Neutrinos from Dark Matter annihilations at the Galactic Centre

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We discuss the prospects for detection of high energy neutrinos from dark matter annihilation at the Galactic centre. Despite the large uncertainties associated with our poor knowledge of the distribution of dark matter in the innermost regions of the Galaxy, we determine an upper limit on the neutrino flux by requiring that the associated gamma-ray emission does not exceed the observed flux. We conclude that if dark matter is made of neutralinos, a neutrino flux from dark matter annihilations at the GC will not be observable by Antares. Conversely, the positive detection of such a flux would either require an alternative explanation, in terms of astrophysical processes, or the adoption of other dark matter candidates, disfavouring the case for neutralinos.

I. INTRODUCTION

There is robust observational evidence for the dominance of non-baryonic dark matter over baryonic matter in the universe. Such evidence comes from many independent observations over different length scales. The most stringent constraint on the abundance of dark matter comes from the analysis of CMB anisotropies. In particular, the WMAP experiment restricts the abundance of matter to lie in the range $\Omega_M h^2 = 0.135^{+0.008}_{-0.009}$ [1]. The same type of analysis constrains the amount of baryonic matter to be in the range $\Omega_b h^2 = 0.0224 \pm 0.0009$, in good agreement with predictions from Big Bang nucleosynthesis $0.018 < \Omega_b h^2 < 0.023$ (e.g. Ref. [2]).

It is commonly believed that such a non-baryonic component could consist of new, as yet undiscovered, particles, usually referred to as WIMPs (Weakly Interacting Massive Particles). It is intriguing that some extensions of the standard model of particle physics predict the existence of particles that would be excellent DM candidates. In particular great attention has been recently devoted to candidates arising in supersymmetric theories. The lightest supersymmetric particle (LSP), which in most supersymmetric scenarios is the so–called *neutralino*, is stable in theories with conservation of R–parity, and can have masses and cross sections of typical WIMPs.

One possible way of probing the nature of dark matter particles is to look for their annihilation signal [3]. For this purpose, the best regions to examine are those where the dark matter accumulates, the annihilation rate being proportional to the square of the particle number density. A wide literature exists discussing the prospects of observing annihilation radiation from the Galactic centre (e.g. Refs. [4, 5, 6]), high energy neutrinos from the Sun (e.g. Refs. [7, 8, 9]), gamma-rays and synchrotron from dark matter clumps in the galactic halo (e.g. Refs. [10, 11, 12, 13]), gamma-rays from external galaxies (e.g. Refs. [14, 15, 16, 17]), positrons and antiproton (e.g. Refs. [18, 19, 20, 21]) and more.

Large uncertainties are associated with predictions of annihilation fluxes, due to our poor knowledge of the distribution of dark matter, especially in the innermost regions of the Galaxy. Numerical simulations suggest that the dark matter density is well approximated by "cuspy" profiles, with a power-law behaviour $\rho \propto r^{-\gamma}$. Estimates of γ vary between having no cusp, $\gamma \sim 0$, [22], to a cusp $\gamma = 1$ that is further steepened by adiabatic compression of the baryons [23]. One can trace these differences in large part to uncertainties in the stellar mass in the inner galaxy as inferred from microlensing experiments. The poor knowledge of γ implies uncertainties of several orders of magnitude in the annihilation flux. The situation is made even worse by the possible influence on the dark matter profile of the probable adiabatic formation of the supermassive black hole lying at the Galactic centre. Such uncertainties make indirect searches less effective for constraining the physical parameters (such as mass and cross sections) of dark matter particles.

We suggest here a method for evading the astrophysical uncertainties in the neutrino flux, by requiring that the associated gamma-ray emission does not exceed the flux observed by the EGRET experiment in the direction of the Galactic centre. In fact, if we normalize the gamma-ray flux to the EGRET data, the corresponding neutrino flux will be an *upper limit* on the actual neutrino flux measurable on Earth. Choosing the EGRET normalization corresponds to fixing the product $J\sigma v N_\gamma$, where the quantity J, defined below, includes all of the astrophysical information, σv is the total annihilation cross section and N_γ is the number of photons produced per annihilation.

This paper is organised as follows: we first discuss the gamma–ray source observed by the EGRET satellite in the direction of the Galactic centre ; in Sec. III we briefly review the results on the distribution of dark matter from observations and N-body simulations. In Sec. IV we present the particle physics details of our candidate, the neutralino, arising in supersymmetric theories, in Sec. V we review the prospects of indirect detection of such candidates through gamma–ray and neutrino emission, for a

typical dark matter profile, and in Sec. VI we compare the prospects of indirect detection through annihilation radiation from the GC with other searches. We present in Sec. VII the upper limit on the neutrino flux, obtained by normalizing the annihilation flux to the EGRET data, and we finally give our conclusions in Sec. VIII.

II. THE EGRET SOURCE AT THE GALACTIC CENTRE

The Galactic centre region has been observed by EGRET, the Energetic Gamma Ray Experiment Telescope, launched on the Compton Gamma Ray Observatory in 1991, and sensitive to an energy range 30MeV–30GeV. A strong excess of emission was observed in an error circle of 0.2 degree radius including the position $l = 0°$, $b = 0°$, the strongest emission maximum lying within 15 degrees from the GC [24].

The radiation exceeds, and also is harder than, the expected gamma ray emission due to the interaction of primary cosmic rays with the interstellar medium (see *e.g.* Strong *et al.* 1998 [25]). At the energies we are interested in, $E \gtrsim 1$ GeV, the main source of photons is the decay of π^0 mesons originating from processes such as

$$p + X \rightarrow \pi^0$$

$$He + X \rightarrow \pi^0$$
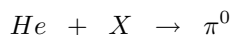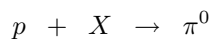
where X is an interstellar atom. The interested reader will find a detailed estimate of the background radiation in Cesarini *et al.* 2003 [26].

It is intriguing to conjecture that such excess emission could originate from dark matter annihilation at the Galactic centre . However, such an interpretation is problematic. In fact, as noticed by Hooper and Dingus [27], the EGRET source is not exactly coincident with the Galactic centre , which would make the interpretation of the signal as due to the annihilation in a spike around the Galactic centre at least problematic.

Furthermore there is some evidence, although weak, that the source could be variable. Such a result could rule out completely the interpretation of the excess emission as due to annihilation radiation from the Galactic centre . The variability of 3EG J1746-2851 has been recently discussed in Nolan *et al.* 2003 [28]. An additional flaw has been pointed out by P.Salati [58], namely the fact that the HI column density was merely interpolated in the region of interest, where it was thought to be unreliable due to strong self-absorption and high optical thickness. It is an open question how the conclusions would change if different assumptions are made about the HI column density.

Here, we will regard the EGRET observation as an *upper limit* on the annihilation gamma-ray flux from the Galactic centre.

III. DARK MATTER DISTRIBUTION

The usual parametrization for dark matter density profiles is

$$\rho(r) = \frac{\rho_0}{(r/R)^\gamma [1 + (r/R)^\alpha]^{(\beta-\gamma)/\alpha}} \quad . \qquad (1)$$

where r is the galacto-centric coordinate, R is a characteristic length and α, β and γ are free parameters.

There is consensus, at present, about the shape of the profile in the outer parts of halos, but not in the innermost regions, due to loss of numerical resolution in N-body simulations and to the poor resolution in observation of rotation curves of outer galaxes. Navarro, Frenk & White [29], found with N-body simulations that the profile could be well approximated at small radii with a power-law $\rho(r) = r^\gamma$ with $\gamma \sim 1$. Other groups reached different conclusions (see e.g. Refs. [30, 31]).

The most recent N-body simulations [32, 33, 34] suggest that profiles do not approach power laws with a well-defined index at very small radii. Profiles continue to become shallower, i.e. the (negative) logarithmic slope becomes higher, when moving towards the centre. Some authors however contend that convergence is reached with $\gamma \approx 0.2 - 0.3$ at 0.3% of the virial radius [35].

An additional complication of the dark matter profile at the center of our Galaxy, is the well-established presence of a a 3.6×10^6 solar mass black hole (see e.g.Ref. [43]), that would accrete dark matter, producing a so-called 'spike' [44], and leading to an enhancement of the annihilation flux by several orders of magnitude (see Ref. [6], and references therein, for a discussion of indirect detection of dark matter in presence of spikes, and of dynamical effects that could potentially destroy them).

The observational situation is even less clear. The analysis of rotation curves of galaxies has led some authors to claim inconsistency of the observed 'flat' profiles with the cuspy profiles predicted by N-body simulations. Other groups [46, 47] claim instead that cuspy profiles are compatible with observations. Hayashi et al [32] compared the observational data directly with their numerical simulations (rather than fits of their simulations) and found no significant discrepancy in most cases. They attributed the remaining discrepancies to the difference between circular velocities and gas rotation speed in realistic triaxial halos.

It is clear that the predictions of annihilation fluxes are strongly affected by the uncertainties in dark matter distribution. In particular, since the annihilation rate is proportional to the square of the particle density, different profiles can lead to uncertainties of many orders of magnitude. To get around these, we will use the gamma–ray flux observed by EGRET in the direction of the Galactic centre , to get rid of astrophysical uncertainties and produce a robust upper limit on the neutrino flux from dark matter annihilation at the Galactic centre .

IV. SUPERSYMMETRIC DM: NEUTRALINOS

Neutralinos are by far the best studied dark matter candidates. They arise in supersymmetric theories with conservation of R-parity, in which the lightest supersymmetric particle (LSP) cannot decay in standard model particles, and is thus stable. In most cases the LSP is the neutralino, i.e. a linear combination of the supersymmetric partners of the gauge and higgs bosons

$$\chi(\equiv \tilde{\chi}_1^0) = z_{11}\tilde{B} + z_{12}\tilde{W}_3 + z_{13}\tilde{H}_1^0 + z_{14}\tilde{H}_2^0. \quad (2)$$

The matrix z diagonalizes the neutralino mass matrix, which is expressed as

$$\begin{pmatrix} M_1 & 0 & -m_Z c_\beta s_W & m_Z s_\beta s_W \\ 0 & M_2 & m_Z c_\beta c_W & -m_Z s_\beta c_W \\ -m_Z c_\beta s_W & m_Z c_\beta c_W & 0 & -\mu \\ m_Z s_\beta s_W & -m_Z s_\beta c_W & -\mu & 0 \end{pmatrix} \quad (3)$$

in the basis $(\tilde{B}, \tilde{W}_3, \tilde{H}_1^0, \tilde{H}_2^0)$.

Similarly defining $V_{11(2)}$ as the wino (higgsino) fraction of the lightest chargino, the neutralino annihilation channels and cross-sections most relevant for indirect detection are

$$\chi\chi \xrightarrow{A} b\bar{b} \quad : \sigma \propto [z_{11(2)}z_{13(4)}]^2$$
$$\chi\chi \xrightarrow{Z} Zh \quad : \sigma \propto [z_{13(4)}^2]^2$$
$$\chi\chi \xrightarrow{\chi^+} W^+W^- : \sigma \propto [z_{13(4)}V_{12}]^2 \text{ and/or } [z_{12}V_{11}]^2 \quad (4)$$

Annihilation in these channels thus increases with the wino or higgsino fraction of the neutralino. The spectra of the indirect detection signals studied here keep an imprint of the dominant channel.

For muon via neutrino production: the W^+W^- and Zh channels produce more energetic neutrinos, *i.e* a harder neutrino spectrum than $b\bar{b}$. Both the neutrino-nucleon cross section ($\sigma_{\nu-N}$) and the muon range (R_μ) being proportional to neutrino energy, harder spectra give higher muon detection rates for the threshold considered here (5 GeV): $\phi_\mu \propto \phi_\nu \sigma_{\nu-N}(E_\nu) R_\mu(E_\nu)$.

For gamma production: the $b\bar{b}$ and also $t\bar{t}$ channels dominate the γ spectra around 2 GeV but at higher energies, the harder WW and Zh channels come in. Experiments with different thresholds can thus see different processes.

The influence of the dominant annihilation channel is displayed on figure 6 below.

We have performed a scan of SUSY models at the GUT scale, computing renormalisation group equations and radiative electroweak symmetry breaking with `Suspect` [36], the neutralino relic density with `Micromegas` [37] and detection rates with `Darksusy` [38] [59]. The SUSY models explored fall in 3 classes (see [8] for definitions)

CMSSM: with universal scalar m_0 and gaugino $m_{1/2}$ mass parameters in the ranges:
$50\text{GeV} < m_0 < 4000\text{GeV}, 50\text{GeV} < m_{1/2} < 2000\text{GeV},$
$A_0 = 0, \tan\beta = 5, 20, 35$

Non universal gaugino mass $M_2|_{GUT}$: same values as above, except for $M_2|_{GUT} = 0.6m_{1/2}$ (instead of $1m_{1/2}$), leading to $M_2 \sim M_1$ in the neutralino mass matrix (eq. 3); the resulting non-zero wino contents (z_{12}) allows for non-negligible relic densities.

Non universal gaugino mass $M_3|_{GUT}$: same values as in the universal case ($\tan\beta = 20, 35$ only) with $M_3|_{GUT} = 0.6m_{1/2}$ (instead of $1m_{1/2}$), to decrease the μ parameter in the neutralino mass matrix (eq. 3) to favour the higgsino fraction ($z_{13(4)}$) and decrease scalar masses, in particular the pseudo scalar A mass. We do not relax Higgs sector universality, whose interesting effects on dark matter are similar to those of a lower $M_3|_{GUT}$.

Finally, we apply the following conservative cuts on our models:

- Higgs mass: $m_h > 113.5$ GeV [39],

- Chargino mass: $m_{\chi^+} > 103.5$ GeV [40],

- Relic density: $0.03 < \Omega_\chi h^2 < 0.3$, but we also show the WMAP [1] range $\Omega_{CDM}^{WMAP}h^2 = 0.1126^{+0.0161}_{-0.0181}$,

- $b \to s\gamma$ Constraint [41]:
  $2.33 \times 10^{-4} < \text{BR}(b \to s\gamma) < 4.15 \times 10^{-4}$,

- The muon anomalous magnetic moment [56]:
  $8.1\ 10^{-10} < \delta_\mu^{susy} = \delta_\mu^{exp} - \delta_\mu^{SM} < 44.1\ 10^{-10}$ [2σ].

Given the recent evolution of this last range, the ongoing debate about the use τ-decay data [57] and the drastic effect of this 2σ cut, which both excludes the SM and many interesting dark matter models, the range $0 < \delta_\mu^{susy} < 8.1\ 10^{-10}$ will not be discarded, but displayed in pale on all plots.

V. GAMMA–RAY AND NEUTRINO FLUX FROM THE GC

Indirect detection of Dark Matter is based on observation of annihilation products like gamma-rays, neutrinos or synchrotron emission of secondary electron–positron pairs. The spectrum of secondary particles of species i from annihilation of DM particles whose distribution follows a profile $\rho(r)$ where r is the Galacto–centric coordinate, is given by

$$\Phi_i(\psi, E) = \sigma v \frac{dN_i}{dE} \frac{1}{4\pi M^2} \int_{\text{line of sight}} ds\rho^2(r(s,\psi)) \quad (5)$$

where the coordinate s runs along the line of sight, in a direction making an angle ψ respect to the direction of the GC. σv and dN_i/dE are respectively the annihilation cross section and the spectrum of secondary particles per annihilation, while M is the mass of the annihilating DM particle.

To isolate the factor depending on astrophysics, i.e. the integral of ρ^2 along the line of sight, we introduce,

following [5], the quantity $J(\psi)$

$$J(\psi) = \frac{1}{8.5\,\text{kpc}} \left(\frac{1}{0.3\,\text{GeV/cm}^3}\right)^2 \int_{\text{line of sight}} d\,s\rho^2\,(r(s,\psi))$$

(6)

and its average over a spherical region of solid angle $\Delta\Omega$, centered on $\psi = 0$, $\overline{J}(\Delta\Omega)$.

With these definitions the flux from a solid angle $\Delta\Omega$ is

$$\Phi_i(\Delta\Omega, E) \simeq 5.6 \times 10^{-12} \frac{dN_i}{dE} \left(\frac{\sigma v}{\text{pb}}\right) \left(\frac{1\,\text{TeV}}{\text{M}}\right)^2 \overline{J}(\Delta\Omega)$$
$$\times \Delta\Omega\,\text{cm}^{-2}\text{s}^{-1}\,. \quad (7)$$

Apart from astrophysics, large uncertainties on the quantities in eq. 7 are associated with the details of particle physics. The dependence of the annihilation cross section on the mass M_χ is different for each DM candidate, and even in the framework of a specific supersymmetric scenario, cross sections for a given mass could span over several orders of magnitude.
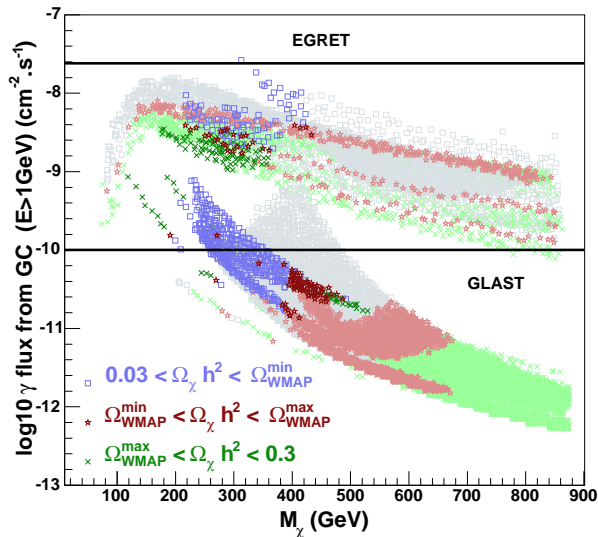
and consider the EGRET source as an upper limit on the WIMP annihilation flux. In this sense, we see from Fig. 1 that if neutralinos are the dark matter particle, then there is room for profiles even more "cuspy" than NFW.

Always assuming a NFW profile, we show in Fig. 2 the neutrino-induced muon flux from dark matter annihilation at the GC. We show for comparison the expected sensitivity of the Antares telescope (e.g. [48], currently under construction in the Mediterranean sea. The telescope sensitivity depend on the incoming neutrino spectrum, we thus show two sensitivity curves (for a 3-years period of observation), one relative to a hard flux (relevant for the W^+W^- and Zh channels), the other relative to a soft flux (relevant for the $b\bar{b}$ channel).As can be seen, the predictions fall several orders of magnitude below the Antares sensitivity. Of course, at this stage, this does not necessarily imply that Antares will not observe any neutrinos from the Galactic centre , as we have seen in the previous section that it is possible that the actual dark matter profile is steeper than NFW, adopted for Figs. 1 and 2.

FIG. 1: Gamma–ray flux from neutralino annihilation at the GC, assuming a NFW profile. For comparison we show the EGRET and GLAST sensitivities. Shades paler than in the legend denote a low δ_μ^{susy} value.
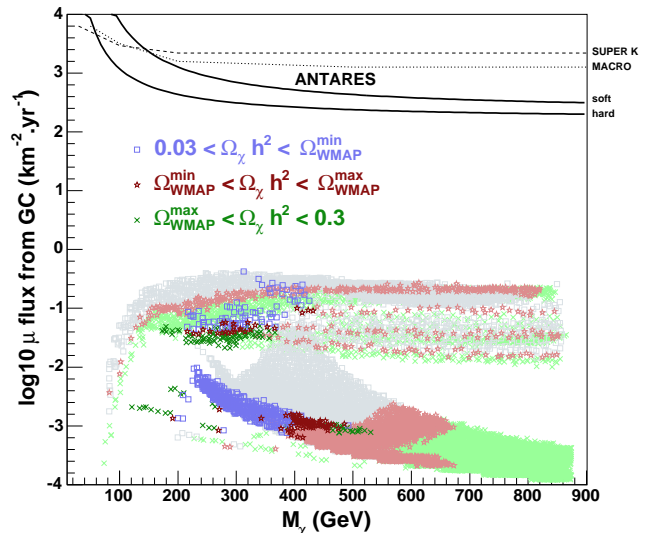

FIG. 2: Neutrino-induced muon flux from neutralino annihilation at the GC, assuming a NFW profile. For comparison we show the expected Antares sensitivity. Shades paler than in the legend denote a low δ_μ^{susy} value.

We show in Fig. 1 the gamma–ray flux from neutralino annihilation at the Galactic centre assuming a NFW profile, along with EGRET and GLAST sensitivities. We see that all the supersymmetric models predict fluxes below the EGRET sensitivity in this case, but many of them could produce fluxes observable by GLAST.

Nevertheless, as already mentioned, EGRET *did* observe a source at the Galactic centre , although it is unclear whether this emission is actually to be attributed to WIMP annihilations. We adopt a conservative approach

VI. COMPARISON WITH OTHER SEARCHES

In this section we compare, for completeness, the prospects of detection of the SUSY models discussed above with other detection techniques, which are actually insensitive to the profile of dark matter in the innermost regions of the Galaxy.

In Fig. 3 we show the flux of neutrinos from neutralino annihilation in the solar core. The projected sensitivities of both Antares and IceCube [49] appear to be able to probe the supersymmetric models with the non-negligible higgsino fraction necessary for an efficient neutralino capture rate in the Sun.
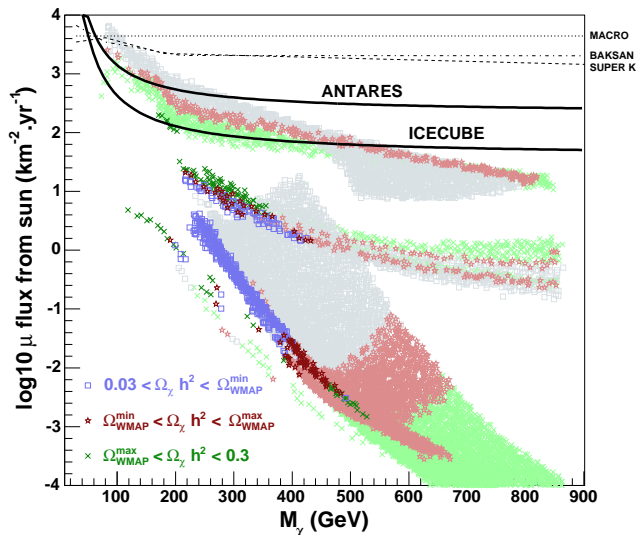

FIG. 3: Neutrino-induced muon flux from neutralino annihilation in the solar core. Shades paler than in the legend denote a low $\delta_\mu^{\mathrm{susy}}$ value.

We also show in Fig. 4 the potential of direct detection techniques to probe the neutralino nature through the search for neutralino-nucleon interactions in large detectors, such as Edelweiss [50] and CDMS [51]. There are a couple of orders of magnitude between the present -day experiment sensitivities and the most optimistic predictions for neutralinos. But this gap could be bridged by next-generation experiments such as Edelweiss II (e.g. [52]) and Zeplin [53].

VII. UPPER LIMIT FOR THE NEUTRINO FLUX

In order to maximize the neutrino flux from dark matter annihilation at the Galactic centre , we normalize the flux of gamma–rays, associated with such a neutrino flux, to the EGRET data. This corresponds to fixing, for each model, the product $J\,\sigma v\,N_\gamma$, with $N_\gamma = \sum_i N_i\,R_i$; here R_i is the branching ratio of all the channels i contributing N_i gamma–rays above a given threshold energy.

Having fixed the particle physics contents of our dark matter candidate, the ratio between the number of photons and the number of neutrinos emitted per annihilation is known. We can thus estimate the neutrino flux from the Galactic centre associated with a gamma-ray
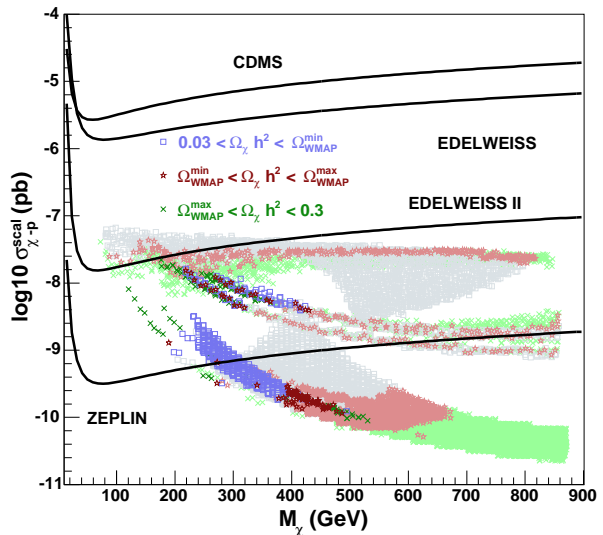

FIG. 4: Prospects of neutralino direct detection. Shades paler than in the legend denote a low $\delta_\mu^{\mathrm{susy}}$ value.

emission reproducing the EGRET data. Finally we can convert the flux of neutrinos into a flux of muons, produced by neutrinos interactions with the rock around detectors on Earth, in order to compare with experimental sensitivities.

The rescaled flux of muons $\phi_\mu^{\mathrm{norm}}(> E_{th})$ will thus be given by

$$\phi_\mu^{\mathrm{norm}}(> E_{th}) = \frac{\phi_\mu^{\mathrm{NFW}}(> E_{th})\,\phi_\gamma^{\mathrm{EGRET}}(E_*)}{\phi_\gamma^{\mathrm{NFW}}(E_*)} \quad (8)$$

where the label NFW reminds that NFW profiles have been used to compute profile-independent flux ratios, and E_* is the energy at which we decide to normalize the flux to the gamma-ray data (in our case $E_* = 2\,\mathrm{GeV}$).

The results are shown in Figs. 5 and 6. The muon flux normalised to the EGRET data represent an upper limit, as the observed gamma–ray emission could be due to processes other than dark matter annihilation. The comparison with the Antares sensitivity shows that only the highest mass neutralinos can possibly be detected in the Galactic centre. Insisting on the WMAP relic density in Fig. 6 and using the hard neutrino spectrum sensitivity appropriate to the relevant Zh channel, we need at least 700 GeV neutralinos, whose contribution to the muon anomalous moment is similar to the (excluded?) Standard Model.

If neutrinos are nevertheless observed above the given fluxes, then their interpretation as due to neutralino annihilation is problematic and would actually require either the adoption of other dark matter candidates annihilating dominantly into neutrino pairs or a different explanation, e.g. in terms of astrophysical sources.
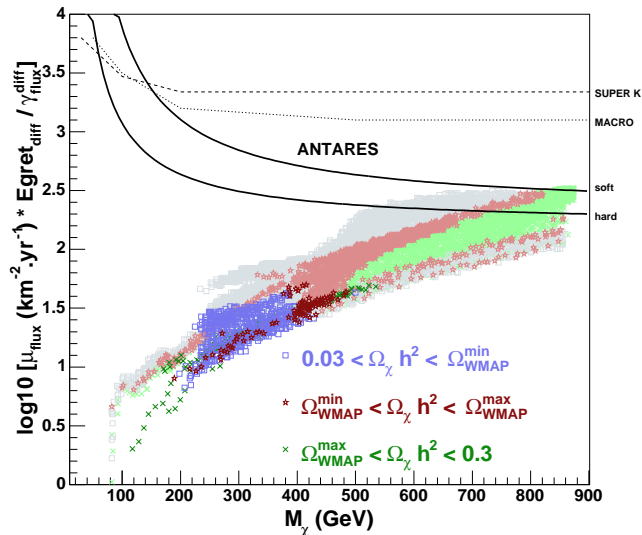
FIG. 5: Neutrino-induced muon flux from the Galactic centre normalized to EGRET with relic density values. Shades paler than in the legend denote a low $\delta_\mu^{\rm susy}$ value.

FIG. 6: Neutrino-induced muon flux from the Galactic centre normalized to EGRET, for models with WMAP-preferred relic density sorted by leading ($\equiv BR > 0.5$) annihilation channel. Shades paler than in the legend denote a low $\delta_\mu^{\rm susy}$ value.

Concerning other dark matter candidates, a case-by-case analysis is needed. For Kaluza–Klein candidates (e.g. Ref. [54] and references therein) , in particular, there are several channels contributing to the neutrino flux (see Ref. [55]). Neutrinos coming from the decay of charged pions originating in quark fragmentations have a relatively soft spectrum, and cannot be detected with Antares, even normalizing the gamma–ray flux to the EGRET data. A similar conclusion applies for neutrinos from prompt semi-leptonic decay of secondary heavy quarks, despite the fact that the spectrum in this case is harder. One last channel could be potentially interesting, the direct production of neutrinos, which is nearly forbidden in the case of neutralinos. This channel is particularly interesting since in this case the spectrum of neutrinos is a line, at energy equal to the mass of the Kaluza–Klein particle. Rescaling the fluxes obtained in Ref. [55] we estimate this flux to be comparable with the Antares sensitivity to line spectra. A detailed analysis of this case will be presented elsewhere.

Finally, to show how our upper bound on the neutrino flux from the Galactic centre would evolve with new data on gamma ray fluxes, we show in Fig. 7 the flux above 60 GeV coming from the same neutralino annihilations in the Galactic centre, applying the same normalization to EGRET that we used for neutrinos in Fig. 5. As in that figure, the points trace an upper bound on the gamma flux above 60 GeV, given the EGRET measurement. If Hess sees a signal (which is not excluded according to Fig. 7), e.g. two orders of magnitudes below this gamma upper bound, the upper bound on the neutrino flux Fig. 5 can accordingly be reduced by two orders of magnitudes.
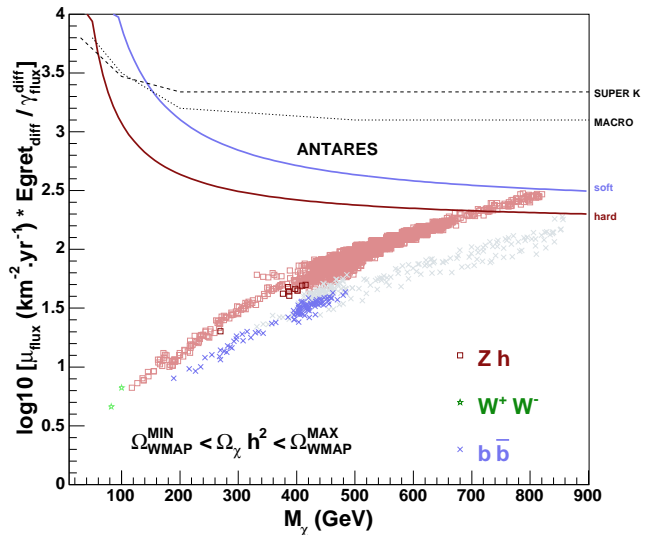
VIII. CONCLUSIONS

The flux of neutrinos from dark matter annihilation at the Galactic centre depends on the assumed dark matter profile and on the details of annihilation of the specific candidate adopted. It is nevertheless possible to obtain an upper limit for the neutrino flux, by requiring that the associated gamma-ray emission do not exceed the flux observed by EGRET in the direction of the Galactic centre .

We have estimated such upper limits in the case of neutralinos and concluded that any associated neutrino flux lies below the experimental sensitivity of Antares, unless the neutralino mass is above ~ 700 GeV . In this case, corresponding to models with a low $\delta_\mu^{\rm susy}$ value, and even assuming that the gamma-ray emission observed by EGRET is entirely due to neutralino annihilation, the upper limit on the neutrino flux is barely above the minimum signal observable by Antares in 3 years.

This means that Antares will not be able to see neutrinos from neutralino annihilation at the Galactic centre . Conversely, the positive detection of such a flux would either require a different explanation in terms, e.g., of other astrophysical sources, or the adoption of dark matter candidates other than neutralinos.
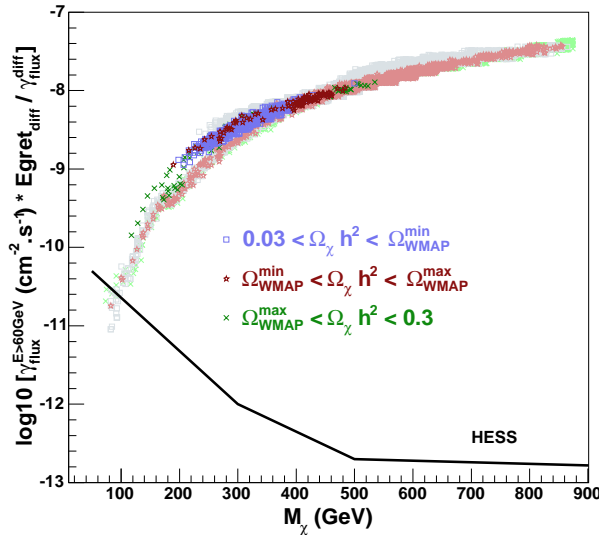
FIG. 7: Gamma–ray flux (above 60 GeV) from neutralino annihilation at the GC normalized to EGRET. For comparison we show the HESS sensitivity. Shades paler than in the legend denote a low $\delta_\mu^{\mathrm{susy}}$ value.

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