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The Life and Death of Massive Stars in the Starburst Galaxy I Zw 18

Dorottya Szécsi and Norbert Langer

Argelander-Institut für Astronomie, Auf dem Hügel 71, Bonn-53121, Germany
email: dorottya@astro.uni-bonn.de, nlanger@astro.uni-bonn.de

Abstract. Massive stars at low metallicity are strong candidates for two of the most energetic explosions in the Universe: long duration gamma-ray bursts and superluminous supernovae. But what is the reason these explosions prefer low metallicity environments? To answer this question, we investigate how massive stellar evolution proceeds in low metallicity environments.

Keywords. stars: evolution, stars: rotation, galaxies: dwarf, galaxies: starburst, gamma rays: bursts, gamma rays: theory

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Rotating and non-rotating massive stars have been modeled with a composition of [Fe/H]=−1.7, appropriate for the actively starforming dwarf galaxy I Zw 18 (Szécsi *et al.* 2015). We found that rotation at this low metallicity is extremely important due

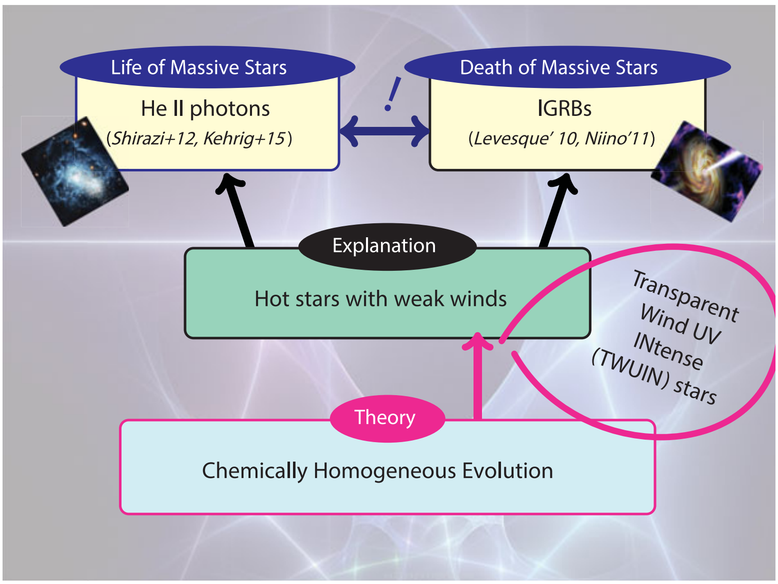

Figure 1. This flowchart summarizes our understanding of two observational phenomena, concerning the life and death of massive stars at low-metallicity. During their lives, these stars are responsible for the unusually high He II photons of dwarf galaxies without Wolf–Rayet features (Crowther & Hadfield 2006, Shirazi & Brinchmann 2012). As for their deaths, they produce lGRBs, an energetic explosion which observationally tends to happen in low-metallicity environments (Levesque *et al.* 2010, Niino 2011). Both of these observational phenomena can be explained by the presence of hot stars with weak winds. We propose the chemically homogeneous evolution as a possible theoretical channel through which the hot stars with weak winds can form. We call these objects TWUIN stars to point out that their spectra are predicted to be different from classical Wolf–Rayet stars. For details, see Szécsi *et al.* 2015.

to the absence of strong mass loss, leading to evolutionary behaviors never predicted at high metallicity. In particular, chemically homogeneous evolution results in fast rotating, compact and hot helium-stars, which are proposed progenitors of long duration gamma-ray burst (lGRB) formation in the collapsar scenario (Yoon & Langer 2005, Woosley & Heger 2006).

These lGRB progenitors have optically-thin winds during the main sequence evolution. They are luminous and hot, therefore predicted to emit intense mid- and far-UV radiation, but without the broad emission lines that characterize Wolf–Rayet stars with optically-thick winds (Szécsi *et al.* 2015). We show that such Transparent Wind Ultraviolet INtense (TWUIN) stars may be responsible for the high number of He II ionizing photons observed in metal-poor dwarf galaxies, e.g. I Zw 18 (Kehrig *et al.* 2015).

Our conclusion is that the high He II flux observed in dwarf galaxies can be a signpost for upcoming lGRBs in these objects (cf. Fig. 1). Additionally, the observed high He II flux may argue that chemically-homogeneous evolution, which leads to the TWUIN stars, is indeed happening in nature.

For more details, see Szécsi *et al.* 2015.

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