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SHORES: Multi-frequency exploration of the faint radio sky

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We introduced the Serendipitous H-ATLAS-fields Observations of Radio Extragalactic Sources (SHORES) survey, which targeted 29 fields in total intensity and polarisation within the Herschel-ATLAS Southern Galactic Field. Observations were performed with the Australia Telescope Compact Array in the 2 GHz band, with a central frequency of 2.1 GHz and 2 GHz total bandwidth. Two fields (Deep-1 and Deep-2) were observed to greater depth, while the remaining 27 shallower fields cover $\sim 26 \text{ deg}^2$, reaching a typical rms of $\sigma \approx 33 \text{ } \mu\text{Jy}$ in the central regions. The Deep-1 field reaches $\sigma \sim 9 \text{ } \mu\text{Jy}/\text{beam}$, and Deep-2 $\sim 18 \text{ } \mu\text{Jy}/\text{beam}$, with a combined coverage of $\sim 1 \text{ deg}^2$ at a mean sensitivity of $\sim 13 \text{ } \mu\text{Jy}/\text{beam}$. Follow-up mosaics at 5.5, 7.25 and 9 GHz reach rms values of 28–39 μJy .

In the shallow component, 2294 sources were detected, with 95% completeness at 497 μJy and reliable counts down to 150 μJy . Thanks to the 6-km ATCA E-W configuration, we achieved angular resolutions of $3.2 \times 7.2 \text{ arcsec}$, with 81% of sources remaining unresolved.

In the deep fields, we extracted 489 sources at 2.1 GHz, of which ~ 100 are also detected at 5.5–9 GHz. Reliability reaches 95% at SNR ~ 5 , while completeness at 95% corresponds to 182 μJy (DEEP-1) and 198 μJy (DEEP-2). The spectral index distribution peaks at $\langle \alpha \rangle \approx -0.7$ with $\sigma \approx 0.3$, dominated by flat-to-steep spectrum sources, while peaked-spectrum sources account for $\sim 16\%$. About 20% of detections lack FIR counterparts and typically show steep spectra, consistent with a population of FIR-dark galaxies at $z > 3$. Among sources with H-ATLAS counterparts ($\sim 19\%$), most exhibit $q\text{FIR} > 1.7$ and spectral indices typical of star-forming galaxies, indicating that star formation dominates below the mJy level.

Euclidean-normalised differential source counts were derived at 2.1 and 5.5 GHz. At 2.1 GHz, we confirm the transition from AGN to SFG dominance below $\sim 0.5 \text{ mJy}$, in agreement with models such as Mancuso et al. (2017). The 5.5–9 GHz counts provide the first direct constraints on the sub-mJy sky at these frequencies, showing an indication of flattening below $\sim 0.3 \text{ mJy}$.

These results demonstrate the value of deep, multi-frequency radio observations in well-characterised extragalactic fields. SHORES bridges the gap between wide-area shallow surveys and ultra-deep pencil-beam fields, offering new constraints on the relative contributions of star formation and AGN activity in preparation for SKA pathfinders and SKA surveys.

Topics

Galaxy Evolution & AGN

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