J/A+A/653/A155 Lockman Hole Polarised Sources at 1.4GHz (Berger+, 2021)

Faint polarised sources in the Lockman Hole field at 1.4 GHz.
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Abstract:
In the context of structure formation and galaxy evolution, the contribution of magnetic fields is not well understood. Feedback processes originating from active galactic nucleus (AGN) activity and star formation can be actively influenced by magnetic fields, depending on their strength and morphology. One of the best tracers of magnetic fields is polarised radio emission. Tracing this emission over a broad redshift range therefore allows an investigation of these fields and their evolution.

We aim to study the nature of the faint, polarised radio source population whose source composition and redshift dependence contain information about the strength, morphology, and evolution of magnetic fields over cosmic timescales.

We use a 15-pointing radio continuum L-band mosaic of the Lockman Hole, observed in full polarisation, generated from archival data of the Westerbork Synthesis Radio Telescope (WSRT). The data were analysed using the rotation measure synthesis technique. We achieved a noise of 7uJy/beam in polarised intensity, with a resolution of 15". Using infrared and optical images and source catalogues, we were able to cross-identify and determine redshifts for one-third of our detected polarised sources. Results. We detected 150 polarised sources, most of which are weakly polarised with a mean fractional polarisation of 5.4%. No source was found with a fractional polarisation higher than 21%. With a total area of 6.5deg^2 and a detection threshold of 6.25σ, we find 23 polarised sources per deg^2. Based on our multi-wavelength analysis, we find that our sample consists of AGN only. We find a discrepancy between archival number counts and those present in our data, which we attribute to sample variance (i.e. large-scale structures). Considering the absolute radio luminosity, we find a general trend of increased probability of detecting weak sources at low redshift and strong sources at high redshift. We attribute this trend to a selection bias. Further, we find an anti-correlation between fractional polarisation and redshift for our strong-source sample at z≥0.6.

A decrease in the fractional polarisation of strong sources with increasing redshift cannot be explained by a constant magnetic field and electron density over cosmic scales; however, the changing properties of cluster environments over cosmic time may play an important role. Disentangling these two effects requires deeper and wider polarisation observations as well as better models of the morphology and strength of cosmic magnetic fields.

Description:
This study is based on the WSRT observations of the Lockman Hole field at 1.4GHz (Prandoni et al., 2018MNRAS.481.4548P 2018MNRAS.481.4548P). The data consist of 16 individual pointings, each observed for a full synthesis of 12-hrs between December 2006 and January 2007. The centre of the mosaic was chosen to be at RA=10:53:16.6; DE=+58:01:15 (J2000).

We present a new deep-field analysis of polarised sources in the Lockman Hole at 1.4GHz, using a bespoke polarised mosaic with a central RMS of 7uJy/beam. We find 150 polarised sources in an area of 6.5deg^2 out of 1708 total-intensity sources in this field (8.8%). This equates to a polarised source density of 23deg^{-2}.

File Summary:

FileName	Lrecl	Records	Explanations
ReadMe	80	.	This file
catalog.dat	163	190	Full source catalogue
list.dat	88	1	Information on fits image
fits/*	.	1	fits image

See also:
J/PASJ/53/445 : ASCA Deep survey in Lockman Hole Field (Ishisaki+, 2001)
J/ApJS/185/433 : SWIRE/Chandra survey in Lockman Hole Field (Wilkes+, 2009)
J/ApJS/198/1 : Photometry catalogs for the Lockman Hole (Fotopoulou+, 2012)

Byte-by-byte Description of file: catalog.dat

Bytes	Format	Units	Label	Explanations
1- 4	A4	---	IslIdPI	Source ID, NNN or NNNA
6- 15	F10.6	deg	RAdeg	Right ascension (J2000)
17- 24	F8.6	deg	e_RAdeg	? Right ascension uncertainty (J2000)
26- 34	F9.6	deg	DEdeg	Declination (J2000)
36- 43	F8.6	deg	e_DEdeg	? Declination uncertainty (J2000)
45- 51	F7.4	mJy	PI	Polarised intensity
53- 58	F6.4	mJy	e_PI	Polarised intensity uncertainty
60- 67	F8.4	mJy	I	? Total intensity
69- 74	F6.4	mJy	e_I	? Total intensity uncertainty
76- 82	F7.4	%	fracpol	? Fractional polarisation
84- 89	F6.4	%	e_fracpol	? Fractional polarisation uncertainty
91- 97	A7	---	SCode	S_code; see paper appendix for details
99-107	A9	---	Flag	Flag on intensity (1)
109-112	F4.1	---	SpIndex	? Spectral index to 150MHz (2)
114-117	F4.2	---	zB	? Photometric redshift (3)
119-123	F5.3	---	b_zB	? Photometric redshift minimum (3)
125-129	F5.3	---	B_zB	? Photometric redshift maximum (3)
131-136	F6.2	mag	BMAG	? Absolute B magnitude (3)
138-163	A26	---	SWIRE	ID of crossmatches SWIRE source (4)

Note (1): Flag indicating if the source is not found in the total intensity image and thus taken from Prandoni et al. (2018MNRAS.481.4548P 2018MNRAS.481.4548P) with their source ID.
Note (2): Taken from Mahony et al. (2016MNRAS.463.2997M 2016MNRAS.463.2997M, Cat. J/MNRAS/463/2997)
Note (3): Taken from Tudorica et al. (2017A&A...608A.141T 2017A&A...608A.141T)
Note (4): From Lonsdale et al. (2003PASP..115..897L 2003PASP..115..897L)

Byte-by-byte Description of file: list.dat

Bytes	Format	Units	Label	Explanations
1- 9	F9.5	deg	RAdeg	Right Ascension of center (J2000)
10- 18	F9.5	deg	DEdeg	Declination of center (J2000)
20- 23	I4	---	Nx	Number of pixels along X-axis
25- 28	I4	---	Ny	Number of pixels along Y-axis
30- 50	A21	"datime"	Obs.date	Observation date
52- 56	I5	Kibyte	size	Size of FITS file
58- 64	A7	---	FileName	Name of FITS file, in subdirectory fits
66- 88	A23	---	Title	Title of the FITS file

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(End) Patricia Vannier [CDS] 27-Jul-2021