

# Distant probes of rotation measure structure: where is the Faraday rotation towards the Magellanic Leading Arm?

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## ABSTRACT

Faraday rotation measures (RMs) should be interpreted with caution because there could be multiple magneto-ionized medium components that contribute to the net Faraday rotation along sightlines. We introduce a simple test using Galactic diffuse polarized emission that evaluates whether structures evident in RM observations are associated with distant circumgalactic medium or foreground interstellar medium. We focus on the Magellanic Leading Arm region where a clear excess of RM was previously reported. There are two gaseous objects standing out in this direction: the distant Magellanic Leading Arm and the nearby Antlia supernova remnant (SNR). We recognized narrow depolarized filaments in the 2.3 GHz *S*-band Polarization All Sky Survey image that overlaps with the reported RM excess. We suggest that there is a steep gradient in Faraday rotation in a foreground screen arising from the Antlia SNR. The estimated strength of the line-of-sight component of the magnetic field is  $B_{\parallel} \sim 5 \mu\text{G}$ , assuming that the excess of RM is entirely an outcome of the magnetized supernova shell. Our analysis indicates that the overlap between the RM excess and the Magellanic Leading Arm is only a remarkable coincidence. We suggest for future RM grid studies that checking Galactic diffuse polarization maps is a convenient way to identify local Faraday screens.

**Key words:** polarization – ISM: clouds – ISM: magnetic fields – ISM: supernova remnants.

## 1 INTRODUCTION

Interpreting Faraday rotation measure (RM) enables studies on the cosmic magnetism. As linearly polarized radiation travels along a line of sight, its plane of polarization rotates through an angle  $\text{RM}\lambda^2$ , where

$$\text{RM} = 0.812 \int_{\text{observer}}^{\text{source}} n_e(r) B_{\parallel}(r) dr, \quad (1)$$

where RM is in units of  $\text{rad m}^{-2}$ ,  $n_e$  is electron density in  $\text{cm}^{-3}$ ,  $B_{\parallel}$  is the magnetic field strength along the line of sight in  $\mu\text{G}$ , and  $r$  is a path-length in pc. Extragalactic compact sources, e.g. radio galaxies and quasars, are often used to probe RM at a pinpoint location on the sky plane. The integration is between the source and the observer along the line of sight; any patch of magneto-ionic media that polarized radiation is transmitted through on the way to the observer causes Faraday rotation and influences the resulting RM.

In practice, it is common to have multiple Faraday rotating regions along a line of sight within a telescope beam. The RM of such ‘Faraday complex’ sources is expressed using the Faraday depth ( $\phi$ ), a parameter that describes the Faraday rotation at individual Faraday screens (Burn 1966):

$$\phi(X) = 0.812 \int_{\text{observer}}^X n_e(r) B_{\parallel}(r) dr, \quad (2)$$

where  $X$  is a certain position along the line of sight and  $\phi$  is a function of  $X$ . In this study, we use RM and  $\phi$  interchangeably. Details will be described in Section 2.1.2.

The ‘RM grid’ technique probes a contrast in the overall distribution of RM on and off magneto-ionic structures, assuming RM sources are mostly in the background of target objects. For this statistical approach, a sufficient number of polarized sources are required in the region of interest. Thus far, the RM source density of current radio surveys (e.g.  $1 \text{ deg}^{-2}$ ; Taylor, Stil & Sunstrum 2009) limits this approach on studies of the large-scale Galactic magnetic fields or several square-degree-size extended objects. Upcoming radio surveys using next-generation radio telescopes are expected to provide immensely denser RM grid (e.g.  $25 \text{ deg}^{-2}$ ; Anderson et al. 2021). Ever-improving RM grids are enabling new measurements of the magnetic field strength and structure in a range of objects including galaxy clusters (e.g. Anderson et al. 2021), individual resolved galaxies (e.g. Gaensler et al. 2005; Mao et al. 2008), Galactic objects (e.g. Harvey-Smith, Madsen & Gaensler 2011), and high-velocity clouds (HVCs; e.g. McClure-Griffiths et al. 2010; Hill et al. 2013).

There is ample evidence that we are surrounded by the multiphase circumgalactic medium (CGM) in the Milky Way halo (see Putman, Peek & Jounge 2012 and references therein). Understanding the nature of the CGM is key to understanding the evolution of galaxies, as it connects the pristine intergalactic medium to the star-forming interstellar medium (ISM). The Milky Way provides a unique environment for studying the complex structures of the CGM on a spatially resolved scale, which is hard to achieve by studies of

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distant galaxies. Although most baryons belonging to the Milky Way are distributed in the Galactic disc, observations have reported the presence of extraplanar gas clouds at high Galactic altitude moving at a high relative velocity with respect to Galactic rotation (Muller, Oort & Raimond 1963; Putman et al. 2002; McClure-Griffiths et al. 2009; Saul et al. 2012). They are so-called HVCs and intermediate-velocity clouds.

As HVCs travel through the halo, they hydrodynamically interact with their surroundings. Ram pressure pushes and strips low-density structures to the opposite direction of the cloud motion, Kelvin–Helmholtz, and the Rayleigh–Taylor instabilities develop turbulent mixing layer across the cloud–wind interface, which is susceptible to the cloud stripping (Jones, Kang & Tregillis 1994; Schiano, Christiansen & Knerr 1995). Taken all together, it is easy to conclude that moving clouds dissipate in a short time-scale and if so, one would expect to find HVCs dominated in the warm ionized phase (Heitsch & Putman 2009). However, a significant mass of observed HVCs are in cold phase H I and they are often suggested as a source of cold gas fuelling the star formation of the Milky Way (Putman, Peek & Jounge 2012). This indicates additional forces that stabilize HVCs so that the clouds survive their journey through the Galactic halo and deliver gas to the Galactic disc.

The magnetic field is proposed as one of the possible sources that provide stability of HVCs (Konz, Brüns & Birk 2002; Santillan, Franco & Kim 2004; Kwak, Henley & Shelton 2011; McCourt et al. 2015; Banda-Barragán et al. 2016; Grønnow et al. 2017; Banda-Barragán et al. 2018; Grønnow, Tepper-García & Bland-Hawthorn 2018). Magnetic fields can be dragged along and amplified following the motion of plasma they are embedded in. This dragging effect leads to the field ‘draping’ around the moving clouds when the relative velocity between the ambient medium and the clouds is high enough to overcome the tension of the ambient magnetic field (Dursi & Pfrommer 2008). Hence, the magnetic field draping is particularly efficient around HVCs due to the high relative velocity and the weak magnetic fields of the Galactic halo.

There have been attempts to observationally constrain the magnetic field strength associated with the Milky Way HVCs using the RM grid (hereafter, McG10; McClure-Griffiths et al. 2010; Hill et al. 2013; Kaczmarek et al. 2017; Betti et al. 2019). In this paper, we present a high-density RM grid towards the Magellanic Leading Arm (LA)/Antlia supernova remnant (SNR) regions. We combine it with the Galactic diffuse polarized emission in order to test whether the Magellanic HVC or the Antlia SNR is the source of Faraday rotation. The paper is structured as follows: in Section 2, we present an overview of observation data and the Faraday RM synthesis technique. In Section 3, we introduce properties of two gaseous objects – the Antlia SNR and the Magellanic LA – overlapping closely with each other. Then, we explore the compact-source RM (Section 4.1) and the diffuse continuum emission (Section 4.2) in the region. The discussions on our results are presented in Section 5, including Section 5.2 where we estimate the magnitude of the line-of-sight magnetic field of Antlia SNR based on the observation data presented. Our conclusions are summarized in Section 6.

## 2 METHODOLOGY

### 2.1 Compact-source RM

For constructing the RM grid covering our field of interest, we use two publicly available RM catalogues in addition to new radio continuum observations with the Australia Telescope Compact Array

(ATCA). A summary of observational specifications are presented in the following subsections.

#### 2.1.1 National Radio Astronomy Observatory Very Large Array Sky Survey and S-band Polarization All Sky Survey/ATCA RM catalogue

First, we have a RM catalogue from the National Radio Astronomy Observatory Very Large Array Sky Survey (NVSS; Condon et al. 1998) RM catalogue (Taylor, Stil & Sunstrum 2009) that covers the sky above a declination of  $-40^\circ$  with the RM source density of  $1 \text{ deg}^{-2}$  on average. Although it has a significant role in the search for magnetised HVCs (McG10; Hill et al. 2013), it should be noted that the RMs are derived from limited coverage in frequency domain: 42 MHz-wide bands centred at 1364.9 and 1435.1 MHz. Yet, the  $n\phi$ -ambiguity tests performed by Ma et al. (2019) has shown that the NVSS RM catalogue is mostly reliable for sources located out of the Galactic plane and in the  $\phi$  range used for this study.

For the southern sky below a declination of  $-1^\circ$ , there is the S-band Polarization All Sky Survey (S-PASS; Carretti et al. 2019). S-PASS/ATCA (Schnitzeler et al. 2019) catalogue is derived from a follow-up observations of sources selected from S-PASS using ATCA. It provides the first wide-band (1.3–3.1 GHz) polarimetry data of compact sources with the average polarized source number density of  $0.2 \text{ deg}^{-2}$ .

#### 2.1.2 ATCA observations

In order to increase the polarized source density, we performed follow-up observations on 737 fields in the region  $10\text{h}:00\text{m}:00\text{s} < \alpha < 13\text{h}:30\text{m}:00\text{s}$  and  $-52.3^\circ < \delta < -32^\circ$  with ATCA. Each source was visited  $\approx 6$  times over a 12-h scan and the total observation time is on average 1.5 min per source. The frequency range used for our analysis is 2 GHz-wide continuum band from 1.1 to 3.1 GHz, and the spectral resolution is  $\approx 1 \text{ MHz}$ . The angular diameter of the largest beam at the lowest frequency is  $13.2 \text{ arcsec}$ . Radio bright sources were identified using AEGEAN source finder (Hancock et al. 2012; Hancock, Trott & Hurley-Walker 2018) based on Stokes  $I$  clean image stacked over the entire 2 GHz-wide band. The total number of sources detected in the field is about 3000, including both polarized and unpolarized sources.

We used the MIRIAD software package (Sault, Teuben & Wright 1995) provided by Australia Telescope National Facility for data reduction and imaging. The software is particularly designed for processing radio interferometry data observed with ATCA. Prior to imaging, we performed flagging using the `mirflag` task in MIRIAD which immediately flags channels whose amplitudes deviate more than 14 times the median deviation from the channel median. For calibration of data, we used 1934–638 as a flux calibrator and 1104–445, 1206–399, and 1215–457 as phase calibrators, respectively for each night. The calibration process determines tables of bandpass functions, antenna gains, and polarization leakage and corrects the observed visibility to get the ideal sky intensity distribution of radio sources.

Imaging of data was performed separately for each polarization (Stokes  $I$ ,  $Q$ ,  $U$ , and  $V$ ) and each chunk of channels, where the channel width ( $\delta\lambda^2$  in the equation 3 below) is determined by estimating the maximum value of observable Faraday depth:

$$\|\phi_{\text{max}}\| \approx \sqrt{3}/\delta\lambda^2. \quad (3)$$

The targeted sky is at relatively high Galactic latitude where we do not normally expect to detect extremely high Faraday rotation

compared to the Galactic disc as both the magnetic field strength and ionized gas density is relatively low. Therefore, we used a channel width of 20 MHz which limits the measurable Faraday depth to around  $\|\phi_{\max}\| \approx 750 \text{ rad m}^{-2}$ . In order to match the spatial resolution throughout the channels, the clean images of the frequency slices were smoothed by the largest beam among them before being stacked into a cube. At the end of this imaging stage, we have Stokes  $I$ ,  $Q$ ,  $U$ , and  $V$  parameters of the identified sources as a function of frequency.

The RM of each source was estimated using the Faraday RM synthesis technique (e.g. Burn 1966; Brentjens & de Bruyn 2005; Heald, Braun & Edmonds 2009; Mao et al. 2010.) We use RM TOOLS 1D software (Purcell et al. 2020) provided by Canadian Initiative for Radio Astronomy Data Analysis. The idea of RM synthesis is to bring the complex polarized surface brightness  $\mathcal{P}$ , defined below using Stokes  $Q$  and  $U$ , to the Faraday depth ( $\phi$ ) domain so that one can interpret the changes in  $\phi$  along the line of sight.

$$\mathcal{P}(\lambda^2) = Q + i U. \quad (4)$$

A simple approach is to introduce the Faraday dispersion function which is a Fourier conjugate of  $\mathcal{P}(\lambda^2)$ .

$$\mathcal{F}(\phi) = \frac{1}{\pi} \int_{-\infty}^{\infty} \mathcal{P}(\lambda^2) e^{-2i\phi\lambda^2} d(\lambda^2). \quad (5)$$

However, there is an incompleteness in  $\lambda^2$  sampling in the following inevitable reasons:

- (i) Mathematically,  $\lambda^2$  can only be positive.
- (ii) Stokes  $Q$  and  $U$ , therefore  $\mathcal{P}(\lambda^2)$ , are measured within a bandwidth of a telescope and discretized to a finite number of channels.
- (iii) Some channels are flagged during the data-reduction process.

The limited sampling of  $\lambda^2$  space results in sidelobes in ‘observed  $\mathcal{F}(\phi)$ ’ (hereafter,  $\tilde{\mathcal{F}}(\phi)$ ) which is distinct from the ideal  $\mathcal{F}(\phi)$ . The Rotation measure spread function (RMSF),  $R(\phi)$  is introduced to describe the discrepancy.

$$\tilde{\mathcal{F}}(\phi) = \mathcal{F}(\phi) * R(\phi) \quad (6)$$

The RM-clean algorithm (Heald, Braun & Edmonds 2009) was introduced in order to uncover physically meaningful signal from a dirty Faraday spectrum with noise and sidelobes; a clean Faraday spectrum is obtained by deconvolving the dirty spectrum with an RMSF. The resolution of the Faraday spectra,  $\delta\phi$ , i.e. full width at half-maximum (FWHM) of the RMSF, and the largest detectable scale in  $\phi$  space,  $\phi_{\max\text{-scale}}$ , are defined as follows

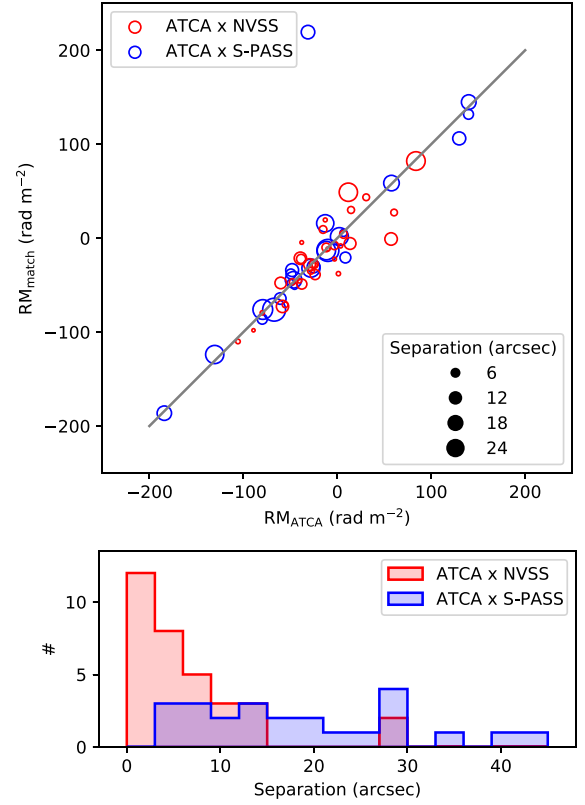
$$\delta\phi \approx 2\sqrt{3}/(\lambda_{\max}^2 - \lambda_{\min}^2), \quad (7)$$

$$\phi_{\max\text{-scale}} \approx \pi/\lambda_{\min}^2. \quad (8)$$

Given the bandwidth of our data  $0.009 \text{ m}^2 < \lambda^2 < 0.074 \text{ m}^2$ , the estimated FWHM is  $\sim 53 \text{ rad m}^{-2}$  and the maximum measurable scale is  $\sim 349 \text{ rad m}^{-2}$ . We determined the Faraday depth at the strongest peak in a clean Faraday spectrum and adopted it as the Faraday depth of a source. Therefore, the Faraday depth and RM are interchangeable and the Faraday complexity is not in the scope of this study.

For the catalogue of RM sources used for our analysis, we adopted thresholds as follows.

- (i) The number of channels used as an input for the RM synthesis is larger than 40 so that a certain level of  $\lambda^2$  coverage is achieved.



**Figure 1.** Top panel: Comparison of RMs matched between different catalogues using sky coordinates (red: ATCA  $\times$  NVSS, blue: ATCA  $\times$  S-PASS). The size of the circles represents the angular separation between matched pairs. The grey line shows the one-to-one relation where RMs from the two catalogues are identical. Bottom panel: The histogram of the separation between the matched pairs.

- (ii) The lower limit of  $\|\phi_{\max}\|$  is set to  $300 \text{ rad m}^{-2}$  to ensure reasonably small separation between the channels in  $\lambda^2$  space after flagging (see equation 3).

- (iii) The signal-to-noise ratio of the peaks in the Faraday spectra identified using the RM-clean algorithm is larger than 7.

- (iv) The observed  $|\phi|$  is smaller than  $\|\phi_{\max}\| \approx 750 \text{ rad m}^{-2}$ . This criterion rejects the artificial peaks that appear close to the lower and upper limit of the Faraday spectra.

The resulting 210 sources that match the above criteria are presented in Table A1.

In order to test the consistency of the observed RMs, we performed a matching between the catalogues. The pairing is based on the sky coordinates of sources. The top panel of Fig. 1 shows the RMs of matched pairs between ATCA  $\times$  NVSS (red) and ATCA  $\times$  S-PASS (blue). The size of the symbols corresponds to the angular separation between the matched pairs. The bottom panel presents the histogram of the separation. Total 33 and 24 pairs were identified, respectively, with the maximum separation between sources limited to 1 arcmin. We found that most of the matched pairs have approximately identical RMs.

## 2.2 S-PASS Galactic diffuse polarization

S-PASS provides maps of polarimetric data of the southern sky ( $\text{Dec} < -1^\circ$ ). The observation of the survey was performed with the S-band (2.2–3.6 GHz) receiver of the Parkes radio telescope.



The FWHM of the beam for the final Stokes  $I$ ,  $Q$ ,  $U$ , and  $V$  images is 10.75 arcmin, which is several times enhanced resolution compared with previous continuum surveys of a similar kind (e.g. Reich, Testori & Reich 2001). This frequency range and the angular resolution enable detailed studies of magnetism at the Galactic disc and the disc–halo interface. We refer interested readers to Carretti et al. (2019) for further description of the survey. In this paper (specifically, Section 4.2), we used the Stokes  $I$  map to examine the continuum emission at our region of interest and the Stokes  $Q$  and  $U$  maps to identify depolarized features arising on top of the diffuse polarized emission from the Galactic ISM.

### 3 POTENTIAL FOR CONFUSION FROM SOURCES ALONG THE LINE OF SIGHT

In this paper, we focus on the Magellanic LA region where the compact-source RM distribution was earlier studied by McG10. There are two gaseous objects which are large in solid angle and closely overlap with each other: the Magellanic LA and the Antlia SNR. Fig. 2 shows the distribution of high-velocity H I emission (integrated between 200 and 300 km s<sup>−1</sup>; blue contours) from the Galactic All Sky Survey (McClure-Griffiths et al. 2009) and the Antlia SNR bright in H $\alpha$  composite image at lower velocity range generated by Finkbeiner (2003) using the Wisconsin H-alpha mapper (Haffner et al. 2003), the Virginia Tech Spectral line Survey, and the Southern H $\alpha$  Sky Survey Atlas (Gaustad et al. 2001). In the following paragraphs, we briefly introduce some known properties of these objects.

The Magellanic LA is a stream of material tidally stripped out from the Magellanic System during the interaction between the Large Magellanic Cloud, the Small Magellanic Cloud, and the Milky Way (e.g. Nidever, Majewski & Butler Burton 2008; Besla et al. 2012; Lucchini et al. 2020). A network of large high-velocity complexes, namely, LA I–IV, and associated cloudlets are found in H I emission. Their distribution is extended from the Magellanic system to the high-latitude sky beyond the Galactic disc. In the field studied in this paper, only LA II and LA III are present.

Given the positive Galactic latitude of the LA II and the LA III, they are often considered to have passed through the Galactic mid-plane (McClure-Griffiths et al. 2008). Recently, a young stellar association was discovered near the tip of the LA II using *Gaia* DR2 (Price-Whelan 1; Price-Whelan et al. 2019; Nidever et al. 2019). The *Price-Whelan 1* star cluster is located at 28.7 kpc from the sun. Its estimated age is comparable with the time since the traversing of the LA through the Galactic disc, which makes the compression of the materials during the interaction a favourable explanation for the formation of the star cluster.

McG10 reported the morphological agreement between the structures in the RM map and the distribution of HVCs in the field. They suggested that the magnetic field associated with the LA II is reinforced by relatively strong magnetic fields of the disc that it penetrated before moving into the halo. The strength of the coherent line-of-sight magnetic field estimated from the RM grid is  $B_{\parallel} \gtrsim 6 \mu\text{G}$ . This simple calculation is valid under an assumption that the structures appearing in the RM and the H I emission are physically associated, in other words, if the HVCs are the dominant source of Faraday rotation along the sightlines.

The Antlia SNR is located at  $(l, b) = (276.5^\circ, +19^\circ)$  and has a large angular diameter of  $24^\circ$  (McCullough, Fields & Pavlidou 2002). Because such high Galactic latitude and size are not common among known Galactic SNRs, whether the object is a supernova-driven remnant or not had been suspected since its first discovery

by McCullough et al. (2002). Only recently, it is confirmed that the remnant reveals shock-driven emission regions in ultraviolet and optical lines supporting the SNR origin (Fesen et al. 2021). This SNR is bright in H $\alpha$  but weak in radio continuum, suggesting that it is a relatively evolved system. The distance to the SNR is not well constrained, but the large angular size and features arising from interacting with nearby ISM (e.g. Gum Nebula) locate it around 60–340 pc away within the Galactic disc (McCullough et al. 2002). Note its striking morphological coincidence with the Magellanic LAs presented in Fig. 2.

## 4 RESULTS

### 4.1 Structures in the compact-source RM map

To construct the RM grid of the field, we combine three RM catalogues as explained in Section 2.1. We achieved the maximum RM source density of  $\approx 2$  sources deg<sup>−2</sup>. Fig. 3 shows interesting features standing out in the RM grid. We separate the field into several regions labelled in Fig. 3 for convenience in the description.

**Region I:** Below Galactic latitude  $b \lesssim 10^\circ$ , especially in the south-eastern side of the field, there are large RMs with high fluctuations. The Faraday rotation towards this region is dominated by high density and strongly magnetized ISM cells distributed along the Galactic disc.

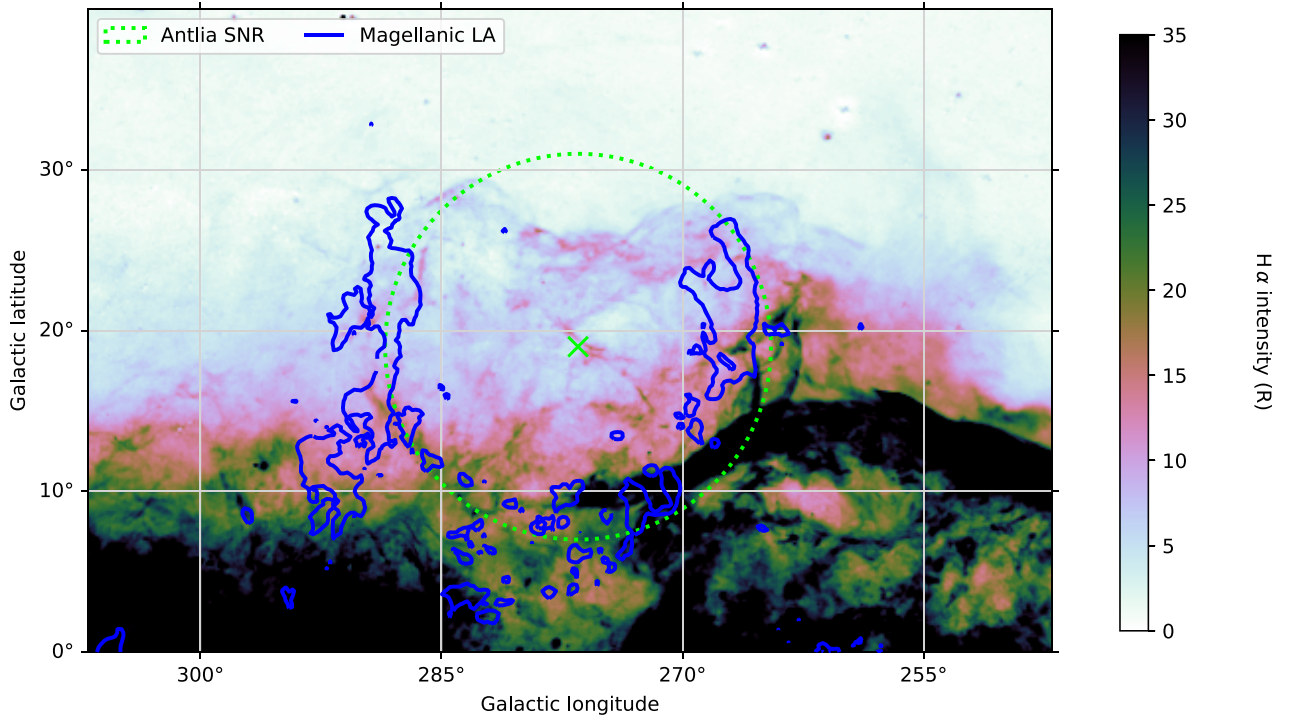
**Region II:** Toward the south-western corner of the field, there is a group of positive RM sources ( $\phi_{\text{obs}} > 100 \text{ rad m}^{-2}$ ) associated with the north-eastern edge of the Gum Nebula which is clearly visible in the H $\alpha$  emission map in Fig. 2. Purcell et al. (2015) constrained the electron density ( $n_e = 1.4 \pm 0.4 \text{ cm}^{-3}$ ) and the magnetic field strength ( $B = 3.9^{+4.9}_{-2.2} \mu\text{G}$ ) in this region from the observed RM distribution together with a simple geometric model of a magneto-ionized spherical shell.

**Region III:** There are positive RMs extending along  $l \sim 265^\circ$  up to  $b \sim 25^\circ$ . This pillar of positive RMs seems to extend from the RM distribution of the Gum Nebula in Region II, but also aligns well with the western edge of the Antlia SNR and LA III. Also, it was earlier reported by Reynoso & Dubner (1997) that there is a vertical H I structure in this region that is possibly related with blown-out ISM from the Galactic disc to the halo (i.e. a galactic chimney). Due to the complexity in the region, it is difficult to identify which object is a dominant Faraday rotator along the line of sight.

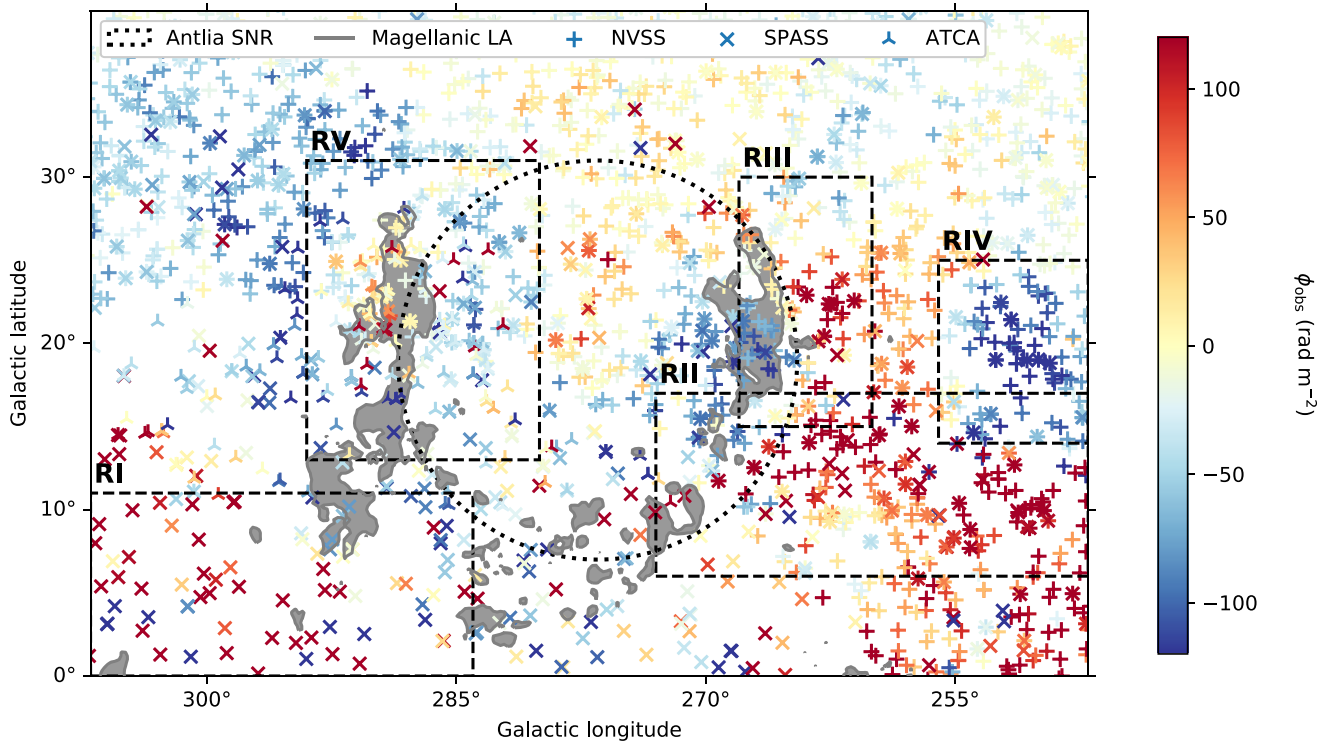
**Region IV:** We also notice a group of negative RMs ( $\phi_{\text{obs}} < -100 \text{ rad m}^{-2}$ ) near the western boundary of the field. Interestingly, there is no corresponding radio continuum or H $\alpha$  emission detected or previously reported magneto-ionized object in this region.

**Region V:** At the eastern edge of the Antlia SNR where it overlaps with the LA II, there is a group of RMs close to zero surrounded by negative RMs. This is the region studied by McG10. McG10 proposed the RM excess in the region as indication of magnetized LA II, but the Antlia SNR in the foreground complicates the determination of the dominant Faraday rotator in the region.

Our inspection of the noticeable structures in the RM grid indicates that it is not uncommon to find multiple gaseous objects along the lines of sights. Especially, the situation is complicated in Region III and Region V due to the coincidence of the Antlia SNR and the Magellanic LAs. Additional piece of information is required in order to determine where along the lines of sight the Faraday rotation occurs in this region.

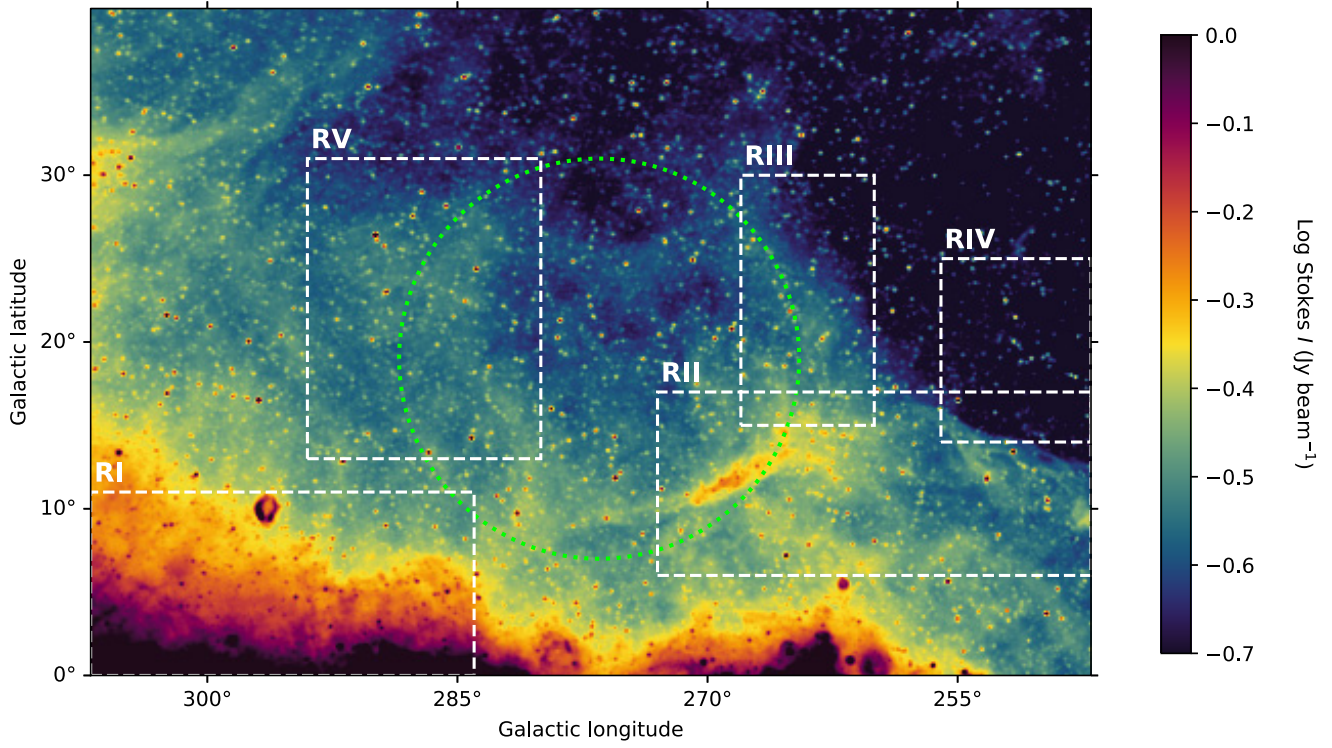


**Figure 2.** The distribution of high-velocity H I clouds [ $v_{\text{LSR}} = (200\text{--}300)\text{ km s}^{-1}$ ; blue contour] overlaid on top of the Galactic H $\alpha$  emission [ $v_{\text{LSR}} = (-100\text{--}80)\text{ km s}^{-1}$ ]. The green dotted circle is a schematic drawing of the Antlia SNR with an angular diameter of  $24^\circ$  (McCullough, Fields & Pavlidou 2002).

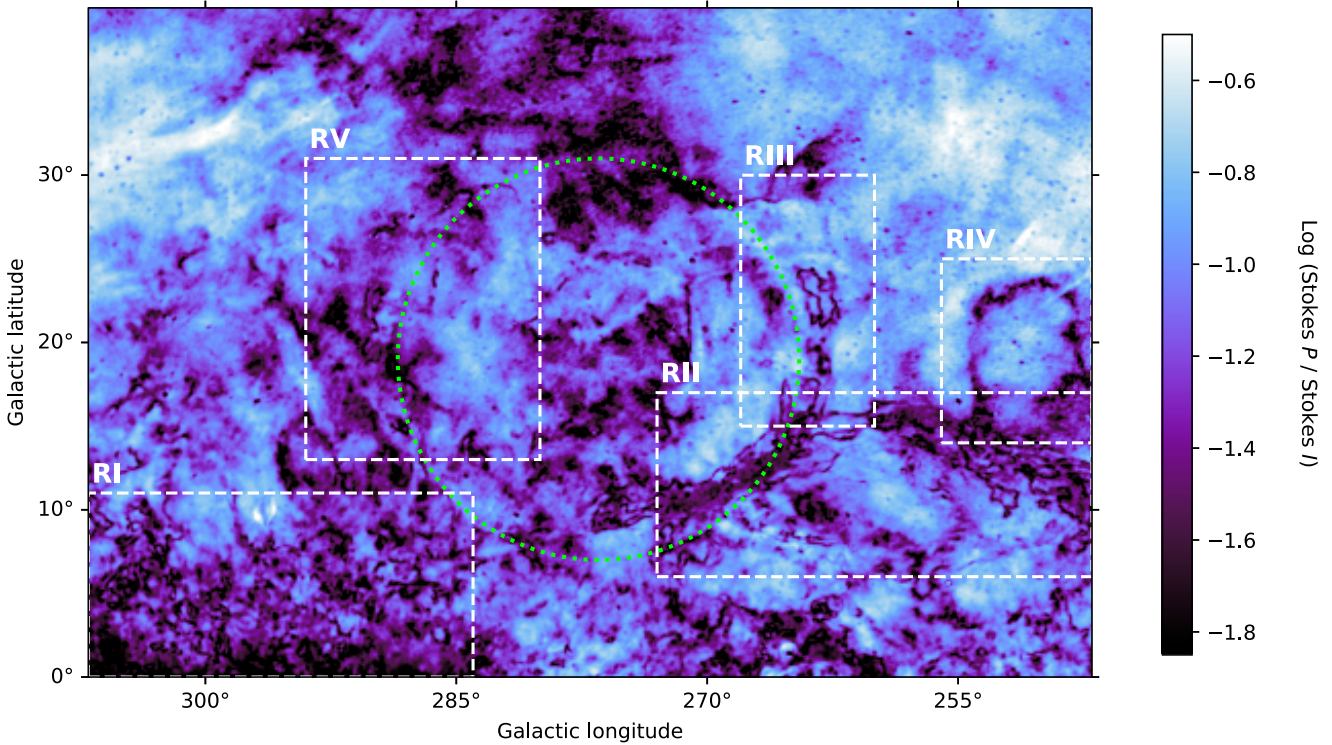


**Figure 3.** Raw RMs from NVSS (+ symbol; Taylor et al. 2009), S-PASS/ATCA (x symbol; Schnitzeler et al. 2019), and our observations with ATCA. The H I contour and the Antlia SNR diagram are the same as Fig. 2, coloured in black for clarity. The dashed boxes are regions discussed in the text.

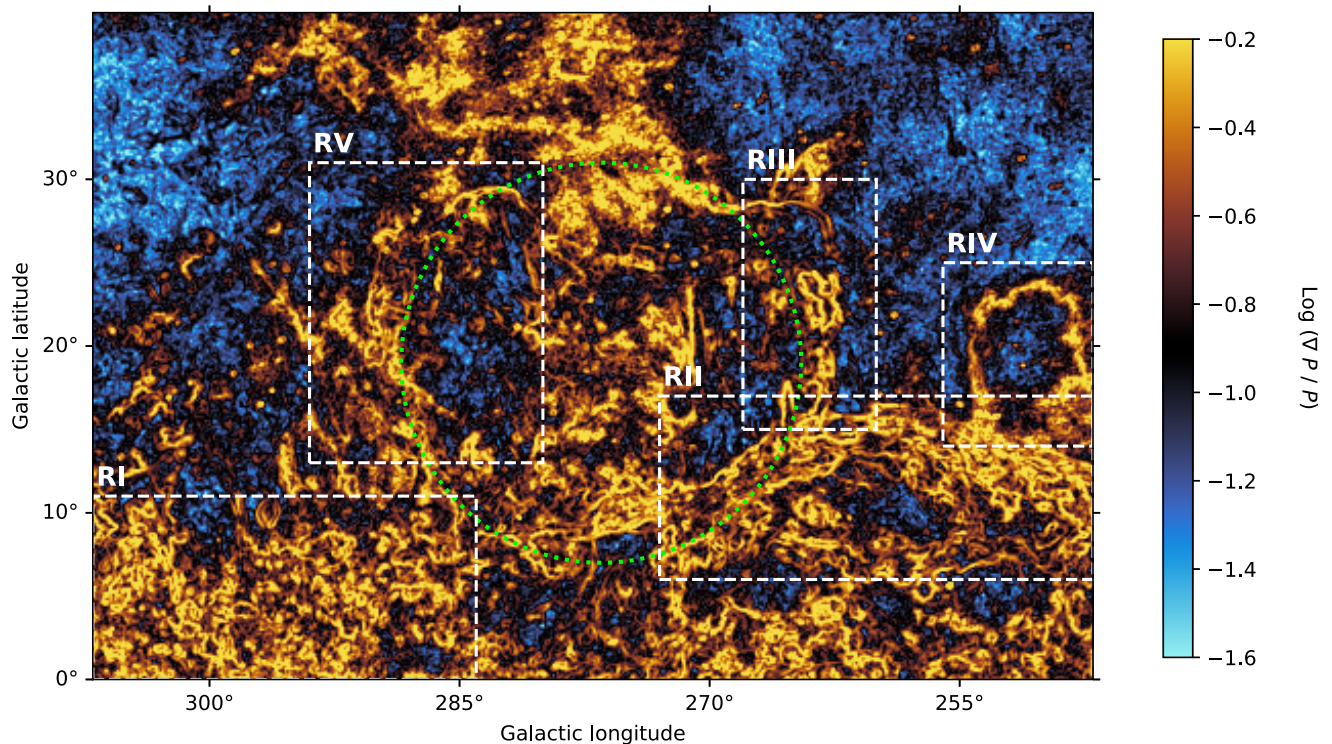




**Figure 4.** The Stokes  $I$  image from S-PASS data. The Antlia SNR diagram (green dotted circle) and the white dashed boxes are the same as Fig. 3 above.



**Figure 5.** The linear polarization intensity calculated from the Stokes  $Q$  and  $U$  of S-PASS data.



**Figure 6.** The normalized polarization gradient ( $|\nabla P|/|P|$ ) of S-PASS data.

#### 4.2 Radio continuum and diffuse polarized emission

Fig. 4 shows the S-PASS Stokes  $I$  image of the field.<sup>1</sup> Our field of interest covers a wide range of synchrotron-emitting regions including the bright Galactic disc (e.g. Region I) as well as the lower brightness diffuse structures. There is weak radio synchrotron emission in the Antlia SNR region. However, its continuum emission is not as prominent as in  $H\alpha$  except for the south-western edge of the SNR where it interacts with the Gum Nebula (Region II). In comparison to the Stokes  $I$  image, the linear polarization intensity map (Fig. 5) shows rich filamentary structures on top of the smooth polarized emission. These depolarized filaments appear if there is a sharp change in electron and/or magnetic properties in the foreground.

The properties of linearly polarized radiation are often characterized with the complex Stokes vector  $\mathcal{P}$ , as defined in equation 4 (Gaensler et al. 2011). Assuming the spatial gradient in  $\mathcal{P}$ , i.e.

$$|\nabla \mathcal{P}| = \sqrt{\left(\frac{\partial Q}{\partial x}\right)^2 + \left(\frac{\partial U}{\partial x}\right)^2 + \left(\frac{\partial Q}{\partial y}\right)^2 + \left(\frac{\partial U}{\partial y}\right)^2}, \quad (9)$$

arises from fluctuations in the Faraday rotation in foreground Faraday screens, we adopt the normalized parameter,  $|\nabla \mathcal{P}|/|\mathcal{P}|$  (Fig. 6). Taking the spatial gradient makes it easier to trace edges of the filaments standing out in Fig. 5. Bright features in the  $|\nabla \mathcal{P}|/|\mathcal{P}|$  map, therefore, highlight depolarization arising from complex layers of Faraday screens in this region of the sky.

With the normalized polarization gradient map in Fig. 6, we revisit the regions discussed earlier in Section 4.1 where we identify noticeable distinction in the distributions of RMs.

**Region I (bottom-left panel):** This area is covered with chaotic small angular scale depolarized filaments. These fuzzy structures are typical at low Galactic latitude (e.g. Uyaniker et al. 2003; Iacobelli et al. 2014) where significant depolarization is expected from the turbulent ISM in the Galactic disc.

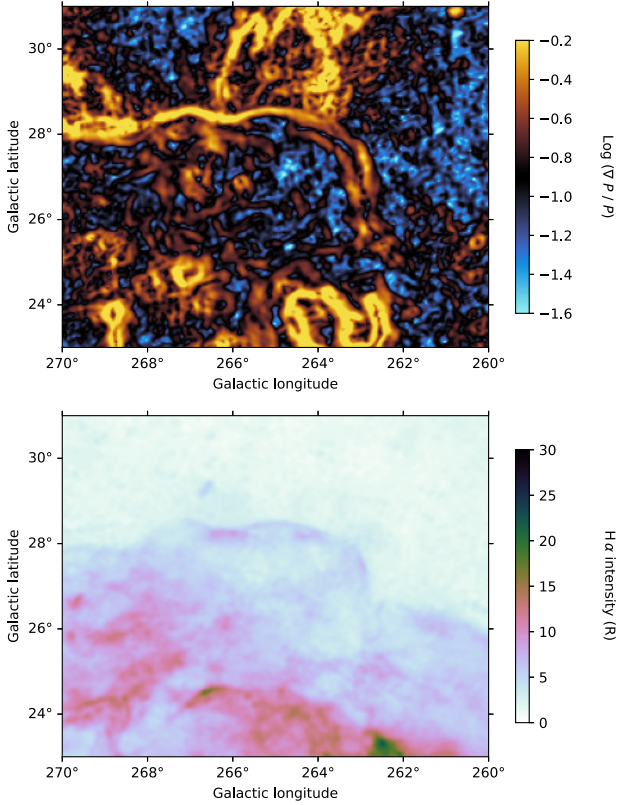
**Region II (bottom-right panel):** The bright web of depolarized filaments spread along the north-eastern edge of the Gum Nebula indicates that the object effectively operates as a Faraday rotating screen. This is not surprising given its (i) high emissivity in  $H\alpha$  (see Fig. 2) suggesting the presence of a substantial amount of free electrons and (ii) the morphological coherence in the RM grid indicating that the nebula is magnetized.

**Region III (right edge of the dotted circle):** There are depolarized filaments and loops extended along the western edge of the Antlia SNR. The remarkable spatial coherence of  $H\alpha$  emission and the  $|\nabla \mathcal{P}|/|\mathcal{P}|$  distribution in this region was earlier reported by Iacobelli et al. (2014). Furthermore, we discovered a narrow filament with ‘double-jump’ profile at  $(l, b) \approx (263, 27)$  which indicates a delta function-like distribution of  $n_e$  and/or magnetic field (e.g. a strong shock; Burkhart, Lazarian & Gaensler 2012). Indeed, Fesen et al. (2021) studied the spectral line ratios of the very filament and supported the shock origin of the filament. We present a zoom-in image of this filament in Fig. 7.

**Region IV (middle-right panel):** The striking feature standing out in this region is a narrow loop. Its single-jump profile suggests a step-function-like change in magnetic field properties in and outside the loop (Burkhart, Lazarian & Gaensler 2012). The negative RMs

<sup>1</sup>We used colour maps provided by CMASHER PYTHON package (van der Velden 2020) in Figs 4, 5, and 6.





**Figure 7.** The zoom-in image of a  $|\nabla P|/|P|$  double-jump profile filament in Region III (the north-western edge of the Antlia SNR) and its  $H\alpha$  counterpart.

found in Fig. 3 are well enclosed within the loop, indicating the enhanced magnetic field strength in this region.

Region V (left edge of the dotted circle): Similarly to Region III, there is a complex network of filaments in this region including a narrow filament at  $(l, b) \approx (284, 29)$  that clearly overlap with a narrow  $H\alpha$ -emitting filament.

## 5 DISCUSSION

### 5.1 Is the Antlia SNR a Faraday rotator?

The observed RM of a distant source ( $\phi_{\text{obs}}$ ) is a superposition of the Faraday rotation occurring at every magneto-ionized medium between the source and the observer. This includes the Faraday rotation at the polarized emitting source ( $\phi_{\text{intrinsic}}$ ) and the Milky Way foreground ( $\phi_{\text{MW}}$ )

$$\phi_{\text{obs}} = \phi_{\text{intrinsic}} + \sum_{i=1}^N \phi_{\text{obj}, i} + \phi_{\text{MW}}, \quad (10)$$

where  $\phi_{\text{obj}, i}$  represents the Faraday rotation taking place at different distance along the line of sight and  $N$  is the number of such Faraday screens which is very likely unknown for any sightlines. RM catalogues from all-sky surveys revealed large Galactic-scale structures in the RM grids which indicates that  $\phi_{\text{MW}}$  is likely to dominate the observed RMs in most of the sky (Taylor et al. 2009; Schnitzeler et al. 2019). In studies of objects with smaller angular scales like HVCs, the contribution of  $\phi_{\text{MW}}$  is often estimated using off-object RMs of the region and subtracted from  $\phi_{\text{obs}}$ . The variation

of the intrinsic polarization of sources ( $\phi_{\text{intrinsic}}$ ) is random and therefore negligible on the basis of the large number statistics.

In the region of the sky studied in this paper, there are several known localized objects that could possibly induce Faraday rotation ( $\phi_{\text{obj}, i}$ ), if magnetized – the Gum Nebula, the Antlia SNR, and the Magellanic LA. The Gum Nebula leaves an imprint on the RM grid that closely follows the morphology of its  $H\alpha$  emission (see Region II in Fig. 3), making it clear that it is the dominating Faraday rotator in the region. However, the overlap of the Antlia SNR and the Magellanic LA on the sky makes it indeterminate whether the features in the RM grid arise due to either of or both the objects. They are not physically associated given their distinct observed velocities and distances. Therefore, if the Antlia SNR is magnetized and significantly affects the RM towards the sightlines, the RM excess identified by McG10 can no longer be clearly associated with the LA.

To test the possibility of whether the intriguing features appearing in the compact-source RM map are associated with the Magellanic LA in the Galactic halo or the Antlia SNR in the foreground, we bring extra information from the diffuse polarized radiation emitted from the large-scale Galactic ISM. The diffuse polarized emission traces large-scale smooth polarized emission from Galactic ISM. On top of that, Faraday screens that alter the polarization properties of radiation coming from behind produce depolarized structures. When polarized radiation emitted from different patches of ISM are combined into a beam, their properties are inevitably averaged out due to the turbulent nature of ISM (i.e. large fluctuations in properties) and finite beam sizes in radio observations. This depolarization effect result in iconic filamentary structures in a polarization emission, e.g. depolarized canals (e.g. Haverkorn & Heitsch 2004; Fletcher & Shukurov 2006).

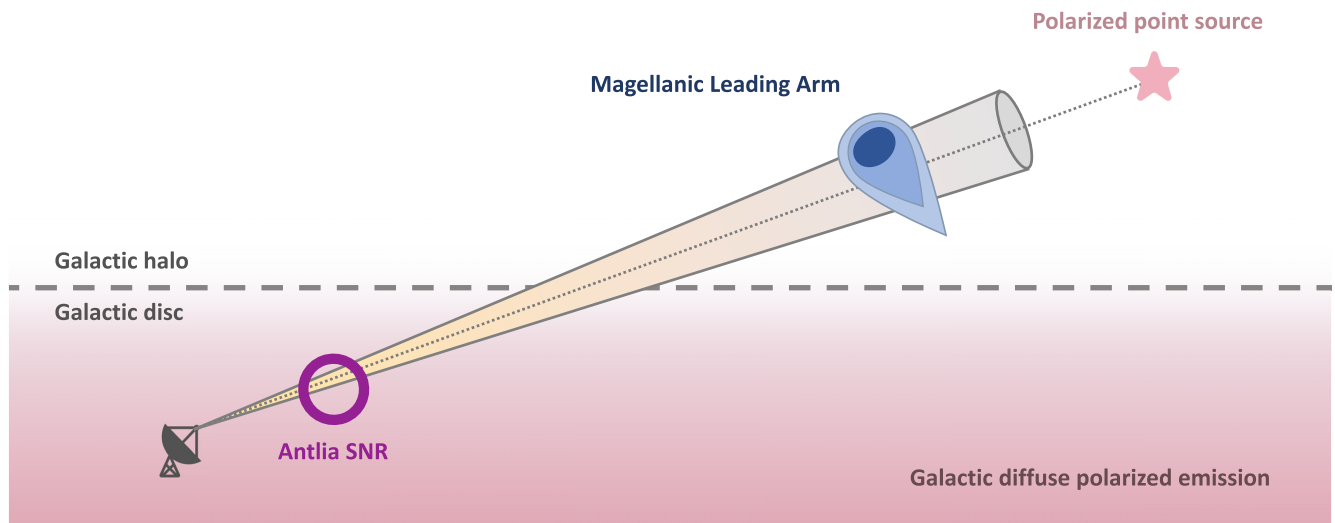
Fig. 8 illustrates the relative location of the objects and roughly where the polarized radiation of point sources and the Galactic diffuse emission come from with respect to the objects. Unlike extragalactic radiations that propagate through both the Magellanic LA and the Antlia SNR, the Galactic diffuse polarization does not experience Faraday rotation (if there is any) at the Magellanic LA since the object is beyond the Galactic disc where most of the emission is coming from. Therefore, the morphological correspondence between the low-velocity  $H\alpha$  filaments (Fig. 2) and the depolarized canals (Figs 5 and 6) is the smoking gun evidence that the Antlia SNR is a Faraday rotator and severely affects the observed RM towards the region where the excess of RM was reported by McG10. Our findings lead to a conclusion that it is not feasible to draw any certain conclusions about the magnetic fields of the Magellanic LA using the RM grid technique. In other words, *it is hard to interpret the RM excess in this region as evidence of the ‘magnetized’ LA.*

We attempt to perform a similar test on the Smith cloud, which is another candidate of magnetized HVCs, but it was impossible since the cloud is located at the celestial equator which is right at the border of the S-PASS sky coverage. To our knowledge, there is no comparable polarimetric survey at the same frequency that covers the northern sky. Yet, the low-velocity  $H\alpha$  emission in the region does not show any structures above 5 Rayleigh unlike the case of the Magellanic LA. We conclude that the Smith cloud region has a less chance of being affected by the Galactic foreground.

### 5.2 Magnetic field strength of the Antlia SNR

In this section, we calculate the line-of-sight magnetic field strength at the eastern edge of the Antlia SNR (i.e. Region V of Figs 3, 4, 5, and 6) assuming the RM excess is entirely due to the magneto-





**Figure 8.** Illustration of the Antlia SNR/Magellanic LA field. The polarized radiation from the extragalactic point source propagate through both the Magellanic LA and the Antlia SNR, while the Galactic diffuse polarized emission knows only about the Antlia SNR. This image is for illustration purpose only. The size of and the distance to the objects does not correspond to the real size and the distance.

ionized shell of the Antlia SNR. This is to check if the estimated field strength is in a reasonable range expected from typical SNRs, in other words, whether the observed RM excess can be explained solely by Faraday rotation at the Antlia SNR.

From the definition of the RM (equation 1), the line-of-sight magnetic field strength can be expressed as follows:

$$B_{\parallel} = \frac{\phi_{\text{SNR}}}{0.812 \langle n_e \rangle f L}, \quad (11)$$

where  $\phi_{\text{SNR}}$  is RM of the SNR,  $f$  is a volume-filling factor of the ionized gas set to 0.5, and  $L$  is a path-length. Note that, here we work with the product of an average electron density and the path-length through the SNR,  $\langle n_e \rangle L$ , since the distribution of the electron density along the sightline,  $n_e(r)$ , is not known. Therefore,  $B_{\parallel}$  is, by assumption, the electron-density-weighted average magnetic field strength along the line of sight.

Under the assumption that the SNR is a dominant source of Faraday rotation other than the smoothly varying large-scale Milky Way ISM, equation 10 can be expressed as

$$\phi_{\text{SNR}} = \phi_{\text{obs}} - \phi_{\text{MW}}, \quad (12)$$

in the region where the excess of RM is. The Voronoi diagram in panel (a) of Fig. 9 shows the overall distribution of  $\phi_{\text{obs}}$  near the eastern edge of the Antlia SNR. The RM excess region is enclosed with a dashed circle.

On the other hand, in the surrounding domain where the RM distribution does not show any correspondence with the SNR, we can consider that the Milky Way is the only Faraday screen (i.e.  $\phi_{\text{obs}} \approx \phi_{\text{MW}}$ ). We estimate  $\phi_{\text{MW}}$  of the RM excess region based on  $\phi_{\text{obs}}$  measurements in the surrounding. This approximation holds only at immediate vicinity where the variance in the large-scale Milky Way field is small and there is no other apparent Faraday screens (e.g. the Gum Nebula). Therefore, we restrict our sample to sources within a region bounded by the solid line in panel (a). The median  $\phi_{\text{obs}}$  in this region is adopted as  $\phi_{\text{MW}} = -56.55 \text{ rad m}^{-2}$ . Panel (b) shows the distribution of  $\phi_{\text{obs}} - \phi_{\text{MW}}$ . The corrected RMs are mostly positive

within the RM excess region as previously pointed out by McG10 and nearly zero in the surrounding region.

The path-length through the SNR ( $L$ ) is estimated from a simple geometric model of a 3D spherical shell. We define  $L$  as a function of the angular separation ( $\theta$ ) from the centre of the SNR at ( $l, b$ ) = (276.5°, +19°):

$$L(\theta) = \begin{cases} 2D\sqrt{\sin^2 \theta_{\text{shell}} - \sin^2 \theta} & \text{if } \theta_{\text{shell}} - d\theta < \theta < \theta_{\text{shell}} \\ 0 & \text{if } \theta > \theta_{\text{shell}} \\ 2Dd\theta & \text{if } \theta < \theta_{\text{shell}} - d\theta \end{cases}, \quad (13)$$

where  $D = 100 \text{ pc}$  is the distance to the Antlia SNR,  $\theta_{\text{shell}} = 18^\circ$  and  $d\theta = 8^\circ$  are the outer radius and the thickness of the shell, respectively, in angular scale.

The average electron density along the sightlines ( $\langle n_e \rangle$ ) is estimated from the emission measure (EM) of the SNR from its  $\text{H}\alpha$  intensity:

$$\text{EM} = 2.75 \left( \frac{T_e}{10^4 \text{ K}} \right)^{0.9} I_{\text{H}\alpha}, \quad (14)$$

where  $T_e = 10^4 \text{ K}$  is the electron temperature and  $I_{\text{H}\alpha}$  is the  $\text{H}\alpha$  emission in Rayleighs. From the definition of EM,

$$\langle n_e \rangle = \sqrt{\frac{\text{EM}}{fL}}. \quad (15)$$

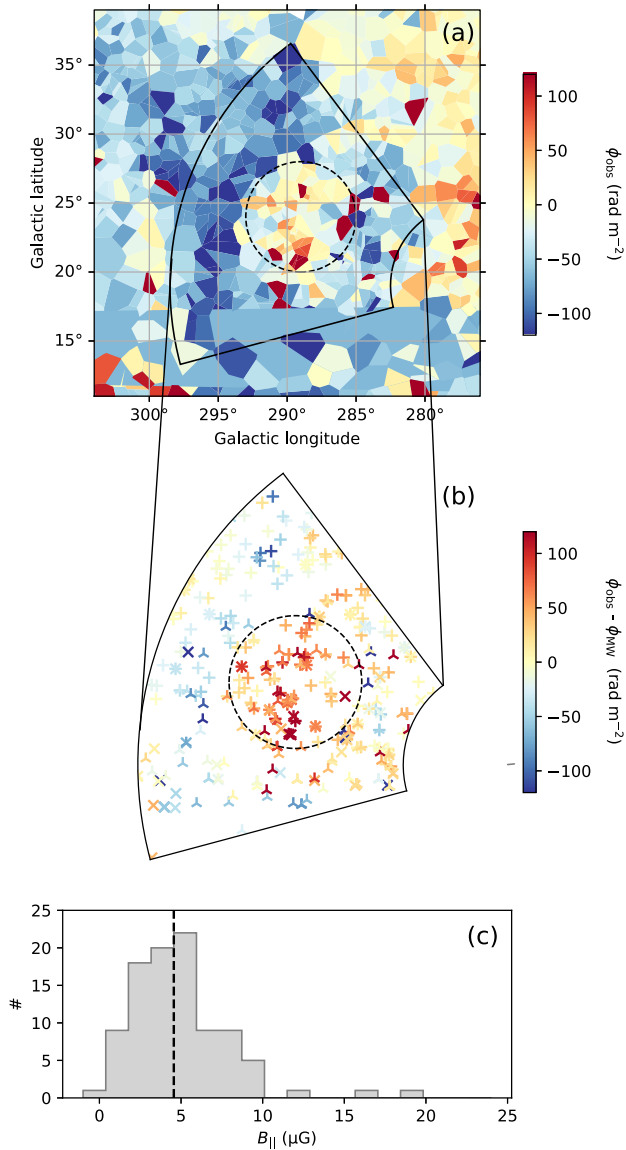
All parameters combined, equation 11 can be expressed as

$$B_{\parallel} = \frac{\phi_{\text{obs}} - \phi_{\text{MW}}}{0.673 \sqrt{I_{\text{H}\alpha}} L}. \quad (16)$$

The histogram in panel (c) shows the distribution of  $B_{\parallel}$  calculated using the individual polarized sources in the RM excess region. The median of the distribution is at  $B_{\parallel} \approx 5 \mu\text{G}$ , which is similar to a typical magnetic field strength in the Galactic ISM.

## 6 SUMMARY

We, hereby, summarize three mutually related major points discussed throughout this paper. First, we argue that the Faraday rotation



**Figure 9.** Panel (a): A Voronoi diagram coloured with  $\phi_{\text{obs}}$ . The RM excess is enclosed within a dashed circle. Panel (b): The Milky Way corrected RM ( $\phi_{\text{obs}} - \phi_{\text{MW}}$ ) in the RM excess region and the surrounding. Panel (c): The distribution of  $B_{\parallel}$  estimated from sources in the RM excess region.

towards the Magellanic LA is highly affected by the foreground SNR. McG10 identified the Magellanic LA as a magnetized HVC. However, we find that the Antlia SNR can equally well explain the observed RM excess.

Second, our work provides information about the structures and the magnitude of magnetic fields associated with the Antlia SNR. The remnant is a Faraday rotator that severely depolarizes the diffuse Galactic polarized emission in the background. We also found double-jump profile filaments in the normalized polarization gradient map which indicate a sharp enhancement along the shock regions that are bright in H $\alpha$  emission and studied by Fesen et al. (2021). From the compact source RM grid, we estimated the line-of-sight magnetic field strength at the Eastern edge of the Antlia SNR to be  $B_{\parallel} \approx 5 \mu\text{G}$ .

Finally, the lesson we learned from our study in the Antlia SNR/Magellanic LA field raises caution for future studies using

the RM grid technique. Upcoming radio telescopes and polarization all-sky surveys are expected to significantly increase the RM source density. This will allow us to study magnetism in much detail and even extend the RM grid technique to extragalactic objects (e.g. Anderson et al. 2021). However, such studies should always be aware that there are local Faraday rotators that can significantly affect the RM grid, like the Antlia SNR in our case. We suggest checking Galactic diffuse polarization maps to identify local Faraday screens.

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Our analysis was performed using the PYTHON programming language (Python Software Foundation, <https://www.python.org>). The following packages were used throughout the analysis: NUMPY (Harris et al. 2020), SCIPY (Virtanen et al. 2020), and MATPLOTLIB (Hunter 2007). This research additionally made use of the publicly available tools: MIRIAD (Sault, Teuben & Wright 1995), RM tools 1D (Purcell et al. 2020), and CMASHER PYTHON package (van der Velden 2020).

## DATA AVAILABILITY

The data underlying this article were accessed from the CSIRO Australia Telescope National Facility online archive at <https://at.oa.atnf.csiro.au>, under the project codes C2741. The derived data generated in this research are available in the article and in its online supplementary material.

## REFERENCES

- Anderson C. S. et al., 2021, *Publ. Astron. Soc. Aust.*, 38, e020
- Banda-Barragán W. E., Parkin E. R., Federrath C., Crocker R. M., Bicknell G. V., 2016, *MNRAS*, 455, 1309
- Banda-Barragán W. E., Federrath C., Crocker R. M., Bicknell G. V., 2018, *MNRAS*, 473, 3454
- Besla G., Kallivayalil N., Hernquist L., van der Marel R. P., Cox T. J., Kereš D., 2012, *MNRAS*, 421, 2109
- Betti S. K., Hill A. S., Mao S. A., Gaensler B. M., Lockman F. J., McClure-Griffiths N. M., Benjamin R. A., 2019, *ApJ*, 871, 215
- Brentjens M. A., de Bruyn A. G., 2005, *A&A*, 441, 1217
- Burkhart B., Lazarian A., Gaensler B. M., 2012, *ApJ*, 749, 145
- Burn B. J., 1966, *MNRAS*, 133, 67
- Carretti E. et al., 2019, *MNRAS*, 489, 2330
- Condon J. J., Cotton W. D., Greisen E. W., Yin Q. F., Perley R. A., Taylor G. B., Broderick J. J., 1998, *AJ*, 115, 1693
- Dursi L. J., Pfrommer C., 2008, *ApJ*, 677, 993
- Fesen R. A. et al., 2021, *ApJ*, preprint ([arXiv:2102.12599](https://arxiv.org/abs/2102.12599))
- Finkbeiner D. P., 2003, *ApJS*, 146, 407
- Fletcher A., Shukurov A., 2006, *MNRAS*, 371, L21
- Gaensler B. M., Haverkorn M., Staveley-Smith L., Dickey J. M., McClure-Griffiths N. M., Dickel J. R., Wolleben M., 2005, *Science*, 307, 1610

- Gaensler B. M. et al., 2011, *Nature*, 478, 214
- Gaustad J. E., McCullough P. R., Rosing W., Van Buren D., 2001, *PASP*, 113, 1326
- Grønnow A., Tepper-García T., Bland -Hawthorn J., McClure-Griffiths N. M., 2017, *ApJ*, 845, 69
- Grønnow A., Tepper-García T., Bland -Hawthorn J., 2018, *ApJ*, 865, 64
- Haffner L. M., Reynolds R. J., Tuftes S. L., Madsen G. J., Jaehnig K. P., Percival J. W., 2003, *ApJS*, 149, 405
- Hancock P. J., Murphy T., Gaensler B. M., Hopkins A., Curran J. R., 2012, *MNRAS*, 422, 1812
- Hancock P. J., Trott C. M., Hurley-Walker N., 2018, *Publ. Astron. Soc. Aust.*, 35, e011
- Harris C. R. et al., 2020, *Nature*, 585, 357
- Harvey-Smith L., Madsen G. J., Gaensler B. M., 2011, *ApJ*, 736, 83
- Haverkorn M., Heitsch F., 2004, *A&A*, 421, 1011
- Heald G., Braun R., Edmonds R., 2009, *A&A*, 503, 409
- Heitsch F., Putman M. E., 2009, *ApJ*, 698, 1485
- Hill A. S., Mao S. A., Benjamin R. A., Lockman F. J., McClure-Griffiths N. M., 2013, *ApJ*, 777, 55
- Hunter J. D., 2007, *Comput. Sci. Eng.*, 9, 90
- Iacobelli M. et al., 2014, *A&A*, 566, A5
- Jones T. W., Kang H., Tregillis I. L., 1994, *ApJ*, 432, 194
- Kaczmarek J. F., Purcell C. R., Gaensler B. M., McClure-Griffiths N. M., Stevens J., 2017, *MNRAS*, 467, 1776
- Konz C., Brüns C., Birk G. T., 2002, *A&A*, 391, 713
- Kwak K., Henley D. B., Shelton R. L., 2011, *ApJ*, 739, 30
- Lucchini S., D’Onghia E., Fox A. J., Bustard C., Bland-Hawthorn J., Zweibel E., 2020, *Nature*, 585, 203
- Ma Y. K., Mao S. A., Stil J., Basu A., West J., Heiles C., Hill A. S., Betti S. K., 2019, *MNRAS*, 487, 3432
- Mao S. A., Gaensler B. M., Stanimirović S., Haverkorn M., McClure-Griffiths N. M., Staveley-Smith L., Dickey J. M., 2008, *ApJ*, 688, 1029
- Mao S. A., Gaensler B. M., Haverkorn M., Zweibel E. G., Madsen G. J., McClure-Griffiths N. M., Shukurov A., Kronberg P. P., 2010, *ApJ*, 714, 1170
- McClure-Griffiths N. M. et al., 2008, *ApJ*, 673, L143
- McClure-Griffiths N. M. et al., 2009, *ApJS*, 181, 398
- McClure-Griffiths N. M., Madsen G. J., Gaensler B. M., McConnell D., Schnitzeler D. H. F. M., 2010, *ApJ*, 725, 275
- McCourt M., O’Leary R. M., Madigan A.-M., Quataert E., 2015, *MNRAS*, 449, 2
- McCullough P. R., Fields B. D., Pavlidou V., 2002, *ApJ*, 576, L41
- Muller C. A., Oort J. H., Raimond E., 1963, *C. R. Acad. Sci., Paris*, 257, 1661
- Nidever D. L., Majewski S. R., Butler Burton W., 2008, *ApJ*, 679, 432
- Nidever D. L. et al., 2019, *ApJ*, 887, 115
- Price-Whelan A. M., Nidever D. L., Choi Y., Schlafly E. F., Morton T., Koposov S. E., Belokurov V., 2019, *ApJ*, 887, 19
- Purcell C. R. et al., 2015, *ApJ*, 804, 22
- Purcell C. R., Van Eck C. L., West J., Sun X. H., Gaensler B. M., 2020, *Astrophysics Source Code Library*, record ascl:2005.003
- Putman M. E. et al., 2002, *AJ*, 123, 873
- Putman M. E., Peek J. E. G., Jounge M. R., 2012, *ARA&A*, 50, 491
- Reich P., Testori J. C., Reich W., 2001, *A&A*, 376, 861
- Reynoso E. M., Dubner G. M., 1997, *A&AS*, 123, 31
- Santillan A., Franco J., Kim J., 2004, *J. Korean Astron. Soc.*, 37, 233
- Saul D. R. et al., 2012, *ApJ*, 758, 44
- Sault R. J., Teuben P. J., Wright M. C. H., 1995, in Shaw R. A., Payne H. E., Hayes J. J. E., eds, *ASP Conf. Ser. Vol. 77, Astronomical Data Analysis Software and Systems IV*. Astron. Soc. Pac., San Francisco, p. 433
- Schiano A. V. R., Christiansen W. A., Knerr J. M., 1995, *ApJ*, 439, 237
- Schnitzeler D. H. F. M., Carretti E., Wieringa M. H., Gaensler B. M., Haverkorn M., Poppi S., 2019, *MNRAS*, 485, 1293
- Taylor A. R., Stil J. M., Sunstrum C., 2009, *ApJ*, 702, 1230
- Uyaniker B., Landecker T. L., Gray A. D., Kothes R., 2003, *ApJ*, 585, 785
- van der Velden E., 2020, *J. Open Source Softw.*, 5, 2004
- Virtanen P. et al., 2020, *Nat. Methods*, 17, 261

## APPENDIX: TABLE OF RM SOURCES



**Table A1.** This table includes information about polarized sources observed using ATCA. See Section 2.1.2 for details of observations and how they are identified.

RA (J2000)	Dec. (J2000)	$l$ ( $^{\circ}$ )	$b$ ( $^{\circ}$ )	$S_I$ (Jy beam $^{-1}$ )	$S_{I, \text{err}}$ (Jy beam $^{-1}$ )	$p$ (Jy beam $^{-1}$ )	$p_{\text{err}}$ (Jy beam $^{-1}$ )	$\phi$ (rad m $^{-2}$ )	$\phi_{\text{err}}$ (rad m $^{-2}$ )
11 <sup>h</sup> 21 <sup>m</sup> 22 <sup>s</sup> .9	−43 <sup>d</sup> 55 <sup>m</sup> 37 <sup>s</sup> .9	286.2590	16.0097	0.08	0.02	0.03	0.002	−36.97	2.21
11 <sup>h</sup> 16 <sup>m</sup> 58 <sup>s</sup> .9	−43 <sup>d</sup> 44 <sup>m</sup> 53 <sup>s</sup> .9	285.4225	15.8887	4.87	0.04	0.70	0.003	−61.41	0.15
11 <sup>h</sup> 14 <sup>m</sup> 41 <sup>s</sup> .3	−41 <sup>d</sup> 09 <sup>m</sup> 25 <sup>s</sup> .5	283.9909	18.1291	6.97	0.08	0.99	0.006	−59.14	0.26
11 <sup>h</sup> 14 <sup>m</sup> 39 <sup>s</sup> .5	−41 <sup>d</sup> 09 <sup>m</sup> 14 <sup>s</sup> .3	283.9840	18.1298	7.32	0.07	1.43	0.007	−80.34	0.20
11 <sup>h</sup> 10 <sup>m</sup> 39 <sup>s</sup> .2	−41 <sup>d</sup> 18 <sup>m</sup> 48 <sup>s</sup> .2	283.3210	17.6888	2.29	0.01	0.04	0.001	−27.11	0.90
11 <sup>h</sup> 20 <sup>m</sup> 19 <sup>s</sup> .0	−38 <sup>d</sup> 22 <sup>m</sup> 39 <sup>s</sup> .7	283.9437	21.1111	5.47	0.12	0.43	0.013	−106.20	1.27
11 <sup>h</sup> 24 <sup>m</sup> 05 <sup>s</sup> .5	−36 <sup>d</sup> 48 <sup>m</sup> 32 <sup>s</sup> .7	284.0781	22.8442	0.94	0.04	0.06	0.002	−51.68	1.30
11 <sup>h</sup> 16 <sup>m</sup> 16 <sup>s</sup> .8	−37 <sup>d</sup> 00 <sup>m</sup> 07 <sup>s</sup> .9	282.5887	22.0820	0.64	0.01	0.05	0.002	−4.95	1.18
11 <sup>h</sup> 12 <sup>m</sup> 36 <sup>s</sup> .9	−37 <sup>d</sup> 45 <sup>m</sup> 46 <sup>s</sup> .0	282.1902	21.0965	0.98	0.12	0.05	0.011	209.59	10.09
11 <sup>h</sup> 14 <sup>m</sup> 41 <sup>s</sup> .3	−41 <sup>d</sup> 09 <sup>m</sup> 25 <sup>s</sup> .6	283.9906	18.1290	6.50	0.08	0.65	0.004	−78.47	0.23
11 <sup>h</sup> 14 <sup>m</sup> 39 <sup>s</sup> .5	−41 <sup>d</sup> 09 <sup>m</sup> 15 <sup>s</sup> .6	283.9841	18.1294	5.46	0.04	0.78	0.003	−81.10	0.17
11 <sup>h</sup> 10 <sup>m</sup> 39 <sup>s</sup> .3	−41 <sup>d</sup> 18 <sup>m</sup> 49 <sup>s</sup> .2	283.3214	17.6886	1.60	0.01	0.09	0.001	−30.93	0.52
11 <sup>h</sup> 10 <sup>m</sup> 33 <sup>s</sup> .8	−41 <sup>d</sup> 18 <sup>m</sup> 16 <sup>s</sup> .2	283.3010	17.6902	0.87	0.01	0.12	0.001	−35.44	0.33
11 <sup>h</sup> 29 <sup>m</sup> 33 <sup>s</sup> .4	−42 <sup>d</sup> 49 <sup>m</sup> 15 <sup>s</sup> .6	287.3244	17.5556	2.23	0.03	0.22	0.003	−56.40	0.51
11 <sup>h</sup> 38 <sup>m</sup> 12 <sup>s</sup> .9	−42 <sup>d</sup> 45 <sup>m</sup> 56 <sup>s</sup> .8	288.8927	18.1010	2.20	0.07	0.25	0.005	−41.58	0.82
11 <sup>h</sup> 38 <sup>m</sup> 12 <sup>s</sup> .9	−42 <sup>d</sup> 45 <sup>m</sup> 56 <sup>s</sup> .4	288.8927	18.1011	1.93	0.03	0.33	0.001	−33.52	0.18
11 <sup>h</sup> 38 <sup>m</sup> 12 <sup>s</sup> .9	−42 <sup>d</sup> 45 <sup>m</sup> 56 <sup>s</sup> .2	288.8925	18.1012	2.09	0.10	0.14	0.005	−42.17	1.58
11 <sup>h</sup> 40 <sup>m</sup> 11 <sup>s</sup> .2	−40 <sup>d</sup> 49 <sup>m</sup> 09 <sup>s</sup> .7	288.6633	20.0699	2.07	0.02	0.04	0.001	−5.35	1.55
11 <sup>h</sup> 28 <sup>m</sup> 14 <sup>s</sup> .8	−39 <sup>d</sup> 08 <sup>m</sup> 32 <sup>s</sup> .3	285.7825	20.9431	3.57	0.02	0.18	0.002	−46.09	0.35
11 <sup>h</sup> 24 <sup>m</sup> 18 <sup>s</sup> .0	−39 <sup>d</sup> 49 <sup>m</sup> 06 <sup>s</sup> .2	285.2681	20.0458	1.99	0.03	0.22	0.003	−47.12	0.65
11 <sup>h</sup> 20 <sup>m</sup> 13 <sup>s</sup> .6	−41 <sup>d</sup> 54 <sup>m</sup> 12 <sup>s</sup> .0	285.2944	17.8233	0.51	0.04	0.18	0.004	−3.17	0.79
11 <sup>h</sup> 37 <sup>m</sup> 06 <sup>s</sup> .1	−44 <sup>d</sup> 11 <sup>m</sup> 01 <sup>s</sup> .8	289.1287	16.6864	0.67	0.03	0.14	0.005	−137.23	1.27
11 <sup>h</sup> 34 <sup>m</sup> 26 <sup>s</sup> .6	−44 <sup>d</sup> 07 <sup>m</sup> 48 <sup>s</sup> .7	288.6374	16.5941	2.24	0.04	0.48	0.002	−135.57	0.19
11 <sup>h</sup> 34 <sup>m</sup> 24 <sup>s</sup> .6	−44 <sup>d</sup> 06 <sup>m</sup> 42 <sup>s</sup> .7	288.6258	16.6097	1.19	0.04	0.24	0.003	−103.67	0.44
11 <sup>h</sup> 34 <sup>m</sup> 26 <sup>s</sup> .6	−44 <sup>d</sup> 07 <sup>m</sup> 49 <sup>s</sup> .0	288.6375	16.5940	2.13	0.02	0.22	0.002	−142.09	0.35
11 <sup>h</sup> 34 <sup>m</sup> 24 <sup>s</sup> .6	−44 <sup>d</sup> 06 <sup>m</sup> 43 <sup>s</sup> .0	288.6256	16.6096	2.12	0.01	0.37	0.002	−136.83	0.20
11 <sup>h</sup> 45 <sup>m</sup> 44 <sup>s</sup> .1	−44 <sup>d</sup> 14 <sup>m</sup> 05 <sup>s</sup> .7	290.6960	17.0703	0.91	0.03	0.30	0.003	−95.61	0.35
11 <sup>h</sup> 46 <sup>m</sup> 30 <sup>s</sup> .3	−43 <sup>d</sup> 51 <sup>m</sup> 44 <sup>s</sup> .4	290.7336	17.4661	0.16	0.06	0.02	0.002	176.67	3.95
11 <sup>h</sup> 33 <sup>m</sup> 11 <sup>s</sup> .8	−42 <sup>d</sup> 23 <sup>m</sup> 25 <sup>s</sup> .8	287.8465	18.1778	0.73	0.06	0.05	0.007	43.26	5.86
11 <sup>h</sup> 23 <sup>m</sup> 10 <sup>s</sup> .5	−41 <sup>d</sup> 41 <sup>m</sup> 20 <sup>s</sup> .7	285.7536	18.2197	1.31	0.02	0.05	0.002	−54.49	1.41
11 <sup>h</sup> 20 <sup>m</sup> 13 <sup>s</sup> .6	−41 <sup>d</sup> 54 <sup>m</sup> 12 <sup>s</sup> .2	285.2944	17.8233	1.23	0.05	0.21	0.005	−28.40	1.08
11 <sup>h</sup> 20 <sup>m</sup> 13 <sup>s</sup> .6	−41 <sup>d</sup> 54 <sup>m</sup> 12 <sup>s</sup> .3	285.2945	17.8233	1.41	0.03	0.26	0.002	−29.54	0.33
11 <sup>h</sup> 20 <sup>m</sup> 13 <sup>s</sup> .6	−41 <sup>d</sup> 54 <sup>m</sup> 13 <sup>s</sup> .0	285.2946	17.8231	1.50	0.04	0.28	0.002	−31.12	0.23
11 <sup>h</sup> 15 <sup>m</sup> 46 <sup>s</sup> .6	−39 <sup>d</sup> 14 <sup>m</sup> 21 <sup>s</sup> .2	283.4152	19.9799	1.17	0.06	0.21	0.003	−60.55	0.64
11 <sup>h</sup> 17 <sup>m</sup> 30 <sup>s</sup> .0	−39 <sup>d</sup> 37 <sup>m</sup> 46 <sup>s</sup> .3	283.9001	19.7454	0.41	0.07	0.03	0.006	133.90	7.78
11 <sup>h</sup> 18 <sup>m</sup> 14 <sup>s</sup> .5	−39 <sup>d</sup> 23 <sup>m</sup> 12 <sup>s</sup> .8	283.9441	20.0240	0.67	0.08	0.14	0.002	−58.58	0.54
11 <sup>h</sup> 16 <sup>m</sup> 06 <sup>s</sup> .4	−40 <sup>d</sup> 03 <sup>m</sup> 41 <sup>s</sup> .1	283.8111	19.2444	4.46	0.03	0.06	0.002	−23.96	0.98
11 <sup>h</sup> 26 <sup>m</sup> 44 <sup>s</sup> .2	−38 <sup>d</sup> 28 <sup>m</sup> 45 <sup>s</sup> .7	285.2427	21.4655	13.56	0.02	0.68	0.001	−45.10	0.08
11 <sup>h</sup> 25 <sup>m</sup> 31 <sup>s</sup> .6	−35 <sup>d</sup> 57 <sup>m</sup> 04 <sup>s</sup> .4	284.0378	23.7486	0.91	0.02	0.08	0.002	−60.20	0.85
11 <sup>h</sup> 29 <sup>m</sup> 46 <sup>s</sup> .2	−39 <sup>d</sup> 06 <sup>m</sup> 51 <sup>s</sup> .8	286.0703	21.0685	0.43	0.01	0.01	0.001	−295.37	3.39
11 <sup>h</sup> 30 <sup>m</sup> 03 <sup>s</sup> .0	−38 <sup>d</sup> 45 <sup>m</sup> 36 <sup>s</sup> .2	285.9990	21.4207	1.90	0.08	0.06	0.002	−33.30	1.83
11 <sup>h</sup> 26 <sup>m</sup> 44 <sup>s</sup> .2	−38 <sup>d</sup> 28 <sup>m</sup> 44 <sup>s</sup> .6	285.2426	21.4658	15.10	0.03	0.52	0.004	−46.36	0.28
11 <sup>h</sup> 28 <sup>m</sup> 09 <sup>s</sup> .5	−39 <sup>d</sup> 00 <sup>m</sup> 44 <sup>s</sup> .4	285.7180	21.0596	2.11	0.04	0.10	0.003	3.66	1.00
11 <sup>h</sup> 28 <sup>m</sup> 14 <sup>s</sup> .9	−39 <sup>d</sup> 08 <sup>m</sup> 31 <sup>s</sup> .4	285.7826	20.9434	2.85	0.06	0.07	0.003	−28.07	1.66
11 <sup>h</sup> 29 <sup>m</sup> 47 <sup>s</sup> .4	−41 <sup>d</sup> 07 <sup>m</sup> 06 <sup>s</sup> .8	286.7800	19.1783	0.89	0.05	0.12	0.003	−40.73	1.13
11 <sup>h</sup> 30 <sup>m</sup> 10 <sup>s</sup> .1	−40 <sup>d</sup> 56 <sup>m</sup> 46 <sup>s</sup> .7	286.7916	19.3644	1.52	0.02	0.07	0.002	−36.88	1.25
11 <sup>h</sup> 30 <sup>m</sup> 14 <sup>s</sup> .4	−41 <sup>d</sup> 36 <sup>m</sup> 00 <sup>s</sup> .6	287.0310	18.7509	2.15	0.11	0.17	0.003	−14.89	0.74
11 <sup>h</sup> 33 <sup>m</sup> 17 <sup>s</sup> .9	−43 <sup>d</sup> 44 <sup>m</sup> 56 <sup>s</sup> .1	288.3097	16.8931	1.40	0.04	0.10	0.002	−117.34	0.64
11 <sup>h</sup> 26 <sup>m</sup> 44 <sup>s</sup> .2	−38 <sup>d</sup> 28 <sup>m</sup> 44 <sup>s</sup> .4	285.2427	21.4659	14.16	0.15	0.61	0.009	−52.33	0.58
11 <sup>h</sup> 26 <sup>m</sup> 44 <sup>s</sup> .2	−38 <sup>d</sup> 28 <sup>m</sup> 46 <sup>s</sup> .0	285.2429	21.4654	5.80	0.06	0.41	0.005	−46.57	0.53
11 <sup>h</sup> 24 <sup>m</sup> 18 <sup>s</sup> .0	−39 <sup>d</sup> 49 <sup>m</sup> 06 <sup>s</sup> .1	285.2681	20.0458	1.66	0.08	0.18	0.006	−38.28	1.31
11 <sup>h</sup> 23 <sup>m</sup> 22 <sup>s</sup> .4	−39 <sup>d</sup> 42 <sup>m</sup> 40 <sup>s</sup> .4	285.0506	20.0831	0.67	0.07	0.08	0.003	−22.89	1.42
11 <sup>h</sup> 14 <sup>m</sup> 47 <sup>s</sup> .4	−39 <sup>d</sup> 32 <sup>m</sup> 52 <sup>s</sup> .5	283.3545	19.6215	2.21	0.07	0.30	0.003	−30.66	0.35
11 <sup>h</sup> 12 <sup>m</sup> 50 <sup>s</sup> .9	−40 <sup>d</sup> 09 <sup>m</sup> 15 <sup>s</sup> .5	283.2411	18.9178	1.50	0.04	0.26	0.002	−36.30	0.32
10 <sup>h</sup> 46 <sup>m</sup> 16 <sup>s</sup> .6	−38 <sup>d</sup> 06 <sup>m</sup> 28 <sup>s</sup> .1	277.4074	18.4829	5.48	0.07	0.18	0.003	−8.27	0.58
10 <sup>h</sup> 46 <sup>m</sup> 10 <sup>s</sup> .8	−38 <sup>d</sup> 05 <sup>m</sup> 52 <sup>s</sup> .1	277.3849	18.4824	2.72	0.02	0.29	0.002	−13.91	0.29
10 <sup>h</sup> 40 <sup>m</sup> 55 <sup>s</sup> .6	−42 <sup>d</sup> 58 <sup>m</sup> 51 <sup>s</sup> .8	278.9739	13.7378	0.75	0.07	0.06	0.008	−69.92	5.93
10 <sup>h</sup> 42 <sup>m</sup> 17 <sup>s</sup> .4	−43 <sup>d</sup> 07 <sup>m</sup> 06 <sup>s</sup> .7	279.2665	13.7404	3.15	0.05	0.13	0.005	329.60	1.52
10 <sup>h</sup> 43 <sup>m</sup> 42 <sup>s</sup> .2	−43 <sup>d</sup> 20 <sup>m</sup> 38 <sup>s</sup> .3	279.6110	13.6689	2.52	0.02	0.10	0.002	−3.57	0.66
10 <sup>h</sup> 54 <sup>m</sup> 04 <sup>s</sup> .3	−44 <sup>d</sup> 57 <sup>m</sup> 29 <sup>s</sup> .8	282.0759	13.1081	2.76	0.04	0.26	0.004	28.85	0.62

Table A1 – continued

RA (J2000)	Dec. (J2000)	$l$ ( $^{\circ}$ )	$b$ ( $^{\circ}$ )	$S_I$ (Jy beam $^{-1}$ )	$S_{I, \text{err}}$ (Jy beam $^{-1}$ )	$p$ (Jy beam $^{-1}$ )	$p_{\text{err}}$ (Jy beam $^{-1}$ )	$\phi$ (rad m $^{-2}$ )	$\phi_{\text{err}}$ (rad m $^{-2}$ )
10 <sup>h</sup> 58 <sup>m</sup> 55 <sup>s</sup> .9	−45 <sup>d</sup> 45 <sup>m</sup> 19 <sup>s</sup> .0	283.2219	12.7668	5.45	0.01	0.06	0.001	−46.24	0.72
10 <sup>h</sup> 55 <sup>m</sup> 22 <sup>s</sup> .0	−43 <sup>d</sup> 35 <sup>m</sup> 41 <sup>s</sup> .7	281.6621	14.4313	2.51	0.02	0.13	0.002	−11.00	0.57
10 <sup>h</sup> 57 <sup>m</sup> 23 <sup>s</sup> .4	−42 <sup>d</sup> 56 <sup>m</sup> 32 <sup>s</sup> .9	281.7047	15.1794	1.12	0.03	0.03	0.002	18.16	2.21
10 <sup>h</sup> 56 <sup>m</sup> 43 <sup>s</sup> .2	−42 <sup>d</sup> 40 <sup>m</sup> 07 <sup>s</sup> .5	281.4652	15.3708	0.73	0.12	0.03	0.009	−147.07	12.64
10 <sup>h</sup> 48 <sup>m</sup> 38 <sup>s</sup> .3	−41 <sup>d</sup> 14 <sup>m</sup> 01 <sup>s</sup> .6	279.3956	15.9585	22.86	0.18	2.73	0.008	−78.97	0.11
10 <sup>h</sup> 37 <sup>m</sup> 24 <sup>s</sup> .1	−39 <sup>d</sup> 35 <sup>m</sup> 41 <sup>s</sup> .7	276.6178	16.3315	4.54	0.05	0.16	0.003	−54.46	0.70
10 <sup>h</sup> 37 <sup>m</sup> 24 <sup>s</sup> .1	−39 <sup>d</sup> 35 <sup>m</sup> 41 <sup>s</sup> .7	276.6178	16.3315	4.42	0.04	0.21	0.002	−53.32	0.40
10 <sup>h</sup> 39 <sup>m</sup> 39 <sup>s</sup> .9	−38 <sup>d</sup> 08 <sup>m</sup> 31 <sup>s</sup> .6	276.2387	17.8057	2.74	0.07	0.30	0.005	−2.62	0.63
10 <sup>h</sup> 41 <sup>m</sup> 37 <sup>s</sup> .8	−44 <sup>d</sup> 22 <sup>m</sup> 54 <sup>s</sup> .3	279.7947	12.5805	5.06	0.06	0.14	0.003	−0.23	0.76
10 <sup>h</sup> 41 <sup>m</sup> 37 <sup>s</sup> .8	−44 <sup>d</sup> 22 <sup>m</sup> 54 <sup>s</sup> .3	279.7947	12.5805	5.21	0.01	0.24	0.001	−13.13	0.15
10 <sup>h</sup> 38 <sup>m</sup> 01 <sup>s</sup> .0	−42 <sup>d</sup> 08 <sup>m</sup> 51 <sup>s</sup> .5	278.0665	14.1922	1.94	0.03	0.05	0.003	−59.89	2.47
11 <sup>h</sup> 04 <sup>m</sup> 31 <sup>s</sup> .0	−42 <sup>d</sup> 34 <sup>m</sup> 45 <sup>s</sup> .3	282.7705	16.0680	0.52	0.02	0.03	0.002	33.88	2.54
11 <sup>h</sup> 04 <sup>m</sup> 31 <sup>s</sup> .0	−42 <sup>d</sup> 34 <sup>m</sup> 46 <sup>s</sup> .1	282.7706	16.0678	4.93	0.16	0.47	0.002	29.77	0.18
11 <sup>h</sup> 07 <sup>m</sup> 05 <sup>s</sup> .8	−48 <sup>d</sup> 08 <sup>m</sup> 26 <sup>s</sup> .9	285.5291	11.1739	5.88	0.03	0.08	0.003	−60.63	1.44
11 <sup>h</sup> 33 <sup>m</sup> 44 <sup>s</sup> .8	−47 <sup>d</sup> 20 <sup>m</sup> 43 <sup>s</sup> .5	289.5336	13.4951	9.21	0.05	0.13	0.002	−28.78	0.62
11 <sup>h</sup> 05 <sup>m</sup> 50 <sup>s</sup> .9	−48 <sup>d</sup> 57 <sup>m</sup> 09 <sup>s</sup> .1	285.6674	10.3474	0.50	0.06	0.06	0.005	−88.24	3.46
11 <sup>h</sup> 04 <sup>m</sup> 30 <sup>s</sup> .2	−48 <sup>d</sup> 56 <sup>m</sup> 16 <sup>s</sup> .2	285.4560	10.2714	0.68	0.02	0.04	0.002	−110.45	1.61
10 <sup>h</sup> 47 <sup>m</sup> 02 <sup>s</sup> .0	−47 <sup>d</sup> 36 <sup>m</sup> 56 <sup>s</sup> .0	282.2128	10.1891	1.34	0.03	0.30	0.003	−23.44	0.39
10 <sup>h</sup> 30 <sup>m</sup> 41 <sup>s</sup> .2	−44 <sup>d</sup> 53 <sup>m</sup> 47 <sup>s</sup> .6	278.3453	11.1513	2.21	0.03	0.03	0.001	−43.77	2.08
10 <sup>h</sup> 08 <sup>m</sup> 05 <sup>s</sup> .4	−41 <sup>d</sup> 21 <sup>m</sup> 22 <sup>s</sup> .2	272.8396	11.7788	2.73	0.04	0.04	0.002	−1.83	2.10
10 <sup>h</sup> 00 <sup>m</sup> 44 <sup>s</sup> .9	−41 <sup>d</sup> 59 <sup>m</sup> 49 <sup>s</sup> .7	272.1207	10.4400	1.67	0.02	0.06	0.003	348.56	1.87
10 <sup>h</sup> 11 <sup>m</sup> 45 <sup>s</sup> .7	−41 <sup>d</sup> 28 <sup>m</sup> 53 <sup>s</sup> .0	273.4836	12.0834	1.06	0.03	0.18	0.003	−171.15	0.74
10 <sup>h</sup> 11 <sup>m</sup> 46 <sup>s</sup> .4	−41 <sup>d</sup> 27 <sup>m</sup> 34 <sup>s</sup> .0	273.4723	12.1025	1.66	0.03	0.09	0.003	−139.11	1.15
10 <sup>h</sup> 17 <sup>m</sup> 17 <sup>s</sup> .2	−40 <sup>d</sup> 47 <sup>m</sup> 56 <sup>s</sup> .4	273.9509	13.2407	4.28	0.03	0.03	0.002	−141.09	2.27
10 <sup>h</sup> 26 <sup>m</sup> 48 <sup>s</sup> .0	−41 <sup>d</sup> 43 <sup>m</sup> 24 <sup>s</sup> .6	276.0069	13.4639	8.69	0.05	0.30	0.004	−174.52	0.57
10 <sup>h</sup> 26 <sup>m</sup> 49 <sup>s</sup> .3	−41 <sup>d</sup> 43 <sup>m</sup> 02 <sup>s</sup> .6	276.0068	13.4712	8.61	0.07	0.61	0.004	−186.46	0.26
10 <sup>h</sup> 38 <sup>m</sup> 17 <sup>s</sup> .3	−45 <sup>d</sup> 09 <sup>m</sup> 39 <sup>s</sup> .4	279.6610	11.6101	1.51	0.04	0.02	0.002	51.83	4.63
11 <sup>h</sup> 07 <sup>m</sup> 23 <sup>s</sup> .0	−42 <sup>d</sup> 21 <sup>m</sup> 55 <sup>s</sup> .8	283.1808	16.4806	2.14	0.10	0.16	0.011	17.68	3.02
11 <sup>h</sup> 08 <sup>m</sup> 17 <sup>s</sup> .1	−42 <sup>d</sup> 07 <sup>m</sup> 48 <sup>s</sup> .2	283.2400	16.7634	1.97	0.04	0.13	0.003	−5.94	0.88
11 <sup>h</sup> 03 <sup>m</sup> 28 <sup>s</sup> .5	−41 <sup>d</sup> 04 <sup>m</sup> 10 <sup>s</sup> .5	281.9248	17.3567	3.38	0.11	0.23	0.003	20.96	0.55
11 <sup>h</sup> 11 <sup>m</sup> 19 <sup>s</sup> .8	−40 <sup>d</sup> 30 <sup>m</sup> 41 <sup>s</sup> .3	283.1095	18.4755	18.08	0.02	1.04	0.003	−25.12	0.12
11 <sup>h</sup> 38 <sup>m</sup> 01 <sup>s</sup> .5	−39 <sup>d</sup> 22 <sup>m</sup> 53 <sup>s</sup> .2	287.7869	21.3216	6.05	0.01	0.69	0.002	6.71	0.11
11 <sup>h</sup> 41 <sup>m</sup> 50 <sup>s</sup> .5	−35 <sup>d</sup> 04 <sup>m</sup> 11 <sup>s</sup> .5	287.1772	25.6637	4.79	0.08	0.17	0.007	5.27	1.72
11 <sup>h</sup> 41 <sup>m</sup> 50 <sup>s</sup> .2	−35 <sup>d</sup> 04 <sup>m</sup> 05 <sup>s</sup> .8	287.1755	25.6649	9.00	0.06	0.16	0.004	−17.21	0.94
11 <sup>h</sup> 44 <sup>m</sup> 07 <sup>s</sup> .4	−39 <sup>d</sup> 22 <sup>m</sup> 52 <sup>s</sup> .7	288.9993	21.6623	0.72	0.06	0.13	0.003	83.99	1.17
11 <sup>h</sup> 44 <sup>m</sup> 30 <sup>s</sup> .9	−34 <sup>d</sup> 57 <sup>m</sup> 57 <sup>s</sup> .9	287.7254	25.9218	1.01	0.04	0.11	0.005	7.35	1.78
11 <sup>h</sup> 45 <sup>m</sup> 47 <sup>s</sup> .6	−31 <sup>d</sup> 59 <sup>m</sup> 01 <sup>s</sup> .3	287.0527	28.8559	7.11	0.11	0.66	0.016	−35.76	0.95
11 <sup>h</sup> 45 <sup>m</sup> 01 <sup>s</sup> .6	−39 <sup>d</sup> 09 <sup>m</sup> 17 <sup>s</sup> .1	289.1130	21.9283	4.89	0.06	0.18	0.003	55.67	0.68
11 <sup>h</sup> 47 <sup>m</sup> 44 <sup>s</sup> .4	−38 <sup>d</sup> 32 <sup>m</sup> 43 <sup>s</sup> .3	289.4856	22.6575	2.38	0.04	0.10	0.003	−8.75	1.35
11 <sup>h</sup> 47 <sup>m</sup> 29 <sup>s</sup> .8	−36 <sup>d</sup> 03 <sup>m</sup> 06 <sup>s</sup> .0	288.7049	25.0473	1.56	0.04	0.04	0.003	−15.02	2.80
11 <sup>h</sup> 46 <sup>m</sup> 36 <sup>s</sup> .5	−37 <sup>d</sup> 57 <sup>m</sup> 21 <sup>s</sup> .1	289.0819	23.1661	0.42	0.02	0.03	0.006	3.60	8.10
11 <sup>h</sup> 47 <sup>m</sup> 01 <sup>s</sup> .5	−38 <sup>d</sup> 12 <sup>m</sup> 11 <sup>s</sup> .7	289.2400	22.9499	33.29	0.19	1.16	0.009	−4.55	0.31
11 <sup>h</sup> 47 <sup>m</sup> 44 <sup>s</sup> .3	−38 <sup>d</sup> 32 <sup>m</sup> 44 <sup>s</sup> .3	289.4854	22.6572	2.30	0.01	0.13	0.002	8.52	0.56
11 <sup>h</sup> 47 <sup>m</sup> 53 <sup>s</sup> .9	−38 <sup>d</sup> 24 <sup>m</sup> 11 <sup>s</sup> .4	289.4773	22.8029	3.85	0.04	0.17	0.003	2.68	0.74
11 <sup>h</sup> 47 <sup>m</sup> 54 <sup>s</sup> .0	−38 <sup>d</sup> 24 <sup>m</sup> 11 <sup>s</sup> .9	289.4774	22.8028	3.23	0.04	0.42	0.003	3.88	0.33
11 <sup>h</sup> 49 <sup>m</sup> 10 <sup>s</sup> .6	−32 <sup>d</sup> 59 <sup>m</sup> 13 <sup>s</sup> .7	288.1504	28.0912	1.14	0.09	0.04	0.008	−377.82	7.88
11 <sup>h</sup> 49 <sup>m</sup> 08 <sup>s</sup> .5	−35 <sup>d</sup> 25 <sup>m</sup> 32 <sup>s</sup> .0	288.8754	25.7400	0.44	0.05	0.04	0.008	126.91	7.53
11 <sup>h</sup> 50 <sup>m</sup> 35 <sup>s</sup> .6	−38 <sup>d</sup> 30 <sup>m</sup> 29 <sup>s</sup> .1	290.0595	22.8380	0.49	0.04	0.07	0.009	24.74	4.77
11 <sup>h</sup> 50 <sup>m</sup> 31 <sup>s</sup> .1	−37 <sup>d</sup> 59 <sup>m</sup> 17 <sup>s</sup> .9	289.9006	23.3371	1.06	0.02	0.06	0.002	48.33	1.22
11 <sup>h</sup> 51 <sup>m</sup> 25 <sup>s</sup> .7	−37 <sup>d</sup> 57 <sup>m</sup> 19 <sup>s</sup> .7	290.0807	23.4142	2.48	0.03	0.05	0.002	59.80	1.75
11 <sup>h</sup> 52 <sup>m</sup> 19 <sup>s</sup> .4	−36 <sup>d</sup> 10 <sup>m</sup> 06 <sup>s</sup> .6	289.7782	25.1888	0.45	0.05	0.05	0.004	16.83	3.13
11 <sup>h</sup> 54 <sup>m</sup> 01 <sup>s</sup> .6	−35 <sup>d</sup> 32 <sup>m</sup> 23 <sup>s</sup> .2	289.9759	25.8834	2.40	0.11	0.56	0.013	34.94	0.97
11 <sup>h</sup> 53 <sup>m</sup> 13 <sup>s</sup> .8	−37 <sup>d</sup> 14 <sup>m</sup> 15 <sup>s</sup> .7	290.2639	24.1981	3.58	0.04	0.45	0.006	−34.54	0.53
11 <sup>h</sup> 55 <sup>m</sup> 55 <sup>s</sup> .8	−36 <sup>d</sup> 56 <sup>m</sup> 39 <sup>s</sup> .7	290.7603	24.6120	2.28	0.05	0.05	0.004	19.40	3.30
11 <sup>h</sup> 56 <sup>m</sup> 16 <sup>s</sup> .9	−36 <sup>d</sup> 41 <sup>m</sup> 20 <sup>s</sup> .0	290.7699	24.8768	0.38	0.05	0.05	0.007	65.09	6.35
11 <sup>h</sup> 24 <sup>m</sup> 50 <sup>s</sup> .6	−33 <sup>d</sup> 54 <sup>m</sup> 58 <sup>s</sup> .0	283.0878	25.5968	0.92	0.06	0.06	0.005	218.09	3.63
12 <sup>h</sup> 01 <sup>m</sup> 18 <sup>s</sup> .7	−35 <sup>d</sup> 13 <sup>m</sup> 54 <sup>s</sup> .8	291.5071	26.5254	2.15	0.07	0.14	0.012	−41.06	3.99
12 <sup>h</sup> 01 <sup>m</sup> 18 <sup>s</sup> .7	−35 <sup>d</sup> 13 <sup>m</sup> 55 <sup>s</sup> .3	291.5072	26.5252	1.61	0.09	0.16	0.007	−39.53	1.86
11 <sup>h</sup> 28 <sup>m</sup> 13 <sup>s</sup> .7	−35 <sup>d</sup> 59 <sup>m</sup> 45 <sup>s</sup> .6	284.6145	23.8985	0.29	0.06	0.04	0.005	−191.43	4.39
12 <sup>h</sup> 03 <sup>m</sup> 37 <sup>s</sup> .5	−34 <sup>d</sup> 23 <sup>m</sup> 18 <sup>s</sup> .1	291.8273	27.4503	0.12	0.02	0.04	0.003	22.52	2.93
11 <sup>h</sup> 30 <sup>m</sup> 41 <sup>s</sup> .3	−34 <sup>d</sup> 10 <sup>m</sup> 34 <sup>s</sup> .4	284.4470	25.7804	3.69	0.12	0.08	0.009	−325.25	4.17
11 <sup>h</sup> 31 <sup>m</sup> 28 <sup>s</sup> .2	−34 <sup>d</sup> 02 <sup>m</sup> 43 <sup>s</sup> .1	284.5667	25.9585	0.71	0.03	0.07	0.002	−26.02	1.11

**Table A1** – *continued*

RA (J2000)	Dec. (J2000)	$l$ ( $^{\circ}$ )	$b$ ( $^{\circ}$ )	$S_I$ (Jy beam $^{-1}$ )	$S_{I, \text{err}}$ (Jy beam $^{-1}$ )	$p$ (Jy beam $^{-1}$ )	$p_{\text{err}}$ (Jy beam $^{-1}$ )	$\phi$ (rad m $^{-2}$ )	$\phi_{\text{err}}$ (rad m $^{-2}$ )
11 <sup>h</sup> 32 <sup>m</sup> 24 <sup>s</sup> .0	−35 <sup>d</sup> 07 <sup>m</sup> 29 <sup>s</sup> .9	285.1672	25.0054	0.66	0.09	0.05	0.007	126.81	5.37
12 <sup>h</sup> 09 <sup>m</sup> 17 <sup>s</sup> .1	−34 <sup>d</sup> 45 <sup>m</sup> 32 <sup>s</sup> .6	293.1956	27.3145	1.03	0.08	0.11	0.009	−146.09	3.36
11 <sup>h</sup> 34 <sup>m</sup> 35 <sup>s</sup> .1	−32 <sup>d</sup> 49 <sup>m</sup> 16 <sup>s</sup> .5	284.7943	27.3293	10.97	0.05	0.49	0.007	−78.75	0.54
12 <sup>h</sup> 13 <sup>m</sup> 43 <sup>s</sup> .0	−36 <sup>d</sup> 33 <sup>m</sup> 28 <sup>s</sup> .0	294.5333	25.6981	2.34	0.07	0.23	0.005	−136.15	0.88
11 <sup>h</sup> 35 <sup>m</sup> 15 <sup>s</sup> .3	−35 <sup>d</sup> 15 <sup>m</sup> 32 <sup>s</sup> .4	285.8240	25.0691	2.14	0.09	0.13	0.007	−23.73	2.30
11 <sup>h</sup> 36 <sup>m</sup> 51 <sup>s</sup> .0	−37 <sup>d</sup> 15 <sup>m</sup> 49 <sup>s</sup> .5	286.8512	23.2679	0.68	0.08	0.06	0.003	−30.99	2.26
12 <sup>h</sup> 07 <sup>m</sup> 42 <sup>s</sup> .6	−45 <sup>d</sup> 30 <sup>m</sup> 22 <sup>s</sup> .8	294.9563	16.6872	1.44	0.11	0.09	0.004	−124.70	1.81
12 <sup>h</sup> 05 <sup>m</sup> 22 <sup>s</sup> .2	−43 <sup>d</sup> 55 <sup>m</sup> 19 <sup>s</sup> .9	294.2262	18.1694	2.42	0.04	0.35	0.003	−96.63	0.35
12 <sup>h</sup> 02 <sup>m</sup> 24 <sup>s</sup> .9	−43 <sup>d</sup> 50 <sup>m</sup> 30 <sup>s</sup> .7	293.6602	18.1456	6.57	0.02	0.59	0.002	−67.54	0.10
12 <sup>h</sup> 02 <sup>m</sup> 24 <sup>s</sup> .9	−43 <sup>d</sup> 50 <sup>m</sup> 31 <sup>s</sup> .0	293.6601	18.1455	4.45	0.08	0.46	0.006	−66.25	0.53
12 <sup>h</sup> 14 <sup>m</sup> 18 <sup>s</sup> .3	−43 <sup>d</sup> 15 <sup>m</sup> 03 <sup>s</sup> .4	295.7889	19.1052	1.51	0.08	0.28	0.002	−107.48	0.28
11 <sup>h</sup> 49 <sup>m</sup> 54 <sup>s</sup> .7	−39 <sup>d</sup> 33 <sup>m</sup> 40 <sup>s</sup> .1	290.2101	21.7859	0.60	0.03	0.13	0.003	25.12	0.76
11 <sup>h</sup> 49 <sup>m</sup> 15 <sup>s</sup> .0	−39 <sup>d</sup> 40 <sup>m</sup> 51 <sup>s</sup> .2	290.1103	21.6375	0.36	0.07	0.05	0.003	28.22	2.42
11 <sup>h</sup> 49 <sup>m</sup> 54 <sup>s</sup> .7	−39 <sup>d</sup> 33 <sup>m</sup> 39 <sup>s</sup> .8	290.2101	21.7860	0.45	0.02	0.02	0.001	2.81	2.01
11 <sup>h</sup> 47 <sup>m</sup> 06 <sup>s</sup> .6	−41 <sup>d</sup> 11 <sup>m</sup> 16 <sup>s</sup> .7	290.1081	20.0764	17.87	0.16	1.03	0.004	37.76	0.15
11 <sup>h</sup> 47 <sup>m</sup> 06 <sup>s</sup> .7	−41 <sup>d</sup> 11 <sup>m</sup> 15 <sup>s</sup> .9	290.1083	20.0767	16.32	0.03	0.97	0.001	37.12	0.06
11 <sup>h</sup> 46 <sup>m</sup> 29 <sup>s</sup> .6	−42 <sup>d</sup> 34 <sup>m</sup> 17 <sup>s</sup> .2	290.3760	18.7114	2.25	0.04	0.20	0.004	389.41	0.82
12 <sup>h</sup> 01 <sup>m</sup> 38 <sup>s</sup> .7	−42 <sup>d</sup> 48 <sup>m</sup> 40 <sup>s</sup> .3	293.2969	19.1271	1.11	0.05	0.04	0.003	−57.05	3.73
12 <sup>h</sup> 06 <sup>m</sup> 52 <sup>s</sup> .7	−42 <sup>d</sup> 52 <sup>m</sup> 54 <sup>s</sup> .0	294.3079	19.2427	8.04	0.02	0.05	0.002	−75.08	1.88
12 <sup>h</sup> 14 <sup>m</sup> 16 <sup>s</sup> .8	−42 <sup>d</sup> 00 <sup>m</sup> 33 <sup>s</sup> .2	295.5831	20.3317	2.92	0.03	0.68	0.004	−130.06	0.22
12 <sup>h</sup> 25 <sup>m</sup> 58 <sup>s</sup> .7	−43 <sup>d</sup> 14 <sup>m</sup> 43 <sup>s</sup> .7	298.0210	19.3834	0.61	0.03	0.05	0.002	−29.37	1.70
12 <sup>h</sup> 27 <sup>m</sup> 55 <sup>s</sup> .6	−44 <sup>d</sup> 20 <sup>m</sup> 57 <sup>s</sup> .8	298.5077	18.3203	6.16	0.02	0.75	0.001	−44.12	0.06
12 <sup>h</sup> 27 <sup>m</sup> 55 <sup>s</sup> .6	−44 <sup>d</sup> 19 <sup>m</sup> 55 <sup>s</sup> .8	298.5059	18.3374	6.76	0.01	0.29	0.001	−47.82	0.15
12 <sup>h</sup> 23 <sup>m</sup> 24 <sup>s</sup> .8	−49 <sup>d</sup> 29 <sup>m</sup> 47 <sup>s</sup> .7	298.2660	13.1211	1.61	0.06	0.10	0.001	17.19	0.49
12 <sup>h</sup> 31 <sup>m</sup> 26 <sup>s</sup> .2	−48 <sup>d</sup> 53 <sup>m</sup> 23 <sup>s</sup> .8	299.5481	13.8503	1.46	0.03	0.04	0.002	−39.02	1.98
12 <sup>h</sup> 35 <sup>m</sup> 18 <sup>s</sup> .9	−46 <sup>d</sup> 00 <sup>m</sup> 40 <sup>s</sup> .7	300.0093	16.7689	1.11	0.04	0.11	0.003	0.57	0.94
12 <sup>h</sup> 15 <sup>m</sup> 59 <sup>s</sup> .6	−42 <sup>d</sup> 30 <sup>m</sup> 28 <sup>s</sup> .2	295.9962	19.8861	1.46	0.02	0.12	0.001	−74.21	0.50
12 <sup>h</sup> 11 <sup>m</sup> 14 <sup>s</sup> .5	−39 <sup>d</sup> 33 <sup>m</sup> 27 <sup>s</sup> .4	294.5492	22.6590	0.36	0.07	0.04	0.006	−158.61	6.44
12 <sup>h</sup> 49 <sup>m</sup> 35 <sup>s</sup> .4	−48 <sup>d</sup> 16 <sup>m</sup> 54 <sup>s</sup> .3	302.6143	14.5889	1.29	0.04	0.01	0.001	71.07	2.98
12 <sup>h</sup> 50 <sup>m</sup> 14 <sup>s</sup> .1	−48 <sup>d</sup> 08 <sup>m</sup> 42 <sup>s</sup> .0	302.7244	14.7262	0.48	0.03	0.03	0.002	30.70	2.33
12 <sup>h</sup> 50 <sup>m</sup> 14 <sup>s</sup> .1	−48 <sup>d</sup> 08 <sup>m</sup> 42 <sup>s</sup> .8	302.7245	14.7261	0.72	0.04	0.05	0.005	39.44	4.21
12 <sup>h</sup> 48 <sup>m</sup> 12 <sup>s</sup> .7	−47 <sup>d</sup> 47 <sup>m</sup> 15 <sup>s</sup> .8	302.3706	15.0805	0.21	0.01	0.01	0.003	−200.26	10.11
12 <sup>h</sup> 19 <sup>m</sup> 01 <sup>s</sup> .6	−44 <sup>d</sup> 09 <sup>m</sup> 42 <sup>s</sup> .1	296.8173	18.3249	0.47	0.05	0.04	0.002	−65.48	2.40
12 <sup>h</sup> 18 <sup>m</sup> 32 <sup>s</sup> .2	−38 <sup>d</sup> 55 <sup>m</sup> 51 <sup>s</sup> .7	295.9617	23.4950	1.09	0.03	0.14	0.003	−88.42	0.94
12 <sup>h</sup> 16 <sup>m</sup> 29 <sup>s</sup> .8	−38 <sup>d</sup> 54 <sup>m</sup> 10 <sup>s</sup> .2	295.5293	23.4662	0.84	0.06	0.04	0.002	−94.46	2.17
12 <sup>h</sup> 15 <sup>m</sup> 19 <sup>s</sup> .1	−39 <sup>d</sup> 04 <sup>m</sup> 28 <sup>s</sup> .1	295.3106	23.2622	1.09	0.04	0.06	0.002	−140.68	1.49
12 <sup>h</sup> 15 <sup>m</sup> 59 <sup>s</sup> .6	−42 <sup>d</sup> 30 <sup>m</sup> 28 <sup>s</sup> .4	295.9962	19.8860	1.04	0.03	0.06	0.002	−79.62	1.27
11 <sup>h</sup> 50 <sup>m</sup> 55 <sup>s</sup> .4	−46 <sup>d</sup> 32 <sup>m</sup> 49 <sup>s</sup> .8	292.2194	15.0620	2.06	0.05	0.06	0.002	−81.09	1.70
12 <sup>h</sup> 04 <sup>m</sup> 59 <sup>s</sup> .4	−38 <sup>d</sup> 50 <sup>m</sup> 32 <sup>s</sup> .9	293.1153	23.1423	2.46	0.04	0.16	0.002	−4.41	0.49
11 <sup>h</sup> 58 <sup>m</sup> 48 <sup>s</sup> .8	−40 <sup>d</sup> 30 <sup>m</sup> 06 <sup>s</sup> .9	292.2286	21.2736	20.63	0.06	0.16	0.003	−27.60	0.81
11 <sup>h</sup> 54 <sup>m</sup> 17 <sup>s</sup> .8	−40 <sup>d</sup> 47 <sup>m</sup> 28 <sup>s</sup> .8	291.4046	20.7979	8.28	0.11	0.58	0.010	−45.71	0.73
11 <sup>h</sup> 47 <sup>m</sup> 06 <sup>s</sup> .7	−41 <sup>d</sup> 11 <sup>m</sup> 16 <sup>s</sup> .5	290.1084	20.0766	21.95	0.05	1.18	0.006	40.19	0.21
11 <sup>h</sup> 51 <sup>m</sup> 21 <sup>s</sup> .2	−40 <sup>d</sup> 50 <sup>m</sup> 17 <sup>s</sup> .8	290.8389	20.6183	1.12	0.03	0.06	0.002	−45.11	1.22
11 <sup>h</sup> 50 <sup>m</sup> 07 <sup>s</sup> .5	−41 <sup>d</sup> 14 <sup>m</sup> 59 <sup>s</sup> .1	290.7087	20.1622	0.88	0.07	0.05	0.002	−14.68	1.95
11 <sup>h</sup> 44 <sup>m</sup> 08 <sup>s</sup> .8	−40 <sup>d</sup> 15 <sup>m</sup> 17 <sup>s</sup> .1	289.2629	20.8242	2.52	0.03	0.10	0.003	138.70	1.21
11 <sup>h</sup> 44 <sup>m</sup> 48 <sup>s</sup> .2	−40 <sup>d</sup> 15 <sup>m</sup> 07 <sup>s</sup> .1	289.3910	20.8612	2.21	0.07	0.16	0.004	129.10	1.10
11 <sup>h</sup> 44 <sup>m</sup> 08 <sup>s</sup> .8	−40 <sup>d</sup> 15 <sup>m</sup> 16 <sup>s</sup> .8	289.2629	20.8242	2.93	0.13	0.11	0.004	136.05	1.55
11 <sup>h</sup> 44 <sup>m</sup> 48 <sup>s</sup> .2	−40 <sup>d</sup> 15 <sup>m</sup> 06 <sup>s</sup> .8	289.3910	20.8613	2.06	0.03	0.15	0.003	117.67	0.86
11 <sup>h</sup> 45 <sup>m</sup> 57 <sup>s</sup> .3	−41 <sup>d</sup> 34 <sup>m</sup> 39 <sup>s</sup> .8	289.9955	19.6432	2.11	0.10	0.16	0.003	−9.56	0.67
11 <sup>h</sup> 47 <sup>m</sup> 06 <sup>s</sup> .7	−41 <sup>d</sup> 11 <sup>m</sup> 15 <sup>s</sup> .8	290.1083	20.0767	18.02	0.01	1.00	0.002	34.06	0.10
11 <sup>h</sup> 49 <sup>m</sup> 09 <sup>s</sup> .8	−41 <sup>d</sup> 06 <sup>m</sup> 59 <sup>s</sup> .3	290.4861	20.2454	1.17	0.05	0.12	0.004	−31.87	1.21
11 <sup>h</sup> 51 <sup>m</sup> 57 <sup>s</sup> .0	−40 <sup>d</sup> 26 <sup>m</sup> 32 <sup>s</sup> .5	290.8521	21.0299	3.71	0.02	0.07	0.003	101.34	1.81
12 <sup>h</sup> 40 <sup>m</sup> 13 <sup>s</sup> .3	−43 <sup>d</sup> 05 <sup>m</sup> 08 <sup>s</sup> .4	300.7566	19.7387	1.52	0.06	0.07	0.004	−34.06	2.36
12 <sup>h</sup> 44 <sup>m</sup> 33 <sup>s</sup> .3	−50 <sup>d</sup> 10 <sup>m</sup> 10 <sup>s</sup> .7	301.8022	12.6870	0.78	0.02	0.09	0.001	14.77	0.47
12 <sup>h</sup> 44 <sup>m</sup> 51 <sup>s</sup> .9	−50 <sup>d</sup> 09 <sup>m</sup> 39 <sup>s</sup> .5	301.8530	12.6970	3.22	0.02	0.22	0.001	3.99	0.22
12 <sup>h</sup> 37 <sup>m</sup> 59 <sup>s</sup> .5	−50 <sup>d</sup> 57 <sup>m</sup> 12 <sup>s</sup> .6	300.7689	11.8618	1.74	0.04	0.06	0.001	35.12	0.75
12 <sup>h</sup> 28 <sup>m</sup> 26 <sup>s</sup> .5	−51 <sup>d</sup> 49 <sup>m</sup> 40 <sup>s</sup> .0	299.3174	10.8825	2.70	0.04	0.40	0.003	51.52	0.34
11 <sup>h</sup> 57 <sup>m</sup> 23 <sup>s</sup> .0	−45 <sup>d</sup> 05 <sup>m</sup> 57 <sup>s</sup> .5	293.0139	16.7289	2.67	0.05	0.13	0.003	−113.87	1.09
11 <sup>h</sup> 49 <sup>m</sup> 46 <sup>s</sup> .2	−43 <sup>d</sup> 45 <sup>m</sup> 37 <sup>s</sup> .8	291.3039	17.7145	4.69	0.03	0.14	0.003	−57.36	1.03
11 <sup>h</sup> 50 <sup>m</sup> 11 <sup>s</sup> .6	−43 <sup>d</sup> 30 <sup>m</sup> 13 <sup>s</sup> .2	291.3149	17.9823	1.38	0.03	0.16	0.003	−95.25	0.64
11 <sup>h</sup> 49 <sup>m</sup> 46 <sup>s</sup> .2	−43 <sup>d</sup> 45 <sup>m</sup> 38 <sup>s</sup> .1	291.3039	17.7144	6.88	0.13	0.28	0.009	−56.66	1.25



Table A1 – continued

RA (J2000)	Dec. (J2000)	$l$ ( $^{\circ}$ )	$b$ ( $^{\circ}$ )	$S_I$ (Jy beam $^{-1}$ )	$S_{I, \text{err}}$ (Jy beam $^{-1}$ )	$p$ (Jy beam $^{-1}$ )	$p_{\text{err}}$ (Jy beam $^{-1}$ )	$\phi$ (rad m $^{-2}$ )	$\phi_{\text{err}}$ (rad m $^{-2}$ )
11 <sup>h</sup> 50 <sup>m</sup> 11 <sup>s</sup> .6	−43 <sup>d</sup> 30 <sup>m</sup> 13 <sup>s</sup> .6	291.3149	17.9822	1.05	0.03	0.06	0.003	−69.51	1.97
11 <sup>h</sup> 50 <sup>m</sup> 06 <sup>s</sup> .6	−43 <sup>d</sup> 29 <sup>m</sup> 56 <sup>s</sup> .6	291.2984	17.9830	0.77	0.03	0.09	0.002	−62.38	1.11
12 <sup>h</sup> 05 <sup>m</sup> 19 <sup>s</sup> .3	−43 <sup>d</sup> 55 <sup>m</sup> 44 <sup>s</sup> .1	294.2187	18.1612	2.65	0.04	0.85	0.003	−95.86	0.14
12 <sup>h</sup> 23 <sup>m</sup> 30 <sup>s</sup> .5	−43 <sup>d</sup> 59 <sup>m</sup> 04 <sup>s</sup> .6	297.6366	18.5998	0.90	0.01	0.13	0.002	−74.22	0.53
12 <sup>h</sup> 42 <sup>m</sup> 01 <sup>s</sup> .4	−45 <sup>d</sup> 35 <sup>m</sup> 09 <sup>s</sup> .8	301.2075	17.2542	0.87	0.02	0.02	0.001	−52.19	3.30
12 <sup>h</sup> 44 <sup>m</sup> 04 <sup>s</sup> .6	−44 <sup>d</sup> 51 <sup>m</sup> 41 <sup>s</sup> .2	301.5605	17.9907	0.86	0.02	0.04	0.002	−59.70	2.23
12 <sup>h</sup> 37 <sup>m</sup> 49 <sup>s</sup> .8	−51 <sup>d</sup> 43 <sup>m</sup> 46 <sup>s</sup> .0	300.7856	11.0856	3.94	0.02	0.08	0.001	−42.52	0.40
12 <sup>h</sup> 13 <sup>m</sup> 14 <sup>s</sup> .3	−49 <sup>d</sup> 59 <sup>m</sup> 35 <sup>s</sup> .0	296.6620	12.4131	4.10	0.07	0.21	0.005	−4.15	1.01
12 <sup>h</sup> 06 <sup>m</sup> 30 <sup>s</sup> .6	−50 <sup>d</sup> 34 <sup>m</sup> 42 <sup>s</sup> .9	295.6764	11.6592	4.93	0.03	0.04	0.001	−88.92	1.47
12 <sup>h</sup> 06 <sup>m</sup> 10 <sup>s</sup> .9	−50 <sup>d</sup> 28 <sup>m</sup> 22 <sup>s</sup> .4	295.6048	11.7539	0.70	0.03	0.02	0.002	−100.04	3.37
11 <sup>h</sup> 55 <sup>m</sup> 04 <sup>s</sup> .8	−50 <sup>d</sup> 51 <sup>m</sup> 30 <sup>s</sup> .9	293.9249	11.0249	1.11	0.03	0.07	0.001	−73.91	0.74
11 <sup>h</sup> 43 <sup>m</sup> 53 <sup>s</sup> .9	−48 <sup>d</sup> 04 <sup>m</sup> 33 <sup>s</sup> .1	291.4303	13.2818	1.69	0.02	0.09	0.001	10.49	0.69
11 <sup>h</sup> 56 <sup>m</sup> 32 <sup>s</sup> .5	−44 <sup>d</sup> 38 <sup>m</sup> 57 <sup>s</sup> .7	292.7589	17.1353	1.58	0.03	0.04	0.002	−47.23	2.09
11 <sup>h</sup> 57 <sup>m</sup> 56 <sup>s</sup> .5	−38 <sup>d</sup> 56 <sup>m</sup> 45 <sup>s</sup> .8	291.6824	22.7543	1.34	0.03	0.12	0.002	−23.88	0.67
11 <sup>h</sup> 56 <sup>m</sup> 41 <sup>s</sup> .9	−39 <sup>d</sup> 14 <sup>m</sup> 39 <sup>s</sup> .4	291.5007	22.4093	1.00	0.03	0.59	0.002	12.28	0.16
12 <sup>h</sup> 10 <sup>m</sup> 35 <sup>s</sup> .7	−40 <sup>d</sup> 28 <sup>m</sup> 18 <sup>s</sup> .3	294.5843	21.7371	0.95	0.05	0.05	0.009	−187.31	7.82
12 <sup>h</sup> 10 <sup>m</sup> 39 <sup>s</sup> .1	−41 <sup>d</sup> 10 <sup>m</sup> 19 <sup>s</sup> .8	294.7231	21.0486	1.39	0.03	0.18	0.002	−83.10	0.52
12 <sup>h</sup> 32 <sup>m</sup> 33 <sup>s</sup> .9	−45 <sup>d</sup> 52 <sup>m</sup> 38 <sup>s</sup> .8	299.5012	16.8685	9.47	0.03	0.07	0.002	25.24	1.18
12 <sup>h</sup> 42 <sup>m</sup> 53 <sup>s</sup> .3	−40 <sup>d</sup> 28 <sup>m</sup> 15 <sup>s</sup> .6	301.1736	22.3716	1.16	0.02	0.07	0.002	−22.16	1.38
13 <sup>h</sup> 11 <sup>m</sup> 21 <sup>s</sup> .5	−43 <sup>d</sup> 00 <sup>m</sup> 24 <sup>s</sup> .4	306.7985	19.7154	2.37	0.04	0.03	0.003	−28.88	4.18
13 <sup>h</sup> 02 <sup>m</sup> 14 <sup>s</sup> .7	−47 <sup>d</sup> 22 <sup>m</sup> 04 <sup>s</sup> .7	304.8302	15.4639	1.96	0.04	0.42	0.002	−0.51	0.20
13 <sup>h</sup> 05 <sup>m</sup> 29 <sup>s</sup> .7	−48 <sup>d</sup> 18 <sup>m</sup> 56 <sup>s</sup> .6	305.3450	14.4902	1.92	0.02	0.05	0.001	134.11	0.62
12 <sup>h</sup> 56 <sup>m</sup> 02 <sup>s</sup> .6	−48 <sup>d</sup> 18 <sup>m</sup> 13 <sup>s</sup> .0	303.7232	14.5611	2.94	0.04	0.25	0.002	158.91	0.25
12 <sup>h</sup> 54 <sup>m</sup> 59 <sup>s</sup> .6	−48 <sup>d</sup> 12 <sup>m</sup> 25 <sup>s</sup> .8	303.5442	14.6603	0.24	0.02	0.02	0.002	421.99	4.08
13 <sup>h</sup> 02 <sup>m</sup> 28 <sup>s</sup> .1	−44 <sup>d</sup> 47 <sup>m</sup> 36 <sup>s</sup> .6	304.9895	18.0342	14.77	0.06	0.61	0.003	−47.63	0.20
12 <sup>h</sup> 59 <sup>m</sup> 57 <sup>s</sup> .3	−44 <sup>d</sup> 06 <sup>m</sup> 30 <sup>s</sup> .4	304.5461	18.7366	0.83	0.06	0.03	0.002	−41.20	2.83
12 <sup>h</sup> 51 <sup>m</sup> 36 <sup>s</sup> .7	−41 <sup>d</sup> 33 <sup>m</sup> 42 <sup>s</sup> .9	302.9667	21.3098	3.37	0.02	0.44	0.003	−54.80	0.25

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