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RUNAWAY MASSIVE STARS AS A NEW CLASS OF GALACTIC GAMMA-RAY SOURCES

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Runaway stars have high spatial velocities, $V > 30$ km s^{-1}, and if the are massive, can produce bowshocks in the surrounding ISM. These bowshocks develop as arc-shaped structures pointing in the same direction as the supersonic stellar velocity. The piled-up shocked matter emits thermal radiation. Additionally, a population of locally accelerated relativistic particles can produce non-thermal emission over a wide range of energies. This has been recently confirmed by a bunch of observations at radio, X-ray and even gamma-ray wavelengths. Runaway early-type stars might be variable gamma-ray sources, with variability time scales depending on the scales of density inhomogeneities in the medium and the stellar velocity. Protons can easily escape from the emitting region without much loss on energy. These protons might diffuse in the surrounding molecular cloud interacting with the matter via p-p inelastic collisions. These yield gamma rays and secondary particles. Molecular clouds illuminated by these relativistic particles might become into diffuse non-thermal sources. We calculate all relevant non-thermal processes related to these stellar objects and discuss the observational prospects.

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THE GALACTIC DISTRIBUTION OF FERMI POINT SOURCES

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The second catalog of high-energy γ-ray sources detected by the Large Area Telescope (LAT), the primary science instrument on the *Fermi Gamma-ray Space Telescope*, allows us for the first time to perform a modeling of the galactic distribution of such sources based on the method of summing up all detectable sources in a grid of lines of sight. The challenge is to produce reliable estimates of counts from small numbers. The catalog contains 1873 sources over the whole sky, giving an average of 0.036 counts/deg^2 for $|b| > 60°$. In a narrow strip centered at $|b| < 0.5°$ we find 128 sources. In this work, we describe our attempts to estimate the density of γ-ray sources along both galactic longitude and galactic latitude. The results of the estimated source counts are compared with the predictions of a model which has an exponential distribution in the radial direction as well as an exponential distribution above the galactic plane. Our conclusions point to a radial length scale consistent with that obtained from near-infrared counts and a very short height scale, typical of very young populations in the Galaxy. We tested both Gaussian and Power-Law forms for the luminosity function. The luminosities cover the range $10^{33} - 10^{36}$ erg/s in the 100 MeV–100 GeV band with space densities (in the solar neighborhood) of $\sim 10^{-8}/\mathrm{pc}^3$.

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A MAGNETIC RECONNECTION MODEL FOR EXPLAINING MICROQUASARS RADIATION

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Very high energy observations of AGNs and microquasars are challenging current theories of particle acceleration (mostly based on shock acceleration) which have to explain how particles are accelerated to energies above TeV in very compact regions compared to the characteristic scales of their sources. The identification of microquasars and AGNs as sites of particle acceleration raises many fascinating and important questions. Recent magneto-hydrodynamical studies have revealed that cosmic ray acceleration by fast magnetic reconnection can be rather efficient because a first-order Fermi process may occur. In this work, we discuss this acceleration mechanism in the coronal region of the accretion disk around microquasars and AGNs. In addition, the accelerated particles lose substantial amounts of their energy due to non-thermal interactions with the surrounding magnetic field, matter and radiation fields. We compute the corresponding acceleration rate and the relevant loss rates in order to reproduce the observed spectral energy distribution for two microquasars (Cygnus-X1, Cygnus-