N91-14148

CIRCUMNUCLEAR IONIZED GAS IN STARBURST NUCLEI

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In order to study kinematical properties of starburst nuclei (SBNs), we made high-resolution spectroscopy of fifteen SBNs in the Hα region using an intensified Reticon system attached to the coudé focus of the 188-cm reflector at the Okayama Astrophysical Observatory. The instrumental resolution is 21 km s^{-1}(FWHM) at $\lambda_{H\alpha}$. As for the archetypical SBN, Mrk 538 (=NGC 7714), we present high-resolution emission line profiles of several species of ions such as [OIII], [NII], [SII], and [OII]. Main results and conclusions are summarized as follows.

(1) It has been known that emission-line profiles of SBNs are symmetrical and narrow. However, our high-resolution spectroscopy shows that the observed emission-line profiles of the SBNs have the following asymmetrical patterns; a) *blueward*, b) *redward*, and c) *double-peaked*. It is known that such features have been observed for narrow line regions (NLRs) of active galactic nuclei (AGNs).

(2) There is no remarkable correlation between the asymmetry index (see Heckman *et al.* 1981) and the reddening indicator such as a Balmer decrement. Thus the line asymmetry is not attributed to inhomogeneous obscuration in the emitting regions. Some of the SBNs (*e. g.*, Mrk 52) have the blue wing emission in their spectra, providing evidence for starburst/supernova winds. The double-peaked emission line profiles show that there are more than a few distinct emitting clouds in the SBNs (eg Mrk 1021 and Mrk 1194).

(3) The observed FWHMs of the Hα emission lines cover a range from 85 km s^{-1} to 318 km s^{-1}and are slightly larger than those of [NII]λ6584Å emission except for the double-peaked SBNs. The FWHMs of Hα emission show a good correlation with sin i (i is an inclination angle of galaxy). This correlation means that the FWHMs of the SBNs suffer significantly from rotational broadening. Mrk 52 is an anomalous SBN because it has narrow emission line widths for its high inclination angle (cf. Taniguchi 1987).

(4) From the above correlation, it is estimated that the intrinsic (*i. e.*, rotation free) FWHMs of Hα emission are about 50 km s^{-1}. The least value of FWHMs is 85 km s^{-1} among the sample SBNs. In addition, the FWHMs of the resolved components in the double-peaked nuclei are about 100 km s^{-1}. Thus, we conclude that an intrinsic FWHM of the starburst

regions is about or less than 100 km s^{-1} (i. e., $\sigma \leq$ 40 km s^{-1}). In summary, a SBN consists of a few or a number of such starburst regions (clumps). The observed line widths suffer the rotational broadening to some extent.

(5) Note that the velocity dispersion of the starburst regions is quite smaller than that of bulges of spiral galaxies ($\sigma >$ 100 km s^{-1}: cf. Kormendy and Illingworth 1983). Thus the starburst regions are not in dynamical equilibrium with the bulge potential (cf. Feldman *et al.* 1982; Weedman 1983; Whittle 1985). Therefore, it is expected that the circumnuclear starburst regions may be self-gravitating in nature.

(6) As for Mrk 538, the several emission lines ([Ocsc iii], [NII], [SII], and [Ocsc ii]) have nearly the same line width (FWHM $\simeq$ 180 km s^{-1}). Therefore, there is no positive correlation between the line width and the critical density. This implies that the emitting region in this SBN has no stratified structure in contrast to the NLRs of AGNs.

REFERENCES

Balzano, V. A. 1983, *Ap. J.*, **268**, 602.

Feldman, F. R., Weedman, D. W., Balzano, V. A., and Ramsey, L. W. 1982, *Ap. J.*, **256**, 427.

Heckman, T. M., Miley, G. K., van Bruegel, W. J. M., and Butcher, H. R. 1981, *Ap. J.*, **247**, 403.

Kormendy, J., and Illingworth, G. 1983, *Ap. J.*, **265**, 632.

Taniguchi, Y. 1987, *Ap. J. (Letters)*, **317**, L57.

Weedman, D. W. 1983, *Ap. J.*, **266**, 479.

Whittle, M. 1985, *M. N. R. A. S.*, **213**, 1.

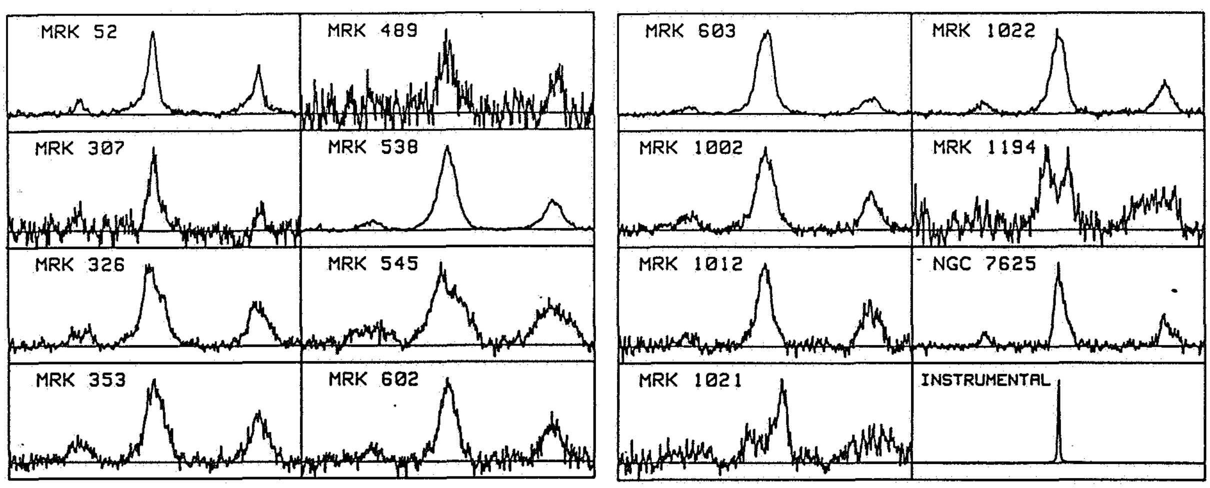

Fig. 1 . The emission line profiles of starburst nuclei in the Hα region. A typical instrumental profile (FWHM = 21 km s^{-1}) is shown in the lower-right corner.

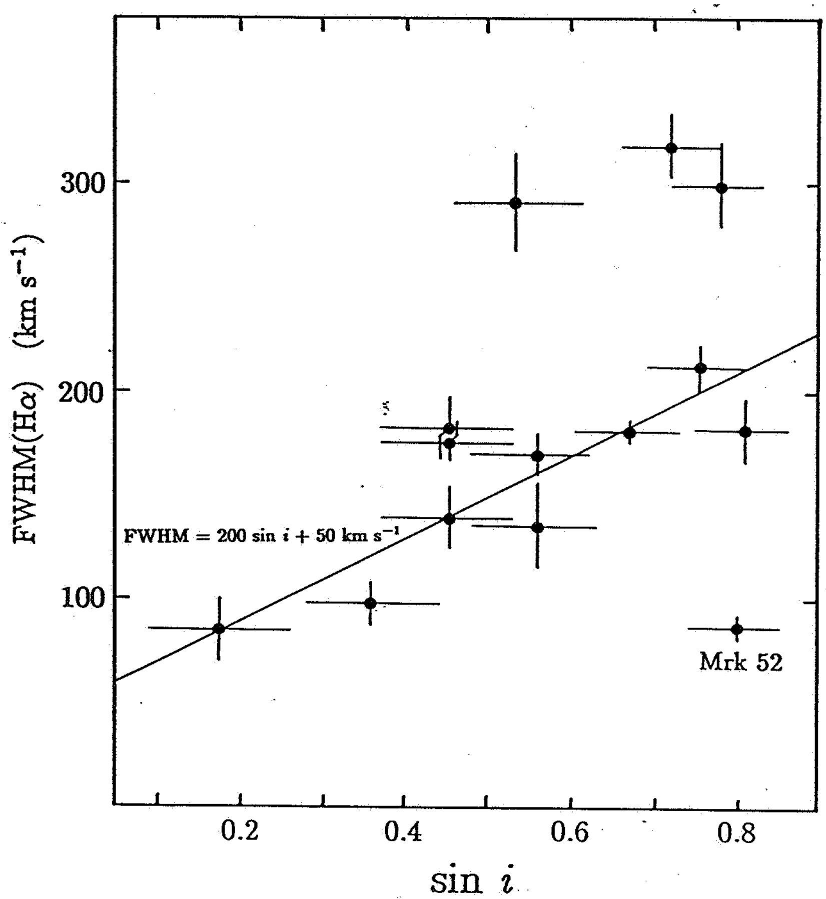

Fig. 2 . A diagram of FWHM versus sin i (i is an inclination angle of the galaxy. Except the double-peaked SBNs and Mrk 52, the data are approximately fitted by a relation FWHM = 200 sin i + 50 km s^{-1}.

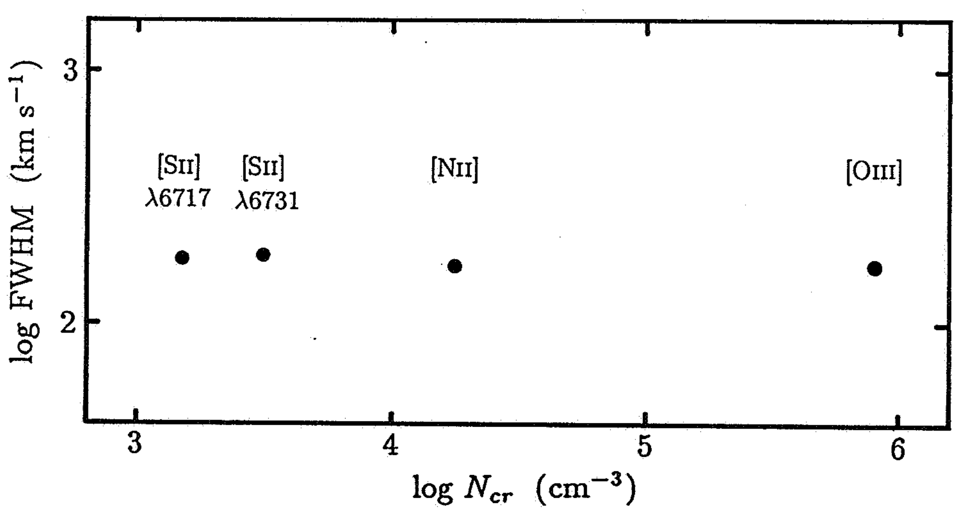

Fig. 3 . A diagram of FWHM versus critical density for the forbidden emission lines for Mrk 538 (= NGC 7714).