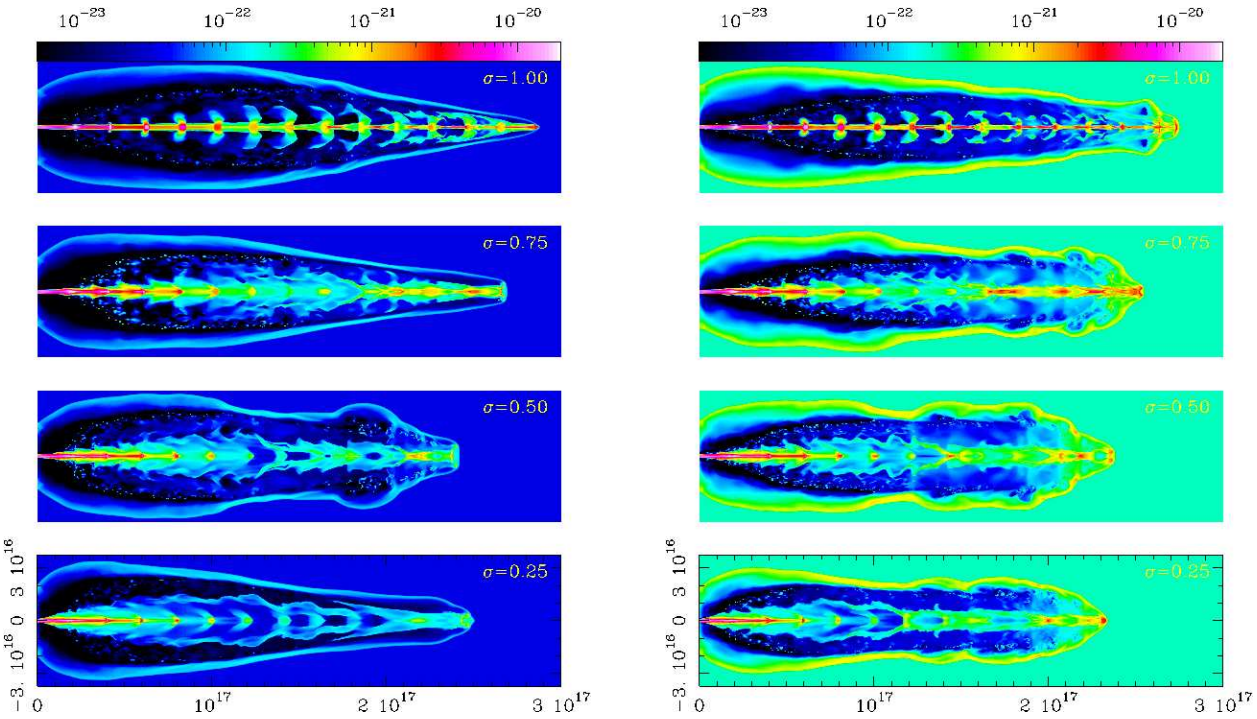

Fig. 1. Density stratifications obtained from the single-sinusoidal mode variable jet models (see § 3). The models of jets moving into an environment with $n_a = 15$ cm^{-3} are shown at $t = 350$ yr integration time (left column) and the models with $n_a = 100$ cm^{-3} are shown at $t = 400$ yr (right column). The results are labeled with the value of σ (the edge-to-center ejection velocity ratio) of each model. The full computational domain is shown on both sides of the symmetry axis (the axes are labeled in cm). The densities are depicted with the logarithmic color scheme given (in g cm^{-3}) by the top bar. The color figure can be viewed online.

the velocity along the jet axis ($v_{\rm axis}$, at $r = 0$). In other words, the ejection velocity has a single-mode, sinusoidal ejection velocity variability, and a center-to-edge, quadratic radial dependence.

When calculating variable ejection jet models, it is of course possible to include a time-variability in the initial density and/or temperature of the jet. Such variabilities, however, lead to the production of shocks with velocities of the order of the initial sound speed (typically of $\approx$ a few km s^{-1} for HH jets). Because of this, if one wants to model the emission along HH jets (which is formed in shocks with velocities $\sim 10 \rightarrow 100$ km s^{-1}), it is clear that an ejection velocity variability with a highly supersonic amplitude has to be included.

We have run two sets of four models (each set corresponding to environments with different densities, see below) with edge-to-center ejection velocity ratios $\sigma = 1.0$ (top hat), 0.75, 0.5 and 0.25. The models have the same ejection variability, with $v_0 = 250$ km s^{-1}, $v_1 = 30$ km s^{-1} and $\tau = 30$ yr. The ejection density and temperature have top-hat profiles with $n_j = 5000$ cm^{-3} and $T_j = 1000$ K (respectively). For the surrounding, homogeneous environment, we have considered a $T_a = 1000$ K temperature, and two possible densities: $n_a = 15$ and 100 cm^{-3}. It is assumed that both the jet and the environment are initially neutral except for C and S, which are assumed to be singly ionized. The jets have a $r_j = 10^{15}$ cm initial radius.

The gas-dynamic equations are integrated together with a set of rate equations for H, He, C, N, O and S ions, with an axisymmetric version of the "yguazú-a" adaptive grid code. The resulting, non-equilibrium ionization has been used to compute the energy loss term (included in the energy equation). The version of the code used is identical to the one described in detail by Kajdic, Velázquez, & Raga (2006) and by Raga et al. (2007). For the present calculations, we use a 6-level, binary adaptive grid which would fill the domain with 4096×512 (axial $\times$ radial) points at the highest grid resolution. The cylindrical domain has an on-axis reflection condition, an inflow condition for $r \leq r_j$ and a reflection condition for $r > r_j$ on the injection ($x = 0$) plane, and outflow conditions at the remaining two bound-