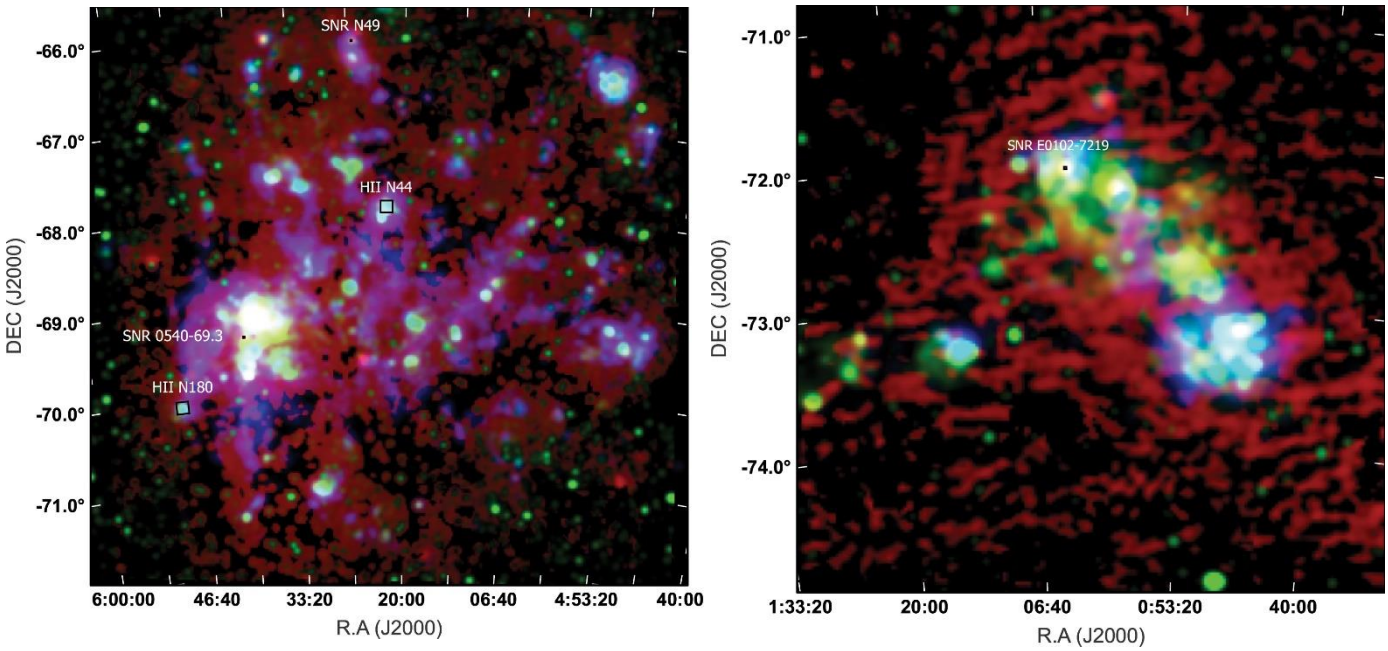
Role of Magnetic Field and Cosmic Rays in The Magellanic Clouds

Irregular dwarf galaxies are galaxies whose gas, dust, and massive stars do not have a spiral distribution and are scattered irregularly within the galaxy. In general, what factors control this interstellar gas is one of the most important questions in astrophysics, because the answer to it can deepen our understanding of how stars form and evolve. In addition to gas and dust, magnetic fields and cosmic rays are the constituents of the interstellar environment, so they must play a role in balancing energy and gas pressure. However, only few observational studies have been conducted in this area; perhaps only in two or three spiral galaxies. These studies show the importance of magnetic fields in the structure formation in normal spiral galaxies, but what about the dwarf irregular galaxies? Optical and infrared observations have shown that the physical properties of dwarf galaxies, such as metallicity and amount of neutral gas and dust, are lower than those of their high-mass counterparts. Are also the factors controlling their interstellar gas different? Recently, a group of international researchers led by the IPM have come to understanding this important issue in two nearest dwarf irregulars, The Magellanic Clouds. In this study, which used observational data at radio, infrared, and optical wavelengths, the magnetic field strength, the energy distribution of the relativistic particles, and the density of ionized gas across these galaxies were carefully determined. " To separate all these components, we used the data taken with the most modern telescopes such as the Very Large Telescope (VLT), the Herschel Space Observatory, and the Murchison Widefield Array (MWA) as well as a novel method to reduce the effect of reddening by dust. ", says Fatemeh Tabatabaei, the faculty member at the IPM's School of Astronomy. This study shows that the pressure from magnetic fields and relativistic particles is greater than the thermal gas pressures and hence they can control the interstellar environment. "For the first time, we also mapped the fraction of dust attenuating the optical emission across these galaxies.", says Hamid Hassani a Research Assistant at the IPM's School of Astronomy and a PhD student at the Alberta University. Thus, in terms of energy balance, The Magellanic clouds are not different from spiral galaxies.

The study is performed in collaboration with Institut de Recherche en Astrophysique et Planétologie (IRAP), the Max Planck Institute for Astronomy (MPIA), and the Universities of Berkeley and California San Diego and is published in the Monthly Notices of the Royal Astronomical Society (MNRAS) journal at the following link:

https://academic.oup.com/mnras/article-abstract/510/1/11/6464669?redirectedFrom=fulltext



Three-color composite images of the Large Magellanic Cloud (left) and the Small Magellanic Cloud (right) showing the magnetic field and cosmic rays (red) based on the GLEAM/ATCA/Parkes observations, the thermal ionized gas traced by the Hα emission from the MCELS survey (green), and the dust traced by Herschel and Spitzer space telescopes (blue). Black squares show the MUSE observed fields.