Triggered Star Formation in a Turbulent ISM
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Thermal and non thermal components of interstellar medium at sub-kiloparsec scales in galaxies

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Abstract. We present the result of the analysis of the point-by-point correlation between the radio continuum (RC) and CO intensities from kpc to sub-kpc scales in 22 BIMA SONG galaxies and the point-by-point correlation at sub-kpc scales between the RC, CO and 24 μm-IR emissions in 6 galaxies for which *Spitzer* images have been recently released. We found that there is no significant variation of the slope and the scatter of the correlations at this spatial resolution. All three correlations are comparably tight with scatter of less than a factor of two.

Keywords. radio continuum: galaxies; galaxies: spiral; ISM: molecules; stars: formation

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One of the most intriguing relationship in astronomy is that between the thermal and non-thermal components of interstellar medium in galaxies. Although the strongest correlation observed between the far-infrared (FIR) and the radio continuum (RC) emission has been known for over two decades, the causes of the relationship are still unclear. In the standard model the FIR, RC and CO emissions are correlated because each is a tracer of massive-star formation, this conventional picture does not plausibly explain the tightness of the correlations given the entirely different processes and timescales involved.

Since we know that relativistic electrons, responsible for synchrotron radiation, diffuse from their birthplaces we would expect that the spatial correlation breaks down below the characteristic diffusion scale-length of the radiating electrons.

With the aim of determining whether the RC-CO(-FIR) correlation persists at sub-kpc scales, we studied these correlations from kpc to sub-kpc scales in galaxies selected from the BIMA SONG sample. We found that all three correlations are comparably tight up to spatial resolution of hundred parsecs. This result shows that we have not yet probed the physical scales at which the correlations break down or that there is a mechanism that compensate the electrons diffusion.

Observations of the radio spectral index help us to understand the processes involving the cosmic-ray electrons production and to determine their diffusion scales in spiral galaxies. We recently found a relation between the RC spectral index and the FIR emission in the galaxy M 51: the spectral index decreases in the spiral arms, where FIR emission is enhanced. This result indicates that electron diffusion is efficient in regions of high star formation rate, then to justify the observed correlations a mechanism compensating the leakages of the synchrotron electron should exist. A possibility is that the galaxy magnetic field is higher in molecular clouds.

Reference

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