ALMA SUMMER STUDENT PROJECT

The Physical Environment of the Organic-Rich Solar-Type Class I

Young Stellar Objects IRS44 and IRS46

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Abstract

The observations of SMA detected CO 2-1 emission from IRS 46 and its neighboring source IRS 44. The CO emission is mainly concentrated toward the Class I source IRS 44 and exhibits an unusual gorge-shape line profile with its line intensity dropping sharply to zero at the line center and a gorge-width of ~5 km s^{-1}. It was firstly guessed that the reason may be due to the missing flux problem. However, in the end, the result show that it was not true, and the true cause remains unknown.

Introductions

A number of solar-type Class 0 young stellar objects (YSOs) have been found to be rich in organic molecules, which are present in hot corinos similar to hot molecular cores in massive star forming regions. Since most of the material accreted during the Class 0 phase is consumed by the forming protostar, a meaningful comparison between interstellar, solar nebular and cometary chemistries can only be made by studying the chemical composition of the circumstellar envelopes and disks of Class I sources.

The SMA observation show that the CO emission is mainly concentrated toward the Class I source IRS 44 and exhibits an unusual gorge-shape line profile with its line intensity dropping sharply to zero at the line center and a gorge-width of ~5 km s^{-1}(Fig1).
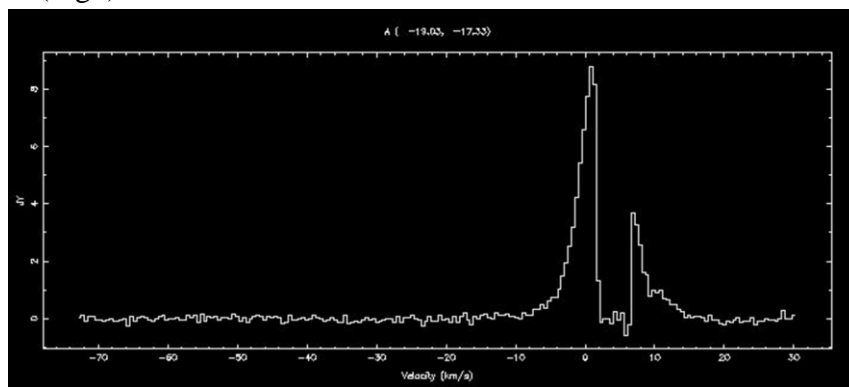

Fig1. The SMA CO emission at IRS44

The first possible explanation is the self-absorption of the CO cloud. However, the

line profile of a self-absorption event should decrease more smoothly rather that drop sharply, so the sharply dropped intensity did not support this explanation.

The second possible reason is the so-called missing flux problem. A uniformly distributed CO emission would be easily resolved-out by the interferometer. In order to investigate the physical mechanism responsible for the "missing" CO emission, we use the SMT to map the CO 2-1 emission in the region to recover the missing flux of CO emission and to determine the true cause of the gorge-like CO line profile.

Methods

The SMT maps gave us a more complete but vague distribution of the CO at IRS44. On the other hand, the SMA maps provided a high resolution image of IRS44 and IRS46 but with a large amount of missing flux due to the minimum baseline of SMA. The two data were thus combined by the linear method, that is combines the two maps of the SMT and SMA directly. The linear method is easier than some other methods, such as Non-linear method, but the sidelobes may appear in the combined maps. The software *MIRIAD* was used to combine these two data. At last, the combined maps would not have the missing flux.

Results

The Fig2 shows the original SMA channel maps and the Fig3 shows the combined channel maps. The Fig4 shows the CO line profile at IRS44 before and after combining. It could be seen that the line profile of IRS44 did not change much.
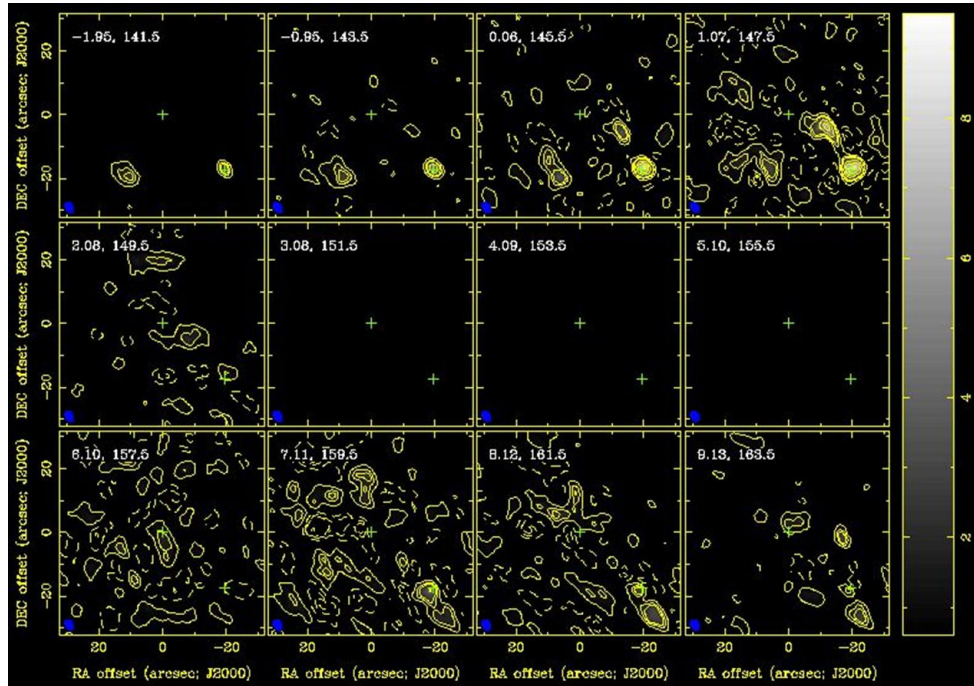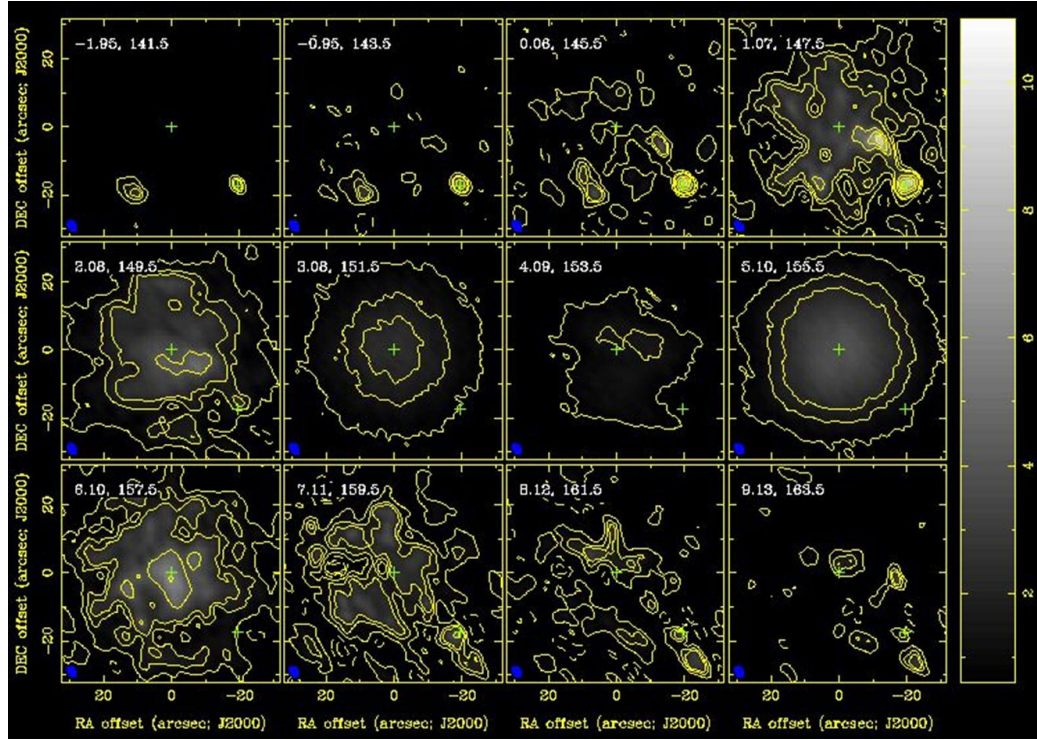

Fig2. The SMA CO channel maps at IRS44 and IRS46.

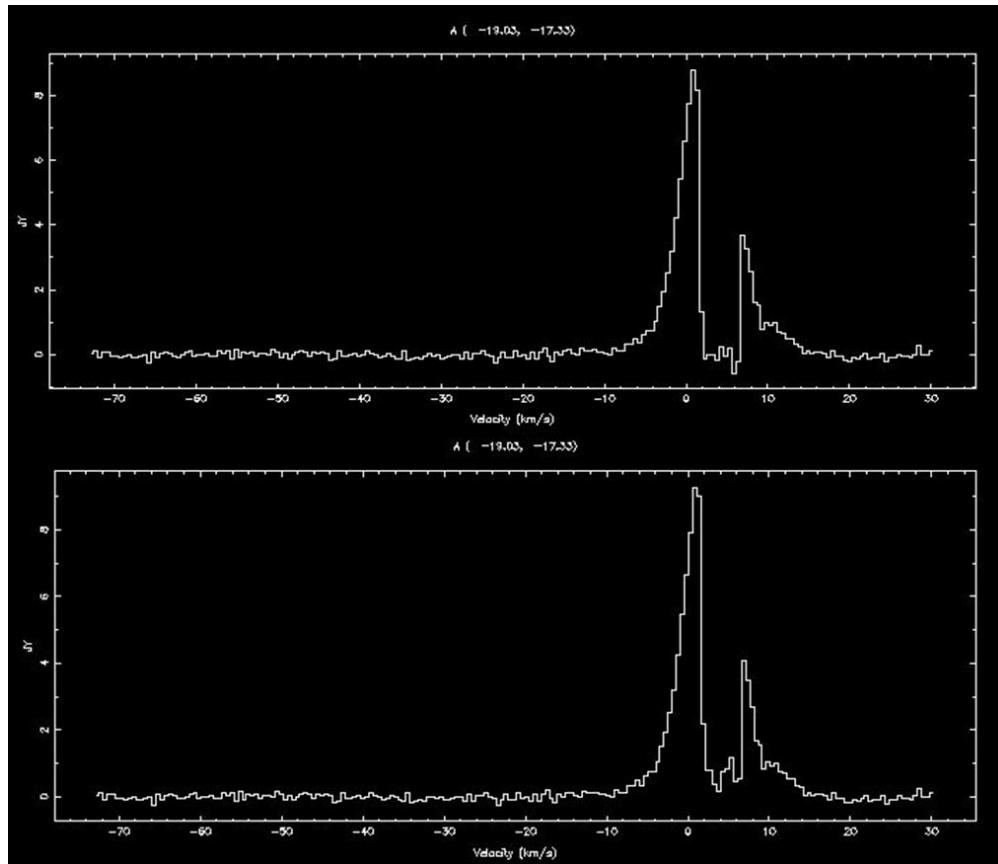Fig3. The combined channel maps at IRS44 & IRS46.

Fig4. The CO emission at IRS44 before and after combining.

Conclusion

The result showed that the "missing flux" explanation do not work, since the dropped "intensity" was not recover after combining the SMA and SMT maps. The missing flux reason was thus ruled out by our results. More observations have to be made to find out the true mechanism which causes this phenomenon. The ALMA is able to provide a more complete and subtle image of IRS44 and IRS46, so the truth may have to be waited until the ALMA observations can be made.