ASTRONOMY 8300 – FALL 2024
Homework Set 1, Due 9/23/24 at 9:30 AM

1.a. (10 pts) Given the equation for a Gaussian profile characterized by dispersion σ, show that the velocity spread parameter $b = \sqrt{2}\sigma$ and that the $FWHM = 2.355\sigma$.

b. (5 pts) For a gas cloud with temperature T = 50 K, what is b, σ, and FWHM for Silicon atoms in this gas (in km/sec)?

c. (5 pts) If a spectrograph has a resolution of 0.05Å (FWHM of the LSF), can it resolve the Si II λ1260.4 absorption line from the above cloud?

d. (5 pts) What technique would you use to measure the column density of this line and other absorption lines from the above cloud? Why?

e. (5 pts) If an observed Si II profile has a FWHM = 100 km/sec, what technique would you use to measure the column density? Explain.

2. Suppose that an interstellar absorption line of Si II λ1260.4 has the following normalized (and resolved) profile:

λ	1260.0	1260.1	1260.2	1260.3	1260.4	1260.5	1260.6	1260.7	1260.8	1260.9	1261.0
F_λ/F_c	1.0	0.75	0.5	0.25	0.01	0.01	0.01	0.25	0.5	0.75	1.0

a. (5 pts) What is the FWHM and radial velocity centroid for the line (in km/sec)?
b. (10 pts) What is the equivalent width of the line?
c. (10 pts) What is the column density of Si II assuming an unsaturated line (i.e., the linear part of the curve of growth)?
d. (10 pts) What is the correct column density of Si II?

3. (35 pts) Given the following measurements from unresolved spectral lines of Si II, use the curve of growth method to determine the column density of Si II, the b-value, and the uncertainties for these two values.

Line (Å)	EW (Å)	EW Error (Å)
1193.3	0.11	0.01
1260.4	0.15	0.02
1304.4	0.06	0.01
1526.7	0.11	0.02