4. Basic solar properties

I have used **Gibson**, *The Quiet Sun*, here because I have it, but am not making a particular recommendation for an overview of solar physics.

From Gibson, Edward G.,
The Quiet Sun, NASA SP-303, 1973.

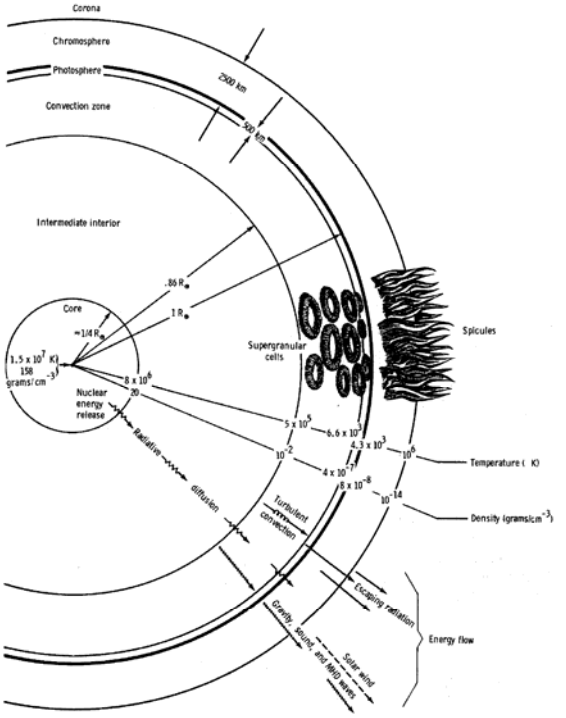


FIGURE 2-3.—Idealized general solar properties, structure, and modes of outward energy flow.

Also at quietsun.pdf

The basic solar properties are summarized in the file **solar.dat**.

A figure summarizing solar structure from R. Suleiman is in **raid-sun.pdf**. He has also supplied a movie of solar on solar properties, **raid-solar-movie.AVI**. Also, see http://sohowww.nascom.nasa.gov/ and the SSP and HEA research sites in http://www.cfa.harvard.edu/research/divresearch.html.

An overview of the spectrum above the Earth and at the surface, plus the variability over the 11-year cycle is in **spec_var_trans_nrl.pdf**.

A coarse resolution but radiometrically accurate solar spectrum is in **uars_avg_0200.dat**.

We have a brand-new version of our solar reference irradiance available at http://www.cfa.harvard.edu/atmosphere.

The paper describing it, “An improved high-resolution solar reference spectrum for Earth’s atmosphere measurements in the ultraviolet, visible, and near infrared,” K. Chance and R.L. Kurucz, *JQSRT*, in press, 2010 is available at http://www.cfa.harvard.edu/atmosphere/publications.html.

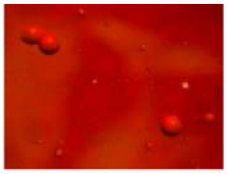
A high resolution R. Kurucz color spectrum is in **rkurucz-solar-irrad.jpeg**. This is to be used in conjunction with **quietsun.pdf** for the following homework problem:

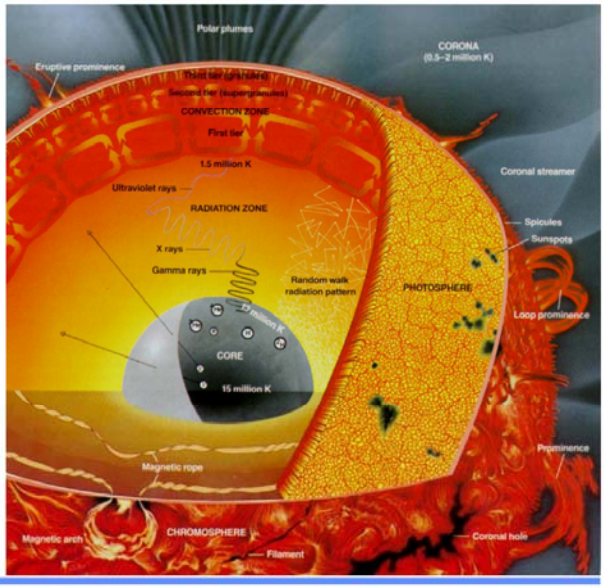
Homework (Assigned February 7, due February 23): Calculate and plot the intensity of blackbody radiation arriving at the Earth from the mean solar distance for temperatures corresponding to the bottom and the top of the solar photosphere. Do this for 1 nm intervals, 300-500. Compare these results with the solar irradiance spectrum. Your conclusions?

Limb darkening is a phenomenon whereby the *limb* (the part next to the horizon) of the Sun (and other stars) is darker than the central portion. This is due to the facts that we see further into the Sun’s atmosphere in the central portion, due to increased *opacity* or *optical thickness* in the longer limb view, and that the temperature is increasing from the top of the photosphere down. These concepts, and the explanation, will become clearer soon. Note that for some objects, at some wavelengths, *limb brightening* is also possible; this should also become clear soon.

The Sun's Structure

- **Core**
  - Where the energy is created.
  - Nuclear reactions burn every second about 700 million tons of hydrogen into helium.
- **Radiation Zone**
  - Where energy is transported by radiation.
  - Although the photons travel at the speed of light, they bounce so many times through the dense material that they use about a million years to escape the Sun.
- **Convection Zone**
  - Energy transported by convection (just like boiling soup) where heat is transported to the photosphere.





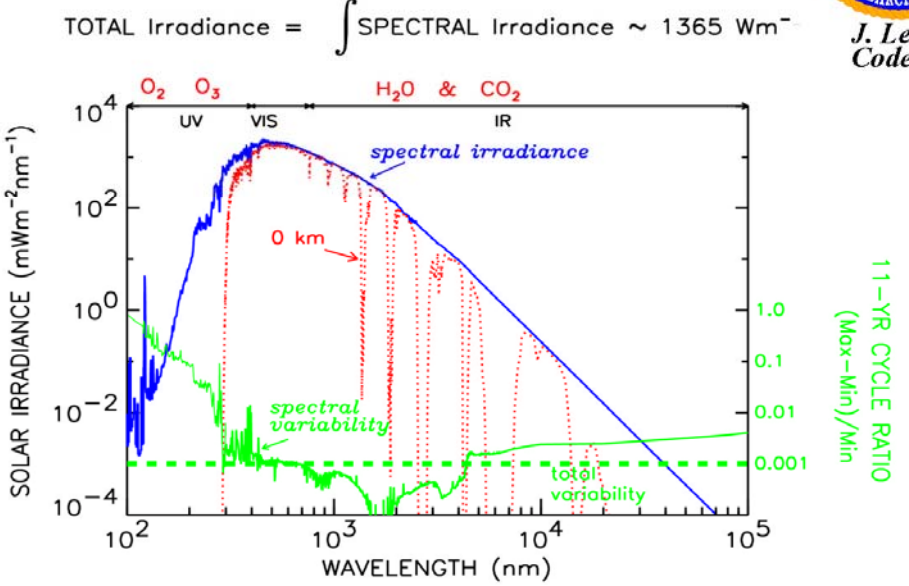
The Sun through the Eyes of SOHO

SOHO Project Scientist Team

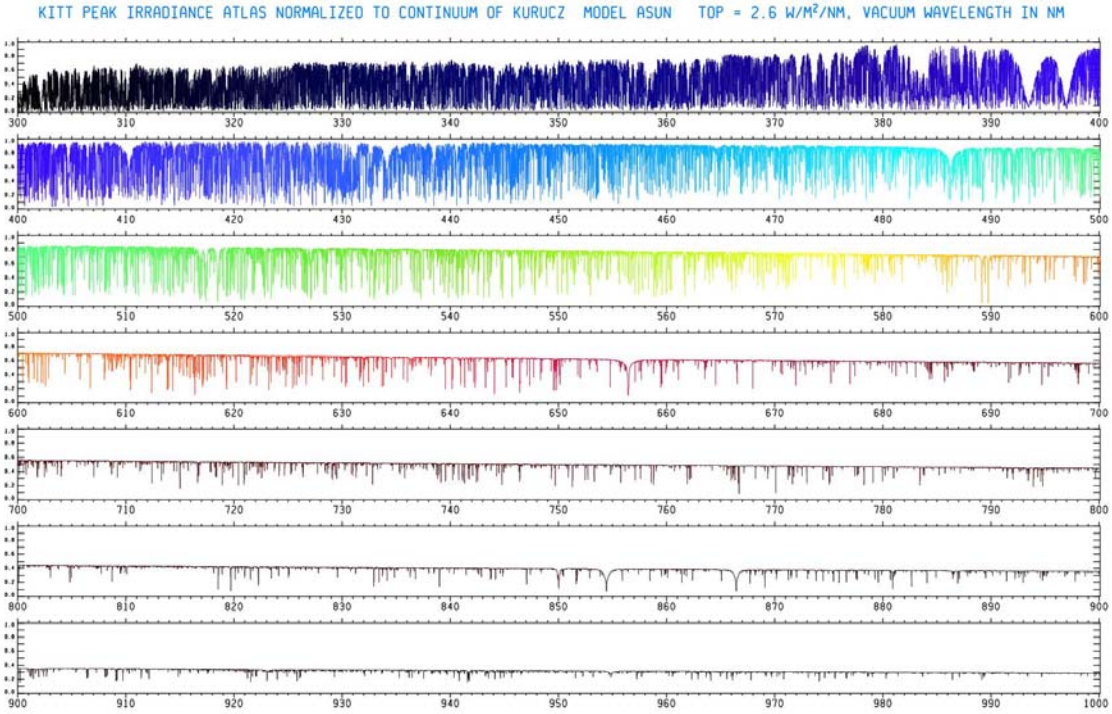
Raid-sun.pdf

SOLAR SPECTRAL IRRADIANCE, ATMOSPHERIC ATTENTUATION & 11-YEAR CYCLE VARIABILITY

J. Lean
Code 7673L



Spec_var_trans.pdf



Rkurucz-solar-irrad.jpeg