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NEW 20-cm RADIO-CONTINUUM STUDY OF THE SMALL MAGELLANIC CLOUD: PART II – POINT SOURCES

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SUMMARY: We present a new catalogue of radio-continuum sources in the field of the Small Magellanic Cloud (SMC). This catalogue contains sources previously not found in 2370 MHz (λ=13 cm) with sources found at 1400 MHz (λ=20 cm) and 843 MHz (λ=36 cm). 45 sources have been detected at 13 cm, with 1560 sources at 20 cm created from new high sensitivity and resolution radio-continuum images of the SMC at 20 cm from paper I. We also created a 36 cm catalogue to which we listed 1689 radio-continuum sources.

Key words. Magellanic Clouds – radio continuum: galaxies – catalogs

1. INTRODUCTION

The Small Magellanic Cloud (SMC), with its well established distance (∼60 kpc; Hilditch et al. 2005) and ideal location in the coldest areas of the radio sky towards the South Celestial Pole, allows observation of radio emissions to be made without interference from Galactic foreground radiation. This means that the SMC is an ideal location to study radio sources such as supernova remnants (SNRs; Filipović et al. 2005, 2008), H II regions and Planetary Nebulae (PNe; Filipović et al. 2009a) which may be difficult to study in our own and other more distant galaxies.

Over the last 40 years extensive radio-continuum surveys of the SMC have been made including interferometric observations using the Molonglo Obervatory Synthesis Telescope (MOST; Ye et al. 1995) and Australia Telescope Compact Array (ATCA; Filipović et al. 2002, Payne et al. 2004, Filipović et al. 2009b, Mao et al. 2008, Dickel et al. 2010), and single dish observations from the 64-m Parkes radio-telescope (Filipović et al. 1997, 1998).

Catalogues of radio-continuum point sources towards the SMC have been produced from these surveys, and from wider surveys of the southern sky. The first SMC source catalogue was produced by McGee et al. (1976) using the Parkes radio telescope at 5009 MHz (λ=6 cm); it contained 27 sources, 13 of them were also detected at 8800 MHz (λ=3.4 cm). The resolution of the observations was limited to $4'$ at 6 cm and $2.7'$ at 3.4 cm.

From the mid-1970s to the present, other surveys have been performed, increasing the number of sources detected (see Table 1). We recently published a set of new high-resolution radio-continuum mosaic images of the SMC at 1400 MHz ($\lambda = 20$ cm), created by combining observations from ATCA and Parkes (Wong et al. 2011, hereafter paper I).

We now present a catalogue of radio-continuum sources towards the SMC derived from an 2370 MHz ($\lambda = 13$ cm) mosaic image from Filipović et al. (2002), one of our 20 cm mosaic radio-conti-

Table 1. Summary of previous radio-continuum source catalogues of the SMC.

Telescope	Freq (MHz)	Beam Size (arcmin)	No of Sources Detected	Reference
Molonglo	408	2.62 × 2.86	75	1
Parkes	1400	15.0	21	2
Parkes	2700	7.7	25	3
Parkes	5009	4.0	27	2
Parkes	8800	2.5	13	2
Parkes	1400	15.0	28	4
MOST	843	0.75	450	5
Parkes	1420	13.8	85	6
Parkes	2450	9.0	107	6
Parkes	4750	4.5	99	6
Parkes	4850	4.9	187	6
Parkes	8550	2.7	41	6
ATCA	1420	1.63	534	7
ATCA	2370	0.67	697	7
ATCA	4800	0.5	75	7
ATCA	8640	0.25	54	7

1. Clarke et al. (1976), 2. McGee et al. (1976), 3. PKSCAT-90, 4. Haynes et al.(1986), 5. Turtle et al. (1998), 6. Filipović et al. (1997), 7. Filipović et al. (2002)

nuum images (Fig. 2 in paper I), and from an 843 MHz (λ = 36 cm) MOST image (Turtle et al. 1998). In Section 2 we describe the data used to derive the radio-continuum point sources. In Section 3 we describe our source fitting and detection methods. Section 4 contains our conclusions and the Appendix contains the radio-continuum source catalogue.

2. DATA

The 13 cm radio-continuum catalogue was produced from a SMC mosaic radio survey of 20 square degrees (Filipović et al. 2002). These observations have a beam size of $\sim 40''$ and r.m.s. noise of 0.4 mJy/beam.

The 20 cm mosaic image (Fig. 2 in paper I) was created by combining data from ATCA project C1288 (Mao et al. 2008) with data obtained for a Parkes radio-continuum study of the SMC (Filipović et al. 1997). This image has a beam size of $17\farcs8 \times 12\farcs2$ with r.m.s. noise of 0.7 mJy/beam.

The 36 cm image comes from a radio survey of 36 square degrees containing the SMC (Turtle et al. 1998). These observations have a beam size of $\sim 45''$ and r.m.s. noise of 0.7 mJy/beam — approximately equal to that of the 20 cm image.

Table 2 contains the field size of all the images used to derive the radio-continuum sources contained in this paper (Appendix).

Table 2. Field size of images used.

Image	RA_1	RA_2	DEC_1	DEC_2
13 cm	00°27′	01°35′	-70°30′	-75°15′
20 cm	00°10′	01°43′	-69°16′	-75°40′
36 cm	00°16′	01°40′	-72°30′	-74°38′

3. SOURCE FITTING AND DETECTION

The MIRIAD task IMSAD (Sault and Killeen 2010) was used to detect sources in the 20 cm and 36 cm images, requiring a fitted Gaussian flux density $>5\sigma$ (3.5 mJy). All sources were then visually examined to confirm that they are genuine point sources, excluding extended emission, bright side lobes, etc.

The radio-continuum sources catalogued in Table A1, are extra sources at 13 cm that were not previously identified as part of the 13 cm catalogue taken from Filipović et al (2002). The 13 cm catalogue retrieved from Filipović et al. (2002) was detected with a fitted Gaussian flux density of $>5\sigma$ (2.0 mJy). Sources catalogued in Table A1 were visually found with a σ between 3σ and 5σ.

Table 3. Information on the images and catalogue of radio-continuum sources.

λ (cm)	RMS (mJy/beam)	Number of Sources	Within of the Field of the 13 cm image	Beam Size (arcsec)
13 cm	0.4	743*	743*	45
20 cm	0.7	1560	824	14.8×12.2
36 cm	0.7	1689	1198	40

* Values include the original catalogue retrieved from Filipović et al. (2002)

The catalogue of radio-continuum sources contains positions RA(J2000), Dec(J2000) and integrated flux densities at 13 cm (Table A1), 20 cm (Table A2) and 36 cm (Table A3). Table 3 contains the r.m.s., number of sources detected, number of sources identified within the field of the 13 cm image and beam size for each image.

4. CONCLUSION

We present a new catalogue of radio-continuum sources towards the SMC, containing sources previously not identified at 13 cm and sources found at 20 cm and 36 cm.

The 13 cm catalogue contains 45 sources from a mosaic 13 cm radio survey (Table A1; Filipović et al. 2002). Containing 1560 sources (Table A2) the 20 cm catalogue has been created from new high-sensitivity and resolution radio-continuum images of the SMC at 20 cm from paper I. We also created a 36 cm catalogue to which we listed 1689 radio-continuum sources (Table A3) created from a MOST radio survey of the SMC (Turtle et al. 1998).

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APPENDIX

Tables A1, A2 and A3 in Appendix are available online at
http://saj.matf.bg.ac.rs/183/pdf/Appendix.pdf.

НОВО ПРОУЧАВАЊЕ МАЛОГ МАГЕЛАНОВОГ ОБЛАКА У РАДИО-КОНТИНУУМУ НА 20 cm: ДЕО II - СНИМЦИ

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Стручни чланак

У другом делу ове студије представљамо нове ATCA радио-континуум каталоге тачкастих објеката у пољу Малог Магелановог облака (ММО) на $\lambda = 20$ cm ($\nu = 1400$ MHz) и $\lambda = 36$ cm ($\nu = 843$ MHz). Такође, представљамо и нових 46 објеката као додатак $\lambda = 13$ cm ($\nu = 2300$ MHz) каталогу Filipović et al. (2002). Укупно у овом новом каталогу представљено је 1576 тачкастих објеката детектованих на 20 cm и 1692 на 36 cm. Ови каталози ће бити коришћени у будућим истраживањима природе ових објеката.