

# AST221: STARS AND PLANETS

UNIVERSITY OF TORONTO — FALL 2019

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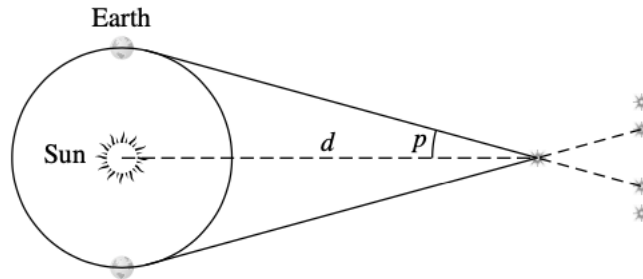
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# 1 Week 1

## 1.1 Stellar Parallax

Trigonometric parallax: using a known distance as a baseline, the distance to an object can be determined by observing it from different locations. Measurements of distances to a star can be made on Earth six months apart, when the Sun will have moved a distance of 2 AU (orbital diameter).



The parallax angle  $p$  is half of the maximum change in position. From this, we can calculate distance as follows:

$$d = \frac{1 \text{ AU}}{\tan p [\text{rad}]} \simeq \frac{1}{p [\text{rad}]} \text{ AU},$$

where for small angles  $\tan p \simeq p$  (small-angle approximation).

Convert this into arcseconds:

$$1 \text{ rad} = 57.3^\circ = 206264.8''$$

Defining a new unit called a **parsec** (parallax-second) as

$$1 \text{ pc} = 2.062648 \times 10^5 \text{ AU} = 3.0856776 \times 10^{16} \text{ m},$$

we get

$$d \simeq \frac{1}{p''} \text{ pc}.$$

In particular, when  $p = 1''$ ,  $d = 1 \text{ pc}$ .

**Light year:** the distance travelled by light through a vacuum in a Julian year:  $1 \text{ ly} = 9.460735 \times 10^{15} \text{ m} = \frac{1}{3.26} \text{ pc}$ .

## 1.2 The Magnitude Scale

## 1.3 The Copernican Revolution

## 1.4 Equations

## **2 Week 2**

### **2.1 Orbital Mechanics**

### **2.2 Newtonian Mechanics**

### **2.3 Kepler's Laws of Planetary Motion**

derivations

#### **2.3.1 N-Body Orbits**

#### **2.3.2 First Law**

#### **2.3.3 Second Law**

#### **2.3.4 Third Law**

### **3 Week 3**

#### **3.1 Tides and Moons**

#### **3.2 Equations**

## 4 Week 3

### 4.1 Hydrostatic Equilibrium

### 4.2 The Virial Theorem

### 4.3 Equations

## **5 Week 5**

### **5.1 Nuclear Fusion**

### **5.2 Blackbody Radiation**

### **5.3 Spectral Lines**

quantization doppler

### **5.4 Light**

### **5.5 Photon Diffusion**

mfp

### **5.6 Equations**

## **6 Week 6**

### **6.1 Stellar Evolution: Pre-MS**

### **6.2 Stellar Evolution: MS**

mass, size, brightness relations

### **6.3 Timescales**

### **6.4 Equations**

## 7 Week 7

### 7.1 White Dwarfs

### 7.2 Electron Degeneracy

### 7.3 Equations



## 8 Week 8

### 8.1 Stellar Evolution: Post-MS

### 8.2 Neutron Stars

### 8.3 Black Holes

### 8.4 Equations