# Lecture #2
# Data Acquisition: About DAQ Hardware and LabView

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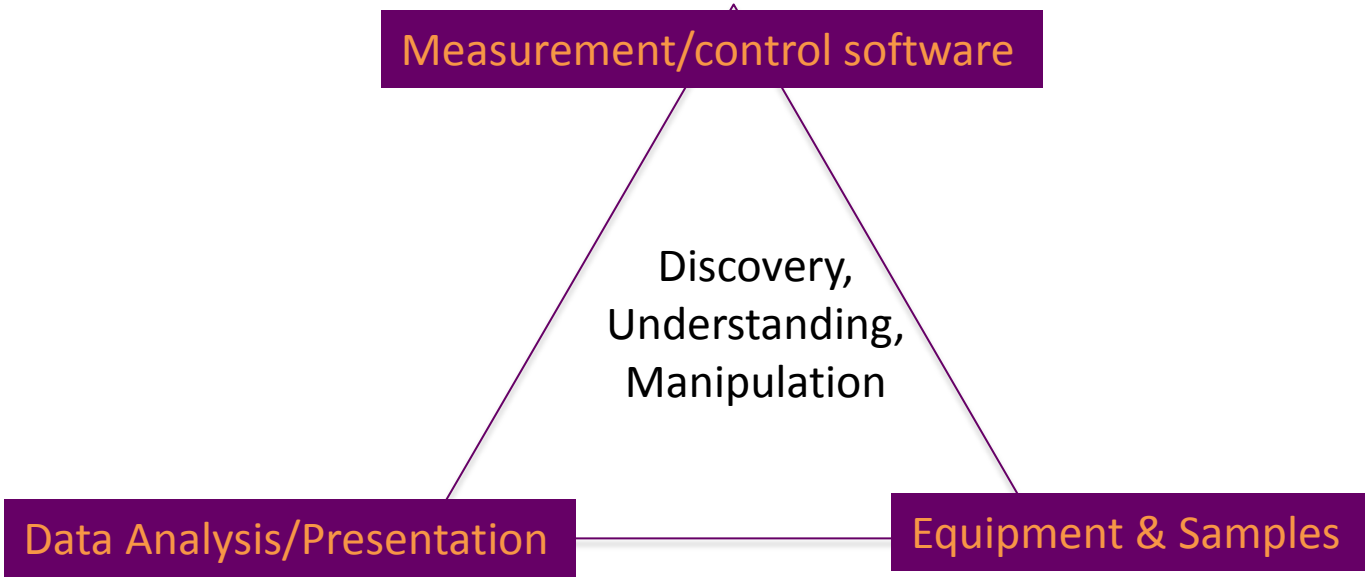
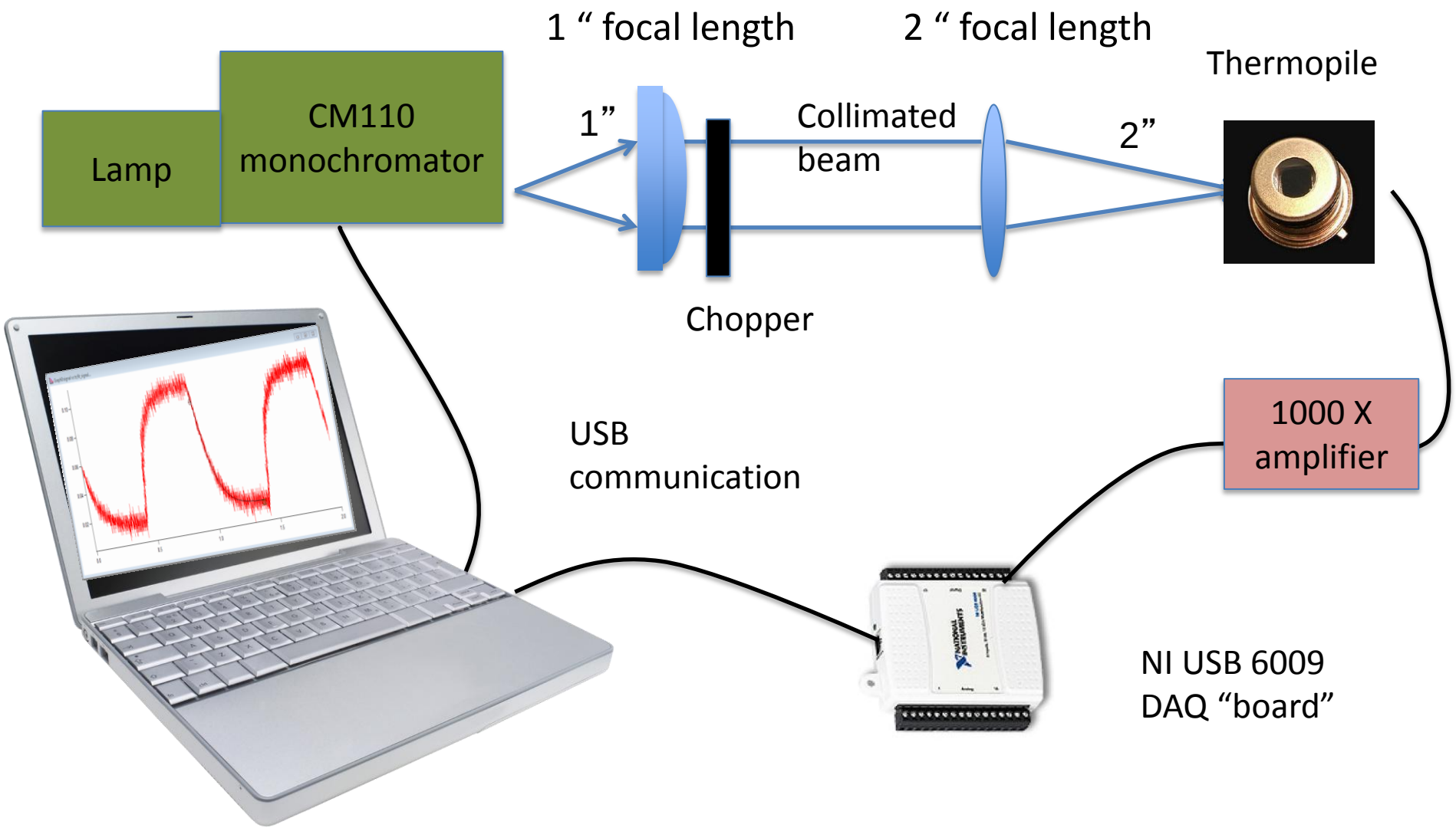
PHYS 4580, 6280, and 7280

# Last week

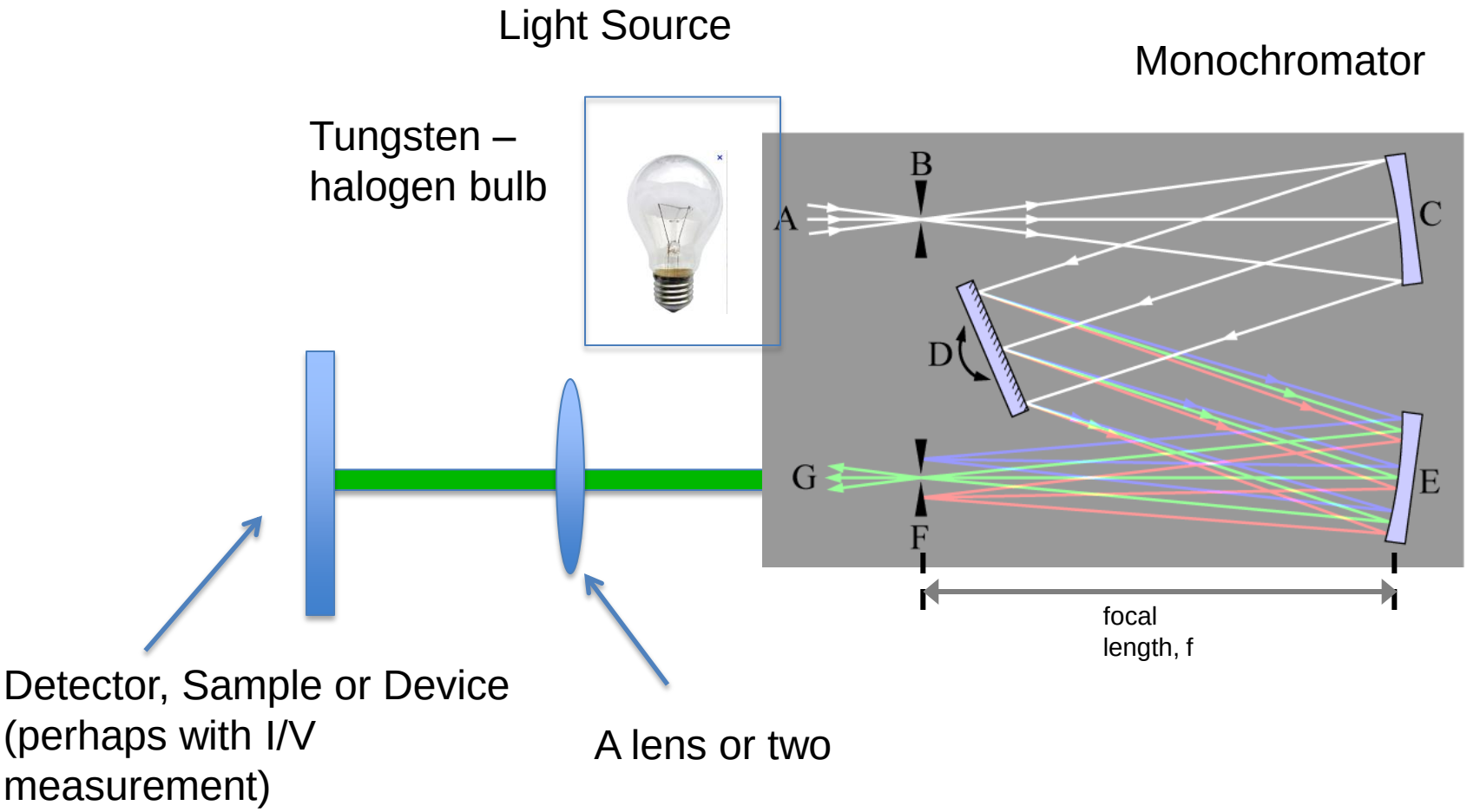
- Exercise to introduce students to:
  - LabVIEW (Measurement/control)
  - Igor Pro (Analysis/Presentation)
  - Optical measurement experimental Set-up.
- Time constant of Thermopile Detector



# Response time of the thermopile (at one wavelength)



# The “Set-Up”




Samples – semiconductor layers, transparent conductive layers, PV devices
Detectors – calibrated thermopile, photodiode

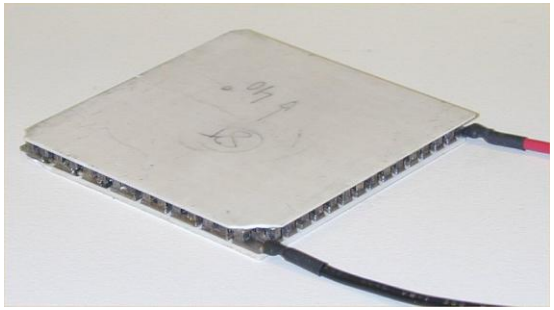
# Thermopile Detector

A thermopile is an electronic device that converts thermal energy into electrical energy. It is composed of several thermocouples connected usually in series or, less commonly, in parallel.

Thermopiles do not respond to absolute temperature, but generate an output voltage proportional to a local temperature difference or temperature gradient.

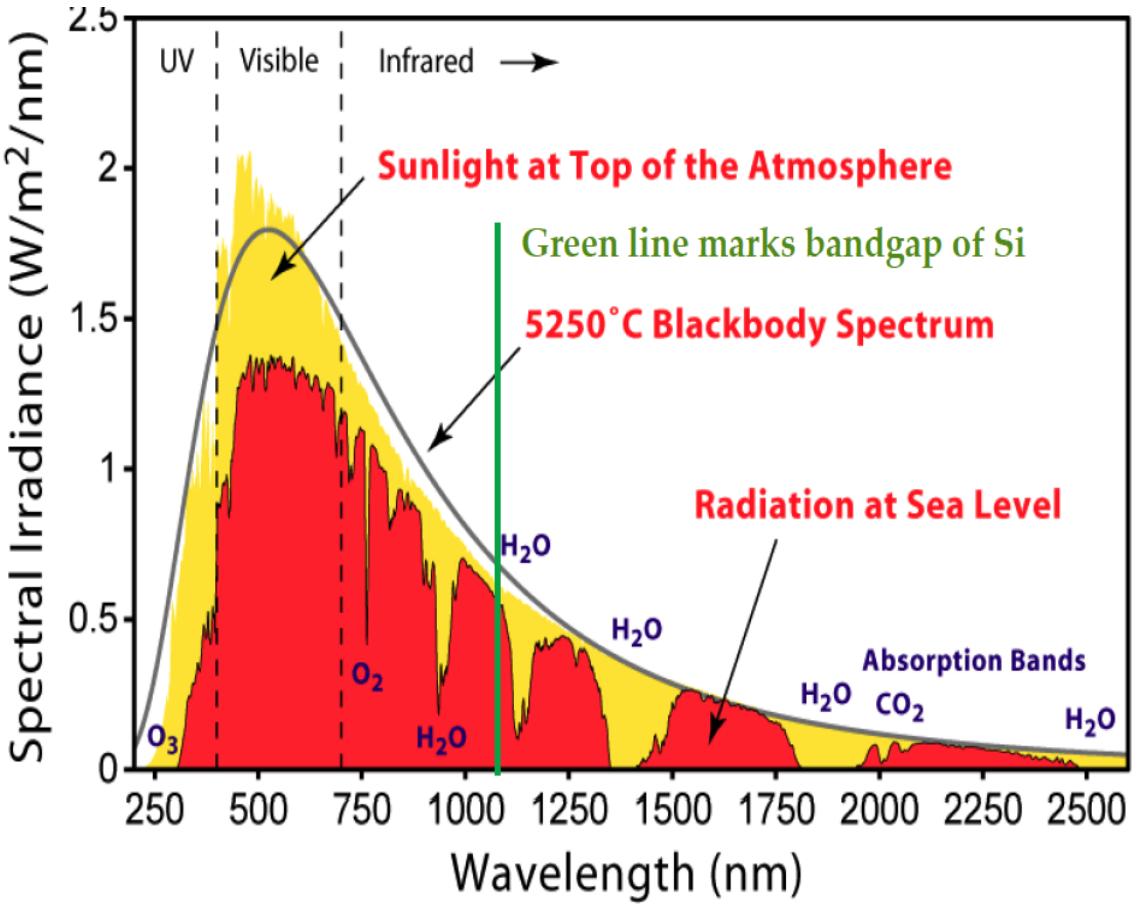
Thermopiles are often used to provide a voltage output in response to temperature as part of a temperature measuring device, such as the infrared thermometers widely used by medical professionals to measure body temperature. They are also used widely in heat flux sensors. The output of a thermopile is usually in the range of tens or hundreds of millivolts.

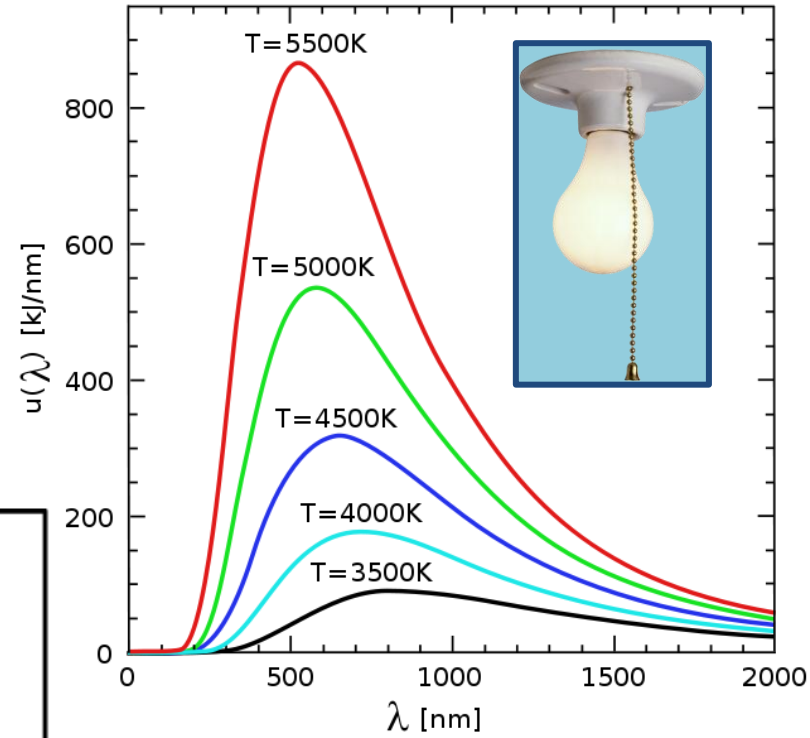
Dexter 2M detector

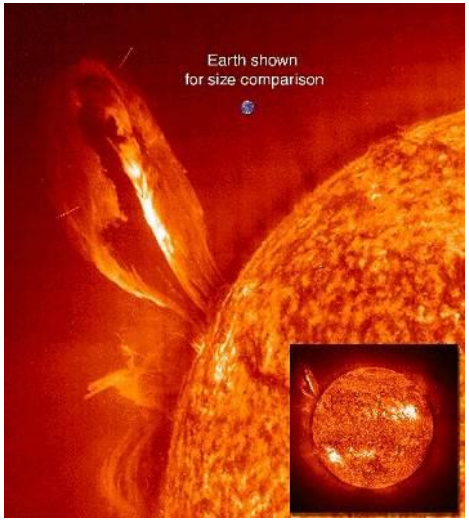


After *Wikipedia and Dexter Research*

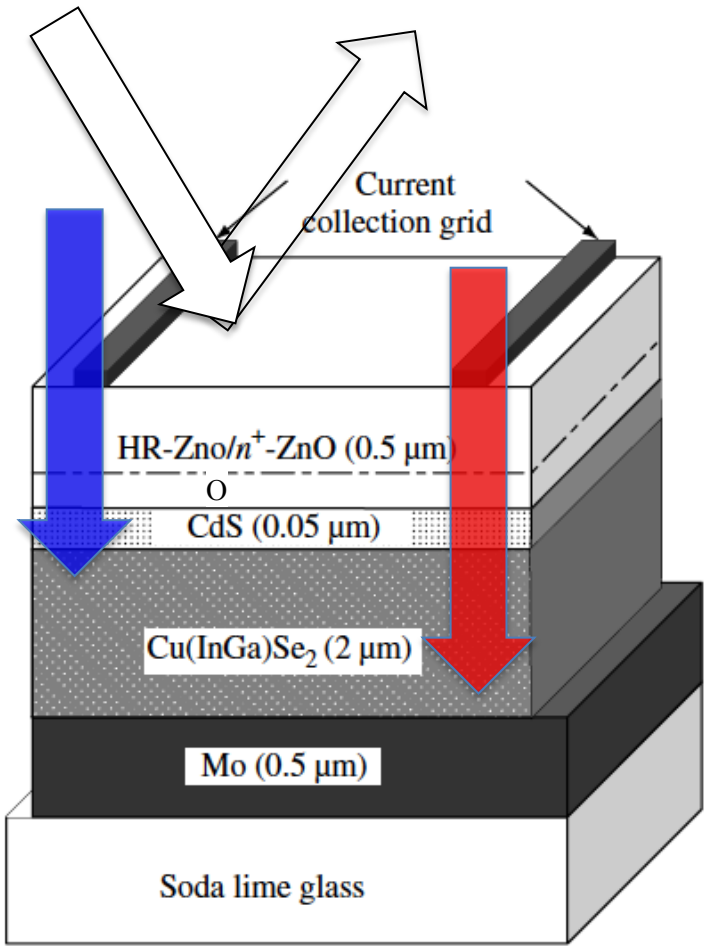
# Our Sun, and other Blackbody light sources, emit more than one wavelength of light.



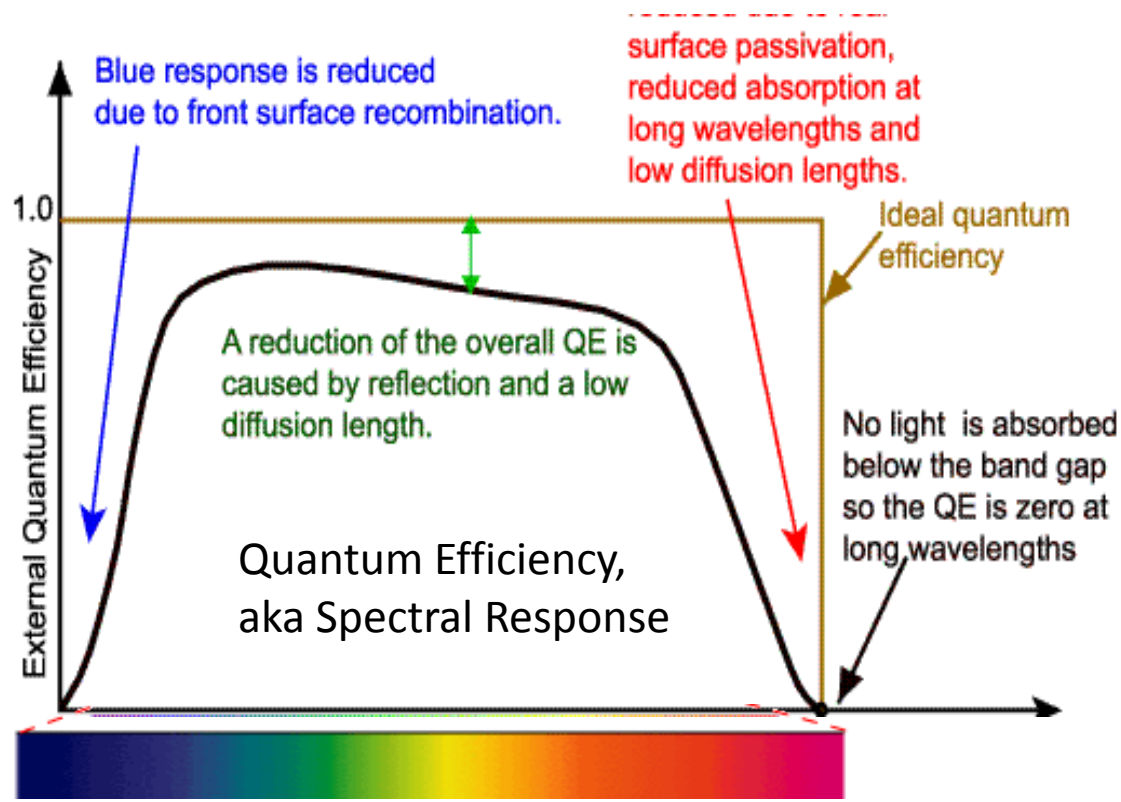



# Wavelength Dependent Response of PV Materials and Devices




Schematic cross section of a typical Cu(InGa)$Se_2$ solar cell



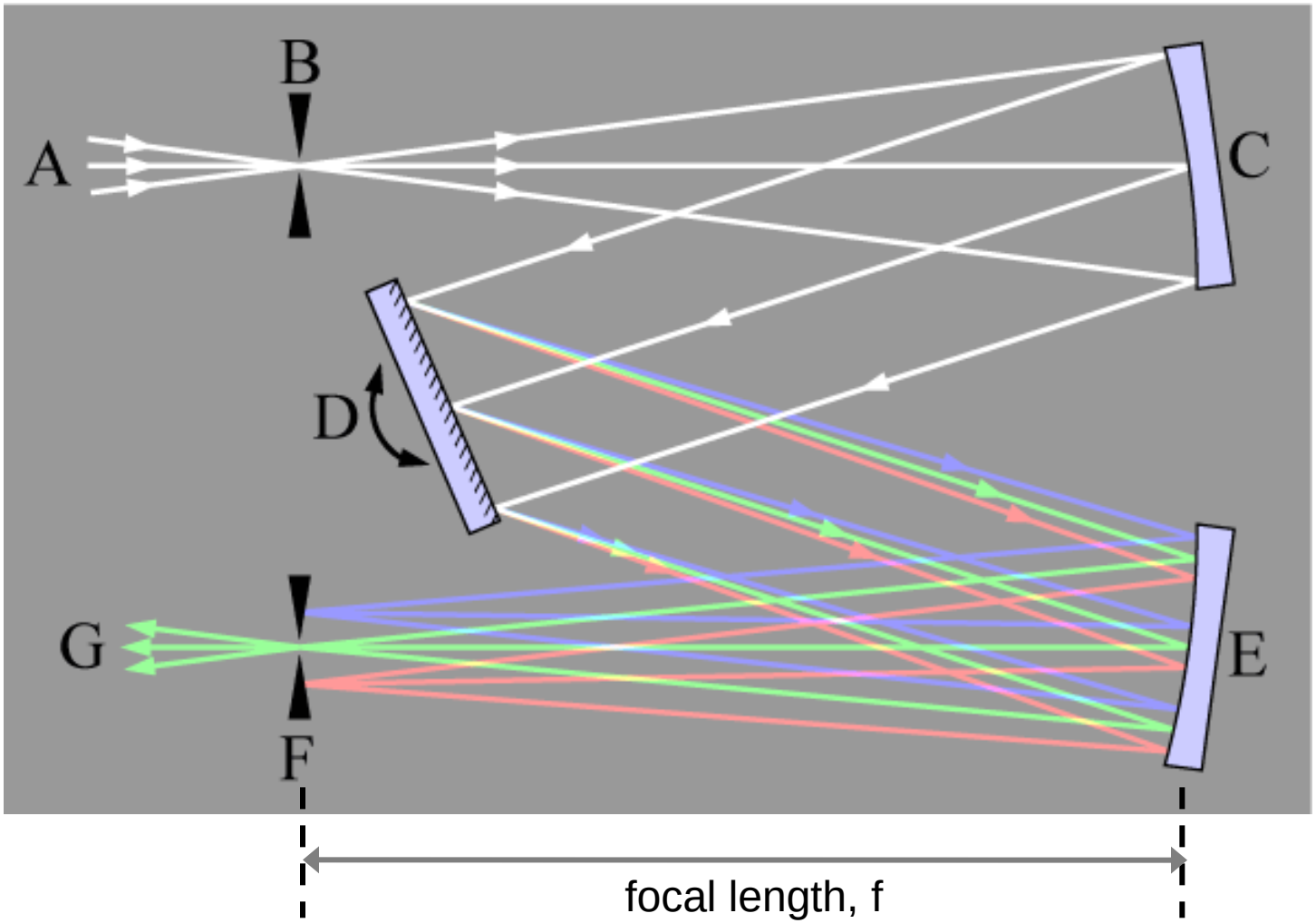

*From "Cu(InGa)$Se_2$ Solar Cells", by Shafarman and Stolt* and *PVEducation.org*

# Spectral Products, CM110 1/8th meter monochromator


| Feature | Value |
|---|---|
| Design: | Czerny-Turner, dual-grating turrets |
| Focal Length: | 110mm |
| f/#: | 3.9 |
| Beam Path: | Straight through standard, right angle provided on request. |
| Wavelength Drive: | Worm and wheel with microprocessor control and anti-backlash gearing. Bi-directional. Usable in positive or negative grating orders. |
| Wavelength Precision: | 0.2nm |
| Wavelength Accuracy: | ± 0.6nm |
| Slewing Speed: | >100nm/second |
| Stray Light: | $<10^{-5}$ |
| Slits: | Standard Set includes; 0.125mm, 0.15mm, 0.30mm, 0.6mm, 1.2mm and 2.4mm x 4.0mm. For other sizes, consult SP. |
| Max Resolution: | <1nm w/1200G/mm grating and standard slits |
| Gratings: | One to two gratings. (30 x 30mm) must be purchased. See Appendix A for options |
| Software: | Demonstration control program and LabView driver included. |
| Power: | UL listed 110/220V power pack |
| Interface: | RS232 standard |
| Warranty: | One year |
| Options: | • Hand-held control module with function keys and display for local control<br>• IEEE-488 interface<br>• Interface cables<br>• Gold optics<br><br>See options and accessories |

Serial commands sent from computer to CM110 via USB

# Czerny-Turner Monochrometer



# LabVIEW Training and References

http://www.ni.com/academic/students/learn/

Reference Textbook:

http://www.amazon.com/Hands-On-Introduction-LabVIEW-Scientists-Engineers/dp/0199925151

Analog to Digital Conversion (a through resource):

http://en.wikipedia.org/wiki/Analog-to-digital_converter