"2-D FRUTTI" SPECTRA OF B SUPERGIANTS IN THE MILKY WAY AND THE LMC

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Digital spectra of 7 B-type supergiants in the Milky Way and 15 B-type supergiants in the Large Magellanic Cloud (LMC) were obtained in December 1986 using the "2-D Frutti" detector (2-DF) and the Carnegie Image Tube Spectrograph on the 1-m telescope at the Cerro Tololo Inter-American Observatory. The 2-DF is a photon counting, 2-dimensional Shechtman-type detector, now available on both the 1-m and 4-m telescopes at CTIO. The detector/spectrograph configuration used for the December observing run yielded spectra covering the classical blue region, 3800-5000 Å, with a resolution of approximately 3 Å. The typical observing procedure was to obtain spectra for each star at several locations along the slit. The individual spectra were then averaged (to reduce the detector fixed pattern noise) resulting in S/N ratios of 50-60 in the 4300 Å region.

Spectra for 11 of the LMC supergiants, ranging from types O9.5 to B9 are shown in Figure 1. The spectra were all smoothed with a 4 point boxcar filter and normalized using the IRAF software installed on the 8600 VAX computer at JILA. The most prominent absorption lines present in the blue spectral region are listed in Table I. The spectral types listed next to the spectra were derived by the author in the usual way (from comparison with Galactic standards) from photographic spectra also obtained with the CTIO 1-m spectrograph.

The resolution and S/N ratio of the 2-DF data are clearly adequate for spectral classification work and for quantitative line strength analyses. The classification criteria developed for photographic spectroscopy may be transferred easily to the digital data. Among the more important of these criteria are: a) the changing ionization state of prominant Si lines, from Si IV in the early B-types, to Si III in the middle B's, to Si II in the later B's; b) the presence of numerous lines of O II for types B0.5 and B1; and, c) the reversal of the He I 4471/Mg II 4481 ratio, and the general weakening of the He spectrum, towards the later B-types.

In addition to their use as a classification basis, the 2-DF data also

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allow a detailed line-strength comparison between the LMC supergiants and their Milky Way counterparts. Figure 2 shows such a comparison for the LMC star Sk130-67 and the Galactic MK classification standard (for type B5 Ia) HD58350. The H and He spectra of the two stars are very well-matched, and their Stromgren Balmer jump indices are nearly identical (c0 ≈ 0.19) indicating a good temperature-gravity match. Perhaps surprisingly, the metal lines are also extremely well-matched. Although the analysis is still proceeding, a general result from these observations seems to be that, at the level of classification-grade stellar spectra, little or no evidence is seen of the generally accepted factor-of-2 lower metal abundance in the LMC. We plan to enlarge the LMC data sample in the future, to search for line strength variations within the LMC, and also to observe a corresponding sample of B-type supergiants in the Small Magellanic Cloud.

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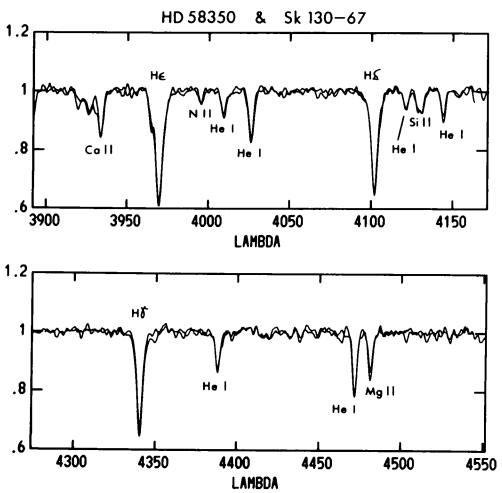
TABLE I (right) - Prominant absorption lines in the classical blue spectral region.

FIGURE 1 (following page) - 2-D Frutti spectra of 11 B-supergiants in the LMC.

FIGURE 2 (below) - Comparison of B5 Ia stars in the Milky Way (HD58350) and the LMC (SK130-67).



Wavelength (Å)	Ion
3820	He I
3835	H I
3889	H I
3933	Ca II
3970	H I
3995	N II
4009	He I
4026	He I
4075	O II
4089	Si IV
4101	H I
4116	Si IV
4121	He I
4130	Si II
4144	He I
4267	C II
4319	O II
4340	H I
4348	O II
4387	He I
4416	O II
4471	He I
4481	Mg II
4553-68-75	Si III
4630-43	N II
4641-49	O II
4650	C III
4713	He I
4861	H I
4922	He I

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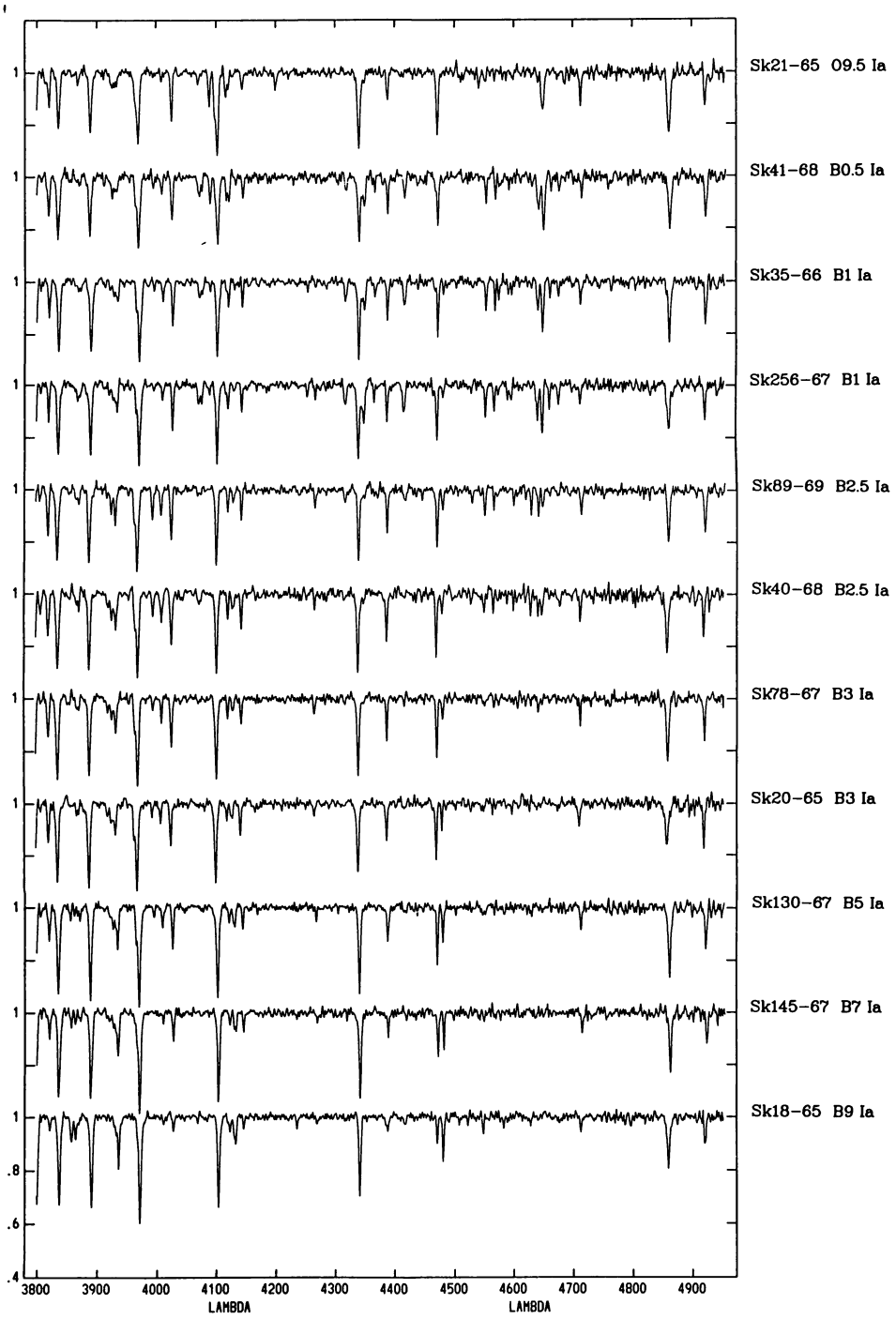

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DISCUSSION

EBBETS The stars in your region of the HR diagram are likely to be a mixed bag of various evolutionary stages. Are there features that can be observed with spectra of the quality you have that could distinguish the various stages, in particular to identify those likely to become supernovae ?

FITZPATRICK Several months ago, I would have said that, by excluding the B supergiants which have shown strong photometric variability and/or emission lines, I was restricting my sample to "first-time" supergiants - i.e., stars evolving left-to-right on the HR-diagram and passing thru the B supergiant phase for the first time. If the progenitor of SN1987A turns out to be SK202-69 then these criteria are clearly not sufficient, since SK202-69 would have qualified as a "first-time" supergiant. My new answer to the question is, "I don't know". I think that quantitative abundance measurements are required for a wide range of early type supergiants, and then, if we are lucky enough, when one of them blows up we can go back, look at the spectrum, and claim that we knew all along that the star was peculiar !

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