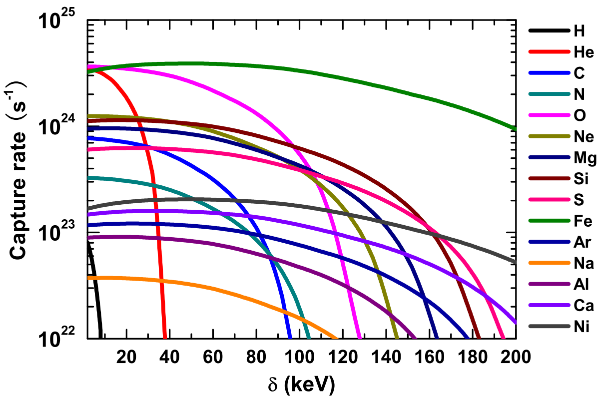

FIG. 1: Capture rate of 50 GeV spin-independent iDM with DM-nucleon cross section of σ_n^{SI} ~10^{-4}pb as a function of the mass splitting δ due to different species of nuclei in the Sun. We choose $\rho_\chi = 0.3$ GeV cm^{-3}, $v_\odot = 220$ km/s and $v_0 = 220$ km/s in the Maxwell-Boltzmann distribution.

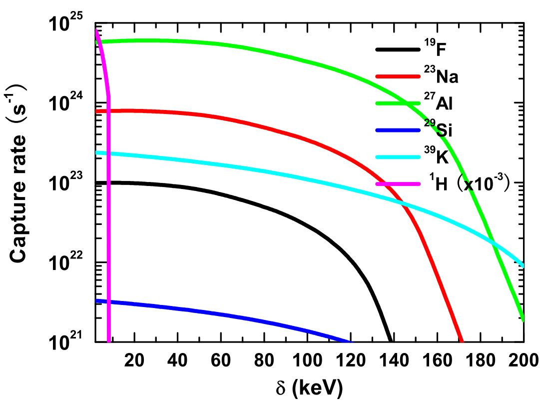

FIG. 2: Capture rate of 50 GeV spin-dependent iDM with $\sigma_n^{SD} \sim 10$ pb as a function of the mass splitting δ due to different species of nuclei in the Sun.

one can safely neglect the Hydrogen contribution in the iSD scattering for $\delta > 10$ keV. The capture rate is always sensitive to the abundance of heavy nuclei.

Finally, we give some short comments on the possible uncertainty in the calculation for solar DM capture rate. The input astrophysics parameters are the local DM mass density ρ_χ, velocity of the Sun $v_\odot$, average local circular velocity v_0, and solar elemental abundances ϵ_i. The capture rate is proportional to ρ_χ and the results will increase if a larger local DM mass density is available [23] or the solar system is passing through DM substructure [24]. We also assume the DM infinity velocity distribution is a Maxwell-Boltzmann distribution which depends on parameters $v_\odot$ and v_0. As discussed in Ref. [15], if these two parameters vary in the region of 200 km/s $< v_\odot, v_0 <$ 300 km/s, the capture rate will be changed by a factor less than two. One should also notice that, if the velocity distribution deviates from an ordinary Maxwell-Boltzmann distribution, the result will also be changed. In our discussions, for simplicity, we assume the solar chemical composition does not change in the Sun. The capture rate is sensitive to the abundance of heavy nuclei and increasing the number density of heavy nuclei in the center of the Sun will increase the overall capture rate by a few [15]. There are also uncertainties arising from the nuclear form factor. For the SI scattering, the Helm form factor we used in the calculation is less accurate at large momentum transfers and might be improved by using some more precise form factors [25]. For the SD scattering, the nuclear structure functions in Ref. [21] are only considered for direct DM search on the Earth, so the q_{max} used in the finite momentum transfer approximation may not be large enough for DM-nucleus scattering in the Sun if our DM is heavy.

III. LIMITS FROM THE NEUTRINO TELESCOPES

If the DM capture and annihilation processes reach equilibrium, we can simply get the DM annihilation rate

$$\Gamma_A = C_\odot/2 \tag{17}$$

The different DM annihilation channels give different initial neutrino spectra [26]. If the DM annihilates to e^+e^- or $\mu^+\mu^-$, they will not contribute to neutrino signals. This is because for muons, they always lose most of their energy before decaying in the center of the Sun. For annihilation channel to $\tau^+\tau^-$, the neutrinos are induced by τ leptonic decays $\tau \to \mu\nu\nu$, $e\nu\nu$, and hadronic decays such as $\tau \to \pi\nu$, $K\nu$, $\pi\pi\nu$ et al. For the heavy final annihilation states W^+W^-, ZZ, $t\bar{t}$, they produce neutrinos via cascade decays and the neutrino spectra for such channels are hard. For quark channels, the hadronization process produces mesons and baryons, and then induces neutrinos via hadron decays. The neutrino spectra for such channels are soft. Notice that the light mesons easily lose their energy before decays, so