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Erratum

Constraining the population of cosmic ray protons in cooling flow clusters with γ-ray and radio observations: Are radio mini-halos of hadronic origin?

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Key words. errata, addenda – galaxies: cooling flows – galaxies: clusters: general – galaxies: clusters: individual: Perseus (A426) – radiation mechanisms: non-thermal

The normalization of the inverse Compton (IC) flux induced by secondary cosmic ray electrons (CRe) in Fig. 3 has been incorrectly computed. The correct ratio of γ-ray flux resulting from decaying pions relative to IC flux from secondary CRe is 1.5×10^{-1} ($\alpha_\mathrm{p} = 2.1$) and 1.7×10^{-3} ($\alpha_\mathrm{p} = 2.7$) at $E_\gamma = 1$ GeV. This is illustrated in Fig. 1, which replaces Fig. 3 of our paper.

This induces a minor change in the expected IC emission (cf. Sect. 4.1.) of hadronically originating CRe in the Perseus cluster. Assuming a cosmic ray proton (CRp) spectral index of $\alpha_\mathrm{p} = 2.3$ and taking the CRp normalization obtained by comparing the hadronically induced synchrotron emission to the observed radio mini-halo of Perseus, the secondary IC emission ought to have read as

$$\frac{\mathrm{d}\mathcal{F}}{\mathrm{d}E}(20\,\mathrm{keV}) = \mathcal{F}_\mathrm{IC}\, 10^{-7}\, \gamma\, \mathrm{cm}^{-2}\, \mathrm{s}^{-1}\, \mathrm{keV}^{-1}, \quad (1)$$

with $\mathcal{F}_\mathrm{IC} = 8.4$, 4.2, and 2.3 for $B_0 = 5\,\mu$G, 10 μG, and 20 μG. Comparing these results to the *post-launch* spectral sensitivity of $4 \times 10^{-6}\, \gamma\, \mathrm{s}^{-1}\, \mathrm{cm}^{-2}\, \mathrm{keV}^{-1}$ to the continuum at 20 keV for an observation time of 10^6 s (3σ detection), there is only a minor chance to detect IC emission of CRe as previously concluded. All other figures, formulae, and conclusions remain unchanged.

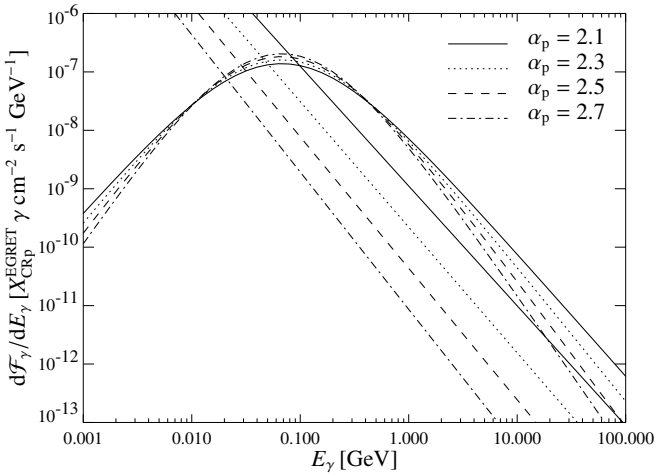

Fig. 1. The simulated differential flux of γ-rays from Perseus reaching the Earth. Shown are upper limits of the IC emission of secondary CRe (power-laws, assuming zero magnetic field) as well as pion decay induced γ-ray emission (represented by broad distribution centered on $E_\mathrm{peak} \simeq 67.5$ MeV). The normalization of the spectra differing in their values of the CRp spectral index $\alpha_\gamma = \alpha_\mathrm{p}$ (Dermer's model) depends on the assumed scaling between CRp and thermal energy density. We fix this scaling parameter X_CRp assuming the isobaric model by comparing the integrated flux above 100 MeV to EGRET upper limits (see Reimer et al. 2003).

References

Reimer, O., Pohl, M., Sreekumar, P., & Mattox, J. R. 2003, ApJ, 588, 155