Q30a Automated extraction of peculiar velocity structures in nearby star-forming clouds with the FilFinder algorithm

李欣儒 (東京大学), 阪本成一 (国立天文台/東京大学)

Star formation occurs in molecular clouds, whose properties and efficiency reflect their physical and kinematic conditions, influenced by perturbations like collisions, outflows, winds, and supernovae. Due to low temperatures (∼10 K), molecular clouds have small thermal velocities, so supersonic motions easily generate shock waves that convert kinetic energy into thermal motion. While strong shocks have been detected, weaker shocks and localized velocity structures remain challenging to identify systematically.

Using data from the NRO Star Formation Legacy Project, we analyzed CO J=1–0 emission from star-forming regions in the Aquila Rift (W40 and Serpens South) and Orion A. We applied spatial median filtering to position-velocity diagrams to isolate small-scale peculiar velocity structures and used the FilFinder algorithm to automate their identification, removing biases from manual searches. The Aquila Rift data covered a $1^\circ \times 1^\circ$ area with $7.5''$ resolution (0.016 pc at 436 pc) and 0.38–0.50 K noise level at full velocity resolution (0.10 km s^{-1}). We identified 51 groups of subparsec-scale peculiar velocity structures in the Aquila Rift, attributing 18 to known molecular outflows and discovering 13 new outflow candidates. Additionally, we uncovered a novel type of structure associated with molecular gas accelerated by an expanding HII region shell.