

Inversion of Water Maser Observations to Shock Physics

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We demonstrate using the rich water maser cluster W49 N as an example, how simultaneously obtained 22 GHz single-dish and multi-epoch VLBI observations of the masing water line can be used to quantitatively diagnose shocked and turbulent regions around protostars. The principal factors that determine the physical properties of a shocked region are the preshock density, the shock velocity (obtained from proper motion measurements of the masers), and the preshock magnetic field parameter (obtained from non-thermal variations in the Doppler velocity within maser features). When two of these are observationally well constrained, all other physical quantities can be determined with available shock and maser models. We succeeded to observationally fix the free parameters in the shock model of Hollenbach and McKee and the maser model of Elitzur, Hollenbach, and McKee. This enabled us to determine some 20 shock and maser parameters of W49 N. The high-resolution imaging capabilities of ALMA should allow detailed studies of a variety of shocked regions of the interstellar medium and also sample transitions at higher frequencies and molecular species other than water.

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