Illuminating Dark Magnetism

Discovering the role magnetic fields play in star formation.

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Molecular clouds are dense environments of cold gas (10—30K) that do not radiate their own visible light and so appear dark with optical telescopes. RCW38 is one of these dark clouds that contains over 38,000 stars and is characteristic as having detectable magnetic fields, molecules, and atoms. By studying this cloud at low radio frequencies we can explore a range of cold molecules and atoms and the properties they imply.

Figure 1: Parkes Telescope (The Dish) is located in New South Wales Australia. It operates at 700 – 4000MHz and offers 3300MHz bandwidth.

Figure 2: The Australian Square Kilometre Array Pathfinder (ASKAP) is located in Western Australia and observes at 700 – 1800MHz. It offers 15,500 frequency channels in spectral line mode with down to 0.5kHz resolution.

Figure 3: The Murchison Widefield Array is located in Western Australia and observes at 70 – 300MHz. It offers 3072 frequency channels with a resolution of 10kHz.

LOW Frequency Molecules:

With observations from the MWA at 70—300MHz can study the gas-phase transitions of simple molecules and the primary low-energy transitions of complex molecules. The benefits of low frequency observations are:

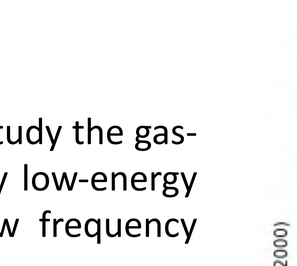
- Less line confusion than at microwave frequencies.
- Sensitive to the cold gas.
- HII regions are optically thin.
- Study different emission mechanism.

More information will be published in Tremblay et al. ApJ Submitted

Cold Molecules – CH :

With observations from ASKAP & Parkes we are sensitive to the 722 and 724MHz transition of methylidyne radical (CH). Not only was it the first molecule discovered in space, it is:

- An important substitute for H_2 column density estimates;
- Sensitive to magnetic fields through Zeeman splitting;
- Found in both dense and diffuse gas.



We aim to study:

- Kinematics of both dense and diffuse gas;
- Role magnetic fields play in star formation through Zeeman splitting of CH;
- Chemical enrichment of the low-frequency sky.

Observations were made with RCW38 to understand the data processing challenges with ASKAP "zoom" mode data and MWA long baseline data. Upcoming observations of W51 will be for the full-scale project.

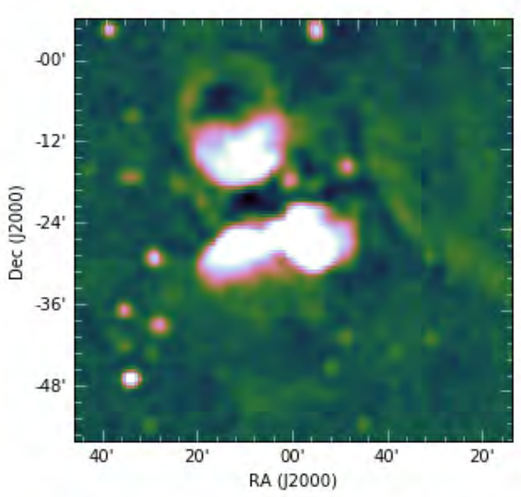


Figure 4: RCW38 imaged with the MWA at a central frequency of 114MHz. Additional continuum is present compared to previous radio observations.

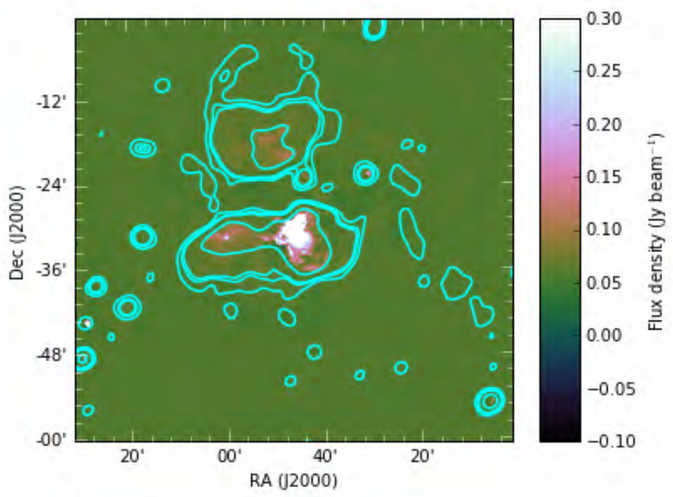


Figure 5: RCW38 imaged with ASKAP at a central frequency of 724MHz and contours from the MWA. The continuum shows more detailed but also is sensitive to the northern emission.

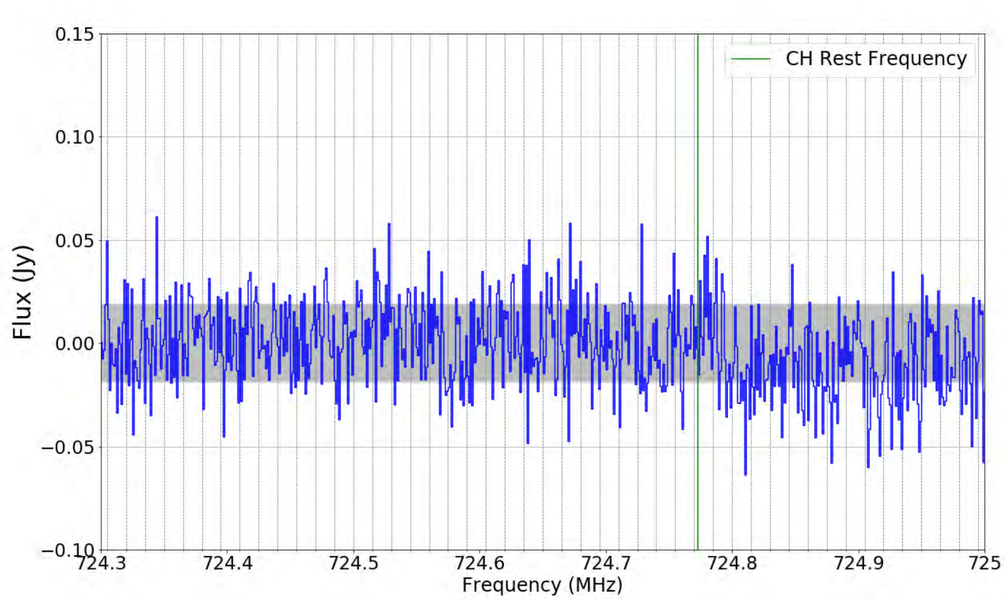


Figure 6: Spectra from a 5-hour observation with ASKAP. Within the 2000 channels imaged, the signal from CH was not detected toward RCW38. It is estimated that 10-15 hours will be needed.

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FOR FURTHER INFORMATION

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REFERENCES:

For more information on any of these topics see:
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