# STARS
# Proper Motion

BRIEF

## Overview

This video lesson is apart of a group of video lessons on Stellar Motion. Consult Radial Velocity and Stellar Motion for a context of how Proper Motion is part of the collective view of how objects in the Universe move.

Proper Motion is essentially the tangential motion of an object that we observe on the night sky.

Measuring this motion is performed via Astrometry and often accomplished over many years as opposed to deriving a Radial Motion which is fairly instantaneous when an object's spectra is analyzed.
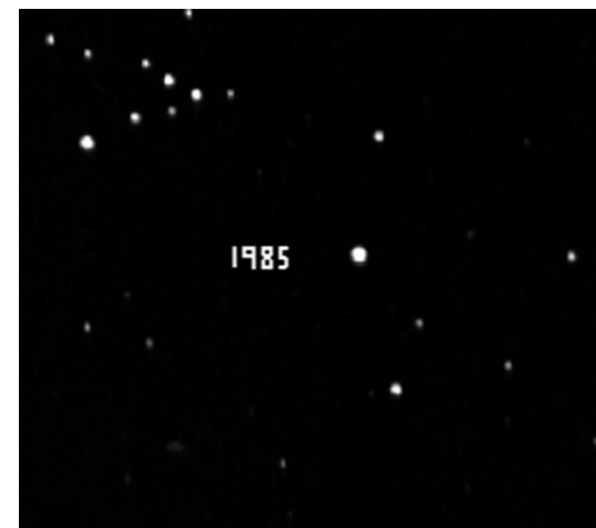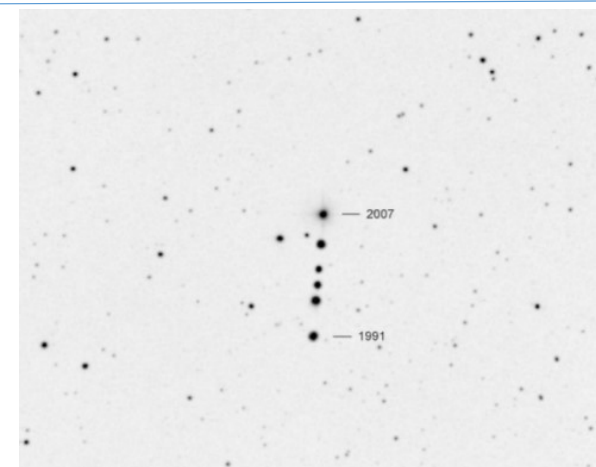
## Proper Motion

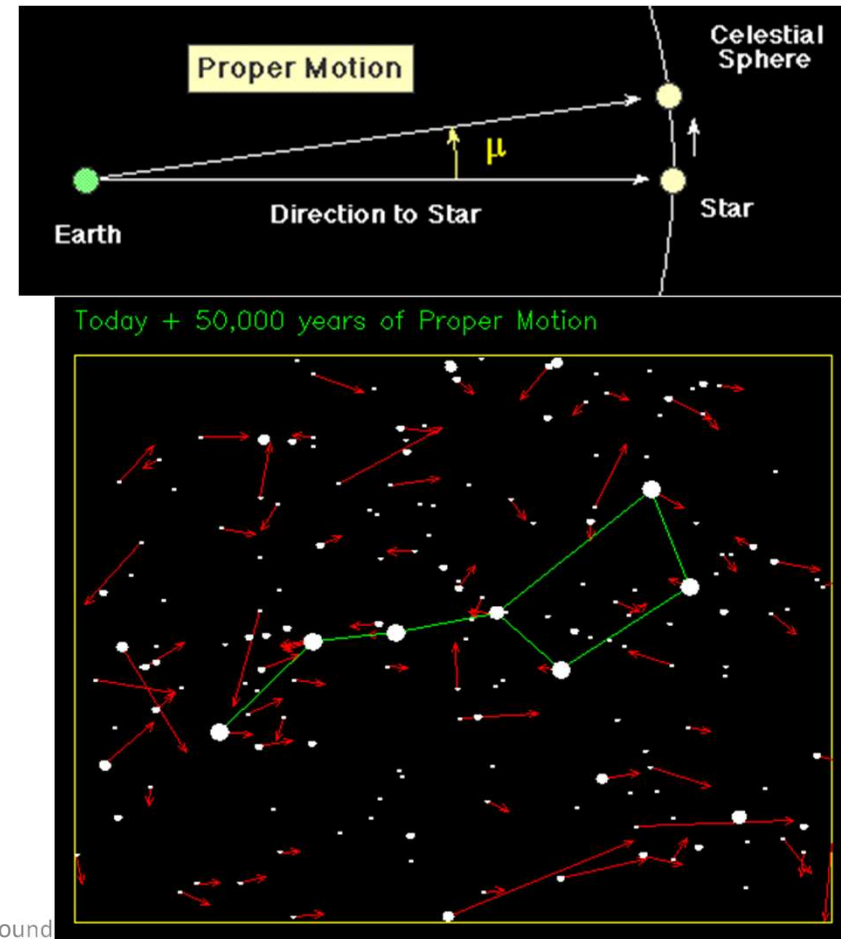Proper motion is a movement from one (x,y) position on the celestial sphere to another in a tangential movement.

Described in two coordinates: Right Ascension and Declination in mili-arcseconds/year or thousands of years.

Directional Indications:
RA + and - indicate eastward and westward motions, and for
Dec + and - indicate north and south

Their combined value is computed as the *total proper motion* having a dimensions of angle per time, typically outlined as arcseconds per year or milliarcseconds per year: $\mu^2 = \mu_{RA}^2 + \mu_{Dec}^2$

**Proper Motion Catalogs**

## 19$^h$ 11$^m$ 39$^s$ - 19$^h$ 12$^m$ 46$^s$                                    1896
## 94301 - 94400

| Number | | Descriptor: epoch J1991.25 | | | | | Position: epoch J1991.25 | | | Par. | Proper Motion | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HIP | | RA | Dec | V | | | α (ICRS) | δ | | π | μ$_{α*}$ | μ$_δ$ |
| | | h m s | ±° ′ ″ | mag | | | deg | deg | | mas | mas/yr | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 94301 | | 19 11 39.93 | +19 25 54.2 | 9.32 | | H | 287.916 356 71 | +19.431 710 10 | | 4.36 | 10.76 | 12.29 |
| 94302 | | 19 11 40.52 | +56 51 32.7 | 5.13 | | H | 287.918 837 62 | +56.859 095 94 | | 9.57 | 48.09 | 48.00 |
| 94303 | | 19 11 41.74 | −33 42 31.2 | 10.70 | | G | 287.923 923 90 | −33.708 672 65 | | 5.45 | 3.45 | −18.20 |
| *94304 | | 19 11 41.95 | −81 24 46.5 | 7.60 | | H | 287.924 807 49 | −81.412 923 39 | | 9.72 | 19.40 | 35.91 |
| *94305 | | 19 11 41.93 | +09 57 06.2 | 8.44 | | H | 287.924 721 08 | +09.951 709 33 | | 3.77 | 1.11 | −8.82 |

## Proper Motion

Distance (near or far) and actual relative motion (fast or slow) has a dramatic impact on observed motion from Earth.

Proper motion cannot be measured for all stars. Historically, only stars that are unusually close or moving unusually fast relative to the Sun, were measurable.

Recently, space telescopes such as HIPPARCOS and GAIA have provided parallax and proper motion values that were previously unattainable. Where HIPPARCOS provided roughly 100,000, GAIA has provided data on trillions of stars. This data is available to all astronomers.
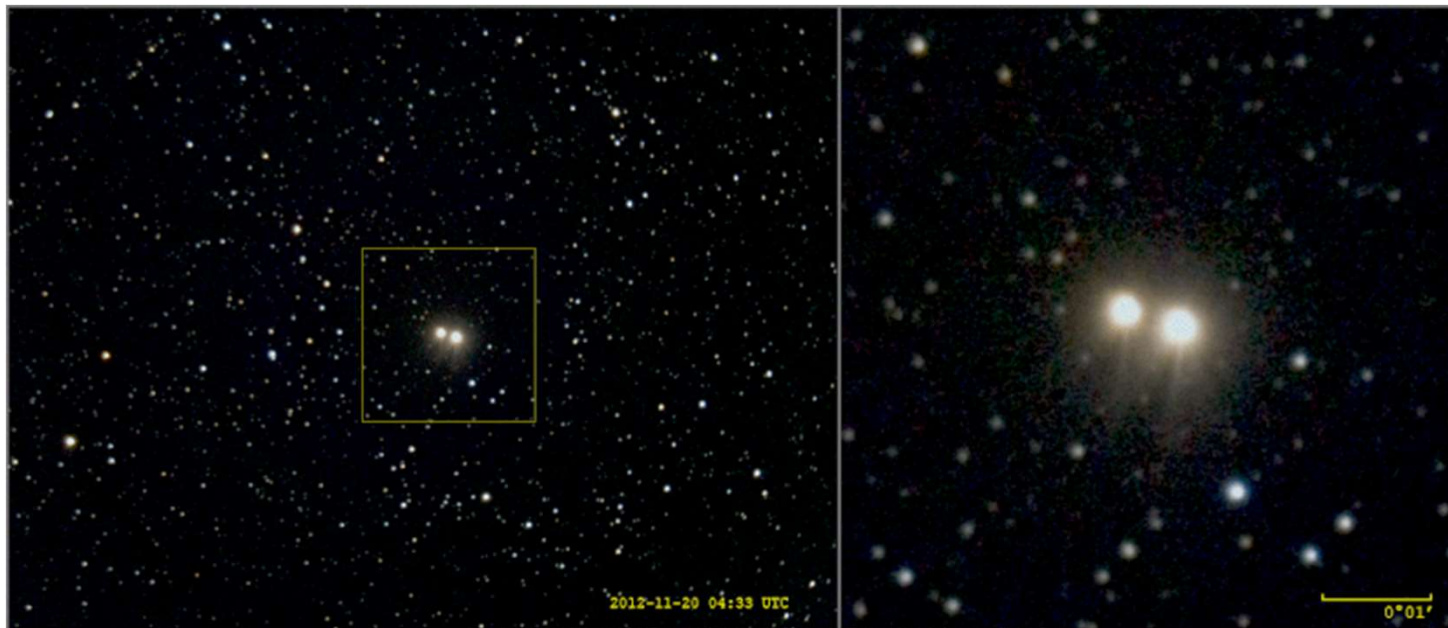
**61 Cygni**

A binary star system in the constellation Cygnus, consisting of a pair of orbiting stars with a period of about 659 years and a large proper motion located about 11.4 light-years away. 61 Cygni currently has the seventh-highest proper motion, and the highest among all visible stars or systems.
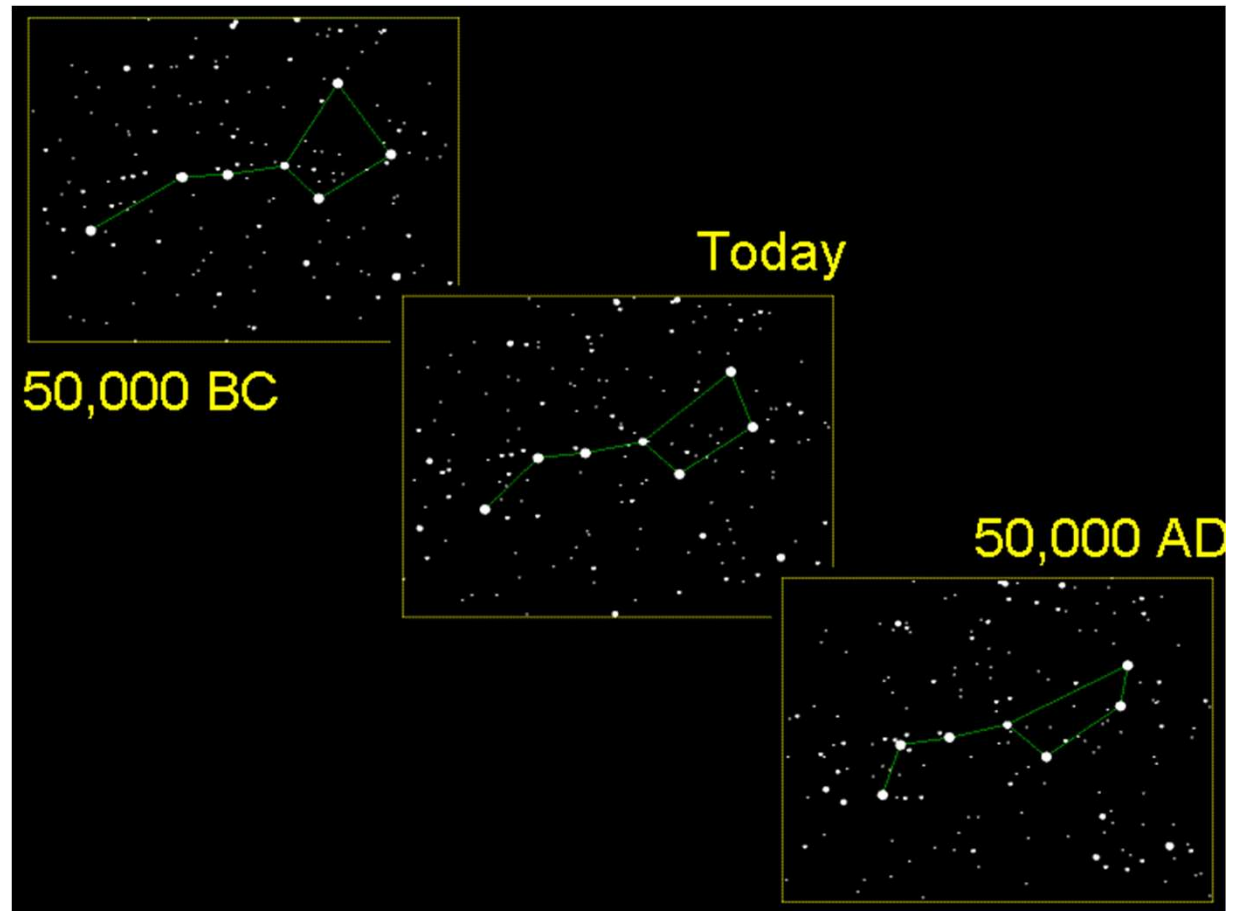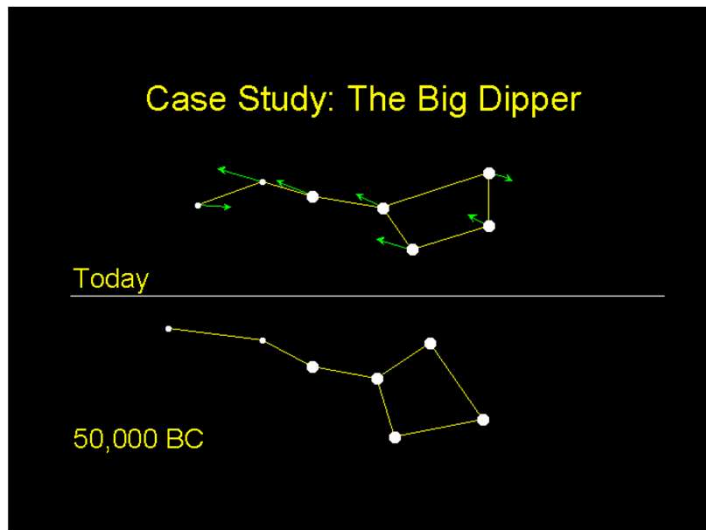
**Examples of Proper Motion**



Case Study: The Big Dipper

Today

50,000 BC



50,000 BC

Today

50,000 AD

**Summary**

Proper Motion is one of the key components in defining a celestial object's motion across the night sky. This can also be translated into galactic motion as well.

Historically, PM has been difficult to determine due to the distances of objects and their relatively slow motion. In the 1990s, the HIPPARCUS and TYCHO catalogs provided the first comprehensive measure of PM of close stars. Recently, GAIA has greatly expanded our knowledge of PMs for 1.7 trillion objects.

PM is expressed in directions of RA and Dec and may be expressed in terms of arcseconds per year, or thousand years and is useful in astrometric studies.

*Questions?*