

SLASH STARS: TWO TYPES, TWO SCENARIOS ?

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Of/WN, or as we will call them here, "slash '/'" stars were first described by Walborn (1977; 1982a; 1982b) as hot luminous stars that have spectroscopic properties of both O and low-ionization WN spectral classes. Walborn called attention to Sk -67° 22, an O3If*/WN6-A star that had strong O-type absorption lines, but also a *broad* emission feature at HeII $\lambda 4686\text{\AA}$. The '/' symbol was used to indicate that there was difficulty in assigning either the Of or the WN type unambiguously. He labeled other LMC stars as Ofpe/WN9 not only because of a similar ambiguity in the classification but also the presence of narrow "nebular" emission lines associated with the star. Conti and Garmany (1983) pointed out the similarity of Sk -71° 34 to Sk -67° 22. A total of ten stars with Ofpe/WN9 character have now been identified in the LMC (Bohannan and Walborn 1989) : HDE 269927C, 269445, 269582, 269687, 269858, 269227; Sk -66 040, -67 266, -69 297; BE 381.

There has also been a long standing classification problem among hot luminous stars in distinguishing between the "most extreme Of star" (HDE 313846, Hutchings 1979) and the "least extreme WN star" (HD 93162, Conti 1976). Leep (1979) has investigated the spectra of known strong (emission) line Galactic Of stars and weak (emission) line WN stars and was able to classify them both to the O and to the WN type. We asked ourselves whether all Of stars such as these should be considered as '/' stars and concluded that this would be pushing the classification too far. We thus adopted as an arbitrary condition that the emission line strength of HeII $\lambda 4686\text{\AA}$ had to be at least 1A equivalent width. With this criterion about half of the known Of stars (disregarding the Walborn (f) and ((f)) types) and a very few WN objects might be considered as '/' stars. These candidates are listed in table below, where we have generally adopted the Of and WN subtypes of Leep (1979) but also re-examined their spectra. The designation before the '/' is the leading classification; that is, if the emission spectrum dominates over the absorption one, the WN comes first, and conversely.

It will be noticed that the Of/WN stars in the LMC and the Galactic candidates contain mostly relatively late WN subtypes with a range of Of classes up to O4; a few stars combine both an early WN and an O3f or O4f subtype. It is these combinations we propose as Of/WNL "(/L)" or Of/WNE "(/E)" subtypes.

The quantitative spectroscopic properties of Of stars may pass smoothly through the '/' objects to pure WN characteristics. In proceeding from Of to WN types, the stellar winds increase in strength; it is possible that the composition also alters gradually in favor of enhanced helium and nitrogen line strengths and abundances (Voels *et al.* 1989; McGregor *et al.* 1989). We would imagine that this transition would further

involve weakening and violet shifting of the absorption spectrum, with a concomitant strengthening of the emission line spectrum, as the wind becomes more optically thick. Alternatively, perhaps the Of/WN stars are binaries, with the Of and WN spectra coming from the individual stellar components? Although it is impossible to assert that a given star cannot be a binary, studies of several objects in our list have not revealed a single case of a double-lined system (*e.g.* Conti, *et al.* 1977; Conti *et al.* 1979).

Table of Candidate '/' Stars in the Galaxy

Star	Walborn	Slash '/'	Star	Walborn	Slash '/'
HD14947	O5If+	O5f/WN8	HD93131	WN6-A	WN6/O4f
HD15570	O4If+	O4f/WN8	HD93162	WN6-A	WN6/O4f
HD16691	O4If+	O4f/WN8	HD150958	O6.5Ia(n)f+	O6.5f/WN9
ζ Pup	O4I(n)f	O4f/WN8	HD152386	O6:Iafpe	O5.5f/WN9
HD92740	WN7-A	WN7/O5f	HD152408	O8:Iafpe	O8f/WN9
HD93129	O3If*	O3f/WN4.5	HDE313846	O7:Iafpe	O7f/WN9

The slash '/' stars may be a transition group between Of and WN in their spectroscopic properties. Are they also a set of stars in transition for their evolution? Do the early and late subtype combinations foretell a somewhat different origin, or fate? One of the original Walborn (/L) stars, HDE 269898 = R127, had a recent violent outburst (Stahl *et al.* 1983) which now with a spectrum similar to S Doradus at maximum light (Wolf *et al.* 1988) qualifies it to be a prominent member of the Luminous Blue Variable (LBV) family. Will others of these '/' stars also become variable at some time in the near future? Further observational and theoretical work is critical to a clearer physical understanding of these stars which appear to play significant—but still poorly understood—roles in the evolution of massive stars.

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