Identification of the Bursting Water Maser Features in Orion KL

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In 2011 February, a burst event of the 22 GHz H_2O maser in Orion KL (Kleinmann-Low object) was detected. This is the third time such phenomena has been detected in Orion KL, followed by the events in 1979–1985 and 1998–1999. In spite of extensive monitoring observations with the Kagoshima 6 m single-dish telescope and VLBA during the last time burst event in 1998–1999, the origin of this maser burst is still unclear. If the current burst event would have a common origin as in the case of previous burst events, the flux density of the H_2O maser in Orion KL is expected to be $>10^6$ Jy, which will provide best opportunity to investigate the maser burst phenomenon. With this in mind, we have started monitoring observations of the bursting H_2O maser features in Orion KL with VERA since 2011 March 09 [1].

In the monitoring observations, we found that the flux density of the H_2O maser reached about 50000 Jy at the beginning of the burst event, which was three orders of magnitudes brighter than that in the quiescent phase (Figure 1), while it was still far below the previous burst events. According to the astrometric observations, the bursting maser features consisted of two spatially distinct components separated by about 5 AU at different velocities, 6.95 km s^{-1} and 7.58 km s^{-1} (Figure 2). We successfully determined the absolute positions of the bursting features for the first time ever with a submilli-arcsecond (mas) accuracy. Their positions are coincident with the shocked molecular gas called the Orion Compact Ridge. It is most likely that the protostellar outflow interacting with the Compact Ridge is a possible origin of the H_2O maser burst.

We still continue monitoring observations with VERA of the bursting masers to achieve higher astrometric accuracy. In addition, we will carry out follow-up observations with the ALAM of the submillimeter H_2O masers in Orion KL. Detailed mechanisms of the maser burst will be studied based on the multi-transition maser data.

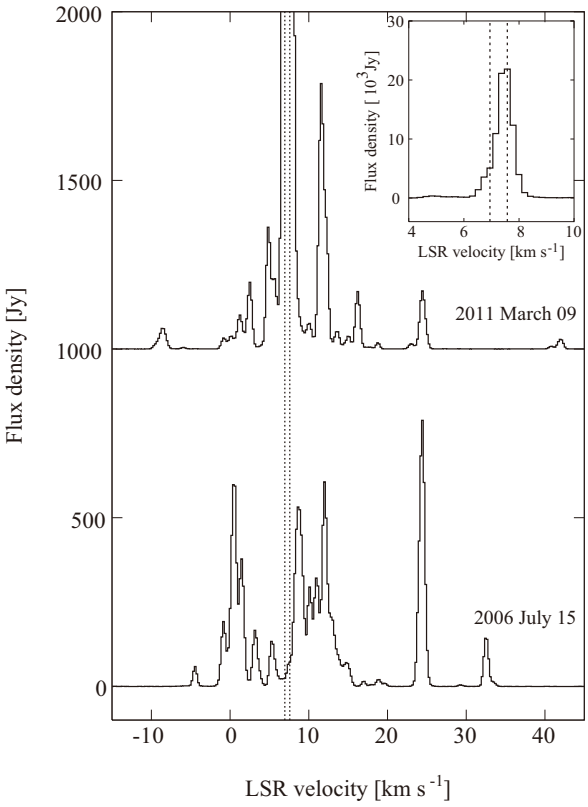

Figure 1: Cross-power spectra of the H_2O masers in the burst (upper) and the quiescent (lower) phases. Dashed lines indicate the radial velocities of the burst features. An inset shows the zoom-up of the bursting component.

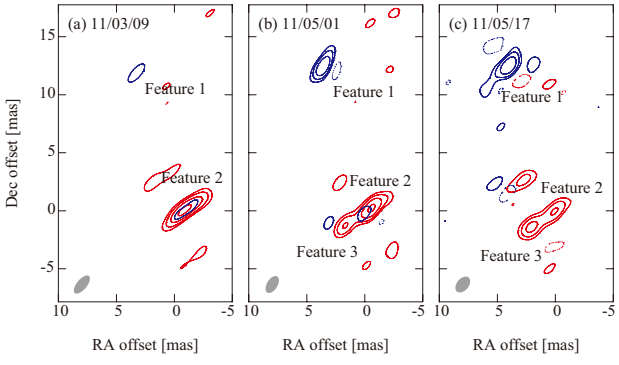

Figure 2: Channel maps of the bursting maser features on (a) 2011 March 9, (b) 2011 May 1, and (c) 2011 May 17. Red and blue contours represent the 7.58 km s^{-1} and 6.95 km s^{-1} features, respectively. The synthesized beam pattern is shown by a gray ellipse at the bottom left corner of each panel.

Reference

[1] Hirota, T., et al.: 2011, *ApJ*, **739**, L59.