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Search for very high energy gamma-ray emission from parts of the Gould belt with the H.E.S.S. ground based Cherenkov telescopes

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Abstract: The Gould belt, a well-known region of enhanced star formation in the solar neighbourhood, is observed to be an expanding disk with a diameter of about 1 kpc and a width of a few 100 pc. Most of the nearby OB stellar associations and molecular clouds are found to be aligned with the Gould belt. With the high star formation rate along the Gould belt, the local supernova rate during the last few million years is believed to be three to four times larger than the Galactic average. Under the assumption that supernova remnants are efficient accelerators of cosmic rays, the Gould belt and its environment should show an increased cosmic ray density with respect to the Galactic average. The cosmic rays are expected to interact with the dense molecular gas which results mainly in pi-meson production with subsequent decay in gamma-rays and neutrinos. We have searched for gamma-ray emission from various parts of the Gould belt with the HESS Cherenkov telescopes. Results will be presented at the conference.

Introduction

The Gould belt is a local region with enhanced stellar formation and molecular clouds within 0.5 kpc of the solar system (for a review see [1]). A large fraction of young (spectral type O and B) massive stars in the solar vicinity are aligned with the Gould belt. However, late type stars have been associated to the Gould belt as well [2]. The age of the stars (≈ 50 Myrs) tracing the Gould belt and the dynamical timescale derived from the expansion velocity of the belt like structure (≈ 25 Myrs, [3, 4]) constrains the age of the Gould belt within roughly a factor of 2 to be 25–50 Myrs.

The nature of the event which triggered the star formation in the Gould belt is unclear, but various suggestions have been made including a cascade of supernova explosions or the impact of a high velocity cloud to the Galactic plane. An initial kinetic energy of 10^{52} ergs (equivalent to 10 supernova explosions) is required to drive the Gould belt expansion [4].

The supernova explosion rate of 75 to 95

$\text{Myr}^{-1} \text{ kpc}^{-2}$ implied by the age and stellar present population in the Gould belt is a factor of 3-5 larger than the expected local value of $20 \text{ Myr}^{-1} \text{ kpc}^{-2}$ [5]. The more massive molecular cloud complexes associated with the Gould belt (e.g. Taurus, ρ -Oph, Lupus, Orion A, Orion B) are therefore good targets to search for gamma-ray emission from the interaction of cosmic rays with the dense molecular clouds (see e.g. [6]).

Observations of regions in the Gould belt with the H.E.S.S. telescopes

The H.E.S.S. system of four imaging air Cherenkov telescopes is located at an altitude of 1 800 m in the Khomas Highlands of Namibia. The telescope system is sensitive to Gamma-rays above 100 GeV. Parts of the Gould belt have been observed during dedicated observation runs as well as part of observations taken on dedicated targets which coincide with the Gould belt region.

Results and Discussion

The final results of the analysis will be presented at the conference.

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