clumpy structure of interstellar cloud. Along with the excitation rate equations of statistical equilibrium, we have solved the problem of radiative transfer in such a model cloud of clumpy structure. Six rotational excitation levels of CO from J=0 to 5 were included in the rate equations; the kinetic temperature of H_2 molecules was fixed at 15K everywhere in the cloud; and 1km/s was adopted for the temperature were assumed to be constant. Number density n of H_2 molecules inside clumps and their volume filling factor f were taken as model parameters.

For six combinations of n and f, we calculated the excitation temperature T_{ex} for various rotational transitions of ^{12}CO molecules, and examined how the resulting excitation conditions vary with radial distance. In clumpy clouds the excitation temperature is generally higher at the cloud center than it is near the boundary. In a cloud with very small filling factor, for example f = 0.13, there is not much difference of radiation density between the center and boundary. When sub-clumps of a cloud occupy only very small fraction of the cloud total volume, the radiation field is essentially the same everywhere in the cloud. Consequently, the difference $\triangle T_{ex}$ in excitation temperature from the center to boundary decreases as f decreases. Even in those clouds that have the same value of n x f, the excitation conditions are quite different from each other, depending on n and f. For a fixed n, the excitation temperatures in clumpy clouds (f less than unity) are substantially lower than they are in a completely filled one (f=1); they generally decrease with decreasing volume filling factor. When f is fixed, T_{ex} varies significantly with the internal density of clump. However, radial gradient in the variation of T_{ex} doesn't change much with n; it is the volume filling factor that controls the radial gradient of T_{ex}.

We will do the same type of calculations for the transitions of ^{13}CO and discuss the roles of optial depth in the formation of molecular lines in clumpy clouds.

THE CO STUDY OF GIANT MOLECULAR CLOUD TOWARD SUPERNOVA REMNANT CTB 87

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The giant molecular cloud toward supernova remnant CTB 87 has been observed in the J=1-0 transitions of CO and ^{13}CO. The CO integrated intensity maps show three clumps with each sub-structure. The two subclumps of clump A are located at the boundary of

the supernova remnant CTB 87 and the ^{12}CO peak emission from subclump on the northest edge of CTB 87 reveals complicated multi-component line profile with weak wing structure. We suggest that these characteristics are related with a possible interaction between the supernova remnant and the cloud. Such a possibility is further supported by the fact that the cloud's total mass is estimated to be 1.7 * 10^6 $M_{\odot}$ as a massive-star formation region where Crablike remnats are originated from.

KHAV201 성운의 구조

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Colombia 1.2m 망원경의 ^{12}CO 관측에서 ~1° × 3° 의 크기를 갖는 KHAV201 성운은 이 영역의 60 m적외선 지도에서 나타나는 반경 ~3° 의 커다란 shell의 한 부분이다. 또한 이 성운에서는 점 적외선원의 밀도도 높아 별탄생이 활발히 일어나는 곳으로 추측되지만 아직까지 이 성운에 대한 연구가 수행되지 못한 실정이다. 이 영역에서의 별탄생 과정을 규명하고자 1차적으로 대덕전파천문대 14m 전파망원경으로 30′ ×60′ 영역에 걸쳐 ^{12}CO 및 ^{13}CO(J=1-0)의 관측을 수행하였으며, 그 개략적인 특성은 다음과 같다.

1. 선폭이 비교적 넓다(FWHM ~4km/sec).
2. 뚜렷한 상극류 분자흐름이 나타나지 않는다.
3. 특정영역에서 동서방향의 속도구배(~1km/sec/arcmin)를 보여준다.
4. 고밀도 분자운의 위치는 60 m 적외선 지도와 잘 일치한다.

ROSAT X-ray Observation of NGC 4636

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We have observed an elliptical galaxy, NGC 4636, with the ROSAT PSPC. NGC 4636 is one of the X-ray luminous ellipticals, well studied by the previous X-ray missions (Einstein and Ginga). We confirmed that the X-ray emission is due to the hot gas(~1keV) and also found temperature gradient in this galaxy in the sense that the temperature increases with distance from the center of the galaxy. The estimated mass to light ratio is still under a significant uncertainty, but it is consistent with optical results.