

Recent results of Forbidden-Velocity Wings with GALFA

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Large-scale (ℓ, v) diagrams of HI 21-cm line emission in the Galactic plane usually show small high-velocity bumps protruding from their surroundings. Since those wing-like features are at forbidden velocities, i.e., at velocities beyond the maximum or minimum values permitted by the Galactic rotation, we call them as “Forbidden-velocity wings (FVWs)”. Fig. 1 (a) is a (ℓ, v) diagram at $b = 4^\circ$. The wing-like feature at $\ell \sim 39$ and $80 \text{ km s}^{-1} \lesssim v_{\text{LSR}} \lesssim 130 \text{ km s}^{-1}$ and the one at $\ell \sim 83$ and $30 \text{ km s}^{-1} \lesssim v_{\text{LSR}} \lesssim 70 \text{ km s}^{-1}$ in Fig. 1 (a) are the examples of FVWs. We suspect that they are the sites where Galactic dynamical events, for example, supernova explosions, stellar winds, or collisions of high-velocity clouds, which could accelerate their surrounding gas, have happened. We have searched for the FVWs using the Leiden-Dwingeloo HI survey and the Southern Galactic Plane Survey data, and identified about 90 FVWs in the Galactic plane ($|b| \leq 13^\circ$) (Kang 2004; Kang et al. 2004). We compared this catalog of FVWs with those of supernova remnants, high-velocity clouds, and nearby galaxies, and found that about 85 % are not coincident with those known objects. The natures of most FVWs are not known yet.

During last January and February, for 15 days, we have carried out commensal observations using the ALFA receiver covering areas including 3 FVWs in the inner Galaxy. Two of them showed shell-like features. FVW39.0+4.0 (Fig. 1, b) is an $\sim 1^\circ$ -sized shell of $v_{\text{exp}} \gtrsim 55 \text{ km s}^{-1}$. As it goes to higher velocities, it becomes fainter and finally disappears, so that its endcap is not seen. Its systematic velocity seems to be less than 73 km s^{-1} . Its distance from the Sun would be less than 5.0 kpc or greater than 8.3 kpc. If it is located in the Sagittarius-Carina arm, the kinetic energy of HI shell would be $\sim 1.2 \times 10^{50}$ erg or $\sim 1.0 \times 10^{51}$ erg, depending on whether it is at close (~ 3.3 kpc) or distant (~ 9.8 kpc) part of the arm. It doesn't have any known OB type stars inside and could be an old supernova remnant. FVW40.0+0.5 (Fig. 1, c) shows center-filled complex of filamentary structures. Since it shows roughly circular shape, it could possibly be part of an endcap of a larger shell. FVW44.5-2.0 (Fig. 1, d) shows a single clump-like structure from 110 km s^{-1} to 90 km s^{-1} , and then connects to a complicated filamentary structure at lower velocities. It seems to be similar to the halo cloud of Lockman (2002) in the sense that it exists near tangent velocity and shows a clump-like structure. These are only three of 26 FVWs observable at Arecibo. Future ALFA survey of the Galactic plane will reveal the nature of FVWs.

REFERENCES

- Kang, J.-h. 2004, M.Sc. Thesis, Seoul National Univ.
Kang, J.-h., Koo, B.-Ch., & Heiles, C. 2004, ASP conference Series, 317, 38
Lockman, F., J. 2002, ApJ, 580, L47 Taylor, J. H., & Cordes, J. M. 1993, ApJ, 411, 674

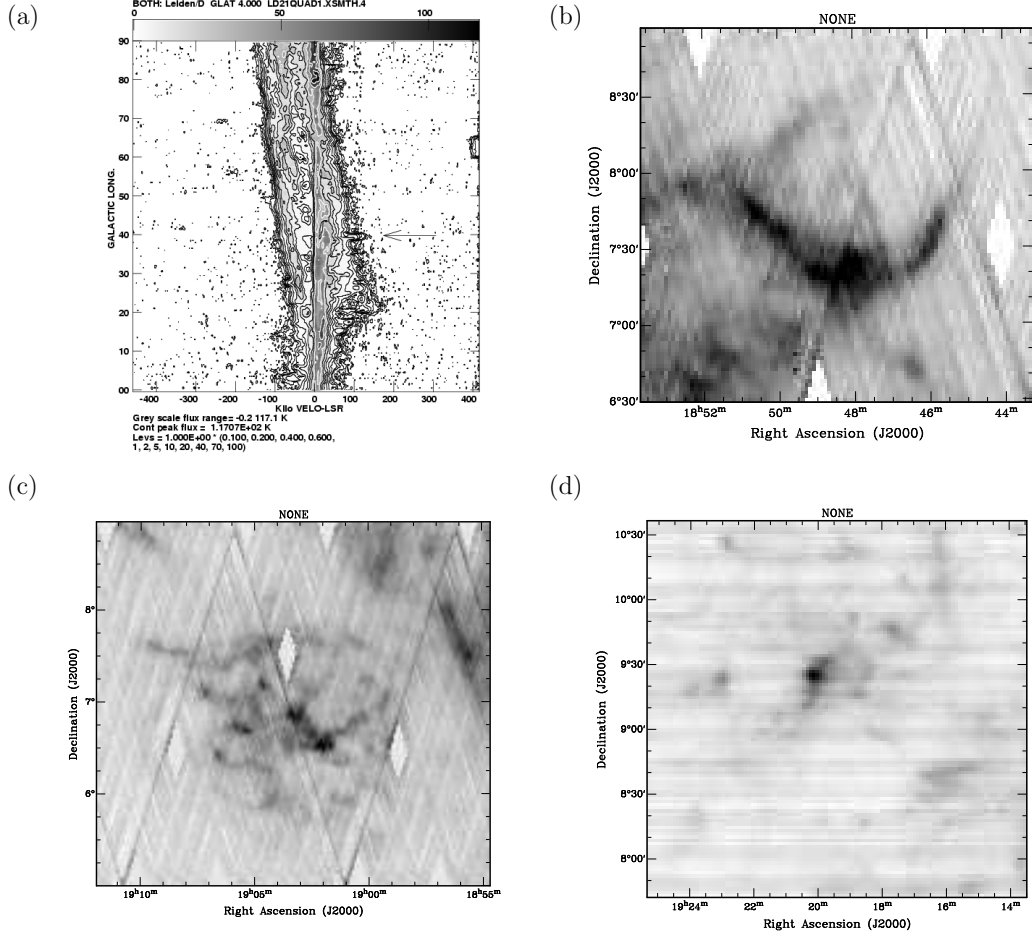


Fig. 1.— (a) Large-scale (ℓ, b) diagram at $b = +4^\circ$ using LD data. Arrow near the center indicates faint extended bump of FVW39.0+4.0. (b) Arcibo image of FVW39.0+4.0 integrated over velocities between $v_{\text{LSR}} = 73 \text{ km s}^{-1}$ and 130 km s^{-1} . (c) Image of FVW40.0+0.5 integrated from $v_{\text{LSR}} = -79 \text{ km s}^{-1}$ to -114 km s^{-1} . (d) Image of FVW44.5-2.0 integrated from $v_{\text{LSR}} = +90 \text{ km s}^{-1}$ to $+110 \text{ km s}^{-1}$.