Star Formation Feedback to a Parent Cloud: The Elias 29 Case

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Elias 29 is a low-mass Class I protostar in the ρ-Ophiuchi molecular cloud complex. According to the recent ALMA observation, a compact component (~50 au) associated to the protostar is abundant in SO and SO_2, while deficient in CS and organic molecules such as CCH and CH_3OH [1]. On the other hand, a southern ridge component apart from the protostar by 500 au is mainly traced by CS and $H^{13}CO^+$. For these interesting features, this source is selected in the ALMA large program FAUST (Fifty AU STudy of the chemistry in the disk/envelope system of Solar-like protostars).

To further characterize this source, we have studied an outflow/jet around the protostar and the star formation feedback to a parent cloud by using the chemical diagnostic power of FAUST. Main results are as follows. (1) We have detected the $C^{18}O$ (2-1) and SO (6_5-5_4) emission at a spatial resolution of 70 au, and found that they trace an outflow cavity on a 2000 au scale for the first time. (2) We have detected a compact component in the SO emission at the eastern side of the protostar. Since the SO emission is often recognized as a shock tracer, this component is likely attributed to a bow shock caused by a protostellar jet.

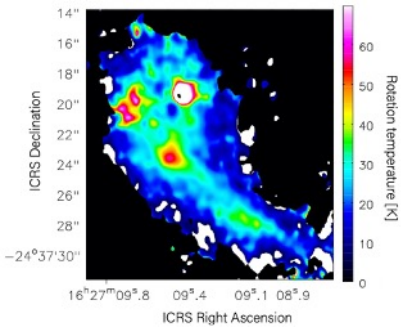

Figure 1: The rotation temperature around the protostar. The highest temperature is observed at the protostar position. The high temperature at the eastern side of the protostar is attributed to the bow shock and that at the southern side to the interaction between the outflow and the ridge.

(3) We have found a relatively low DCO^+/HCO^+ ratio in the southern ridge. In particular, the ratio is as low as 0.0029 at the interaction position between the outflow and the ridge. Thus, this low ratio would originate from the outflow interaction. (4) We have evaluated the rotation temperature around Elias 29 by using the SO (6_5-5_4) and SO (6_6-5_5) emission and identified the relatively high temperature at the position of the bow shock and the interaction region.

This study reveals a chemical change associated to a small-scale (~100 au scale) dynamic interaction between the Class I outflow/jet structure and the surrounding cloud material, i.e., the southern ridge.

References

[1] Oya et al., 2019, ApJ, 881, 112