Dust polarization as a tool to study magnetic fields in the core of the starburst galaxy NGC253

Davide Belfiori[1]

[1] *University of Bologna, Italy*

The interstellar space contains a complex mixture of gas and dust, along with cosmic rays and magnetic fields (B-fields), which exert a significant impact on the physical characteristics of the interstellar medium (ISM). Each of these components emits electromagnetic radiation across a broad range of wavelengths, making it essential to compare different tracers to gain a comprehensive understanding of their influence on the structure and evolution of galaxies. B-fields, which cannot be directly detected, are especially challenging to study, but they play a crucial role on different spatial scales, such as affecting the global rotation of gas, driving gas mass inflows into galactic cores, and regulating the collapse of molecular clouds where star formation occurs.

The observation of cosmic dust polarized emission is one of the most effective tools to study B-fields in the cold phase environment of external galaxies. This method relies on the fact that elongated dust grains can be oriented with their major axis perpendicular to the interstellar magnetic field lines by paramagnetic or radiative torque alignment and emit thermal linearly polarized radiation in the FIR and millimeter wavelength range with their E-vector pointing perpendicular to the field. From the polarization angle of the measured radiation rotated by 90° it is possible to infer the B-field lines in the plane of the sky. Unlike the traditionally used synchrotron radio polarimetric observations, dust polarized emissions can map the B-field characteristics in the cold, dense areas of the ISM in galaxies, such as molecular clouds, where star formation occurs. To understand the crucial role of B-fields in star formation processes, investigating dust FIR and millimeter polarimetric emissions is a critical step.

We present the analysis of ALMA polarization observations in band 7 ($\sim$ 350 GHz) of the central regions of the galaxy NGC253, a well studied nearby starburst galaxy, with resolution up to 8 pc in physical scale. This galaxy's central area exhibits a complex structure characterized by 14 dense clumps of molecular gas, likely hosting young super starclusters. Starting from the Band 7 observations we computed a detailed parsec-scale map of dust-traced B-field and polarization fraction distribution in the galaxy, exploring their relationship with the super starclusters and the several structures in the molecular gas observed in the region. The findings highlight a tight correlation between local minima of polarization fraction structures of the galaxy and the presence of super starclusters, alongside a more general anti-correlation between dust column density and polarization fraction. One of the physical origins which could explain these correlations is the disruption of large dust grains in dense regions of the ISM where the star formation is high, with consequent lowering of fractional polarization.