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Cosmic ray transport in the proximity of pulsars and the formation of gamma-ray halos

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- The HAWC collaboration detected extended gamma-ray halos around the Geminga and Monogem pulsars, that have been widely interpreted as inverse Compton scattering halos generated by electrons and positrons produced by the pulsar and diffusing in the ISM.

- The extension of such halos has been interpreted in the assumption of pure isotropic diffusion, which lead to the conclusion that the CR diffusion coefficient around pulsars should be at least two orders of magnitude smaller than that typically inferred for Galactic CR propagation. The possibility of a suppressed diffusion around pulsars has acquired consensus in the community, but it is difficult to be explained theoretically and poses concerns on the possible location of multi-TeV electrons (detected up to ~ 20 TeV).

- We analyze the HAWC data in the assumption of isotropic diffusion taking into account the transition between the ballistic regime, valid at small times-scales after particles injection from a source, and the diffusion regime, which is established after multiple scatterings.

- We show that, when such effect is taken into account, the Geminga and Monogem gamma-ray halos can be explained with standard values of the interstellar diffusion coefficient, without the need of a suppressed diffusion.