ho}^*$ s (107 L $_\odot$ /kpc ³)	<i>r</i> *s (pc)	α*	β*	γ^*
Boöl	0.287 ± 0.053	176.1 ± 5.3	0.6	3.2	0.6
Boölll	0.23 ± 0.10	3.91 ± 0.17	0.4	1.0	3.6
СВе	1.53 ± 0.70	85.1 ± 7.7	0.4	3.4	1.2
Dral	102 ± 28	58.0 ± 4.6	0.6	2.6	0.0
Grull	0.190 ± 0.035	75.6 ± 7.1	0.6	2.8	0.6
Retll	2.98 ± 0.27	25.0 ± 1.6	0.6	3.0	1.0
Scl	770 ± 360	31.5 ± 2.2	0.2	2.4	1.0
Seg1	35 ± 26	5.92 ± 0.51	0.6	3.2	0.2
Sex	0.41 ± 0.19	255 ± 12	0.8	3.0	0.2
Sgrl	6.6 ± 1.8	473 ± 36	0.2	3.0	1.6
Sgrll	123 ± 11	7.97 ± 0.57	0.4	2.4	0.2
Trill	13.1 ± 6.0	30.8 ± 2.1	0.2	2.6	1.6
Wil1	73 ± 54	8.1 ± 1.5	0.4	2.8	0.2 18

 In-house calculation of astrophysical factors for DM annihilation and decay in dSphs — *IN PROGRESS*

- J/D-factor profiles to be computed as a function of the integration angle up to 2^o for both cuspy (Einasto) and cored (Burkert) DM density profiles
- 2D maps of J/D-factors to be computed up to 10° FoV for both DM density profiles





Upper Limits 95% CL CTOOLS v1.5.1:



Upper Limits 95% CL CTOOLS v1.5.1:

Integrated values J(alpha_int = 10^o)



Summary

- We will include the limits for extended Sources in the paper
- We are calculating upper limits for all the selected targets
- Compatibility with gammapy is under study.
- Update to the last IRFs
- Study IRF systematics.
- We are updating the final draft of the document

CTA CONTRIBUTION TO DM RESEARCH



Gabrijela Zaharijas DMEP group Status Report May 21 2020

CTA CONTRIBUTION TO DM RESEARCH (SUMMARY)

- CTA has good prospects to probe for the first time WIMP models with thermal relic cross-section and masses above 200 GeV;
- Together with Fermi CTA will be able to exclude thermal WIMPs within the mass range from a few GeV up to a few tens of TeV.
- For heavy WIMPs (>TeV) CTA will provide unique observational data to probe parameter space not reachable by the other experiments.
- CTA is complementary instrument to LHC and direct DM searches probing some non-overlapping regions of DM particle parameter space.
- If DM is detected by CTA, it will also be possible to explore some properties of DM particle through the study of annihilation channels, etc.
- Control of systematics in deep observations of GC halo and dSph(s) is critical for the success of these studies and will require full knowledge of the instrumentation (hence CTA KSP)
- Better understanding of J factors is essential for interpretation of observational data and derivation of limits.