Indirect study of low-energy CRs at the prospect of future MeV gamma-ray detectors

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Low-energy cosmic rays (LECRs) contribute substantially to the energy balance of the interstellar medium and play a significant role in the heating and chemistry of gas, that consequently impact on the star formation process. Despite current difficulties of studying LECRs directly, in the near future, next-generation MeV telescopes will provide us unique opportunity for the indirect research of LECRs through nuclear de-excitation lines that are produced via the interaction of LECRs and interstellar medium. By analytical calculation, we find LECRs are concentrated around their acceleration sites due to the slow propagation coupled with enhanced energy losses of sub-relativistic particles. Then we present results on the production of MeV de-excitation lines combining the numerical treatment of nuclear reactions using the code TALYS, with the propagation and energy losses of LECRs. Then, we estimate the possible MeV lines from the young SNR Cas A, taking into account the CR injection spectrum, chemical abundance of the medium. We also investigate the possible detectability of MeV line emission from the Cas A against the newly measured diffuse Galactic background in MeV band given the capability of the proposed MeV telescopes. In addition, we take the mid-aged SNR W44 as an example and study the predicted gamma-ray spectrum from the SNR assuming both hadronic or leptonic origin and discuss the detection probability of future MeV missions on these emissions and possible implications.

Collaboration (if any)

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