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The formation of Wolf-Rayet stars in the SMC is not dominated by mass transfer

Tomer Shenar, R. Hainich, H. Todt, A. Sander, W.-R. Hamann, A. Moffat, J. J. Eldridge, H. Pablo, L. Oskinova and N. Richardson

Institut für Physik & Astronomie, Universität Potsdam,
Karl-Liebknecht-Str. 24-25, 14476 Potsdam, Germany
email: shtomer@astro.physik.uni-potsdam.de

Abstract. We analyzed spectra of all Wolf-Rayet stars in the Small Magellanic Cloud (SMC). We find that, unlike predicted, mass-transfer in binaries is not needed to explain their formation.

Massive Wolf-Rayet (WR) stars, characterized by strong mass-loss and hydrogen depletion, can form either as single stars (e.g. Cassinelli 1979) or as mass donors in binaries (e.g. Paczynski 1973). Population synthesis studies (e.g. Meynet & Maeder 2005, Georgy *et al.* 2015) suggest that the majority or all of the WR stars in the SMC ($Z \approx 0.1-0.2\,Z_{\odot}$, Larsen *et al.* 2000) formed via the binary formation channel (see also Foellmi *et al.* 2003).

The Potsdam Wolf-Rayet (PoWR) model atmosphere code (Gräfener *et al.* 2002, Sander *et al.* 2015) is a state-of-the art tool for the analysis of hot stars (e.g. Shenar *et al.* 2015). Using the PoWR code, we performed a spectral analysis of all known single (Hainich *et al.* 2015) and binary (Shenar *et al.* 2016) WR stars in the SMC. By comparing the observed properties of each binary system to evolution tracks which account for mass-transfer (Eldridge *et al.* 2008), we could derive the complete set of initial masses and periods for the WR binaries in the SMC. We find that, while mass-transfer has likely occurred in most WR binaries, the WR primaries were initially massive enough to enter the WR phase regardless of mass-transfer ($M_{\rm i} \gtrsim 60\,M_{\odot}$). Combined with our results for the single WR stars, we conclude that the binary formation channel is not needed to account for the WR population in the SMC, in contradiction to previous predictions.

Why are there more massive WR stars in the SMC than expected? Where are the WR stars forming via mass-transfer in the SMC? These are key questions that should drive future studies and observational campaigns in the coming years.

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