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The low-frequency radio continuum—star formation rate relation in nearby galaxies with LOFAR

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We present first results of our survey of nearby galaxies with 140-MHz data from pointed observations and from the LOFAR 2-m Sky Survey (LoTSS). With the facet calibration technique we are now able to reach an rms noise level close to the thermal noise of ~150 μJy/beam at 7—10 arcsec spatial resolution. These maps are sensitivity matched with medium-deep (1 hr) observations of other state-of-the-art radio interferometers such as the Jansky VLA. We have selected our galaxies from the SINGS and KINGFISH infrared surveys, which provide us with ample of ancillary data. The infrared maps from HERSCHEL and Spitzer can be combined with GALEX far-ultraviolet maps in order to construct reliable star-formation rate surface density maps, corrected for internal absorption by dust. Balmer Halpha maps can be used to separate the thermal radio continuum emission, although at 140 MHz we expect the thermal fraction to be small (< 10 per cent). We also have ancillary radio maps, both 1.4-GHz continuum maps from the WSRT SINGS survey, as well as HI line emission maps from the VLA THINGS survey. We also have selected some highly inclined (>80 degree) galaxies from the CHANG-ES survey with complementary Jansky VLA data at 1.5 and 6 GHz. These data can be used to study the spatially resolved radio continuum—star formation rate (RC—SFR) relation on a 1-kpc scale in a statically meaningful sample. As part of this study, we will explore the effects of cosmic-ray transport by diffusion in galactic discs, the relation between the magnetic field and gas density as well as gas kinematics and the vertical cosmic ray transport by advection in galactic winds.

Summary

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