New Views of the Magellanic Clouds
IAU Symposium, Vol. 190, 1999
Y.-H. Chu, N.B. Suntzeff, J.E. Hesser, and D.A. Bohlender, eds.

The IRAS Vela Shell: a "Super Shell" in the Making?

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Abstract.
The IRAS Vela shell was first seen as a ring of infrared emission in the IRAS maps of the Gum-Vela region coincident with the Gum Nebula. We have studied the kinematics of the molecular material (^{12}CO) associated with the IRAS point sources and Southern Dark Clouds seen in this region and established the presence of a giant expanding shell of molecular gas. The estimated mass, size and expansion velocity of the shell lead us to conclude that it is the remnant of a GMC, in the process of disintegration through the influence of a central OB association. We conjecture that the IRAS Vela shell is a nearby example of a "super shell" in its early stages of evolution and as such is an ideal opportunity to study these objects now widely seen both in our Galaxy and in new observations of the Magellanic Clouds.

1. Introduction

The IRAS-Vela shell is a ring-like structure discovered from the IRAS Sky Survey Atlas in the 25, 60 and 100 μm maps. It is a large feature seen in the longitude range $l^{II} = 245°$ to 275° and up to 15° latitude below the Galactic plane. The shell also shows up as an enhancement in Hα emission and is seen projected against a large HII region, the Gum Nebula. A detailed study of the region has been carried out by Sahu (1992). Based on the fact that the kinematics of the shell is quite different from that of the Gum Nebula, she concluded that it was a separate entity. The shell is also clearly seen in the IRAS Point Source Catalogue (IPSC). We carried out a survey of molecular gas in the shell. We also examined the kinematics of this gas and estimated its mass in an attempt to understand the nature of the shell.

2. Observations and Results

The observations were carried out from the 10.4 m millimetre wave telescope at the Raman Research Institute in the 115 GHz line from the J= 1→ 0 transition of the ^{12}CO molecule. We looked for molecular gas in the direction of the infrared point sources seen in the IPSC. To maximize the chances of detections we selected sources which were probable Young Stellar Object (YSO) candidates. We observed in the direction of about 100 of the ~3750 IPSC sources in the

region of the shell which satisfied the YSO criteria. The spectral resolution was ~ 0.26 km s^{-1} and the rms noise level was ~ 0.2 K antenna temperature.

The observations yielded detections for 42 of the 100 or so sources. This confirms the presence of molecular gas associated with the shell. The distribution of this molecular gas is clumpy and also hints at a shell-like structure.

3. Kinematics

Previous studies of ionized gas in the region had indicated that the shell could be expanding. The only available study of molecular gas in the vicinity of the shell was restricted to the $\sim$ 35 or so cometary globules in the Gum Nebula (Sridharan 1992). These dark clouds with head-tail morphology also show systematic expansion from a common center at about 12 kms^{-1}. We analysed the radial velocities of our detections to check for expansion. We also extended this study to all the Southern Dark Clouds (SDCs) in the region. The radial velocities of these were made available to us from a survey of SDCs by Otrupcek *et al.* (1995). Our analysis clearly shows that the entire shell of molecular gas including the large number of SDCs in the region is expanding about a common center at ~ 13 km s^{-1}.

4. Nature of the IRAS-Vela Shell

Our study reveals the presence of a very large shell (angular diameter $\sim 12.5°$) of molecular gas associated with IRAS-Vela shell. If we assume that the typical molecular clump in the shell has a mass equal to a large cometary globule, the total mass of molecular gas in the shell is of the order of 10^5 M$_\odot$. We arrive at a similar estimate as well by assuming a typical star formation efficiency and counting the number of YSOs in the shell. This mass is comparable to that of a GMC. The shell is symmetrically placed around the OB association Vela OB2. Distance estimates to Vela OB2 place it at 450 pc, which is also the estimated distance of the shell. The clumpy nature of the shell, its expansion, the presence of the cometary globules etc. all lead us to confirm the conjecture that the shell is the remnant of the GMC within which Vela OB2 was born. Under the influence of stellar winds and supernovae from the association, the gas is being dissociated and swept outwards. Although at present there is no conclusive evidence for neutral gas in the shell, we estimate that as the shell continues to sweep up gas, it will be visible as a "supershell" in HI. Such shells are prevalent in our Galaxy and recent HI surveys of the Magellanic Clouds reveal a large number of shells in them. The IRAS-Vela shell could be a nearby young supershell and as such provides an ideal subject to study the early evolution of these objects.

References

Sahu, M.S. 1992, Ph.D. Thesis, University of Groningen

Sridharan, T.K. 1992, JAp&A, 13, 217

Otrupcek, R.E., Hartley, M., Jing-Sheng, W. 1995, unpublished (private communication, Otrupcek)