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Extragalactic radio sources with sharply inverted spectrum at metre wavelengths

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Abstract. Even for a perfectly homogeneous radio source, inverted spectrum with a slope $\alpha > +2.5$ cannot arise from self-absorption in synchrotron plasma with the standard (power-law) energy distribution of relativistic electrons. Therefore, any such spectra, if found, would require invoking either a non-standard electron energy distribution (e.g., Maxwellian; c.f. Rees 1967; de Kool & Begelman. 1989) or, alternatively, extrinsic thermal free-free absorption. As a first step towards finding such rare objects, we have started a systematic search for extragalactic radio sources having integrated spectrum with $\alpha > +2$, which is a previously unexplored spectral domain. The search was carried out by combining two low-frequency wide-area sky surveys with high sensitivity and sub-arcminute resolution, namely the TIFR GMRT SKY SURVEY at 150 MHz (data release 5) [1] and the Westerbork WISH survey at 352 MHz (De Breuck et al., 2002). The overlap region between these two surveys was found to contain 7056 WISH sources classified as 'single' (S type) and having an (intergrated) flux density ≥ 100 mJy at 352 MHz. Out of these, we have found 7 inverted spectrum sources having $\alpha > +2$, including two sources which are undetected at 150 MHz. We term such rare sources ($\alpha > +2$) as "Extremely Inverted Spectrum Extragalactic Radio Sources (EISERS)". Using additional flux measurements from the NED database, we have plotted the radio spectra of

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the 7 EISERS and these are nearly always found to be of GPS type (O'dea 1998). To fully establish the shapes of the inverted spectra of these 7 EISERS, the present work should be followed up with quasi-simultaneous flux measurements below ∼1 GHz (Details in Gopal-Krishna et al 2014).

Keywords : radiation mechanisms: non thermal – galaxies: ISM – galaxies: jets – galaxies: nuclei – quasars: general – radio continuum: galaxies

Table 1. List of the EISERS candidates.

Source position (Ref. NED)	150MHz (mJy) TGSS	352MHz(mJy) WISH	Spectral Index (150-352 MHz)
Strong Cases			
02 42 10.64 −16 49 32.9	<14.24	106±4.5	>2.35
12 09 14.65 −20 32 39.9	<27.69	207±8.4	>2.36
Probable Cases			
04 42 01.24 −18 26 33.6	16.33±7.3	105±4.4	2.18±0.53
10 03 06.11 −25 14 04.3	11.99±4.1	143±6.1	2.46±0.32
10 31 52.36 −22 28 23.4	30.06±5.9	191±7.9	2.17±0.24
12 07 06.05 −24 46 19.6	67.08±8.2	380±15.3	2.03±0.15
16 26 51.86 −11 27 23.9	25.84±11.2	206±8.5	2.43±0.51

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