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A multi-wavelength view of the cosmic ray confinement in star-forming galaxies

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Cosmic rays (CRs) are responsible for a tight correlation between the star formation rate (SFR) and the radio and gamma-ray luminosity observed in star-forming galaxies (SFGs). This correlation can possibly be explained by a linear scaling between the SFR and the number of CR acceleration sites, such as supernova remnants, coupled to the dependence of particle escape with galaxy properties.
Observations in radio and gamma rays are important tools to probe CR activity, but they may not be sufficient to fully probe the confinement properties of galaxies. For instance, CR calorimetry is one of the most intriguing unanswered aspects in star-forming regions which could result not only in emission through the neutrino channel but possibly also in the hard X-ray energy band.
We perform a multi-wavelength investigation with the aim of characterizing the CR population and the effective fields affecting their transport within SFGs with different levels of activity. In particular, we focus on the possibility of testing proton confinement in the X-ray and MeV bands. With this goal, we develop a model describing the CR transport in SFGs for a broad range of SFRs. Hadronic byproducts and pair production are computed self-consistently in a multi-wavelength context ranging from radio up to X-rays and gamma rays.
We conclude that a panchromatic view of the SFR-luminosity correlations in SFGs is key to place strong constraints on the physical processes that govern the non-thermal emission of these sources.

Keywords

cosmic ray; galaxies; starburst; star-formation; gamma-rays; X-rays; radio continuum

Collaboration

other Collaboration

Subcategory

Theoretical Results

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