

Cosmic ray induced ionization

Schuppan, Florian¹, Tjus, Julia¹ and Black, John H.²

¹Ruhr-Universität Bochum, Fakultät für Physik & Astronomie, Theoretische Physik I, 44780 Bochum, Germany

²Dept. of Earth and Space Sciences, Chalmers University of Technology, Onsala Space Observatory, 439 92 Onsala, Sweden

Observed by a variety of instruments, supernova remnants are known cosmic ray accelerators. As a consequence, they are often bright in gamma rays. However, whether the gamma rays are caused by electrons or high energy protons –neither of them directly observable– is very difficult to tell from gamma detections only. A correlation study might help distinguishing a leptonic scenario from a hadronic one for supernova remnants interacting with a molecular cloud. If there is a molecular cloud in the vicinity of a supernova remnant, the cosmic rays interact with cloud matter. Low energy protons accelerated by the supernova remnant are very efficient in ionizing the cloud, whereas electrons do not penetrate the cloud sufficiently deep to significantly contribute to the total ionization rate. Besides cosmic ray particles, X-rays are also a possible source of ionization. Profiles of the ionization rate as a function of penetration depth into the cloud from cosmic ray protons and X-rays are calculated to examine the ionization rate in a molecular cloud, triggering a chemical network forming a variety of molecules.