

the DM contributions are dominated by the ICS process which is typically 1  $\sim$  2 order of magnitude below the current Fermi-LAT data [43]. The ICS process contributes to a broad spectrum from  $10^{-2}$  GeV to a few hundred GeV. At higher energy region  $E \sim 10 - 100$  GeV, the ICS contribution becomes significant as the background drops rapidly. The ICS has no significant dependence on the mass hierarchy as it only depends on the spectrum of the final state electrons. In general, compared with ICS processes, VIB and FSR contribute to gamma-rays at higher energy. For photon energy above 500 GeV, they become dominant sources and may lead to an up turn of the photon spectrum. This prediction can be tested by the future gamma-ray detectors. The similar conclusions can be obtained for the galactic center region ( $0.25^\circ < |b| < 2.75^\circ$ ,  $0.25^\circ < l < 2.75^\circ$ ,  $357.25^\circ < l < 359.75^\circ$ ) and the galactic pole region ( $60^\circ < |b| < 90^\circ$ ,  $0^\circ < |l| < 360^\circ$ ). As shown in Figs. 8 and 9, the DM particle decay can give significant contributions to the high energy gamma-rays for the three typical regions. For an illustration purpose, we naively sum up the DM contributions (ICS, FSR and VIB) and the diffuse gamma-ray background ( $\Phi_\gamma^{\text{Galactic}}$  and  $\Phi_\gamma^{\text{EG}}$ ). One finds that all the cases are compatible with the current Fermi-LAT preliminary results [43, 44].

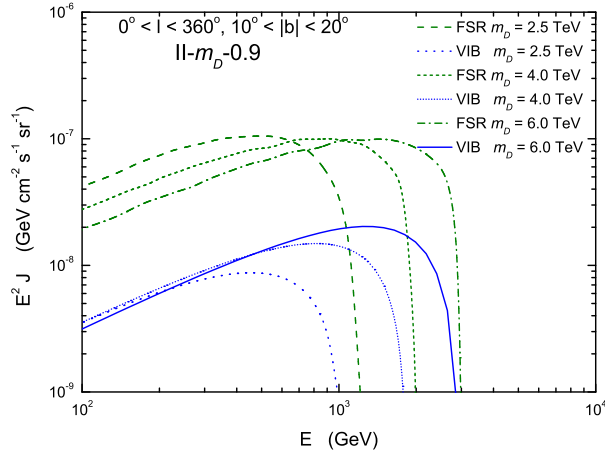


FIG. 10: Comparison of the predicted energy spectra between FSR and VIB process. The curves corresponds to  $S_D = 2.5, 4.0$  and  $6.0$  TeV respectively, with the mass of triplet scalar  $m_{\delta_L}$  fixed at 1 TeV and  $\tau_D = 0.9 \times 10^{26}$ s.

The FSR and VIB processes show stronger dependence on the masses of the triplet scalars, and the two contributions are correlated. It follows from Eq. (15) that for fixed masses of initial DM particle and final states, the decrease of the triplet mass will enhance VIB while slightly suppress FSR. Thus the VIB process can be important for the case with large mass