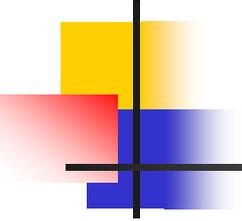


# CD Spectroscopy

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Dr. Chen-Hanson Ting  
Silicon Valley Forth Interest Group  
6/27/2015

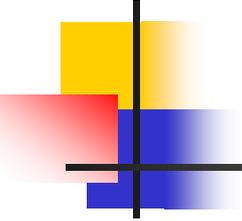


# CD Spectroscopy

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**CD's are manufactured with EXTRAordinary technology. So many of them are produced and they become ORDINARY, and escape attention.**

**CD's are excellent gratings, despite the circular grooves. Spectroscope, spectrograph and spectrometer can be built based on CD gratings.**



# CD Spectroscopes

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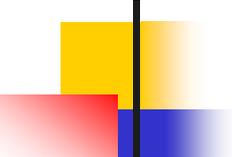
**Eyeballs are great instruments.**

**A very simple spectroscope can be built with 1 piece of CD fragment and 1 slit on a cereal box.**

**Improvement on the bare bone spectroscope can be realized in many ways.**

# CD Spectroscopy





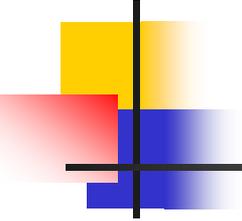
# CD Spectroscope



# Compact Fluorescent Lamp (CFL)

- **Very efficient**  
**Use  $\frac{1}{4}$  energy**
- **Interesting spectrum**  
**Mercury discharge**  
**Rare earth phosphors**





# CFL Bulb

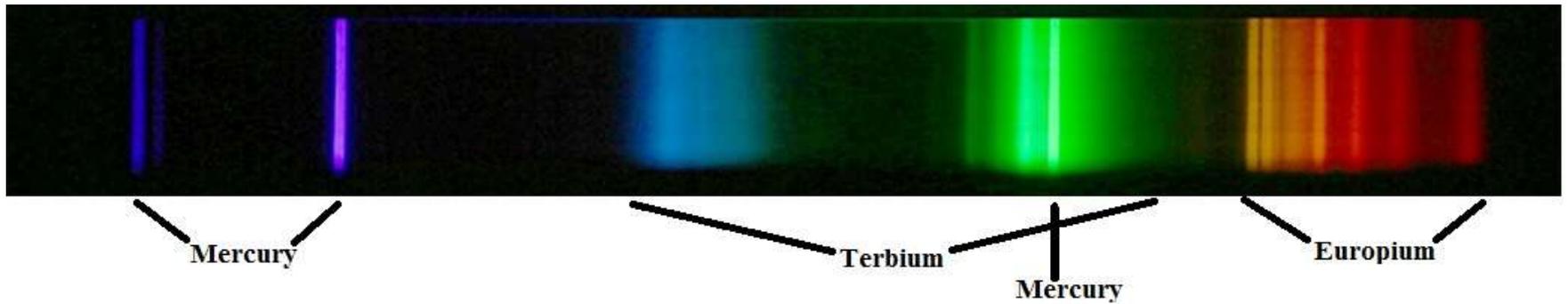
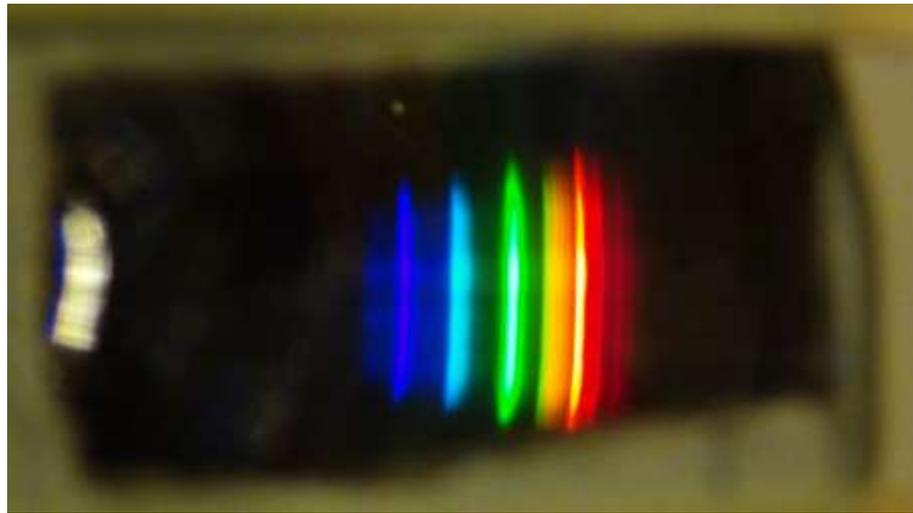
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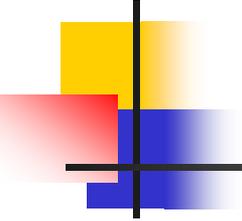
**It uses rare earth elements to make very efficient phosphors.**

**It requires rare earth elements yttrium, terbium, and europium.**

**All CFL bulbs are now manufactured in China, because China produces 80% of rare earth materials.**

# CFL Spectrum





# CFL Spectrum

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**Mercury discharge produces very sharp spectrum lines in ultraviolet, blue and green.**

**Ultraviolet light from mercury excites terbium and europium phosphors.**

**Terbium produces blue and green colors.**

**Europium produces red color.**



# Mercury Discharge Lamp

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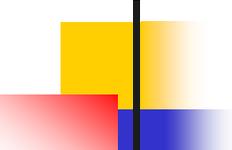
**Low pressure discharge mercury discharge lamp has very sharp atomic emission spectrum.**

**We used its deep UV light to erase UV-EPROMs.**

**It has sharp line in blue and green.**

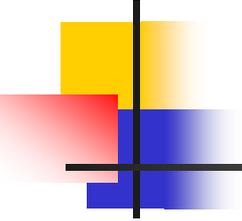
# Mercury Discharge Lamp





# Mercury Spectrum





# CD Spectrograph

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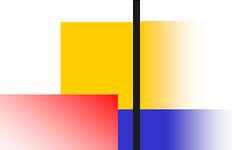
**Spectrographs are spectra recorded on photographic plates.**

**Modern digital cameras have millions of pixels and are capable of recording good spectrographs.**

**Digital spectrographs still need “development”.**

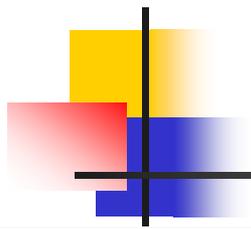
# My Spectrograph





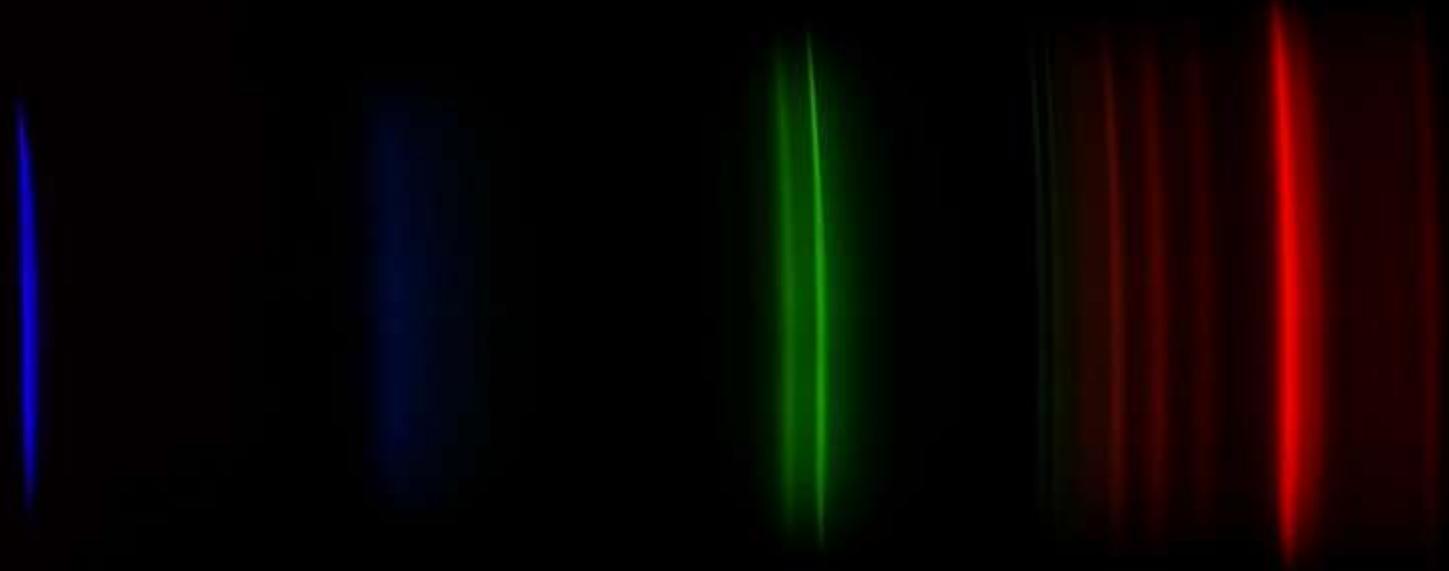
# My Spectrograph

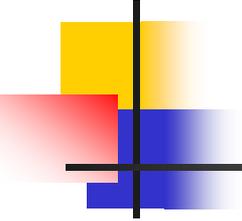




# Spectrograph of CFL

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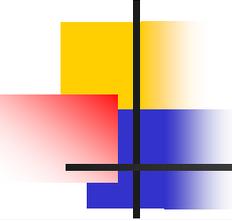
# Fraunhoffer Spectrum

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**The spectrum of sun has many dark lines, which were first discovery by Fraunhoffer.**

**The dark lines are caused by absorption of atoms in the atmosphere of sun.**

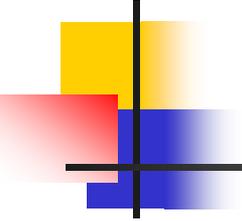
**It is not an easy task to photograph the Fraunhoffer lines.**



# Fraunhofer Lines of Sun

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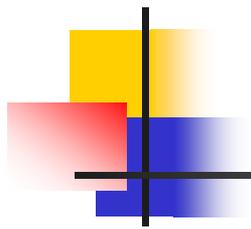


# CD Spectrometer

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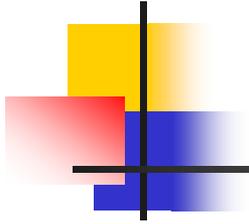
**Spectrometers record and display spectra electronically.**

**When the digital cameras develop smooth computer interfaces, the CD spectrograph I built can be converted to a spectrometer instantly.**



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**Questions?**



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**Thank you very much.**