TABLE 4

DESCRIPTION OF INPUT PARAMETERS FOR LINE FITS[a]

Parameter	Value	Description
$R_{\rm max}$	4.2	Maximum extent of line-forming region, in units of R_*
$V_{\rm max}$	–	Terminal wind speed, in units of $V_{\rm th}$
$V_{\rm th}$	50	Thermal velocity, in km s^{-1}
R_a	3.9	Extent of linear acceleration region, in units of R_*
R_i	–	Radius of the *i-th* region
X_0	–	Opacity parameter at R_*
X_i	–	Opacity parameter at R_i

[a]In Column 2 we list the values of those parameters that were held constant.

Sobolev approximation only in those portions of the wind where the approximation is valid. Where the Sobolev approximation breaks down (i.e., where the wind velocity gradient is small compared to the local Doppler velocities) it computes the radiative transfer precisely. A description of the input parameters is given in Table 4. The line is assumed to arise in a region whose maximum extent is $R_{\rm max}$. In the linear approximation, R_a is the distance over which the velocity increases; and R_i, with $i = 1,2, ...,n$ are the radii of regions within the wind having different opacities. All distances are given in units of the stellar radius, R_*, which is the hydrostatic radius. The opacity in the different regions is parametrized with the opacity factor, X, which is a nondimensional parameter that enters into the line-profile calculation through the optical depth, τ, defined as

$$\tau = \int \frac{X(r)}{[v(r)/v_{\rm th}](r/R_*)^2}\varphi[x - v_z(z)]d(z/R_*), \quad (1)$$

where $v(r)$ is the wind velocity law, $v_{\rm th}$ is the Doppler velocity, v_z is the projection of the wind velocity along the line of sight from the star to the observer in Doppler units, φ is the line profile function, x is the non-dimensional line frequency, and z is the coordinate along the line of sight. The maximum speed attained in the line-forming region is $V_{\rm max}$. It is specified in the code in units of $v_{\rm th}$.

The code allows the value of $X(r)$ to be specified for an arbitrary number of radial positions within the line-forming region. We represent its different values as X_i for the corresponding regions R_i. Note that by defining wind regions R_i with different X_i values, we are assuming that the excitation and/or ionization structure can change with distance from the stellar core.

Our analysis will be restricted to the "blue" wing of the N V 4604 line because its P Cygni absorption component is formed in the column of wind material that lies along the line of sight from the observer to the continuum emitting core. Hence, it describes the behavior of wind material whose location is constrained, thus simplifying the interpretation. In addition, it is not contaminated by other lines. This is unlike its centrally-located emission which is blended with the P Cygni absorption produced by the neighboring N V 4620 Å doublet member.

We used a linear velocity law of the form $v(r) = v_0 r$ because a standard β-velocity law failed completely to describe the observed line profiles. A β-law predicts a strong and sharp P Cygni absorption at the wind terminal speed ($\sim$1900 km s^{-1}) which is not observed. This problem can be avoided if the line opacity goes to zero in the region where the wind velocity tends asymptotically to v_∞. Hence, we opted to use a velocity law in which the wind accelerates linearly up to R_a, and then expands at a constant speed thereafter. The form of the velocity law in the code is $v(r) = V_{\rm max} r/R_a$, so the velocity at the stellar surface is $v(R_*) = V_{\rm max}/R_a$.

We chose to fix the value of $R_{\rm max} = 4.2$ based on the deduced ionization structure of HD 50896's wind from Hillier (1988; Figure 2) which shows that this is the extent of the region where the abundance of NV dominates over that of N IV. We also fixed $v_{\rm th} = 50$ km s^{-1}. This value was chosen in part because the ionization potential of NV is 98 eV which, under equilibrium conditions, corresponds to a thermal speed of 37 km s^{-1}, and in part because the code does not include turbulent broadening in the calculation and the added velocity serves to increase the Sobolev length accordingly. Since the velocities are given in units of $v_{\rm th}$, the product $V_{\rm max}\ v_{\rm th} = v_\infty$ is constrained by the observations. We also fixed the value of the acceleration radius, $R_a = 3.9\ R_*$.