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Instabilities in Very Massive Stars

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Abstract. Detailed dynamical models and nucleosynthesis yields of very massive stars from early pre-MS through very late stages have been computed. The recent reduction of mass loss rates for the WR stages can have important consequences for both the evolution, surface composition and stability. Depending on mass and metallicity, in the present models instabilities occur during the accretion phase (pre-ZAMS), LBV stage and very late stages (WC).

1. Models and Results

The code includes a very large and flexible nuclear network. Semiconvection, overshooting and time-dependent convection are taken into account. For more details see Ødegaard (1999).

In these models convective zones are *not* assumed to be chemically homogeneous. The mixing due to convection, semiconvection and overshooting is followed in great detail. During late stages, μ-gradients often occur inside convective zones because
a) material mixed in from top and bottom has not had time to fully mix,
b) time scales of nucleosynthesis and mixing may become comparable,
c) extension of convective zone may change rapidly.

Due to extreme mass loss, in particular during the LBV and WR stages, in these models the mass is reduced from $120M_\odot$ (ZAMS) to $4.76M_\odot$ at the pre-SN stage. Recent studies have favoured a reduction of the mass loss rates during the WR stages by at least a factor of 2. This will cause a weaker decline of L and will also affect the L/M ratio and the stability. In the present models, pulses related to the interaction between accretion, a growing convective core and nuclear burning of light species, occur late in the accretion phase. Pulsations of several different periods, as well as a few major outbursts, occur during the LBV stage. The WC model star experiences very rapid (minutes) pulsations of small amplitude.

Reference

Ødegaard, K. J. R. 1999, in Lecture Notes in Physics, Vol. 523, Variable and Non-Spherical Stellar Winds in Luminous Hot Stars, ed. B. Wolf, O. Stahl, & A. W. Fullerton (Berlin: Springer), 353

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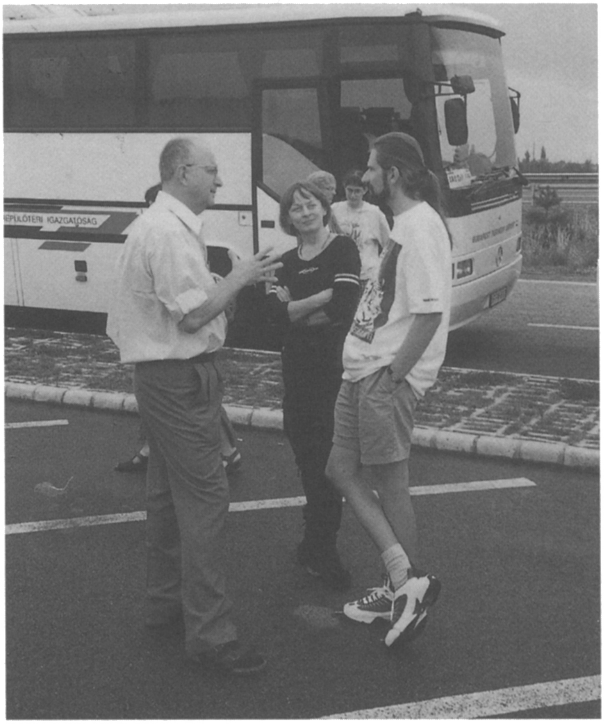

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