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Supernova Remnants in the UWISH2 and UWIFE Surveys

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Abstract. We report the preliminary results for the detection of H_2 and [Fe II] line features around the Galactic supernova remnants (SNRs) from the UWISH2 and UWIFE surveys that cover the first galactic quadrant of $7^\circ < l < 65^\circ$ and $|b| < 1.3^\circ$. By this time, we have found a total of 17 H_2-emitting and 14 [Fe II]-emitting SNRs in the coverage, and more than a half of them are detected in both H_2 and [Fe II] emissions, which implies that the environment of these SNRs might be complex and composed of multi-phase medium. In this paper, we present our identification strategy and some preliminary results including H_2 and [Fe II] luminosity distributions.

Keywords. surveys, ISM: supernova remnants, infrared: ISM

1. Introduction

The UWISH2/UWIFE (UKIRT Wide-field Infrared Survey for H_2/[Fe II]) is near-infrared (NIR) H_2-2.12 μm/[Fe II]-1.64 μm narrow-band imaging survey for the first Galactic quadrant ($7^\circ < l < 65^\circ$; $|b| < 1.3^\circ$) that have been performed with the Wide-Field Camera at the United Kingdom Infrared Telescope (Froebrich *et al.* 2011; Lee *et al.*, in prep.). Since the H_2 and [Fe II] lines trace the shocked and/or fluorescently excited regions of molecular and atomic gases associated with jets/outflows around star formation regions, photo-dominated regions, planetary nebulae, evolved massive stars, and supernova remnants, the combination studies of the H_2 and [Fe II] are one of the valuable tools for studying the formation and death of stars.

We have searched for the H_2 and [Fe II] line features around the Galactic SNRs from the survey data. A total of 77 SNRs are falling in the survey area among the currently known 274 Galactic SNRs (Green 2009). These two complementary NIR H_2 and [Fe II] imaging surveys can help us to understand not only the environment and evolution of the individual remnants but also statistical properties of the Galactic SNRs.

2. Observation & Continuum Subtraction

The H_2 survey had been completed in August 2011, while the [Fe II] survey is expected to finish in September 2013. The pixel scale of both surveys is 0.2 arcsec by using 2×2 microstepping sequence, and the median seeings are 0.73 arcsec and 0.80 arcsec for H_2 and [Fe II] surveys, respectively. The total per-pixel integration time is 720 s in both surveys, and the 5σ detection limits of point sources in H- and K-bands are ~ 19 and ~ 18 magnitude, respectively. That limits may show diffuse structures as deep as the surface brightness of $\sim 10^{-19}$ W m^{-2} arcsec^{-2}.

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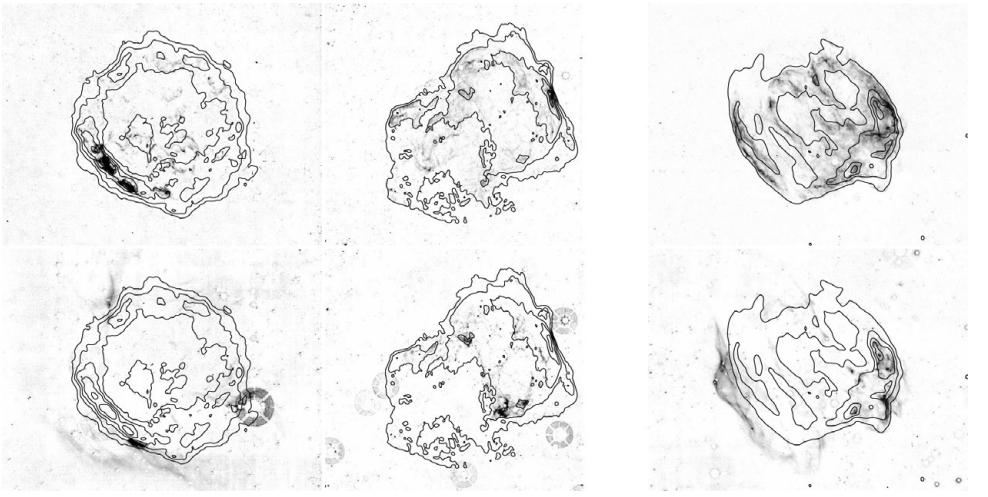

Figure 1. Continuum-subtracted images of G11.2-0.3 (left), 3C 391 (middle), and W49B (right). The upper-pannel shows [Fe II] in UWIFE, while the lower-pannel presents H_2 in UWISH2. Radio continuum contours are superposed on each pannel.

In order to identify the narrow-band emission features, we subtract the *H* and *K*-band continuum images obtained as part of the UKIDSS GPS (UKIRT Infrared Deep Sky Survey of the Galactic Plane) from the H_2 and [Fe II] narrow-band images, respectively. For this, we developed an IDL-based automatic program for dealing with complex and space-variant Point Spread Functions (PSFs) using the subroutines of *Starfinder* code (Diolaiti *et al.* 2000).

3. Preliminary Results

By this time, we have found 17 H_2-emitting and 14 [Fe II]-emitting SNRs corresponding to 22% (17 out of 77) and 26% (14 out of 56) in detection rates, respectively. More than a half of them are newly-confirmed H_2/[Fe II]-emitting SNRs that have never been reported in previous studies. This is likely to increase in future as we inspect the images in more detail. About 60% of the H_2-emitting SNRs have [Fe II] features as well, thus the environment of these SNRs might be complex and composed of multi-phase medium.

Fig. 1 shows three SNRs (G11.2-0.3, 3C 391, and W49B) that radiate both strong H_2 and [Fe II] emissions. Note that the [Fe II] emission features are well correlated with the radio morphologies, while the H_2 emissions are often found outside of the radio boundary.

According to our preliminary results, the extinction-corrected luminosities ranges from 2.4 $L_\odot$ to 2.1×10^3 $L_\odot$ in H_2, and from 2.3 $L_\odot$ to 8.6×10^3 $L_\odot$ in [Fe II], and the brightest SNR is W49B in both H_2 and [Fe II]. This luminosity range is comparable to that of the LMC SNRs, but slightly lower than that of the starburst galaxies, such as M82 and NGC 253 (Alonso-Herrero *et al.* 2003).

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