Adiabatic photoevaporation flow

Bernoulli equation: $\frac{1}{2}v^2 + w = \text{Constant}$

"w is what Landau & Lifshitz use. Whereas Shu uses h"

Enthalpy, $w = \begin{cases} \text{ISOTHERMAL} & c_s^2 \ln \rho/\rho_0 \equiv w_\infty \\ \text{ADIABATIC} & \left(\frac{\gamma}{\gamma-1}\right) c_0^2 \left[\left(\frac{\rho}{\rho_0}\right)^{\gamma-1} - 1\right] \equiv w_\gamma \end{cases}$

$h = \int_{\rho_0}^{\rho} \frac{dP}{\rho}$

So

ρ/ρ_0	v/c_0	w_∞/c_0^2	v/c_0	$w_{5/3}/c_0^2$	T/T_0	$w_{4/3}/c_0^2$	$w_{1.1}/c_0^2$
1	1	0	1	0	1	0	0
0.5	1.55	−0.7	1.68	−0.92	0.63	−0.82	−0.73
0.1	2.36	−2.3	2.22	−1.96	0.22	−2.14	−2.26
0.01	3.19	−4.6	2.41	−2.4	0.05	−3.14	−4.06
0		$-\infty$	2.45	−2.5	0	−4	−11

So in the adiabatic case, the velocity increase is limited, even as $\rho \to 0$.

$$\frac{1}{2}v^2 - 2.5c_0^2 = \frac{1}{2}c_0^2 \Rightarrow v^2 = 6c_0^2$$
$$\Rightarrow v = 2.45\,c_0$$

$\frac{T}{T_0} = \left(\frac{\rho}{\rho_0}\right)^{\gamma-1}$ So T falls to 500K when ρ falls by 100 in case of $\gamma = 5/3$.

This will also affect calculation of h_0, since α_B goes up as T goes down. Assuming $\alpha_B \propto T^{-1}$ then we will have $\int n^{4/3}\,dr$ instead of $\int n^2\,dr$.

So, for instance at constant velocity we would have $\int_1^\infty x^{-8/3}\,dx$ instead of $\int_1^\infty x^{-4}\,dx = -\frac{1}{3}\left[x^{-3}\right]_1^\infty = \frac{1}{3}$

$= \frac{3}{5}$, so it nearly doubles the value of h_0

So in general $\left(\frac{v}{c_0}\right)^2 = 1 - 2\frac{w}{c_0^2} \Rightarrow v = (1-2w)^{1/2}$ in units of c_0

Adiabatic: $w = \frac{5}{2}(\rho^{2/3} - 1)$; $v^2 = 6 - 5\rho^{2/3}$

Isothermal: $w = \ln\rho$; $v^2 = 1 - 2\ln\rho$

$$r^2 \rho v = 1 \Rightarrow r = (\rho v)^{-1/2}$$

ρ	Isothermal v	r	Adiabatic v	r	c_s
1	1	1	1	1	1
0.5	1.55	1.13	1.68	1.09	0.79
0.1	2.36	2.06	2.22	2.12	0.47
0.01	3.19	5.6	2.41	6.44	0.22