NEAR INFRARED IMAGING SURVEY OF BOK GLOBULES: DENSITY STRUCTURE.

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We carried out a near infrared imaging survey of ten Bok globules using the infrared camera SIRIUS on the IRSF 1.4 m telescope in South Africa. A_V distributions for the globules were derived through measurements of the *H-K* color excess or the stellar density at *J*, *H*, and K_s (star count). Radial column density profiles for each globule were analyzed using the Bonnor-Ebert sphere model [1-3]. Using the data of our ten globules and four globules [4-8] in the literature, we investigated the stability of globules on the basis of ξ_{max} which characterizes the Bonnor-Ebert sphere as well as the stability of the equilibrium state against the gravitational collapse (Fig. 1). We found that more than half of starless globules (7 out of 11 sources) are located near the critical state (ξ_{max} = 6.5±2). Thus, we suggest that a nearly critical Bonnor-Ebert sphere characterizes the typical density structure of starless globules. Remaining starless globules show clearly unstable states (ξ_{max} > 10). Since unstable equilibrium states are not long maintained, we expect that these globules are on the way to gravitational collapse or that they are stabilized by non-thermal support. It was also found that all the star-forming globules show unstable solutions of ξ_{max} > 10, which is consistent with the fact that they have started gravitational collapse. We investigated the evolution of a collapsing gas sphere whose initial condition is a nearly critical Bonnor-Ebert sphere [9]. We found that the column density profiles of the collapsing sphere mimic those of the static Bonnor-Ebert spheres in unstable equilibrium. The collapsing gas sphere resembles marginally unstable Bonnor-Ebert spheres for a long time. We found that the frequency distribution of ξ_{max} (density contrast) for the observed starless globules is consistent with that from model calculations of the collapsing sphere. In addition to the near-infrared observations, we carried out radio molecular line observations ($C^{18}O$ and N_2H^+) toward the same ten globules. We confirmed that most of the globules are dominated by thermal support. The line width of each globule was used to estimate the cloud temperature including the contribution from turbulence, with which we estimated the distance to the globules from the Bonnor-Ebert model fitting.

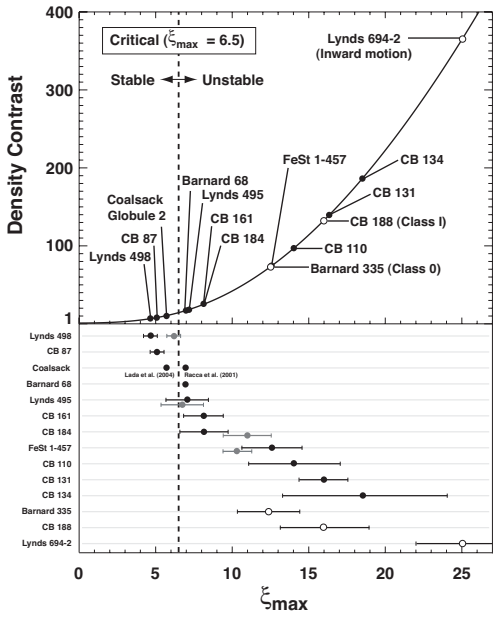

Figure 1 --- The solid line shows the relation between ξ_{max} and density contrast (center-to-edge density ratio). The location of our ten globules and previously reported four globules [4-8] are shown. Filled and open black circles denote starless and star-forming globules, respectively. The vertical dashed line denotes critical state of ξ_{max} = 6.5. In the lower panel of the figure, horizontal error bars denote 1σ error in the density profile fitting.

References: [1] Kandori, R. et al., 2005, AJ, In press. [2] Bonnor, W. B., 1956, MNRAS, 116, 351. [3] Ebert, R., 1955, Zs. Ap., 37, 217. [4] Alves, J. F. et al., 2001, Nature, 409, 159. [5] Harvey, D. W. A. et al., 2001, ApJ, 563, 903. [6] Harvey, D. W. A. et al., 2003, ApJ, 598, 1112. [7] Lada, C. J. et al., 2004, ApJ, 610, 303. [8] Racca, G. et al., 2002, AJ, 124, 2178. [9] Aikawa, Y., et al. 2005, ApJ, 620, 330.