THEORETICAL LIGHT CURVES FOR TYPE IA SUPERNOVAE
AND DETERMINATION OF THE HUBBLE CONSTANT

KOICHI IWAMOTO AND KEN’ICHI NOMOTO
Department of Astronomy, University of Tokyo
Yayoi 2-11-16, Bunkyo ward, Tokyo 113, JAPAN

The large luminosity ($M_V \approx -19 \sim -20$) and the homogeneity in light curves and spectra of Type Ia supernovae (SNe Ia) have led to their use as distance indicators ultimately to determine the Hubble constant ($H_0$). However, an increasing number of the observed samples from intermediate- and high-$z$ ($z \sim 0.1 - 1$) SN Ia survey projects (Hamuy et al. 1996, Perlmutter et al. 1997) have shown that there is a significant dispersion in the maximum brightness ($\sim 0.4$ mag) and the brighter-slower correlation between the brightness and the postmaximum decline rate, which was first pointed out by Phillips (1993). By taking the correlation into account, Hamuy et al. (1996) gave an estimate of $H_0$ within the error bars half as much as previous ones.

To clarify the possible reason of this new observational fact, we calculated monochromatic light curves for a variety of explosion models of SNe Ia with a time-dependent, multi-frequency, and multi-angle radiative transfer code. The models applied here include a standard deflagration model W7 and a series of delayed detonation models with a parameterized transition density from deflagration to detonation. We find that amongst the Chandrasekhar mass white dwarf models the difference in the $^{56}$Ni mass in delayed detonation models may reproduce the observed correlation due to the difference in thermal structure of the ejecta and the temperature dependence of opacities. As a result of light curve fit for some of the above samples of SNe Ia, we found the value of the Hubble constant to be $H_0 = 66 \pm 12$ km sec$^{-1}$ Mpc$^{-1}$ (Iwamoto 1997, Iwamoto et al. 1998)

References
Iwamoto K. et al., 1998, in preparation