PHYS 4580/6280

Week 3

September 4, 2012

The University of Toledo
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Late Policy

- 1 through 6 days late:

2% deduction per day, may be waived with communication/approval.

Larger deductions may be applied to reports for students who are repeatedly late.

- More than 7 days late:

50% loss of credit.

- More than 14 days late:

0% credit.

Where Are We Now? (Assessment/Review)

- Experience with Igor Pro (any software will do)
  - Data manipulation, graph generation, curve fitting

  "A picture is worth a thousand words"

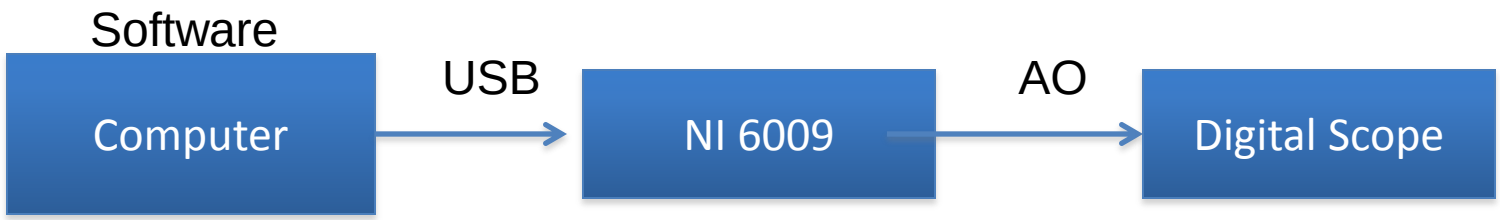
  "A graph is worth a thousand pictures"

  "A theory is worth a thousand graphs"
- Experience with Labview
  - Instrumentation control, data acquisition

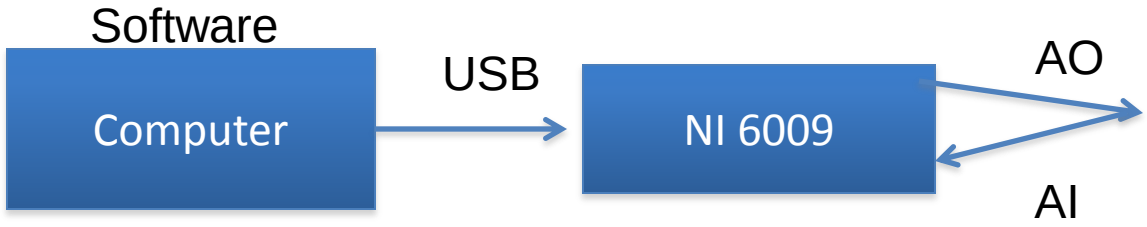
  "Conducting the orchestra"
- Next steps
  - Advanced Igor Pro and LabView Work

LabView Exercises

Last week



This week



Sine wave, Cosine wave, whatever you want. But please explore the timing/programming limitations of AO/AI with the NI 6-009 board.

NI USB 6009

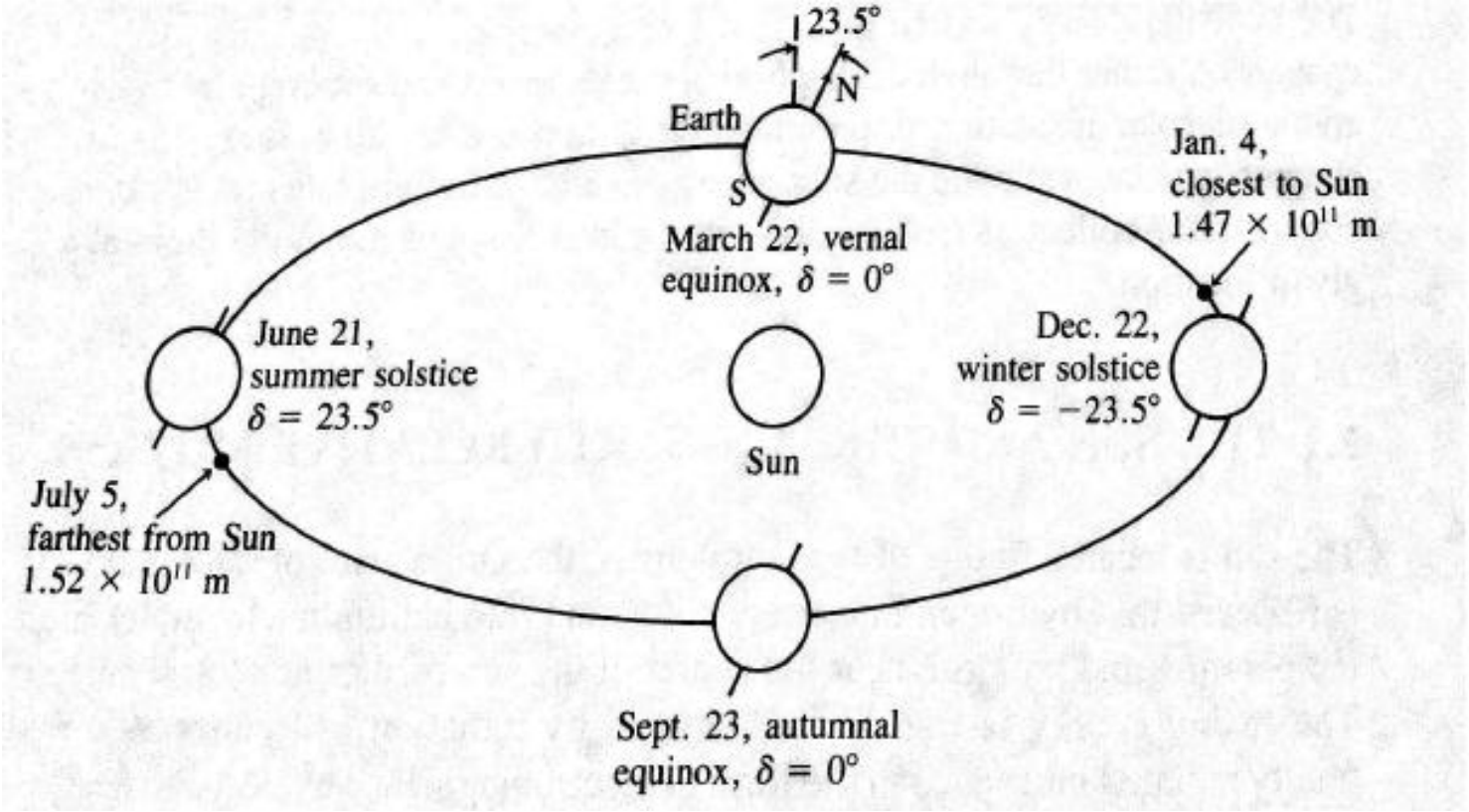
NI USB-6009

14-Bit, 48 kS/s Low-Cost Multifunction DAQ

- 8 analog inputs (14-bit, 48 kS/s)
- 2 analog outputs (12-bit, 150 S/s); 12 digital I/O; 32-bit counter
- Bus-powered for high mobility; built-in signal connectivity
- OEM version available
- Compatible with LabVIEW, LabWindows/CVI, and Measurement Studio for Visual Studio .NET
- NI-DAQmx driver software and NI LabVIEW SignalExpress LE interactive data-logging software

2^12 = 4,096 2^14 = 16,384

Earth's Motion around the Sun



δ = angle of declination between Sun's rays and the plane of the equator

From "Solar Cells", by C. Hu and R.M. White

After Coordinate Transformation (earth-centric view)

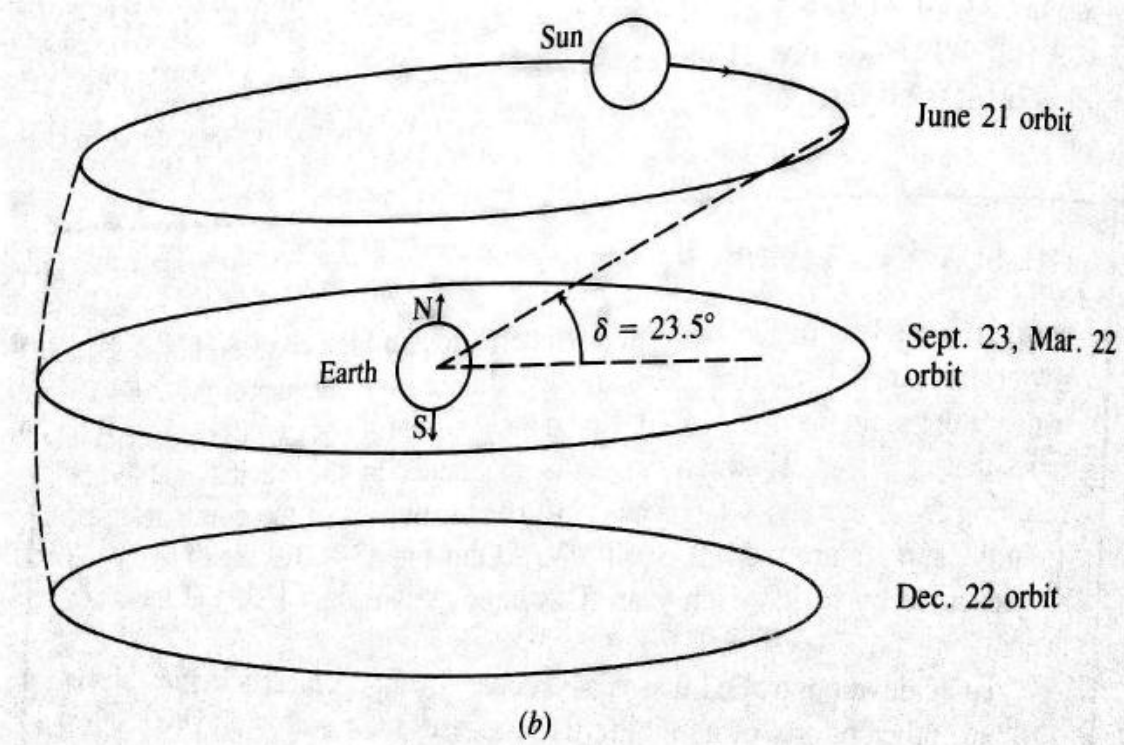


Figure 2.1 (*a*) The conventional sun-centered view of the sun-earth system. (*b*) An earth-centered view, which is easier to visualize. For example, the declination angle δ between the sun ray and the plane of the equator is better illustrated in *b*. The date given may vary by one day or so.

From “Solar Cells”, by C. Hu and R.M. White

Daily Variation in Energy Collection

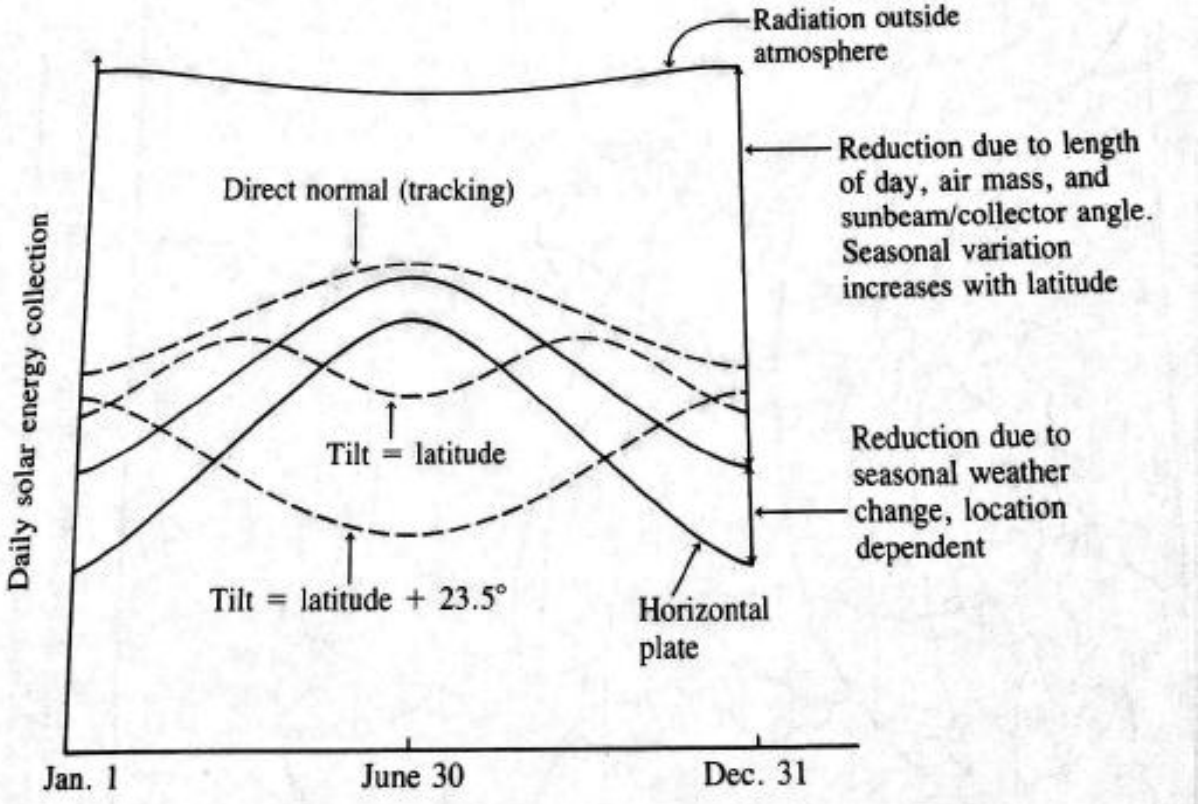


Figure 2.7 Qualitative plots of seasonal variations of daily solar energy collection for a location north of 23.5°N. "Tilt" (see Sec. 2.5) is the angle between the collector plate and the horizontal plane. The plate is tilted due south.

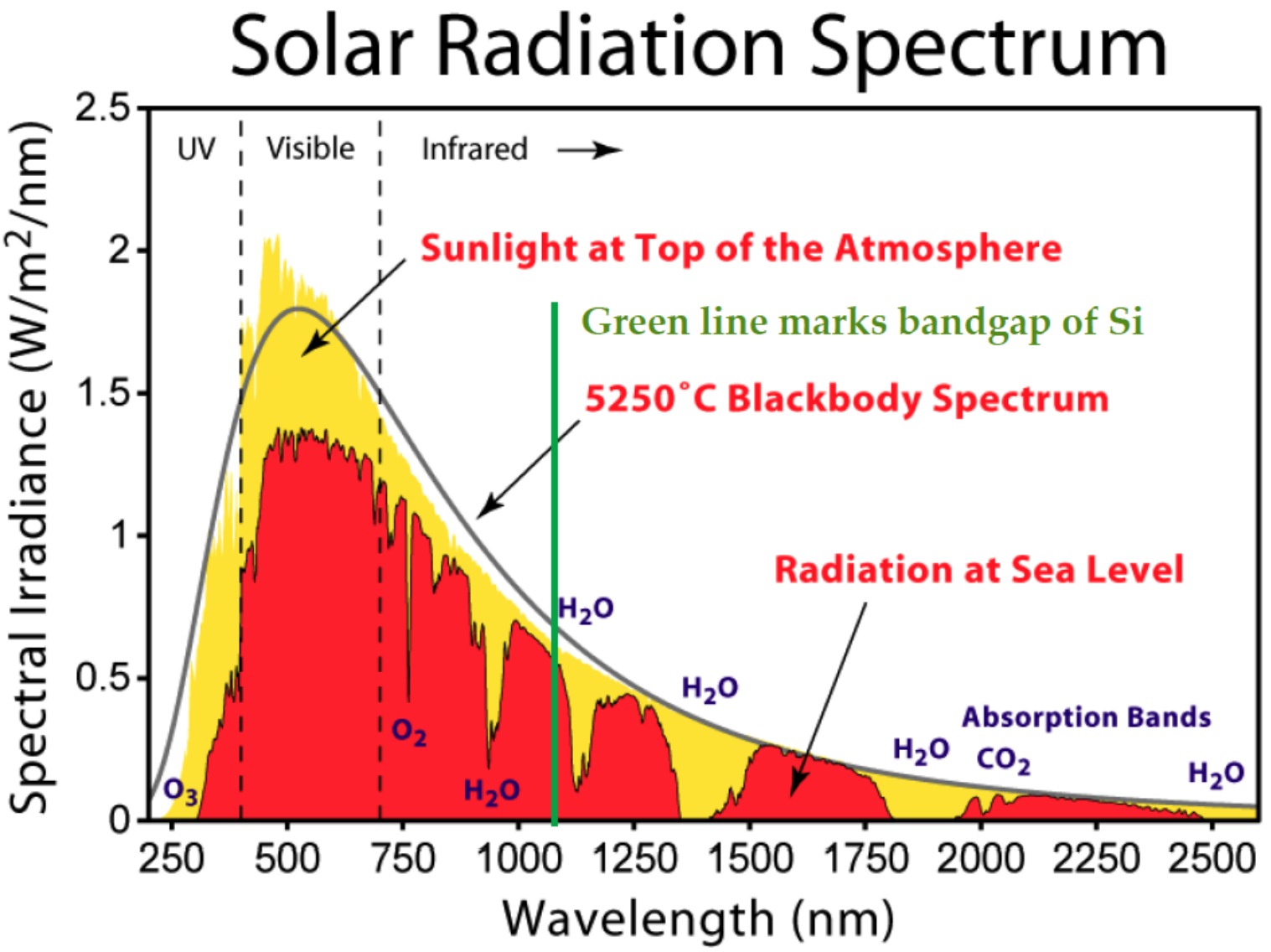
From "Solar Cells", by C. Hu and R.M. White

http://www.worldatlas.com/aatlas/imagee.htm

AM1.5

- AM1.5: The receiving surface is defined in the standards as an inclined plane at 37° tilt toward the equator, facing the sun (i.e., the surface normal points to the sun, at an elevation of 41.81° above the horizon)
- **Toledo latitude: 41.6639° N**

From Wikipedia



http://rredc.nrel.gov/solar/spectra/am1.5/

Lab Assignment

- LabView Follow on work, as indicated on Slide 4
- Explain how AM1.5G spectrum compares to the spectrum in Toledo
- (Possibly) Igor related
  - Download and Fit the AM0 spectrum to the Black Body spectrum (see next slide)
    - http://rredc.nrel.gov/solar/spectra or
    - http://www.pveducation.org/sites/default/files/PVCDROM/Appendicies/AM0AM1_5.xls

Black Body Spectrum

$$\frac{dN}{dt} \propto \frac{B}{\lambda^4 (e^{hc/\lambda kT} - 1)}$$

Here, we consider dN/dT to be the **spectral photon flux** (with units of *photons/(time-area-Δλ)*

Explain why the BB spectrum can be used as a fit, and report the fit temperature. Explain the Solar Constant, and its variation. How much sunlight hits the world?

Some reading material:

http://www.pveducation.org/pvcdrom/properties-of-sunlight/blackbody-radiation

NREL's PV Watts Calculator
http://www.nrel.gov/rredc/pvwatts/

http://www.pvresources.com/SiteAnalysis.aspx

Reference Spectrum here:

http://rredc.nrel.gov/solar/spectra