Discussion

Within this study, no statistically significant dark matter signal was found within the twelve regions surveyed. The test statistic obtained by surveying the global likelihood of the selected dark matter sources can only be converted into a population value through extensive source and spectra modeling. Previous experimental research yields that a TS=25 corresponds to p=.08. At this point, there is statistically significant evidence - the interval of significance for the gamma-ray flux contribution of a source.

The largest global deviation from the null hypothesis was at a mass of MDM = XYZ in the XYZ annihilation with T = XYZ. At this point, the difference in the likelihood of the null and alternative hypotheses can solely be attributed to background flux uncertainty and fluctuation within the observation period. It should be noted that the test statistic varies widely from source to source, with the largest being the XYZ galaxy in the XYZ annihilation channel at XYZ with TS = XYZ, and the smallest being the XYZ galaxy in the XYZ annihilation channel at XYZ with TS = XYZ. As these sources lie outside the local group of galaxies, measurements are subject to exposure to undocumented extragalactic gamma rays, which are unable to be factored for by models. Additionally, the significant distance of these objects away from the Earth limits the photonic flux reaching the Earth and increases the uncertainty in the measurements conducted by the Fermi LAT. As a result, averaging the test statistic over all sources can limit the uncertainty measured.

The 95% confidence interval of the WIMP annihilation cross-section can be used to constrain the dark matter content. For all six of the annihilation channels surveyed, the cross-section lay within one standard deviation of the blank-sky fields observed, which were assumed to represent the null hypothesis (no DM source). Again, this signifies that there is no significant dark matter signal from the surveyed galaxies. Additionally, within all annihilation channels, the cross-section obtained through the joint likelihood within this study, other than the bb channel, lies below the results collected by Ackermann et al. in 2015 for dark matter content within local dwarf spheroidal galaxies. Again, fewer photons were received over these regions of interest due to their distance, leading to the assumed flux, thus the annihilation cross-section, to be lower than their putative value. Future surveys of this class of object must factor in this inherent uncertainty in these measurements.

Within the bb, uu, and tau-tau annihilation channels, the cross-section fell below the relic cross-section of 3.0*10-26 XYZ for m ~< 100 GeV. As the presence of dark matter within galactic sources is considered to be significantly higher than empty space, the theoretical dark matter mass range must exclude these values. This is consistent with the results found by Ackermann et al., who also discovered that the bb channel annihilation cross-section lies below the relic cross-section for mdm < 100 GeV.

To increase the accuracy of the dark matter measurements, uncertainty within the J-factor measurements must also be considered. A likelihood function for J-factor must be added to the source likelihood to maximize the fit of the J-factor over the selected source; computing the J-factor by using the dark matter profile equations does not take into account the subhalo structure of the dark matter, which may significantly affect this value. As a result, kinematic observations of the galactic region of interest must also be collected, which can be used to derive the J-factor while also taking into account the internet complexities of the object. As these objects serve as a new class of observables and are situated far away from the Earth, no data on these measurements have been collected, indicating that currently, the distant galaxies surveyed during this study serve as weak candidates for dark matter content analysis. In the future, the development of more advanced optical/telescoped technology may support further photon sensitivity and the kinematic J-factor determination of these distant sources. However, at this time, as these issues are not easily addressed, the uncertainty present within these sources remains high, and are thus non-optimal candidates for dark matter surveys.