Ch. 8 The SUN

Intro: The Sun is the basis for much of our knowledge of stellar astronomy. It is just an average star, but it is \_\_\_\_\_\_\_\_ x closer to us than the

next nearest star, \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_.

I. Physical Properties (Sec 8.1)

A. **STAR**: Glowing ball of gas held

together by \_\_\_\_\_\_\_\_ & powered

by nuclear \_\_\_\_\_\_\_\_\_ in its core.

B. **Hydrostatic equilibrium** – \_\_\_\_\_\_

vs. \_\_\_\_\_\_\_

C. Sun Statistics

1. **Diameter** obtained from its

\_\_\_\_\_\_\_ \_\_\_\_\_ (**.**50):

\_\_\_\_ dE (~ 875,000 miles)

2. **Volume**: ~ 1 million VE

3. **Mass**: 332,000 ME

4. **Density**: 1,400 kg/m3 (Jovian)

5. **Rotation**: ~ once per \_\_\_\_\_\_\_

a. It’s a \_\_\_\_\_\_\_\_\_\_\_ rotation

b. Faster at the \_\_\_\_\_\_\_\_ (25 days)

c. \_\_\_\_ days at 600 latitude

6. **Surface temp**: \_\_\_\_\_\_\_ K

(obtained from blackbody curves)

D. Energy

1. **Solar \_\_\_\_\_\_\_\_**: Amount of solar

energy reaching every \_\_\_\_\_ \_\_\_\_\_

of Earth’s surface.

a. \_\_\_\_\_ W/m2 (top of atm.)

b. Only \_\_\_ W/m2 hits Earth’s surface

Ex/ Sunbather- 10 75W bulbs

2. **Luminosity**: \_\_\_\_\_\_ amount of

Sun’s energy in \_\_\_ directions.

a. Sphere, 1 AU radius: 4 x 1026 W

b. Every sec. = \_\_\_\_ \_\_\_\_\_\_ nukes!

c. Time to evaporate oceans- \_\_\_\_\_

II. Understanding the Sun (Sec 8.2)

A. Studying the Sun

1. Standard Solar Model-

Math/theoretical model

a. No \_\_\_\_\_\_ measurements, but..

b. \_\_\_\_\_% agreement w/observations

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - Study of solar interior by analysis of surface \_\_\_\_\_\_\_\_.

3. Ground-based Solar Observatories

a. \_\_\_ \_\_\_\_\_ in Cali. b. \_\_\_\_ Network

4. Solar Satellities Ex/ \_\_\_\_ \_\_\_\_\_\_

B. Fusion in the Sun

1. Core Statistics

a. 125,000 mile radius

b. Temp.: \_\_\_ million K

c. \_\_\_ x denser than iron

d. 60 \_\_\_\_\_\_ Joules of energy released

from each kg (Mass ⇒ \_\_\_\_\_\_\_\_ )

**E = mc2**

2. Nuclear fusion (\_\_\_\_ vs. \_\_\_\_\_\_)

a. Critical Temp needed: \_\_\_ million K

b. Proton-proton chain:

4 (1H) → 4He + \_\_\_\_\_ + neutrinos

c. The \_\_\_\_\_\_\_\_\_ Problem

i. Not detecting amount predicted

ii.May be transformed before reaching us

III. Layers of the Sun (Sec 8.3)

A. Radiation & Convection Zones

1. All \_\_\_\_\_\_\_ from core are absorbed

(Only \_\_\_\_\_\_\_\_ go directly to Earth)

2. Energy reaches surface thru radiation,

then \_\_\_\_\_\_\_\_ - up to 1 years!

3. At the surface, \_\_\_\_\_\_\_ gets too low

for convection- \_\_\_\_\_\_\_\_ rules again

B. Photosphere

1. 1. What we see as the “\_\_\_\_\_\_\_\_”

2. \_\_\_\_\_\_\_ x less dense than air

3. Gas too thin to absorb radiation

\_\_\_\_\_\_ has a chance to escape.

4. Temp. down to only \_\_\_\_\_ K!

5. **Granulation**

a. Areas of dark/bright gas- \_\_\_\_\_\_\_\_\_

b. Each granule size of \_\_\_\_\_ \_\_\_\_\_\_\_.

c. \_\_\_-\_\_\_ minute lifetime

d. Several \_\_\_\_\_\_ granules at any time

IV. Solar Activity (Sec 8.4)

A. Sunspots

1. Size of \_\_\_\_\_\_, often in groups

2. May be \_\_\_\_\_\_\_\_\_, or none

3. Last \_\_ to \_\_\_\_ days

4. Relatively “cool” regions ~ \_\_\_\_\_ K

5. Have a black \_\_\_\_\_\_, and a gray

\_\_\_\_\_\_\_\_\_\_\_\_\_

6. Rotate fastest at the \_\_\_\_\_\_\_\_

B. Magnetism

1.Causes sunspots (come in \_\_\_\_\_\_)

a. Upward field lines - \_\_\_\_\_\_

b. Downward - \_\_\_\_\_\_

2. Same \_\_\_\_\_\_\_\_\_\_\_ observed

throughout each hemisphere (N & S)

C. The Solar Cycle

1. # of spots maximum every \_\_\_ yrs.

a. Diminish to almost zero

b. Polarity \_\_\_\_\_\_\_\_\_ for next 11 yrs.

c. Total cycle: ~ 22 yrs. to repeat

2. \_\_\_\_\_\_\_\_\_\_ minimum (1645-1715)

a. Few sunspots / no \_\_\_\_\_\_\_\_

b. “Little \_\_\_\_ \_\_\_\_\_”

D. Active Regions

1. Found near sunspots

2. \_\_\_\_\_\_\_\_\_\_\_\_ (aka filaments)

a. \_\_\_\_\_ or arch of ejected glowing gas

b. Avg. size: \_\_ x width of Earth!

3. \_\_\_\_\_\_

a. Greater energy than a prominence

b. Up to \_\_\_\_ \_\_\_\_\_\_\_ K !!

c. Material is actually blown into space

4. \_\_\_\_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_\_\_\_\_:

a. Bubble of ejected ionized gas

b. Can interact with Earth (Quebec ‘89)

V. The Solar Atmosphere (Sec 8.5)

2. A. Composition

1. Found from \_\_\_\_\_\_\_\_\_\_\_ lines

2. At least \_\_\_ elements detected so far

3. \_\_\_% H; \_\_% He; O, C, N, Si..

B. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (pinkish/red layer)

1. Faint - less \_\_\_\_\_ than photosphere

2. \_\_\_\_\_\_\_ - thin spikes of matter

C. \_\_\_\_\_\_\_\_\_\_\_

1. The upper \_\_\_\_\_\_\_\_\_\_\_ of the Sun

2. During a total eclipse,

\_\_\_\_\_\_\_\_\_\_ lines appear

3. \_\_ \_\_\_\_\_\_\_\_ K !! Seems to

contradict common sense.. Energy

transferred as magnetism & ”sound”

4. Corona can be studied using \_\_\_\_\_\_\_

D. The Solar Wind

1. The stream of \_\_\_\_\_\_\_\_\_\_\_ particles

that constantly escape the Sun’s gravity

2. The Sun is \_\_\_\_\_\_\_\_ due to the solar

wind – millions of tons per second!

3. Still < \_\_ % of its mass has been lost!

4. \_\_\_\_\_\_\_ \_\_\_\_\_ are sparse regions

where the solar wind originates

E. \_\_\_\_\_\_\_\_\_\_ – Charged particles from

the Sun are accelerated by the \_\_\_\_\_\_\_

\_\_\_\_\_\_\_ of planets and give off light.

Different elements emit different \_\_\_\_.

Ex/ \_\_\_\_\_\_\_ – greens & reds;

\_\_\_\_\_\_\_ - blues & violets