## Moving Cluster Method:

The angle between a cluster star and the convergent point is angle "a". You already know the relationship of distance, proper motion, and tangential velocity. It is:

Vr = Vs cos (a)
and Vt = Vs sin (a)
so Vt = Vr tan (a)
Since Vt = 4.74 $\mu$ [arcsec/yr] d [pc]
d [pc] = Vr tan (a) / 4.74 $\mu$

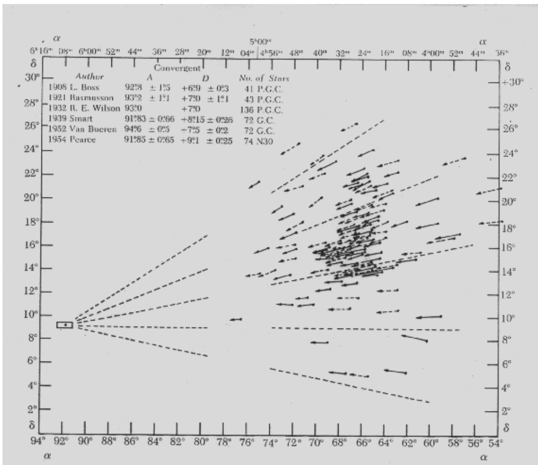


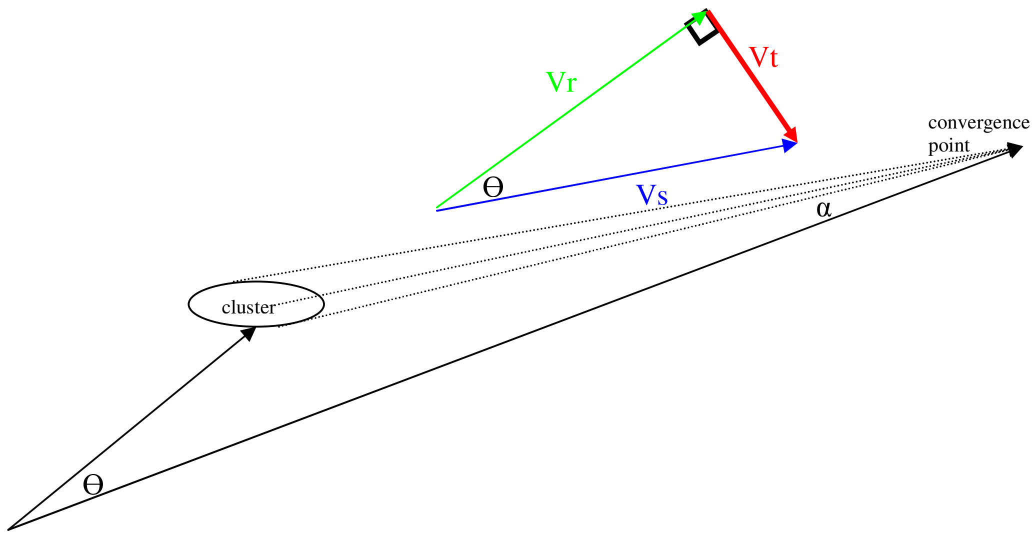

**Figure 14–7.** *The Hyades.* This most famous moving cluster (in the constellation Taurus) contains about 200 identified members, subtends 25° × 25° on the sky, and converges towards $\alpha = 6^h8^m$, $\delta = +9°$. (From O. Struve, B. Lynds, and H. Pillans: *Elementary Astronomy*. New York, Oxford University Press, 1959.)

$$X_{[AU]Tangential} = Vt_{\left[\frac{AU}{year}\right]} \times year = \theta \times d_{[pc]} \Rightarrow \qquad \frac{\theta_{[arc\sec]}}{year} \times \left[\frac{1AU}{1arc\sec}\right] = Vt_{\left[\frac{AU}{year}\right]}$$

$$\frac{AU}{year} = \frac{1.5 \times 10^8{}_{km}}{365 * 24 * 3600_{\sec}} = 4.74\frac{km}{\sec}$$

$$d_{[pc]} = \frac{Vt_{\left[\frac{AU}{year}\right]}}{\left[\frac{\theta}{year}\right]} = \frac{Vt_{\left[\frac{km}{\sec}\right]}}{4.74 \times \left[\frac{\theta}{year}\right]} = \frac{Vr_{\left[\frac{km}{\sec}\right]} \tan\theta}{4.74 \times \left[\frac{\theta}{year}\right]}$$

Where $\mu$ is the proper motion in arc-seconds/year.




## *Example:*

The angle between a cluster star and the convergent point is angle 28.5°.
The radial velocity is 30km/sec.
and the proper motion is = 2.85arcsec/year

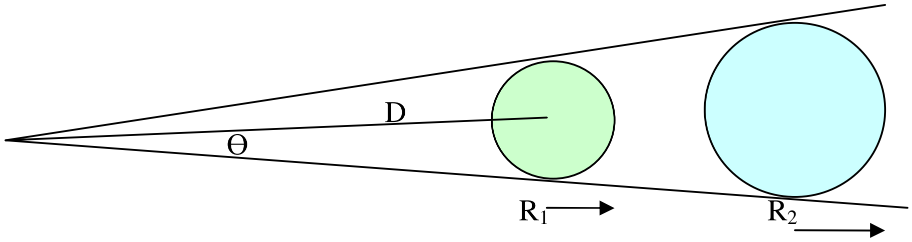
You already know the relationship of distance, proper motion, and tangential velocity. It is:

Vr = Vs cos (a)
and Vt = Vs sin (a)
so Vt = Vr tan (a)
Since Vt = 4.74 $\mu$ [arcsec/yr] d [pc]
d [pc] = Vr tan (a) / 4.74 $\mu$

hence:
d [pc] = 30km/sec* tan (28.5°) / (4.74 *2.85arcsec/year) ≈ 1.2 pc

## *Approaching Cluster*

When a cluster of stars approaches us directly we can only measure radial velocity through red or blue shift, and its apparent radius. We assume that there is not much of a transverse velocity, so the change in its radius is due only to its approaching.




Measuring the angle Θ we get the relation $\sin\theta = \frac{R}{d} \square\ \theta \Rightarrow R = \theta d$

and $Vr = \frac{dD}{dt}$.

The ln of this expression will also give a correct relation so we get:

$$\ln R = \ln\theta + \ln d$$

Since we assume the actual radius does not change in time, the time derivative of the above expression should equal:

$$\frac{1}{R}\frac{dR}{dt} = 0 = \frac{1}{\theta}\frac{d\theta}{dt} + \frac{1}{D}\frac{dD}{dt} \Rightarrow \frac{1}{D} = \frac{1}{\theta}\frac{d\theta}{dt}\cdot\frac{1}{Vr}$$

The angle between a cluster star and the convergent point is angle $50^{\circ}$.
The radial velocity is 30km/sec.
and the proper motion is = 5arcsec/year

You already know the relationship of distance, proper motion, and tangential velocity. It is:

Vr = Vs cos (a)
and Vt = Vs sin (a)
so Vt = Vr tan (a)
Since Vt = 4.74 $\mu$ [arcsec/yr] d [pc]
d [pc] = Vr tan (a) / 4.74 $\mu$

hence:
d [pc] = 30km/sec* tan ($50^{\circ}$) / (4.74 *5arcsec/year) ≈ 1.5 pc ≈ 5ly