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TYPE Ia SUPERNOVAE, THE HUBBLE CONSTANT, AND PROSPECTS FOR THE DECELERATION PARAMETER

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ABSTRACT

Three different, but related, studies of Type Ia supernovae (SNe Ia) were reviewed. First, the blueshift of the Si II λ 6355 absorption feature in SN Ia spectra has been found to be correlated with the morphological type of the supernova's parent galaxy (Branch & van den Bergh 1993, AJ, 105, 2231). SNe Ia with very low blueshifts (< 9500 km s^{-1} at 10 days after maximum light) are found in E and S0 galaxies. SNe Ia in spirals have higher blueshifts but span a wide range. A few SNe Ia in early-type galaxies showing evidence for recent (10^8 to 10^9 yr) star formation have very high blueshifts. The result proves that the Si II blueshift differences reflect global physical differences among SNe Ia rather than just asymmetries in the ejected matter, and suggests that the Si II blueshift depends on the time interval between the formation and explosion of the white-dwarf supernova progenitor. Second, the observational dispersion of the absolute blue magnitudes of spectroscopically normal, essentially unextinguished SNe Ia has been found to be 0.3 mag., comparable to the expected errors in distance, apparent magnitude, and extinction (Branch & Miller 1993, ApJ, 405, L5). The intrinsic SN Ia dispersion probably is no larger than 0.2 mag., despite the Si II blueshift differences. Calibration of the SN Ia Hubble diagram astronomically via the Cepheid based distance to SN 1937C (Sandage et al. 1992, ApJ, 401, L7) and astrophysically via the nickel radioactivity method (Branch 1992, ApJ, 392, 35) gives a Hubble constant near 50 km s^{-1} Mpc^{-1}. Finally, exploiting the small absolute magnitude dispersion of SNe Ia to determine the value of the cosmic deceleration parameter appears to be feasible (Vaughan & Branch, unpublished). A moderate sample (dozens) of SNe Ia at $z \approx 1$ should be obtainable and adequate for the purpose. The spectroscopic homogeneity of SNe Ia may allow supernova photometric redshifts to substitute for supernova or galaxy spectroscopic redshifts, although spectroscopic spot checking of a portion of the sample will be desirable to guard against (unexpected) evolutionary effects.

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