The high energy gamma-rays produced by the ICS process $e^{\pm}\gamma \to e^{\pm'}\gamma'$ have the following energy spectrum [37, 38]:

$$\frac{d\Phi_{\gamma'}}{dE_{\gamma'}} = \frac{\alpha_{em}^2}{\Delta\Omega} \int_{\Delta\Omega} d\Omega \int_{LOS} ds \int\int f_{e^+}(E_e, r, z)\; u_\gamma(E_\gamma, r, z)\; f_{ICS} \frac{dE_e}{E_e^2} \frac{dE_\gamma}{E_\gamma^2}\; . \tag{35}$$

Since the photon may be emitted from both electron and positron, an overall factor of 2 has been multiplied in the equation. The differential energy density $u_\gamma(E_\gamma, r, z)$ of interstellar radiation field (ISRF) contains three components: the cosmic microwave background (CMB), thermal dust radiation and star light. Here we adopt the GALPROP numerical result for u_γ in Ref. [39]. The parameter f_{ICS} is defined by [37]

$$f_{ICS} = 2q\ln q + (1+2q)(1-q) + \frac{1}{2}\frac{\epsilon^2}{1-\epsilon}(1-q)\; , \tag{36}$$

with

$$\epsilon = \frac{E_{\gamma'}}{E_e}, \qquad q = \frac{E_{\gamma'} m_e^2}{4E_\gamma E_e(E_e - E_{\gamma'})}\; , \tag{37}$$

where $0 \leq q \leq 1$. In Eq. (35), $f_{e^+}(E_e, r, z)$ is the positron differential number density. Because of the ICS and synchrotron, high energy electrons and positrons will loss most of their energy within a kpc. Therefore one may neglect the diffusion term of Eq. (16) and approximately calculate $f_{e^+}(E_e, r, z)$ for every point in the CR propagation region. In this case, $f_{e^+}(E_e, r, z)$ is given by the following formulas [37, 40]

$$f_{e^+}(E_e, r, z) = \frac{1}{b_{ICS}(E_e, r, z)} \frac{\rho(r, z)}{m_D} \sum_k \Gamma_k \int_{E_e}^{m_D} dE' \frac{dn_{e^+}^k}{dE'}\; , \tag{38}$$

where the electron energy loss rate $b_{ICS}(E_e, r, z)$ is

$$b_{ICS}(E_e, r, z) = \frac{2\pi\alpha_{em}^2}{E_e^2} \int dE_\gamma \frac{u_\gamma(E_\gamma, r, z)}{E_\gamma^2} \int dE_{\gamma'}(E_{\gamma'} - E_\gamma) f_{ICS}\; . \tag{39}$$

Here we neglect the synchrotron energy loss rate b_{syn} as $b_{syn} \ll b_{ICS}$ [38]. It is worthwhile to stress that the above energy loss rate $b_{ICS}(E_e, r, z)$ is position dependent[1].

In order to compare with the experimental data, one needs to know the diffuse gamma-ray background which includes a galactic $\Phi_\gamma^{\rm Galactic}$ contribution and an extragalactic (EG) $\Phi_\gamma^{\rm EG}$ contribution. The galactic gamma-ray background $\Phi_\gamma^{\rm Galactic}$ mainly comes from pion

[1] If a position independent energy loss rate is assumed, one can use Eq. (19) to calculate $f_{e^+}(E_e, r, z)$.