INJECTION OF MASS AND ENERGY INTO THE ISM BY MASSIVE STARS

CLAUS LEITHERER, LAURENT DRISSEN, and CARMELLE ROBERT
Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218.

A large set of radiatively driven wind models for massive stars has been computed. We followed the stars from the ZAMS until they reach $T_{eff} = 15,000\ K$. The metallicity range is $0.1Z_{\odot} \leq Z \leq 3Z_{\odot}$. Power-law fits to the mass-loss rates and terminal velocities give:
$\log(\dot{M}/M_{\odot}yr^{-1}) =$
$2.20\log(L/L_{\odot}) - 0.68\log(M/M_{\odot}) + 1.38\log(T_{eff}/K) + 0.70\log(Z/Z_{\odot}) - 23.65 \quad (\sigma = 0.15)$;
$\log(v_{\infty}/kmsec^{-1}) =$
$-0.33\log(L/L_{\odot}) + 0.60\log(M/M_{\odot}) + 0.70\log(T_{eff}/K) + 0.15\log(Z/Z_{\odot}) + 1.00 \quad (\sigma = 0.12)$.
We adopted Maeder's (A&AS **84**, 139 [1990]) tables for massive star evolution at different metallicities. These models were extended to lower-mass stars using the results of Maeder and Meynet (A&AS **76**, 411 [1988]). The kinetic energy flux, the momentum flux, and the total energy content due to stellar winds in *all* evolutionary phases, including supernova explosions, have been computed.

The two figures below show the kinetic energy flux of a population of stars forming with $SFR = 1\ M_{\odot}yr^{-1}$ for $Z = 2Z_{\odot}$ (left) and $Z = 0.1Z_{\odot}$ (right). A Salpeter IMF extending from 0.1 $M_{\odot}$ to 120 $M_{\odot}$ has been assumed. At ~4 Myr, OB and Wolf-Rayet (WR) stars are equally important for the energy flux. The energy flux scales nearly linearly with Z since $\dot{M} \propto Z^{0.70}$ and $v_{\infty} \propto Z^{0.15}$. The energy flux due to SN explosions is independent from Z. Therefore stellar winds are more important in a high-Z environment whereas SNe dominate in a low-Z environment. During the early phase of a starburst (< 3 Myr) stellar winds dominate the energetics. At later stages (depending on Z) SNe take over. For a typical starburst of age 10 Myr having solar Z both must be taken into account.