

## Influence of Convection on Line Asymmetry

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We attempted to analyze atmospheric inhomogeneities and velocity fields by examining quantitative behavior of their line asymmetry. As the result, it is found that the surface inhomogeneities and the strength of the velocity overshooting increase as one goes to earlier spectral types.

## SiO Maser Survey and Statistical Study of Mira Variable Stars

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The simultaneous observations in six transitions of silicon monoxide;  $^{28}\text{SiO}$ ,  $J=1\rightarrow 0$ ,  $v=0, 1, 2, 3$  and  $^{29}\text{SiO}$ ,  $J=1\rightarrow 0$ ,  $v=0, 1$  were performed for 106 late type stars using the 45m telescope of Nobeyama Radio Observatory. 83 sources were detected and 26 of them were new SiO maser emission sources. The ground vibrational  $^{29}\text{SiO}$  maser emission generally occurs at the stellar velocity. In most cases,  $^{29}\text{SiO}$  maser emission are narrower and stronger than  $^{28}\text{SiO}$   $v=0$  emissions, in spite of less abundance of  $^{29}\text{SiO}$ , i.e.  $(^{28}\text{SiO})/(^{29}\text{SiO})\simeq 20$ .

Based on the above observational results, extensive statistical analyses were carried out to test for the correlations between various SiO emission properties and the stellar parameters. Clear correlation was found between SiO and IR flux densities. Several evidences for phase dependence of SiO maser were found. Almost all of the  $v=3$  and  $v=0$  emissions are observed only for the stars with optical phase of about 0.2. The  $v=1$  and  $v=2$  masers tend to show maximum flux near the phase of 0.2.

Detailed analyses for velocity structures reveal that the vibrationally excited masers of  $v=1$  and  $v=2$  show redshifted mean velocities during the phase from 0.3 to 0.8, while sources with blueshifted mean velocities are dominant during the phase from 0.8 to 0.2. This fact shows that the line formation region of the vibrationally excited SiO masers is located very close to the star and directly affected by the stellar pulsation.

## Bipolar Molecular Outflows in NGC 7023

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NGC 7023 have been observed in  $^{12}\text{CO}$  and  $^{13}\text{CO}$  ( $J=1\rightarrow 0$ ) molecular line emissions. It possesses bipolar molecular outflows which are moving out both eastward and westward in Right Ascension with a velocity range of  $\pm 9 \text{ kms}^{-1}$  with an inclination of  $\sim 80^\circ$ . The mass loss rate is  $\sim 10^{-5} M_\odot \text{ yr}^{-1}$  with an assumed stellar wind velocity of  $\sim 100 \text{ kms}^{-1}$ ; the dynamical age of this outflow is  $\sim 5.5 \times 10^4$  years. The bipolar molecular outflows would be collimated by the molecular disk surrounding HD 200775, which is explained by either the velocity gradient of  $0.25 \text{ kms}^{-1} \text{ arcmin}^{-1}$  in the position-velocity map of  $^{12}\text{CO}$  along the Declination or the peak temperature maps of

both  $^{12}\text{CO}$  and  $^{13}\text{CO}$ . The outflows also yield high density regions at their ends, producing the region of the low mass star formation.

### **Initial Mass Functions of Massive Stars in OB Association**

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We derived Initial Mass Functions (IMF) of massive stars in three different regions of spiral arms within 2.5 kpc from the sun. The derived IMF slope  $\beta$  of Local Arm stars is found to be  $-2.09 \sim -2.06$ , very close to that of Bisiacchi et al. (1983). For Sagittarius-Carina arm stars  $\beta$  ranges from  $-1.77$  to  $-1.72$  which is close to that of overall stars given by Garmany et al. (1982). Possible causes inducing the regional difference in IMF's are discussed.

### **Mass Determination of Giant Stars in Open Clusters and Its Implications for Evolution**

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The masses of 'clump giants' in a few open clusters including Hyades, Praesepe and NGC6633 were derived by using the surface gravities observed by the DDO photometry. The derived mean masses of clump giants are  $1.6M_{\odot}$  for Hyades,  $2.1M_{\odot}$  for Praesepe and  $0.6M_{\odot}$  for NGC6633 within observational errors of  $\Delta \log (M/M_{\odot}) = \pm 0.3$ . Some values are significantly less than the Main Sequence turn-off masses. If we identify these stars as Horizontal Branch stars being in the He-core burning stage (Faulkner and Cannon 1973), they must have been experienced considerable mass loss during the giant branch phase and He flash if existed.

### **Structure of Bars in 8 Barred Galaxies**

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Luminosity distribution of bars in 8 barred galaxies was investigated from the Kiso V-band plates by composition approach. In decomposition of the surface brightness profile of the galaxies, we assumed, at first, de Vaucouleurs  $r^{1/4}$  bulge and exponential disk, and examined several functional forms for bars which fit the observation best.

It is known that most of the bars in 8 barred galaxies are gaussian along the bar minor axis and step-wise exponential along the bar major axis.