Contribution ID: **23** Type: **Poster**

MIGHTEE: The radio luminosity and star-formation rate relation for galaxies in the COSMOS field

Wednesday 2 October 2024 16:40 (20 minutes)

Utilising the MeerKAT International GHz Tiered Extragalactic Exploration (MIGHTEE) Early Science data from the COSMOS field, we select radio-detected galaxies down to a radio flux density limit of 2 μJy. Source detection was performed using the PYTHON Blob Detector and Source Finder (pybdsf) catalogue. Cross-matching these detections with multiwavelength photometric data in the X-rays, optical, and infrared allows us to select the radio active galactic nuclei (AGN) host galaxies and star-forming galaxies (SFGs) across the redshift range 0 ⊠ z ⊠ 6. Using MAGPHYS, we fit the spectral energy distribution for the selected radio galaxies to obtain their stellar masses (M_*) and star formation rates (SFR). Our key objective is to calibrate the SFR-1.4 GHz radio luminosity ($L_{1.4\ \mathrm{GHz}}$) relation for non-jetted AGN (i.e., radio-quiet AGN), radio-loud AGN (RL AGN), and SFGs. We obtain a positive correlation for non-jetted AGN, with an average slope of 0.81, while RL AGN deviates significantly from the linear trend observed for non-jetted and SFGs, particularly at $L_{1.4\ \mathrm{GHz}} > 10^{23}$ W/Hz. Our findings indicate that at $z < 0.5$, the radio emission observed in non-jetted AGN is driven by star formation processes within the host galaxies, following a relation like SFGs. However, at higher redshift ($z > 0.5$), the radio-FIR correlation becomes shallower, suggesting that while FIR luminosity (tracing star formation) increases significantly, the corresponding increase in radio luminosity is slower. This suggests that in the early universe, non-jetted AGN experience increased star formation, but the radio emission is suppressed. This is likely due to young stellar populations that have not yet evolved to produce supernova remnants.

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Session Classification: Poster Session

Track Classification: Active Galactic Nuclei