« Dark Matter targets »

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LPNHE
Salle Jonquille

Dark Matter: from clumps to Galaxies

Hierarchical structure formation
=> In Λ-CDM, small structures form first, big ones later (merging)

Mini-halo are potential wells which accrete baryons
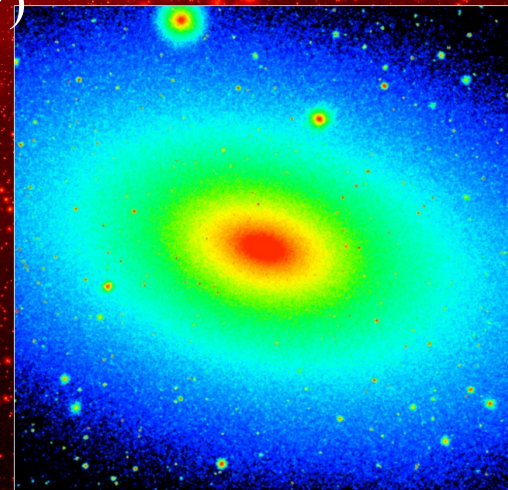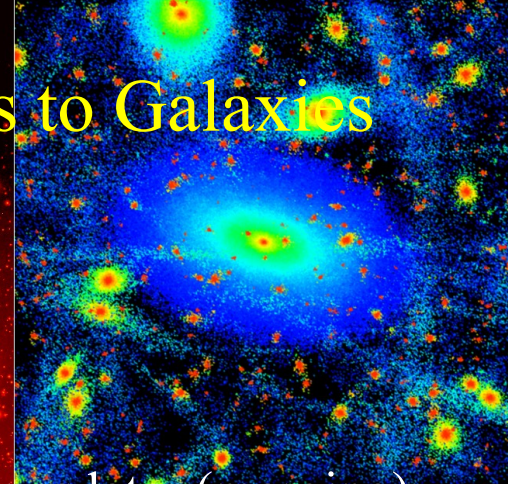=> small surviving halos are pure DM (clumps)
=> dSphs are dark matter dominated

Best to look for annihilations where DM density is as large as possible
=> Galactic center (but astrophysically polluted)
=> dSphs (DM spatial distribution in their core?)
=> Clumps (but where to look for?)

More and more discovered...

Name	Year Discovered
LMC	1519
SMC	1519
Sculptor	1937
Fornax	1938
Leo II	1950
Leo I	1950
Ursa Minor	1954
Draco	1954
Carina	1977
Sextans	1990
Sagittarius	1994
Canis Major	2003
Ursa Major I	2005
Willman I	2005
Ursa Major II	2006
Bootes	2006
Canes Venatici I	2006
Canes Venatici II	2006
Coma	2006
Leo IV	2006
Hercules	2006
Leo T	2007
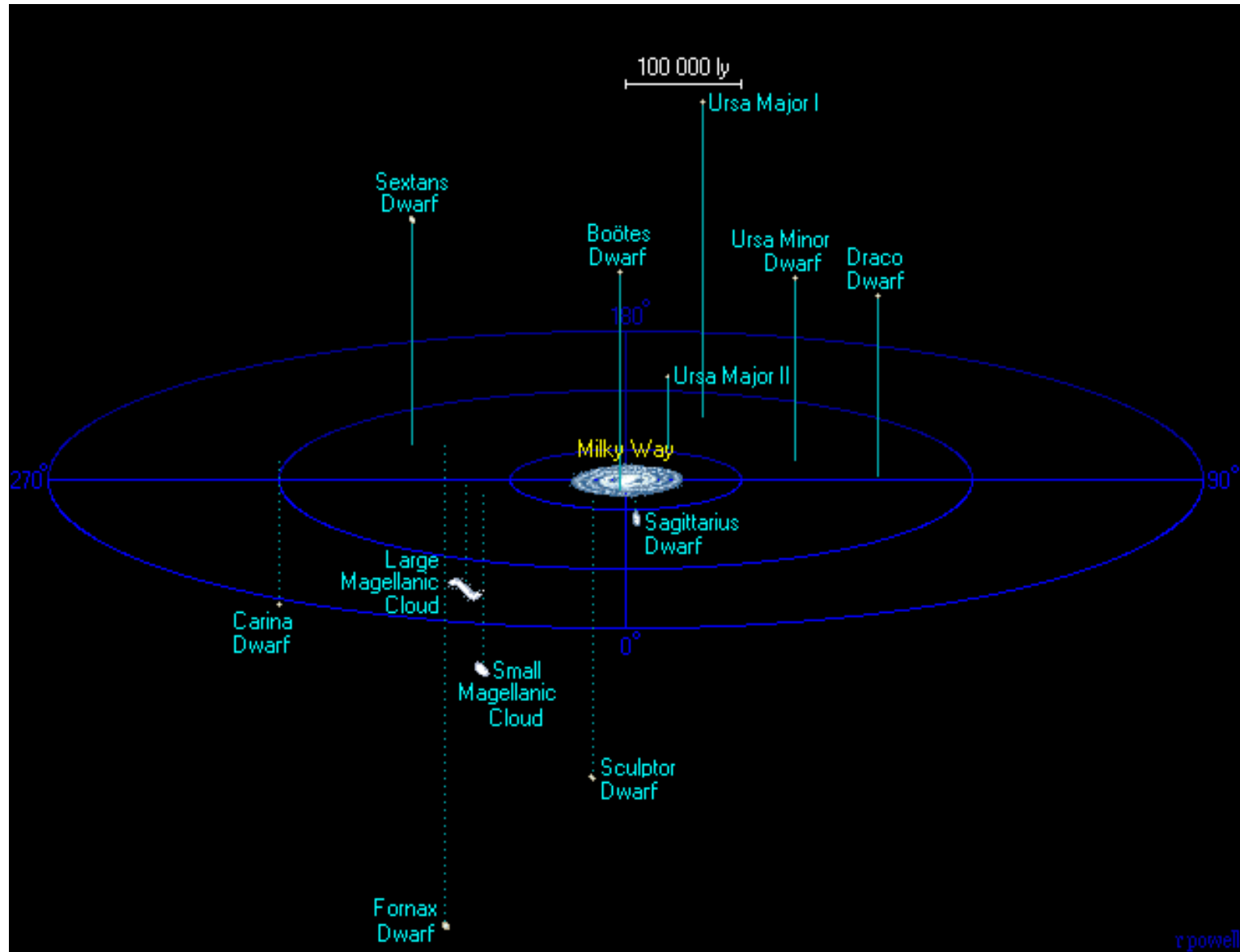
But not all visible for ACT (e.g. H.E.S.S.)
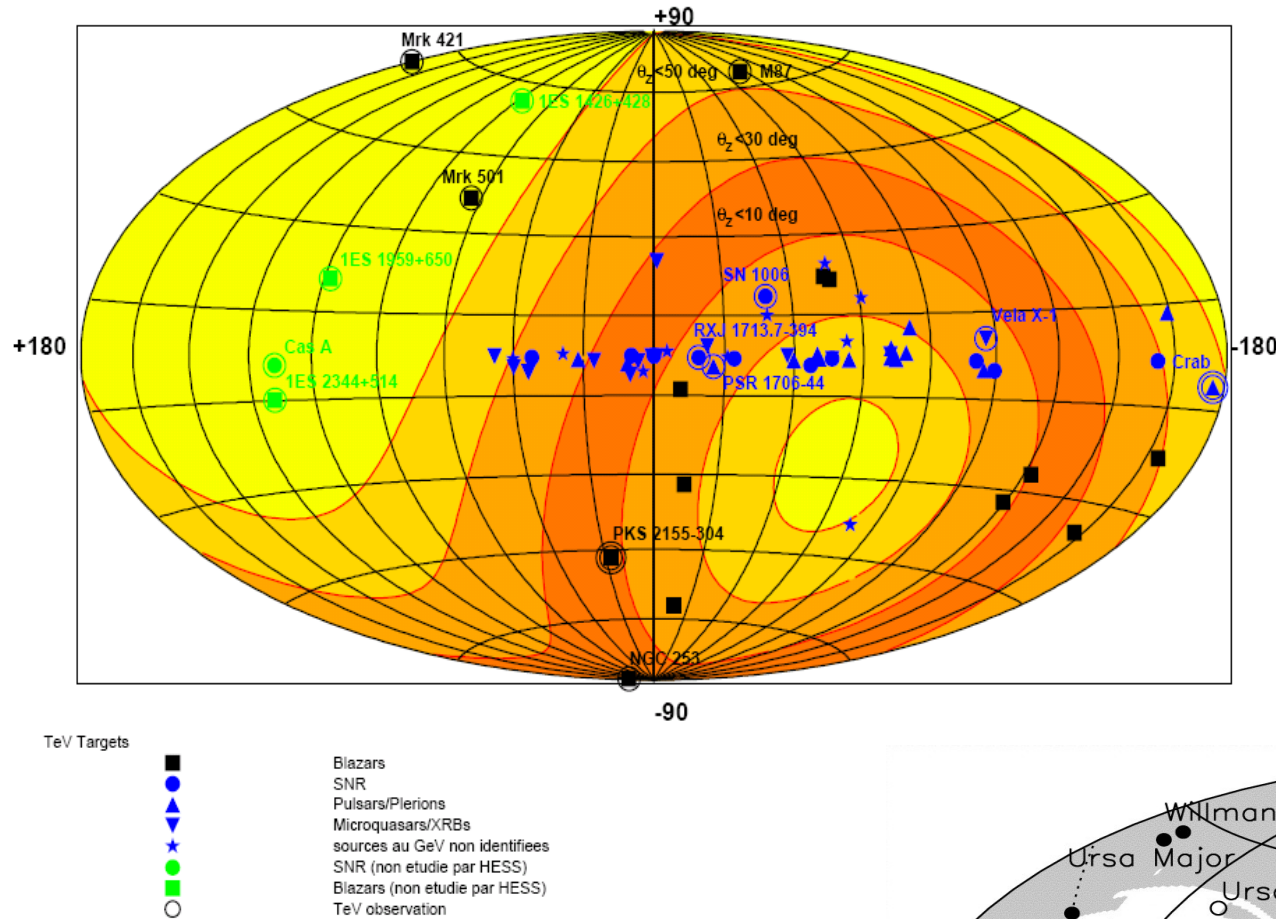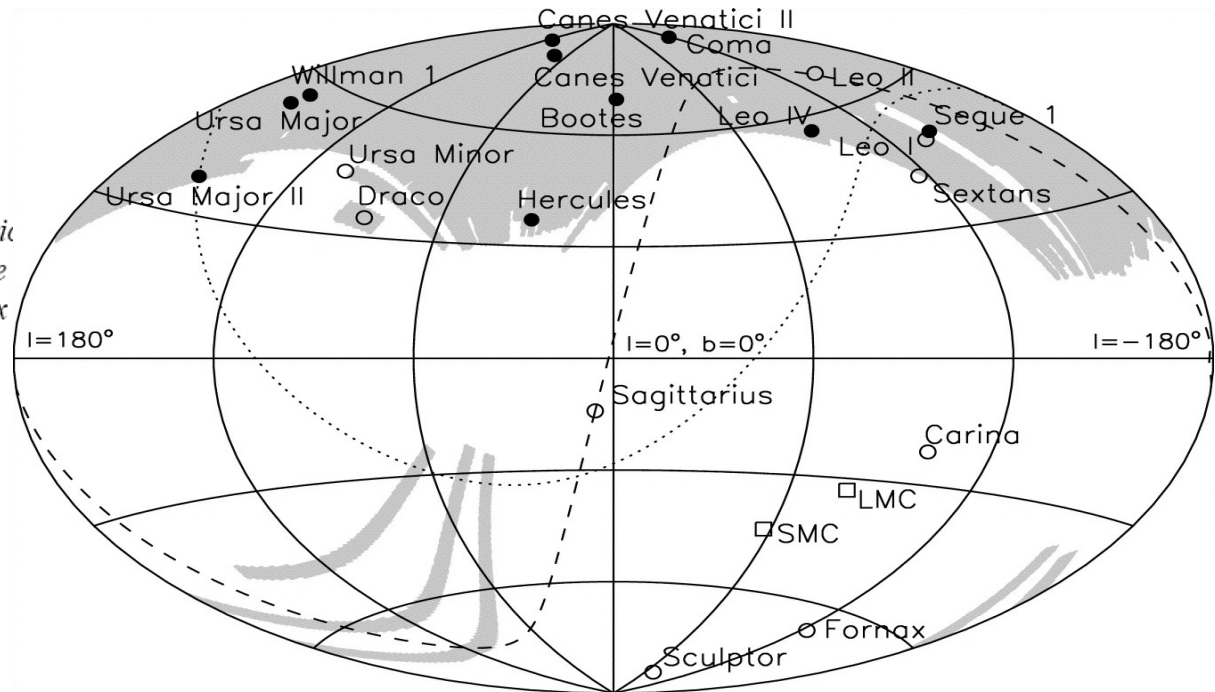

Figure 7.4: *Les contours indiquent l'angle zénithal maximal de chaque régio
zénithal maximal est indiqué dans chaque bande. La bande la plus foncée
à moins de 10° du zénith. Les bandes les plus claires correspondent aux
zénithal, > 50°.*

Dwarf spheroidals (dSphs)
as targets for dark matter indirect detection through γ-ray annihilations

Where to look at?
What do we expect to detect?

- There are known knowns. There are things we know that we know.

- There are known unknowns. That is to say, there are things that we now know we don't know.

- But there are also unknown unknowns. There are things we do not know we don't know.

Donald Rumsfeld (2002)
[post-invasion Afghanistan]

Known unknowns
and
unknown unknowns

Experiments

- TeV: Čerenkov Arrays (HESS, CTA)
- GeV: Fermi
[+ Multi-Wavelength signatures]

Particle physics model

$$\frac{d\Phi^{pp}}{dE_\gamma}(E_\gamma) = \frac{1}{4\pi} \frac{\langle \sigma v \rangle}{2m_\chi^2} \frac{dN_\gamma}{dE_\gamma}$$

$$\frac{d\phi^{tot}}{dE_\gamma}(E_\gamma, \psi, \Delta\Omega) = \frac{d\phi^{pp}}{dE_\gamma}(E_\gamma) \times \phi^{cosmo}(\psi, \Delta\Omega)$$

$$\Phi^{cosmo}(\psi, \Delta\Omega) = \int_{\Delta\Omega} d\Omega \int_{los} dl \, \rho^2(l, \psi)$$

Cosmology vs dynamics

What are the best targets?
- the closer the better
- the less massive, the most DM dominated

Dark matter distribution

- Cored or cusped?
- Substructure boost?