Massive stars on the verge of exploding: The properties of oxygen-sequence Wolf-Rayet stars

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Context. Oxygen sequence Wolf-Rayet (WO) stars represent a very rare stage in the evolution of massive stars. Their spectra show strong emission lines of helium-burning products, in particular highly ionized carbon and oxygen. The properties of WO stars can be used to provide unique constraints on the (post-)helium burning evolution of massive stars, as well as their remaining lifetimes and the expected properties of their supernovae. Aims. We aim to homogeneously analyze the currently known presumed-single WO stars to obtain the key stellar and outflow properties and to constrain their evolutionary state. Methods. We use the line-blanketed non-local thermal equilibrium atmosphere code cmfgen to model the X-Shooter spectra of the WO stars and deduce their atmospheric parameters. We calculate dedicated evolutionary models to determine the evolutionary state of the stars. Results. The WO stars have extremely high temperatures that range from 150 kK to 210 kK, and have very low surface helium mass fractions that range from 44% down to 14%. Their properties can be reproduced by evolutionary models with helium zero-age main sequence masses of M(He,ini) = 15-25M sun that exhibit fairly strong (a few times 10ô€€€^5 Msun/ yrô€€€), homogeneous (fc > 0.3) stellar winds. Conclusions. WO stars represent the fi nal evolutionary stage of stars with estimated initial of Mini = 40-ô€€€60Msun . They are post core-helium burning and predicted to explode as type Ic supernovae within a few thousand years.

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Comments:

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