Example of an high-mass molecular cloud generated by colliding flows

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Some models of high-mass formation, e.g. [1], proffer dynamical scenarios in which OB stars result of colliding flows associated with the genesis of the hosting cloud. These colliding flows would generate low-velocity shocks at large scale. Hints of detection of such shocks have been presented (e.g. [2]) but none could disentangle a low-velocity shock from a large scale unresolved protostellar cluster, by lack of angular resolution. [1] reported such a hint for detection with a bright and extended SiO emission ($N_{\text{SiO}} \sim 6\times10^{13}$ cm$^{-2}$ over $\sim$43 pc$^2$) in the W43-MM1 molecular cloud, for which we here present follow-up observations with the IRAM/PdBI interferometer (Louvet et al. 2016). With our study we were able to disentangle high and low velocity components (see Fig. 1-Left). We further compared the integrated SiO(2-1) low-velocity component to a dedicated grid of shock-models (see Fig. 1-Right) and concluded that the observed emissions are compatible with shocks at 8-10 km/s. This study, together with the recent results of [4], show that the W43-MM1 ridge is still building material although the star formation processes are already ongoing.

Figure 1: Left: SiO(2–1) integrated from 80 km.s$^{-1}$ to 120 km.s$^{-1}$. The red and blue contours highlight the outflows, seen in SiO, arising from protostellar objects, first presented in Louvet et al. 2014. The map highlights a very extended SiO(2-1) emission of $\sim$5pc. The outflows explain for a part of the emission but most of it is linked to another processus: the low-velocity shocks accompanying the formation of the parent cloud.

Right: The integrated intensity of the SiO(2–1) transition against the shock velocity, calculated over the $n_{\text{H}} = 10^3$ cm$^{-3}$ fragment of our grid of models (colored symbols), and compared to the observations (thick and horizontal, black line, obtained in position 1 (see Fig. 1-Left), with thinner lines corresponding to $\pm 15\%$ uncertainty). The color code is indicated in the panels, where pre-shock free silicon ($= 1$ or 10 $\%$) is shown for each model.

References: