Investigating the Vela SNR's Emission of Electron Cosmic Rays with CALET at the International Space Station

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The ISS-based Calorimetric Electron Telescope (CALET) is directly measuring the energy spectrum of electron+positron cosmic rays up to 20 TeV. Cosmic-ray electrons of TeV region energy are limited by energy loss to a propagation range of about 1 kpc, therefore the expected sources are a few nearby supernova remnants (SNR), with the Vela SNR dominating the spectrum.

The latest all-electron spectrum measured by CALET together with the positron-only flux published by AMS-02 is fitted with a comprehensive flexible model including the parametrized flux from distant SNR, secondaries, and nearby pulsars as the source of the positron excess as background, to which the flux from the nearby SNR as calculated with DRAGON is added. The integrated energy emitted by each SNR in electron cosmic rays above 1 GeV is taken as a variable scale factor for the flux, for which a best-fit estimate and 95%CL limits are calculated under a variety of propagation and injection conditions. The expected flux anisotroy for each case is calculated for a comparison with Fermi-LAT anisotropy limits.

Both the results of a study considering only Vela as the dominating soruce in the TeV-region, and one considering the three significantly contributing SNR (Vela, Monogem and Cygnus Loop) are presented. In either case, the preferred range for the energy emitted by a SNR in electron cosmic rays is found to be in a range of several 10^{47} erg over a wide variety of conditions for propagation, release timing and spectral cut-off, with 95%CL limits on the order of a few 10^{48} erg. Conditions under which cosmic rays from Vela can only partly propagate to Earth due to delayed release and low propagation speed constitute a special case where no strong constraint can be set on the Vela SNR alone, but limits of $\sim 5 \times 10^{48}$ erg, exceeding those from Fermi-LAT anisotropy data, can be set, if considering the combined flux from all three nearby SNR.

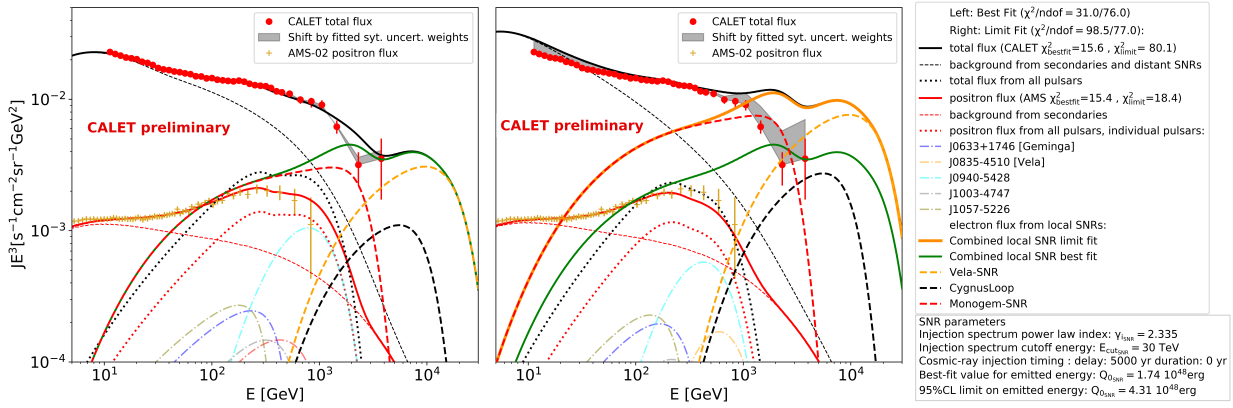

Figure 1: An example of a best fit (left) and limit fit (right) for the case of burst-like emission from the three nearby SNR after a 5 kyr delay, with a power-law injection spectrum with exponential cut-off at 30 TeV. See legend for explanation of each graph element.