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)

1.
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