A Study of the Interstellar Medium towards the VHE gamma-ray sources HESS J1614-518 and HESS J1616-508

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Dedication

I would like to dedicate my thesis to my family, Mum, Dad, Michael, Grandma and Grandad who have provided me with amazing support and truly astronomical quantities of chocolate. Simon has also been wonderfully supportive and has kept me calm during the stressful times. I would not have completed this thesis without this support.

Abstract

One of the most intriguing problems in galactic astronomy is the observation of the highest energy photons. Very high energy (VHE) gamma-ray telescopes such as HESS have located sources of TeV (10^{12} eV) gamma-rays which are not associated with any known objects. Whilst these could be a new type of particle accelerator, it is more likely that they are related to supernova remnants (SNRs), pulsar wind nebula (PWN) or massive stellar regions. They may result from high energy cosmic-ray (CR) interactions with interstellar gas (ISM). This project used new radio data which provided information on molecular clouds to model the production of gamma-rays from CR interactions. The densities of protons in these clouds were used in models to determine if potential particle accelerators surrounding the two HESS sources, HESS J1616-508 and HESS J1614-518 were capable of producing the emission. The potential accelerators surrounding HESS J1616-508 were all found to have insufficient gas within their diffusion radius. Thus, it was not possible for those sources to produce gamma-rays through hadronic interactions despite only requiring modest CR energy budgets compared to that provided from a SNR. The same result was also found for WR 73-1 and PSR J1613-5211 near HESS J1614-518. However, Pismis 22 and WR 74 contained CO RoI CO1, CO2 and CO25 within their diffusion radii. The energy in CRs required for each region to generate the overlapping gamma-ray emission was compared to the available energy if a SNR was assumed to be the accelerator. The required energy was found to be less than the energy available. Thus, WR 74 and Pismis 22 could still generate the hadronic gamma-ray emission from HESS J1614-518.