Weekly Group Meeting

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Introduction of About My Previous Work

1. My task was to reproduce this paper “Searching for Dark Matter Annihilation from Milky Way Dwarf Spheroidal Galaxies with Six Years of Fermi-LAT Data” [arXiv: 1503.02641], [arXiv: 1606.04138].

2. The dwarf spheroidal satellite galaxies (dSphs) of the Milky Way are some of the most Dark Matter dominated objects known.

3. By the gamma-ray observations $\tau+\tau$ of the Milky Way dSphs, we present strongest upper limits on the DM annihilation cross section.

4. For setting the strongest limits on the DM annihilation cross section, each dSphs have typically been “stacked” in a joint-likelihood analysis, utilizing optical observations to constraints the DM density profile in each dSphs.

5. These limits have typically been computed only for singular annihilation final states, such as bbar or $\tau + \tau -$¿

6. By generalizing this approach we set constraints on model where DM particle annihilates into multiple final states fermions.

The J-factor or the Geometrical factor tells us much information about the Dark Matter Distribution in the Galactic Halo.

The total mass within the half-light radius and the integrated J-factor have been found to be fairly insensitive to the assumed DM density profile..

We assume that the DM distribution in dSphs follows a Navarro-Frenk-White (NFW) profile is:

$$\rho_{\rm DM}(r) = \frac{\rho_0 r_s^3}{r(r_s + r)^2},$$

And the J-Factor is:

$$J = \int_{\Delta\Omega} \int_{l.o.s} \rho^2(\mathbf{r}) dl d\Omega'.$$

Kinematic data indicate that the dwarf spheroidal satellite galaxies (dSphs) of the Milky Way contain a substantial DM component [6, 7]. The gamma-ray signal flux at the LAT, ϕ_s ($\mathrm{ph\,cm^{-2}\,s^{-1}}$), expected from the annihilation of DM with a density distribution $\rho_{\rm DM}(\boldsymbol{r})$ is given by

$$\phi_s(\Delta\Omega) = \underbrace{\frac{1}{4\pi} \frac{\langle\sigma v\rangle}{2m_{\rm DM}^2} \int_{E_{\rm min}}^{E_{\rm max}} \frac{\mathrm{d}N_\gamma}{\mathrm{d}E_\gamma} \mathrm{d}E_\gamma}_{\text{particle physics}} \times \underbrace{\int_{\Delta\Omega} \int_{\rm l.o.s.} \rho_{\rm DM}^2(\boldsymbol{r}) \mathrm{d}l \mathrm{d}\Omega'}_{\rm J-factor} . \qquad (1)$$

Here, the first term is dependent on the particle physics properties — i.e., the thermally-averaged annihilation cross section, $\langle\sigma v\rangle$, the particle mass, $m_{\rm DM}$, and the differential gamma-ray yield per annihilation, $\mathrm{d}N_\gamma/\mathrm{d}E_\gamma$, integrated over the experimental energy range.[1] The second term, known as the J-factor, is the line-of-sight (l.o.s.) integral through the DM distribution integrated over a solid angle, $\Delta\Omega$.

Data Analysis Tools

1. C++ Programming Language with gsl library packages.

2. Python.

4. Mathematica

5. GALPROP

6. ROOT and for minimization using minuit-2.

So, basically we were doing data analysis and we were doing Dark Matter phenomenology.

The Work at IHEP (Thanks to Xin and his Group)

I have started the data analysis for psi(2s) to e+e- decay.

My work is motivated by BESIII collaboration paper "Search for invisible decays of omega and phi with j/psi data at BESIII" [arXiv: 1805.05613].

The First week of my work, I had tried to learn the basic bash commands to submit the jobs on the cluster with my afs account.

I have done the MC sample run only for 100 events for chic0→ e+e- and uploaded to github website PR#20.

I have done is that reconstruction for the 100 events generated for chic0→ e+e- github website PR#22.

I have done is that pre selection for these 100 events github PR#23.

Thank You.! Wish you all a very Happy Summer Holidays..