
Modern Astronomi
HT 05

Lärare

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Kurslitteratur

Universe
(Freedman & Kaufmann)

Fyra delar:

- Fundamenta
- Stjärnor
- Galaxer
- Planeter

Komplement på svenska

- Den svenska almanackan
- Astronomi - en bok om universum (Lagerqvist & Olofsson)
- Astronomi för alla (Gunnar Welin)
- Populär Astronomi

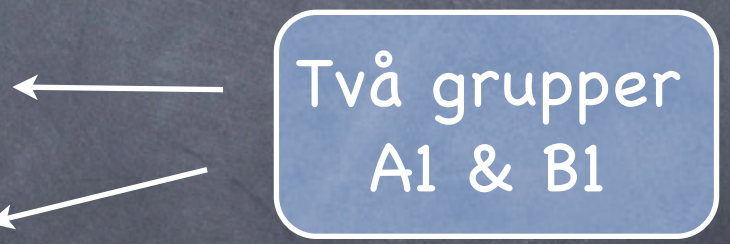
Kursmaterial

- Stjärnkarta
- Hitta rätt i Svenska almanackan
- Astronmins grunder
- Magnitudskalan
- Räknehäfte + formelsamling
- Laborationer (1,2,3)
- Gamla tentor

www.astro.su.se/utbildning/kurser/modern_astronomi

Schema

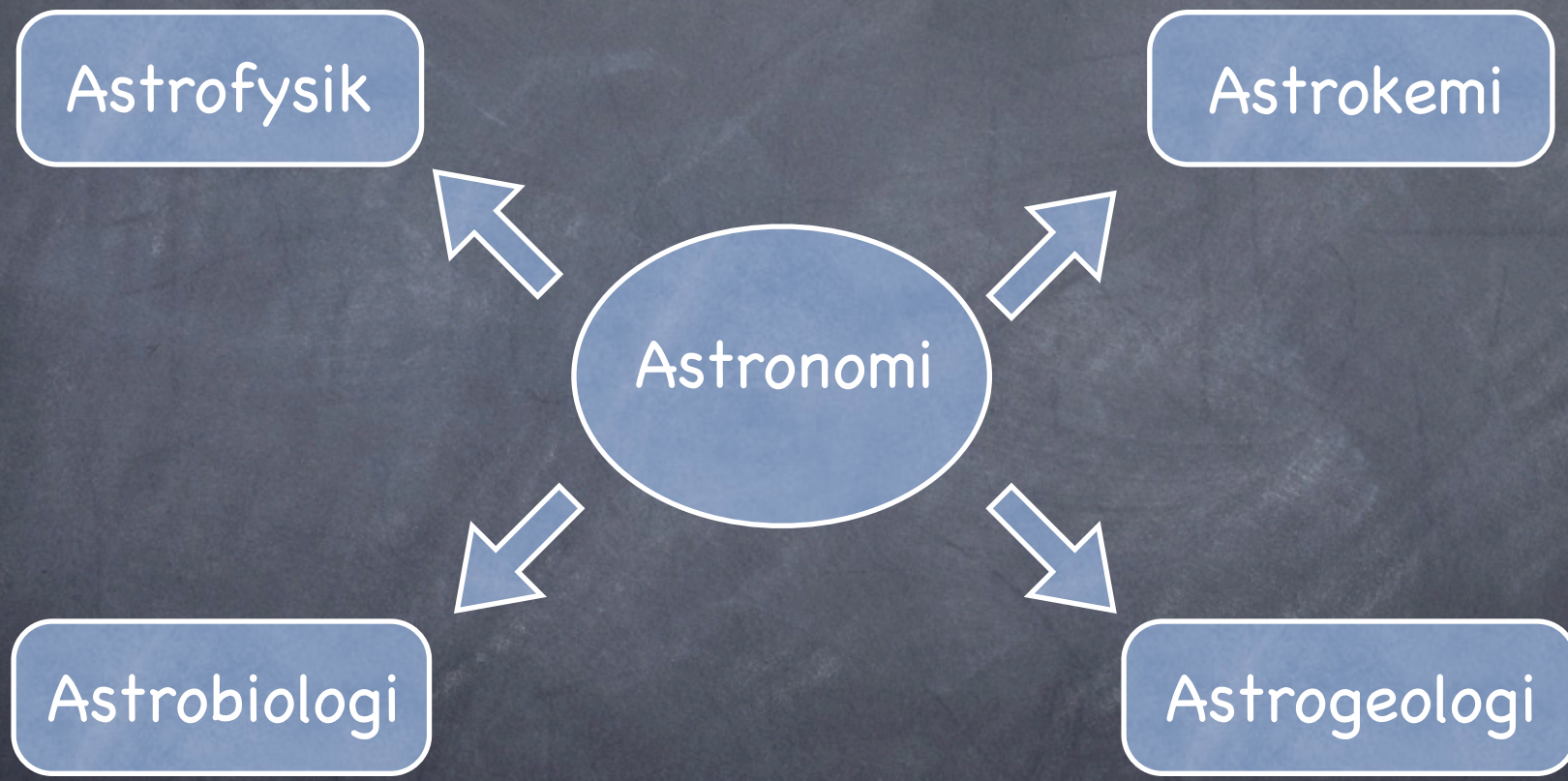
- 17 föreläsningar
- 8 räkneövningar
- 3 laborationer



Kursinnehåll

- L1-L6: Introduktion, stjärnhimlen, celest mekanik, elektromagnetisk strålning, observationsteknik
  (kap 1-6)
- L7-12: Solen, grundläggande astrofysik, det interstellära mediet, stjärnornas utveckling
  (kap 18-24)
- L13-17: Vintergatan, galaxer, kosmologi
  (kap 25-30)
- L18-19: Planeter (sammanfattning)
  (kap 7-17)

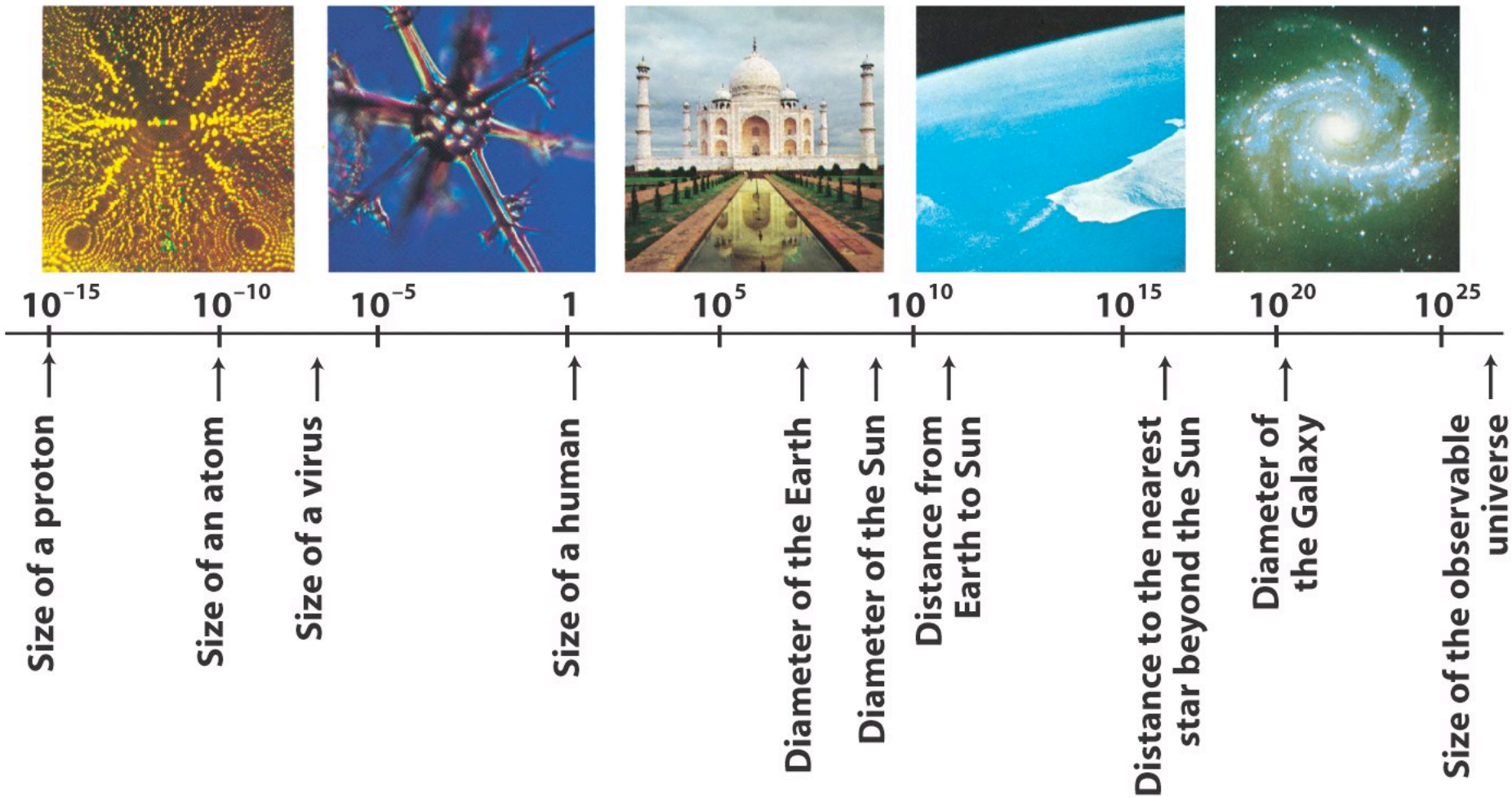
Astronomi är en interdiciplinär vetenskap



Forskning vid Stockholms Observatorium

- Solfysik
- Planetsystem
- Stjärnbildning
- Sen stjärnutveckling: AGB stjärnor, planetariska nebulosor, supernovor
- Högenergi-astrofysik: tex gammablixtar
- Galaxer
- Observationell kosmologi

Powers-of-ten notation is a useful shorthand system for writing numbers



Common Prefixes

Factor		Name	Symbol
(billion)	10^{9}	Giga-	G
(million)	10^{6}	Mega-	M
(thousand)	10^{3}	kilo-	k
(hundredth)	10^{-2}	centi-	c
(thousandth)	10^{-3}	milli-	m
(millionth)	10^{-6}	micro-	μ
(billionth)	10^{-9}	nano-	n

Vetenskaplig metodik är baserad på observation, logik, och skeptesism

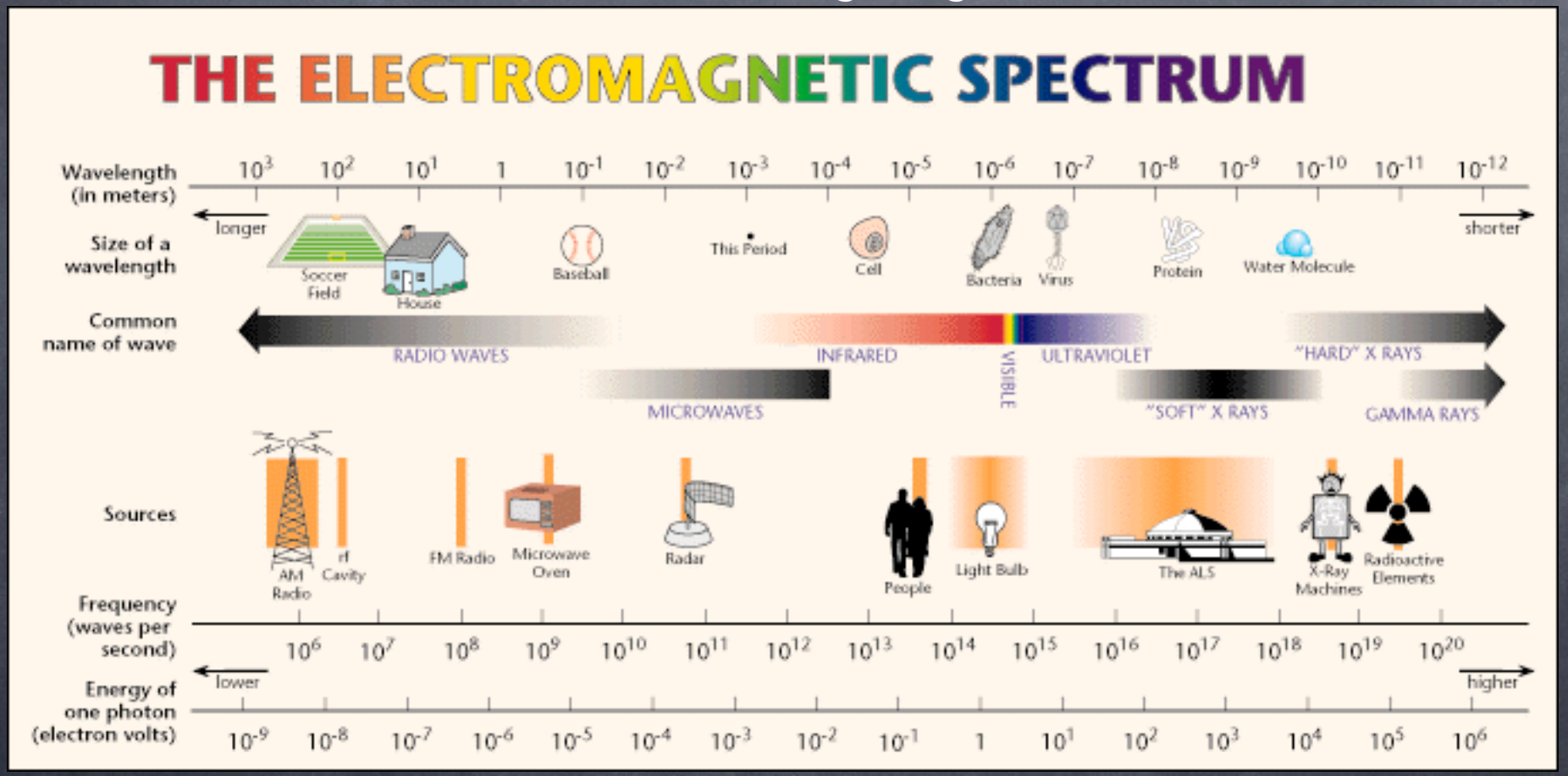
- **Hypotes**
  - ideer som förklarar ett observerat fenomen
- **Modell**
  - hypoteser som har stått emot observationella och experimentella tester
- **Teori**
  - En samling relaterade hypoteser som sammantaget bildar en självkonsistent beskrivning av naturen
- **Fysikens lagar**
  - teorier som noggrant beskriver den fysikaliska verkligheten och har stått emot alla tester och visat sig ha en stor och betydande tillförlitlighet

Astronomi är en observationell vetenskap

- Elektromagnetisk strålning
- "cosmic-ray" partiklar (ex. protoner, elektroner)
- Neutrinos
- Gravitationsvågor
- Meteoriter

Elektromagnetisk stålning

Karakteriseras av våglängd (frekvens)

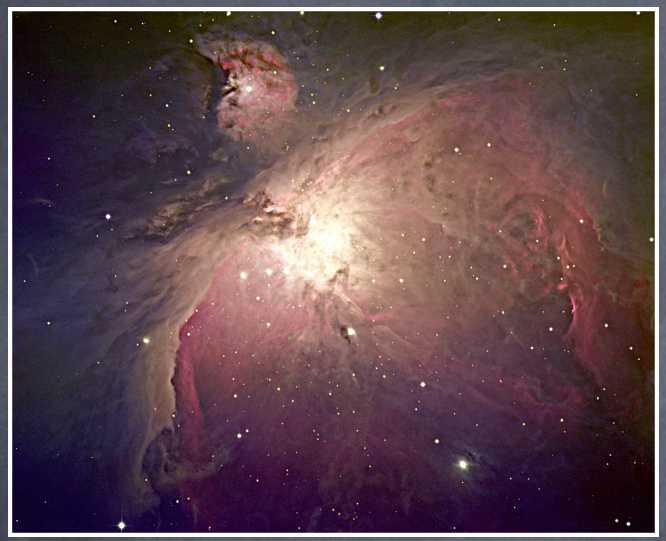


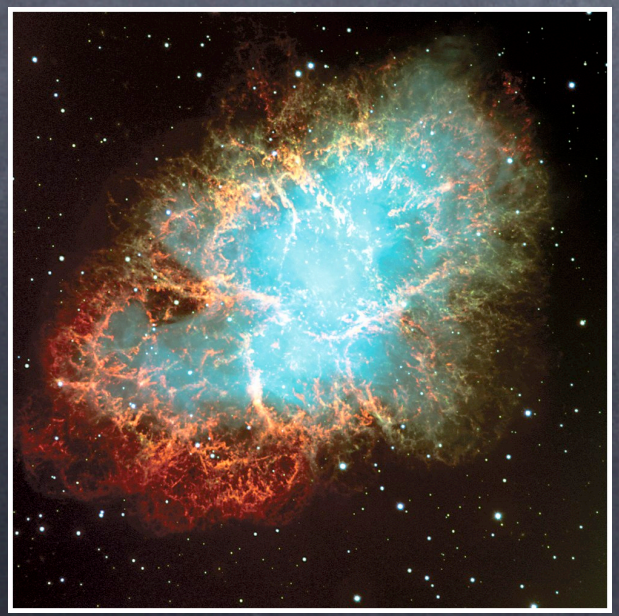
EM-strålning utbreder sig med ljusets hastighet

$c = 2.997925\ 10^8$ m/s

i vakum

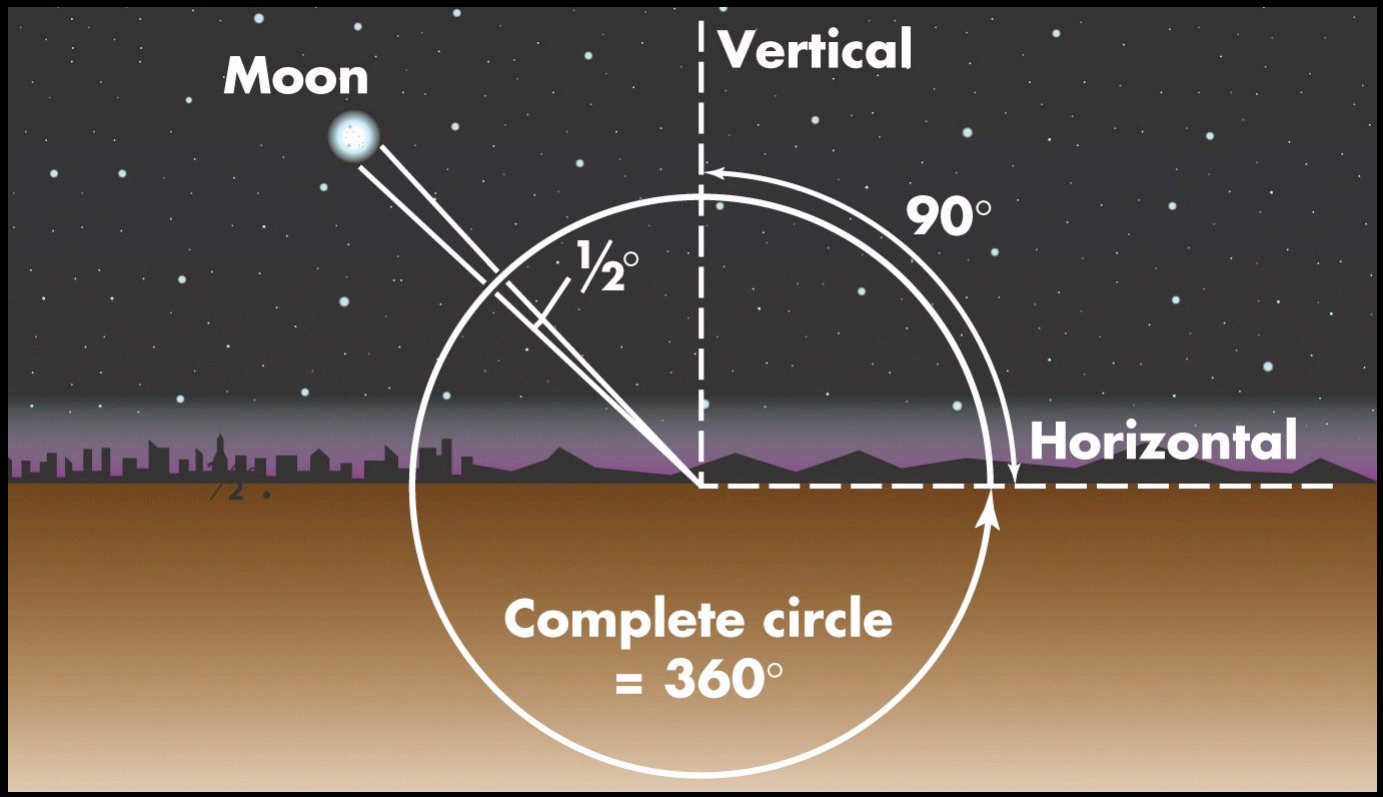
By studying stars and nebulae, astronomers discover how stars are born, grow old, and die



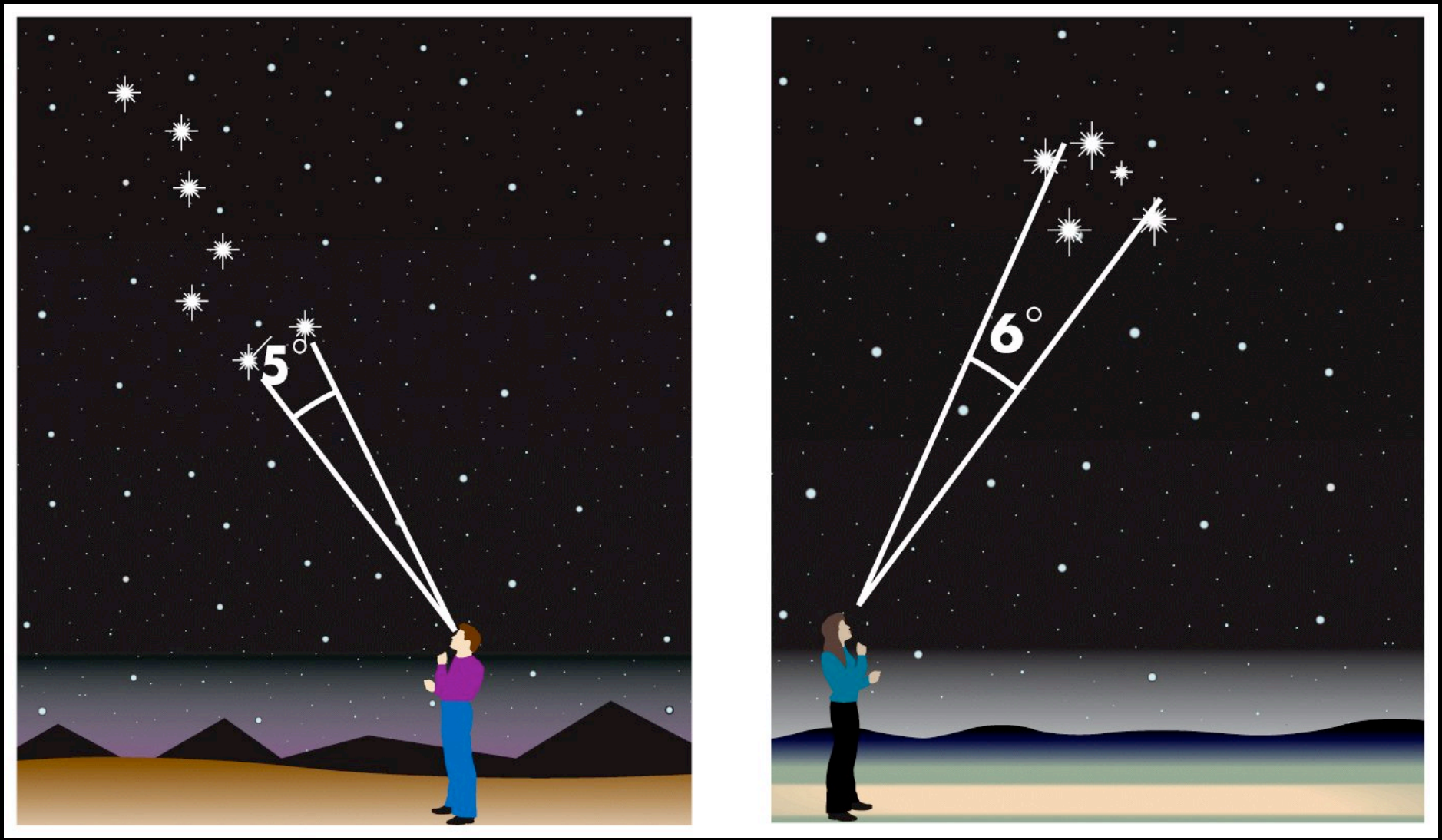


By observing galaxies, astronomers learn about the origin and fate of the universe

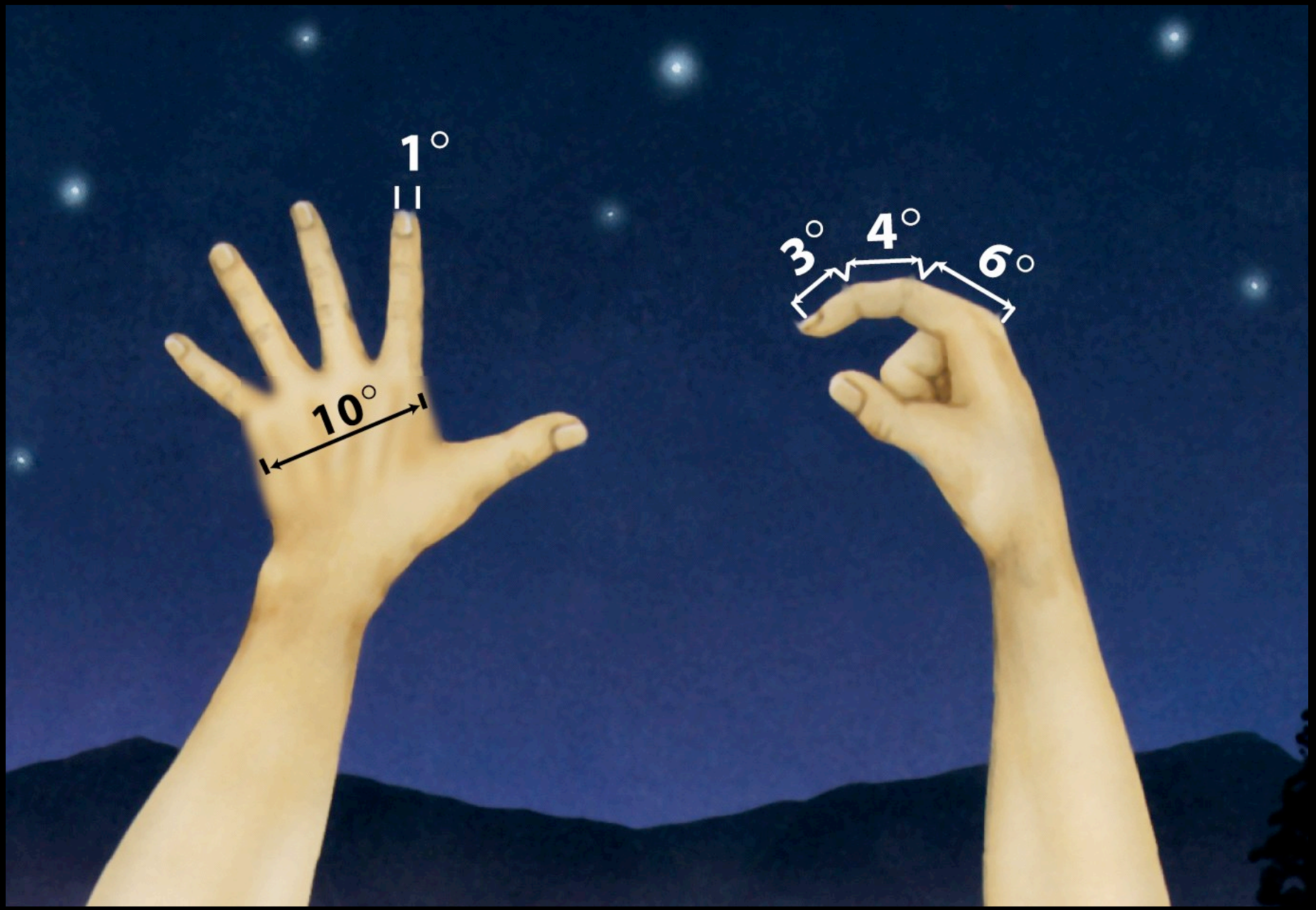
Astronomers use angles to denote the positions and apparent sizes of objects in the sky



- The basic unit of angular measure is the **degree (**°).
- Astronomers use angular measure to describe the apparent size of a celestial object—what fraction of the sky that object seems to cover
- The **angular diameter** (or **angular size**) of the Moon is ½° or the Moon **subtends** an angle of ½°.



If you draw lines from your eye to each of two stars, the angle between these lines is the **angular distance** between these two stars



The adult human hand held at arm's length provides a means of estimating angles

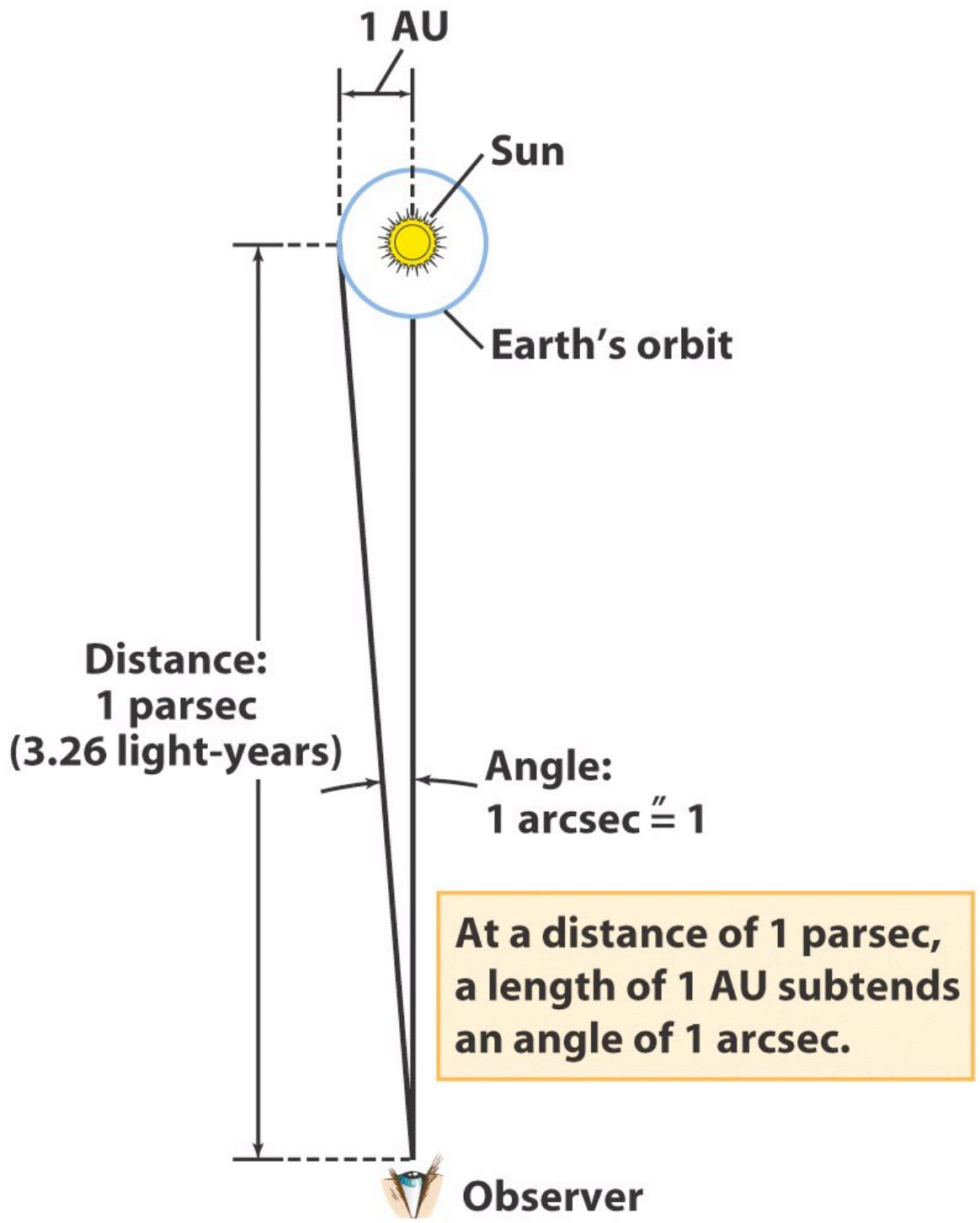
Angular Measurements

- Subdivide one degree into 60 **arcminutes**
  - minutes of arc
  - abbreviated as 60 arcmin or 60´
- Subdivide one arcminute into 60 **arcseconds**
  - seconds of arc
  - abbreviated as 60 arcsec or 60”

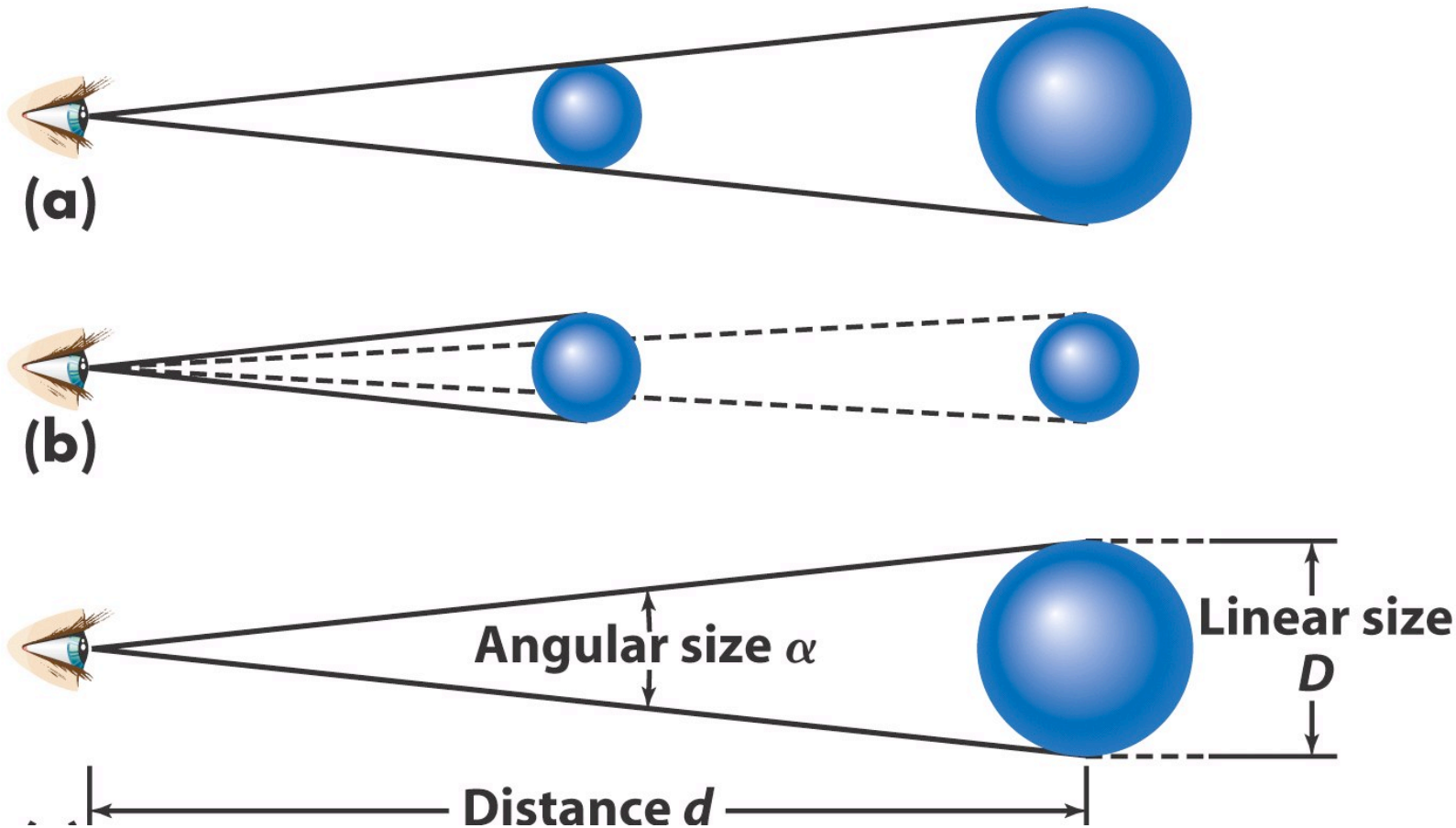
1° = 60 arcmin = 60´
1´ = 60 arcsec = 60”

Astronomical distances are often measured in astronomical units, parsecs, or light-years

- **Astronomical Unit (AU)**
  - One AU is the average distance between Earth and the Sun
  - 1.496 X 10^8 km or 92.96 million miles
- **Light Year (ly)**
  - One ly is the distance light can travel in one year at a speed of about 3 x 10^5 km/s or 186,000 miles/s
  - 9.46 X 10^{12} km or 63,240 AU
- **Parsec (pc)**
  - the distance at which 1 AU subtends an angle of 1 arcsec or the distance from which Earth would appear to be one arcsecond from the Sun
  - 1 pc = 3.09 × 10^{13} km = 3.26 ly


1 AU
Sun
Earth's orbit
Distance:
1 parsec
(3.26 light-years)
Angle:
1 arcsec = 1
At a distance of 1 parsec, a length of 1 AU subtends an angle of 1 arcsec.
Observer

The Small Angle Formula



D = linear size of object

a = angular size of object (in arcsec)

d = distance to the object

$$D = \frac{\alpha d}{206265}$$

Small Angle Formula Example

- On July 26, 2003, Jupiter was 943 million kilometers from Earth and had an angular diameter of 31.2”.
- Using the small-angle formula, determine Jupiter’s actual diameter.

$$D = \frac{31.2'' \times 943 \times 10^6\, km}{206265} = 1.43 \times 10^5\, km$$