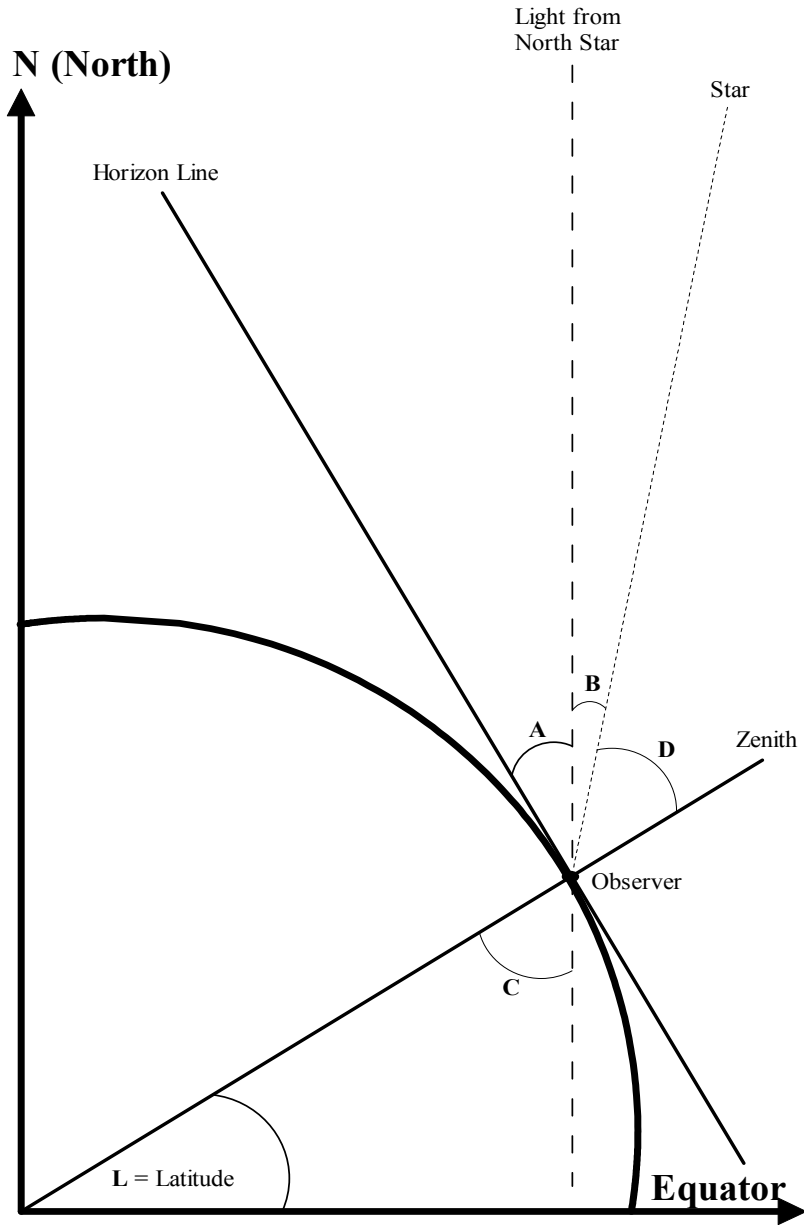


Latitude and Declination



First, some definitions. The observer's *zenith* is the point directly over the observer's head. The observer's *meridian* is an imaginary arc in the sky which runs north-south (so passes over the poles) and through the observer's zenith. The meridian lies directly over the observer's great circle of longitude. The observer's *horizon* is the plane tangent to the earth and passing through the observer; it's perpendicular to the line from the center of the earth, going out toward the zenith.

The *celestial equator* is the plane which passes through the earth's equator and extends out into space.

The observed *altitude* of a star is its angular distance above the observer's horizon. A star's altitude will vary with the time of observation. A star's *declination* is its angular distance above the celestial equator. The declination is also 90 degrees minus the angle the star makes with the earth's axis; Since the North Star (Polaris) lies on this axis, we can say that the declination is the complement of the star's angular distance from the North Star (Polaris).

We are assuming that the observer, the zenith, the star observed, and Polaris all lie in the same plane. This will happen when the star "crosses the meridian" of the observer. (Note: when the sun crosses the meridian of the observer, it's *noon*: thus, AM = *Ante* (before) *Meridian* and PM = *Post Meridian*!)

Angle **A** is the altitude of Polaris; it's also equal to the observer's latitude **L**. To see this, note that **A** is the complement of **B + D**. But **B + D** equals **C** since they are "vertical angles." But **L** is the complement of **C** since they lie in a right triangle. Thus, Latitude = **L** = **A**.

Next, note that **A + B** = the Altitude of the star, by the above definition of altitude. But **B** is the angular distance of the star from Polaris, so **B** = (90 - Declination). Thus, we have: Altitude = **A + B** = Latitude + (90 - Declination). We can solve this for the Latitude, giving us the fundamental formula:

$$\text{Latitude} = \text{Altitude} + \text{Declination} - 90$$

This formula works for any star. If the star lies south of the equator (so its angular distance from Polaris is greater than 90 degrees), we must take the declination to be negative. We must also take latitudes below the equator to be negative.