Rotating Wolf-Rayet stars in a post RSG/LBV phase. An evolutionary channel towards long-duration GRBs?

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(shortened) We investigate the properties of Galactic Wolf-Rayet (WR) stars and their circumstellar (CS) environment to identify evolutionary channels that may lead to the formation of long-duration Gamma-Ray bursts (LGRBs). To this purpose we compile available information on the spectropolarimetric properties, the presence of CS ejecta, and the CS velocities in the environment of Galactic WR stars. We use linear line-depolarization as an indicator of rotation, nebular morphology as an indicator of stellar ejecta, and velocity patterns in UV absorption features as an indicator of increased velocities in the CS environment. We find that the ~23% WR stars with "possible ejecta nebulae" dominate the population of WR stars with spectropolarimetric signatures of rotation, while WR stars without such nebulae only rarely show indications of rotation. The corresponding objects are most likely in an early stage after a preceding RSG or LBV phase, and have not yet lost their angular momenta due to the strong mass-loss in the WR phase. From their photometric periods we estimate rotation parameters in the range omega = 0.04...0.25, corresponding to moderate rotation speeds of 36...120 km/s. These values are very uncertain, but comply with the specific surface angular momentum requirement for LGRB progenitors. Our results indicate that, in the Galaxy, mainly "young" WR stars shortly after a RSG/LBV phase show spectropolarimetric signatures of rotation. Their rotation rates are thus likely enhanced with respect to the majority of Galactic WR stars. According to their estimated specific surface angular momenta, a subgroup of stars exploding in this phase may represent an evolutionary channel towards LGRBs at high metallicities, comparable to the Galaxy.

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