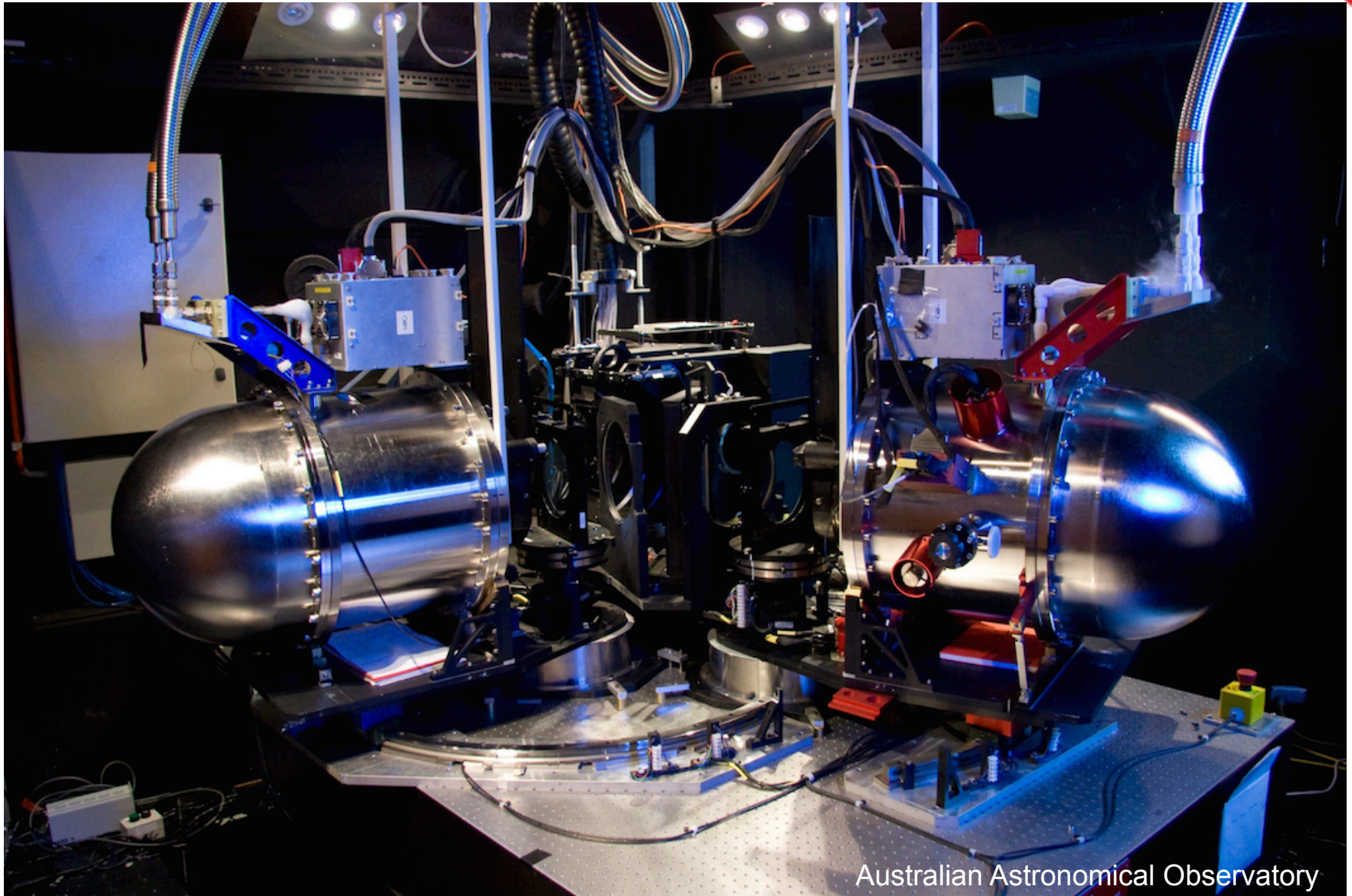




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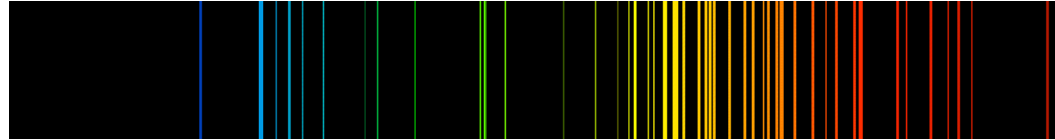
Spectrographs



Australian Astronomical Observatory

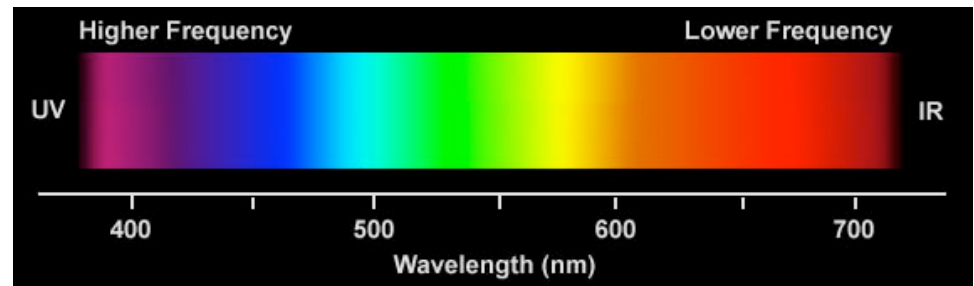
Different kinds of spectra

› Emission Spectrum



Alan Jircitano, University of Kansas

› Continuum Spectrum



Steven Pemberton, CWI

› Absorption Spectrum



<http://www.astronomyknowhow.com/spectral-lines.htm>



Emission Spectra



Electron orbits in a hydrogen atom

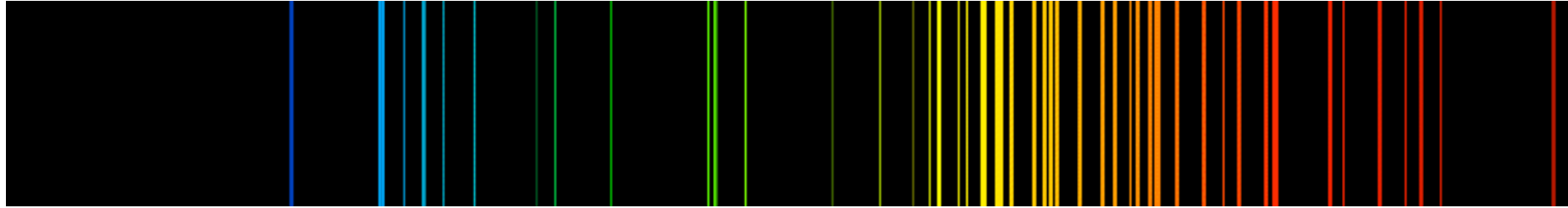


Electron levels in a hydrogen atom

<http://www.bbc.co.uk/bitesize/higher/physics/radiation/optoelectronics/revision/2/>

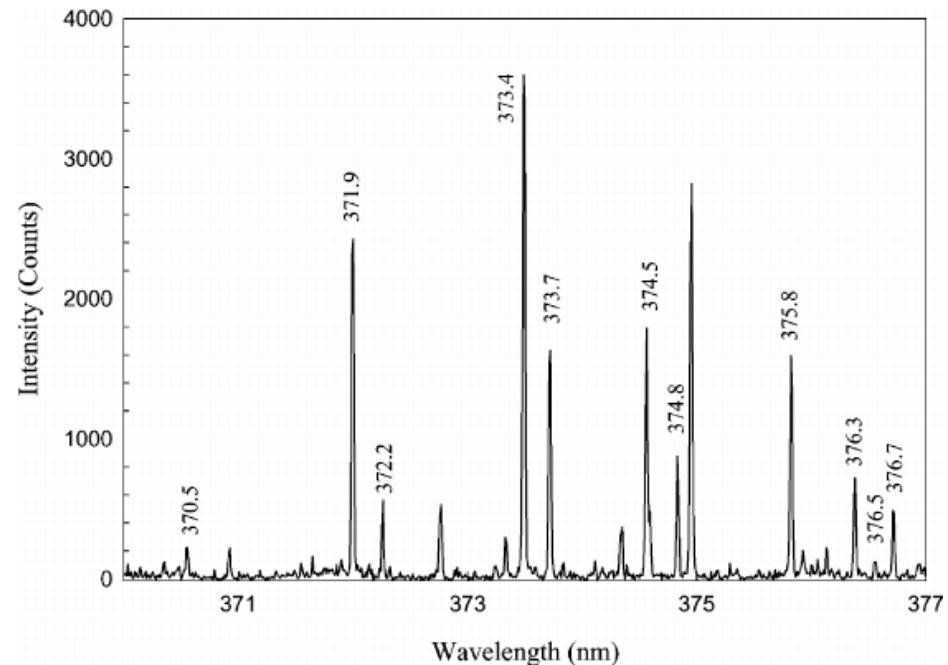
- › Electrons can only sit in specific energy levels around an atom
- › When they move between these levels they must either gain or lose a specific amount of energy
- › When they lose energy they emit this as a photon with a specific energy, corresponding to a specific wavelength (colour)

Emission Spectra



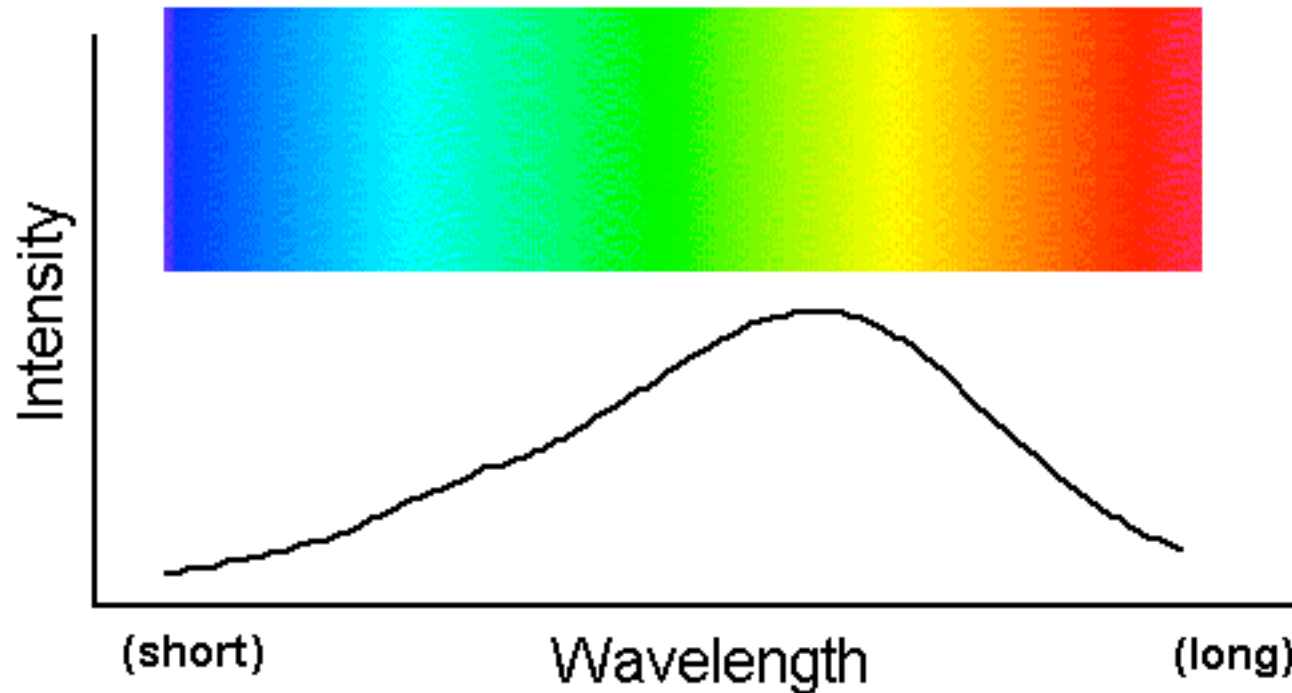
Alan Jircitano, University of Kansas

- › Narrow lines with very little light in between
- › Produced by a hot, low-density gas
- › Each element has different energy levels, so a different emission spectrum
- › <http://chemistry.bd.psu.edu/jircitano/periodic4.html>



Detalle et al., (2001)

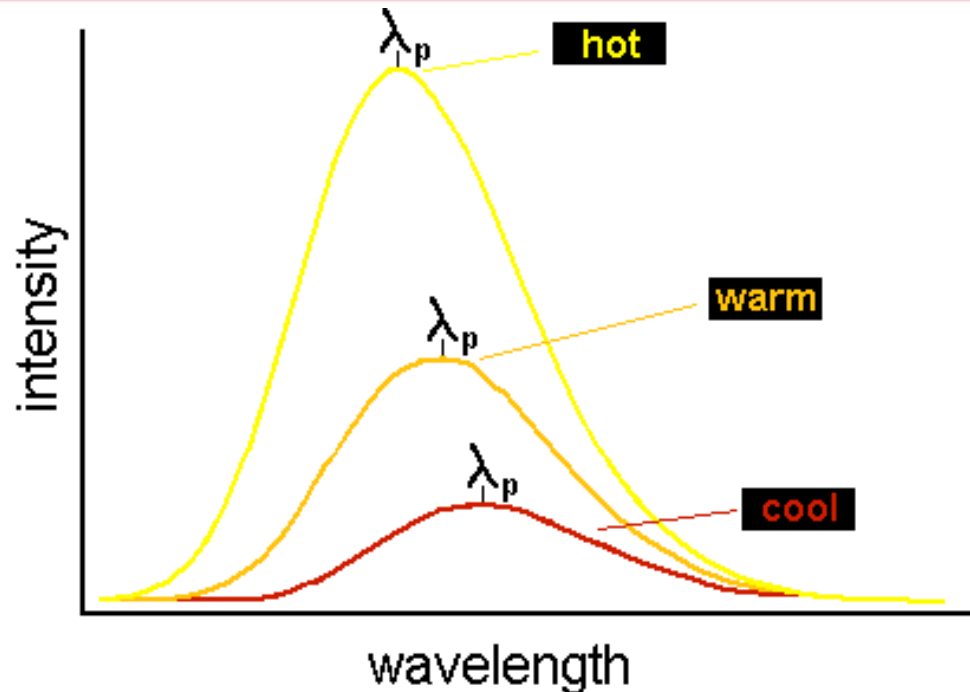
Continuum Spectra



<http://www.sarracenia.com/astronomy/remotesensing/physics040.html>

- › In dense materials the emission lines in emission spectra can get blurred out and merged together
- › If it is dense enough the lines all merge into one continuous sequence – a continuum spectrum

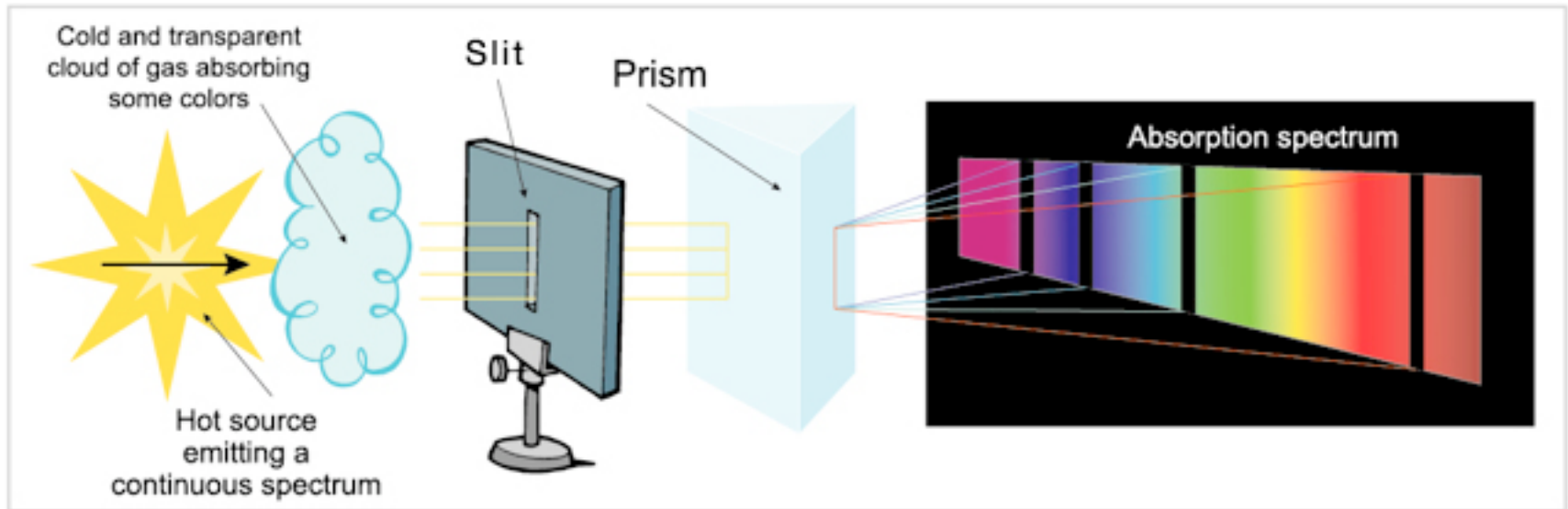
Continuum Spectra



<http://www.sarracenia.com/astronomy/remotesensing/physics040.html>

- › But just because it's a continuous spectrum doesn't mean the original light was white – different amounts of red/green/blue light can be emitted
- › A special kind of continuum spectrum is a black body – a spectrum that depends only on the temperature of the source of the light
- › https://phet.colorado.edu/sims/blackbody-spectrum/blackbody-spectrum_en.html

Absorption Spectra



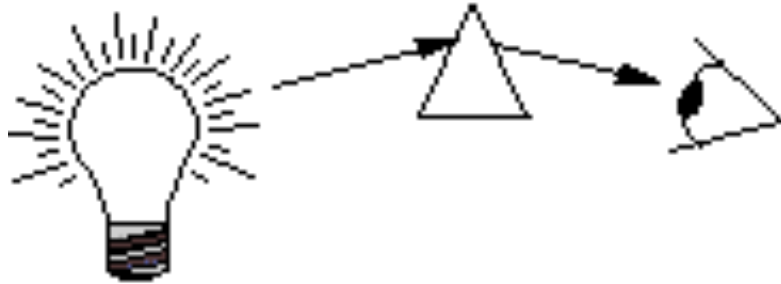
www.virtualmuseum.ca/edu

- › What happens when we put a cloud of cold gas in front of a black body spectrum?
- › Hot gas emits an emission spectrum, but cold gas absorbs at the same wavelengths!

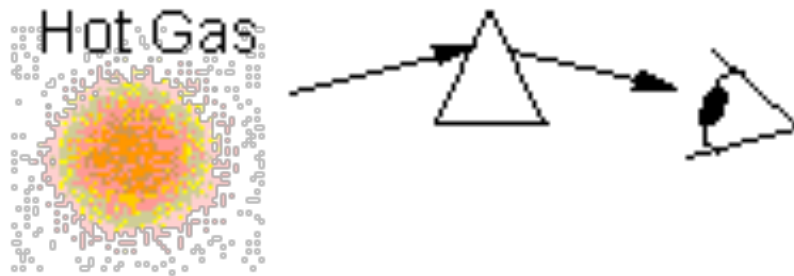
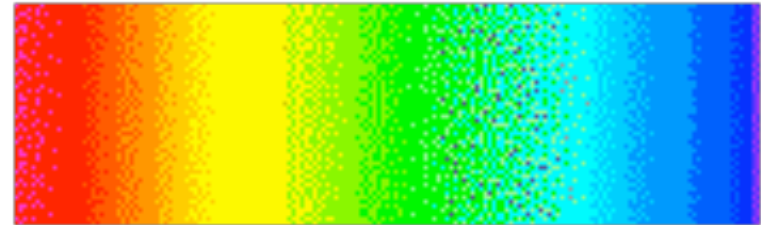


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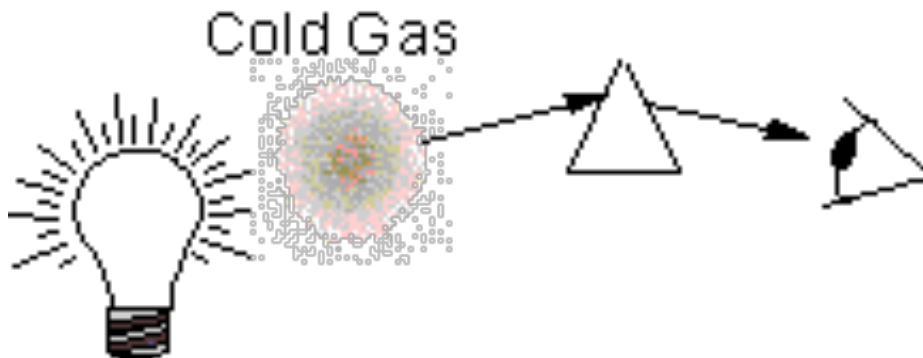
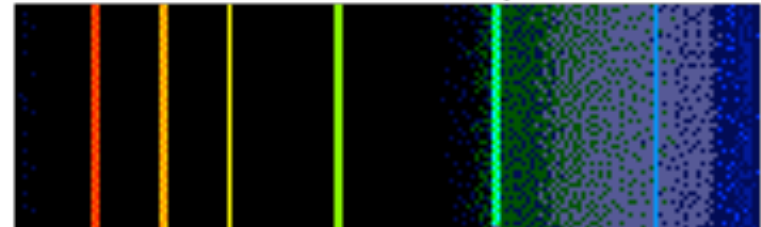
Different kinds of spectra



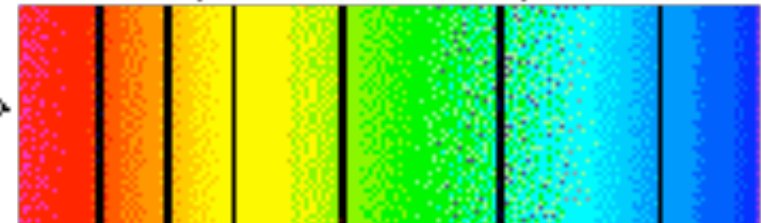
Continuum Spectrum

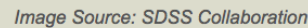


Emission Line Spectrum



Absorption Line Spectrum

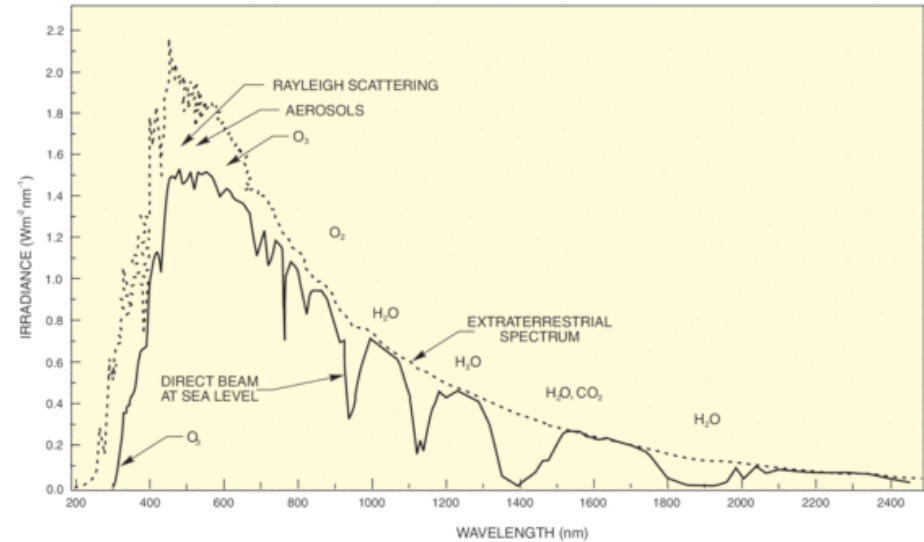
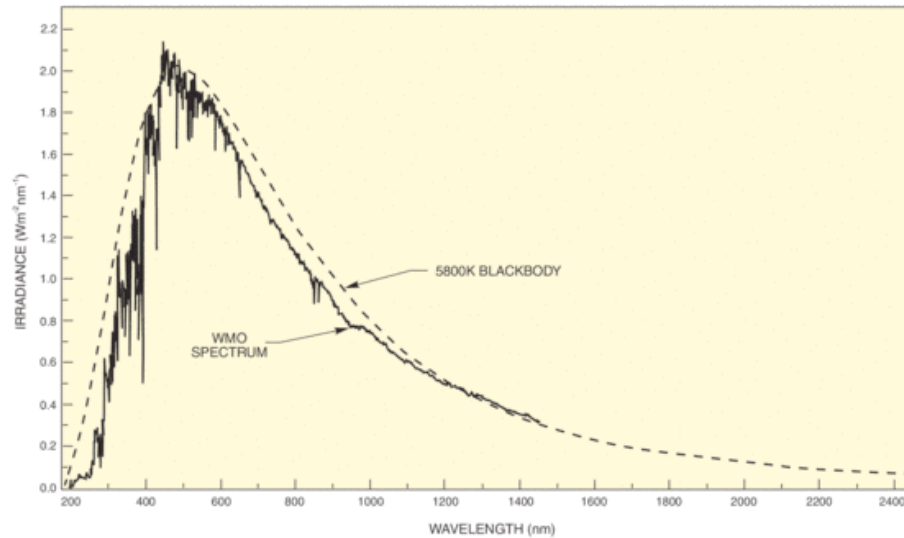




- › White dwarf stars are 'dead' stars that are hot and dense
- › O and B stars are extremely massive, hot, young stars



Astronomical Spectra – the Sun

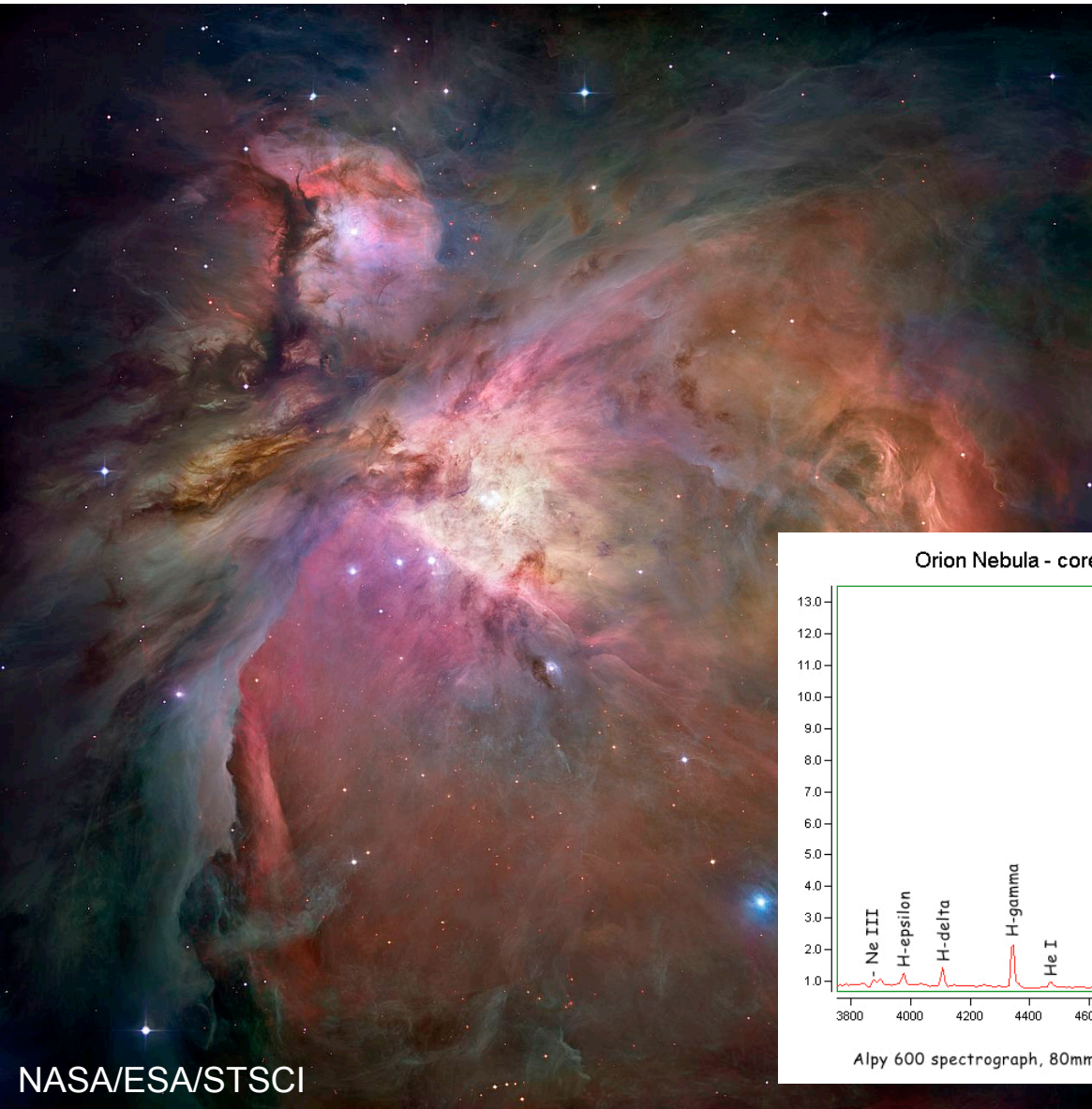


<https://www.newport.com/t/introduction-to-solar-radiation>

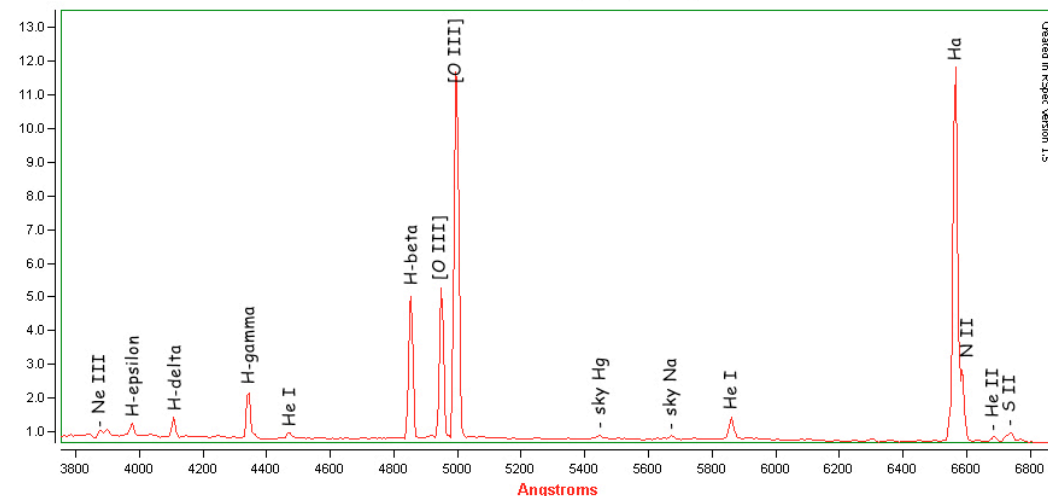
- › The spectrum of our Sun is more complicated – it is like a black body but with many complex absorption features
- › These absorption features tell us about the chemical composition of the Sun, and the density and temperature of the Solar atmosphere
- › At the surface of the Earth we see even more absorption features due to the Earth's atmosphere

Astronomical Spectra - nebulae

- › Nebulae are clouds of hot gas
- › Either hot gas around recently formed stars
- › Or hot gas produced by an old or dying star

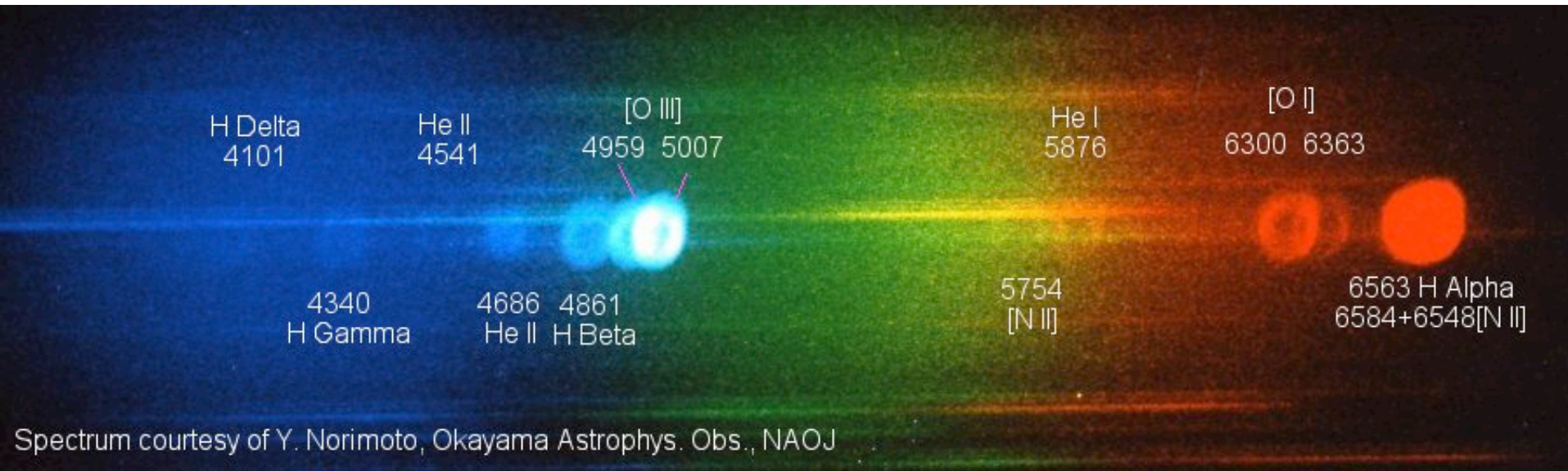


Orion Nebula - core next to Trapezium star group Alpy 600/DMK41 01 Feb 2014

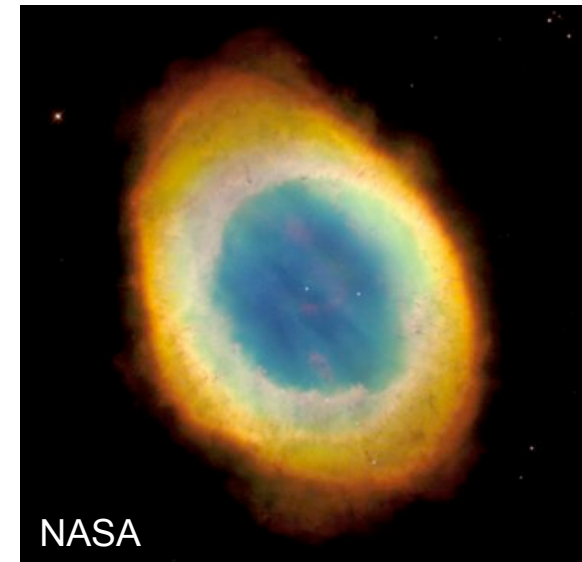


Alpy 600 spectrograph, 80mm f/6 APO, DMK41 CCD video Jim Ferreira, Livermore CA bakerst@comcast.net

Astronomical Spectra - nebulae

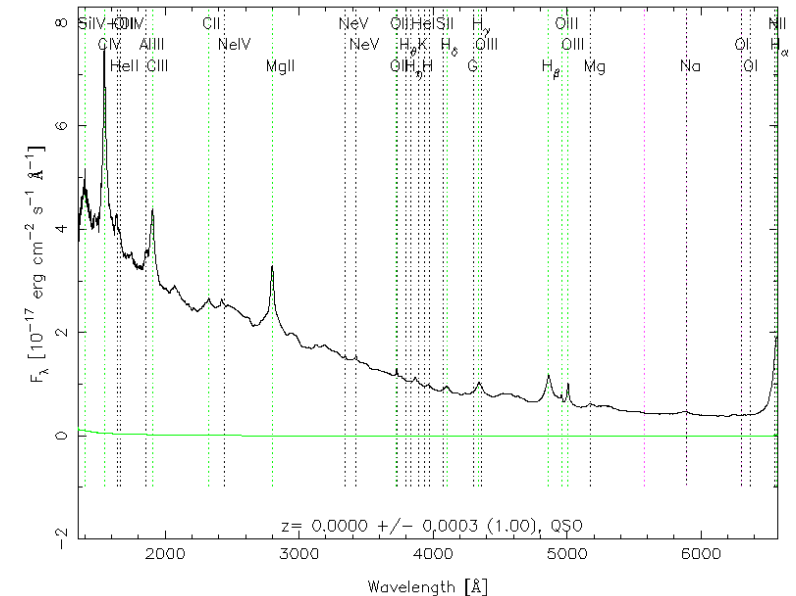
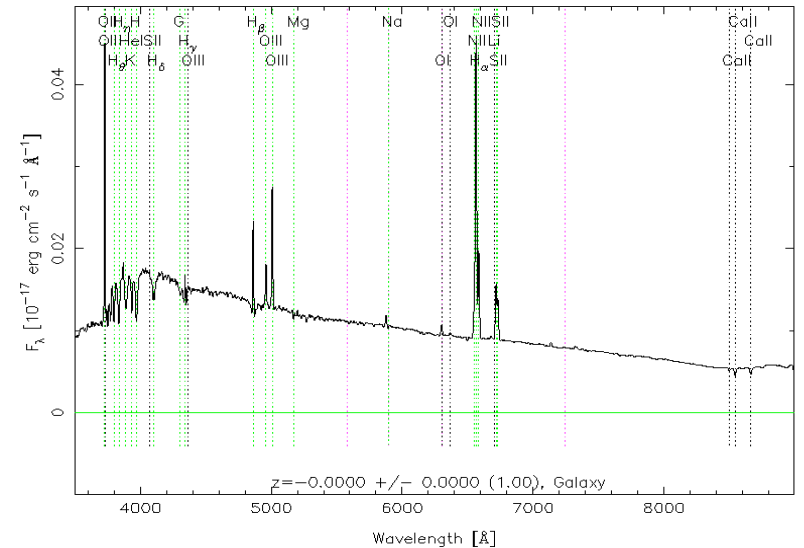
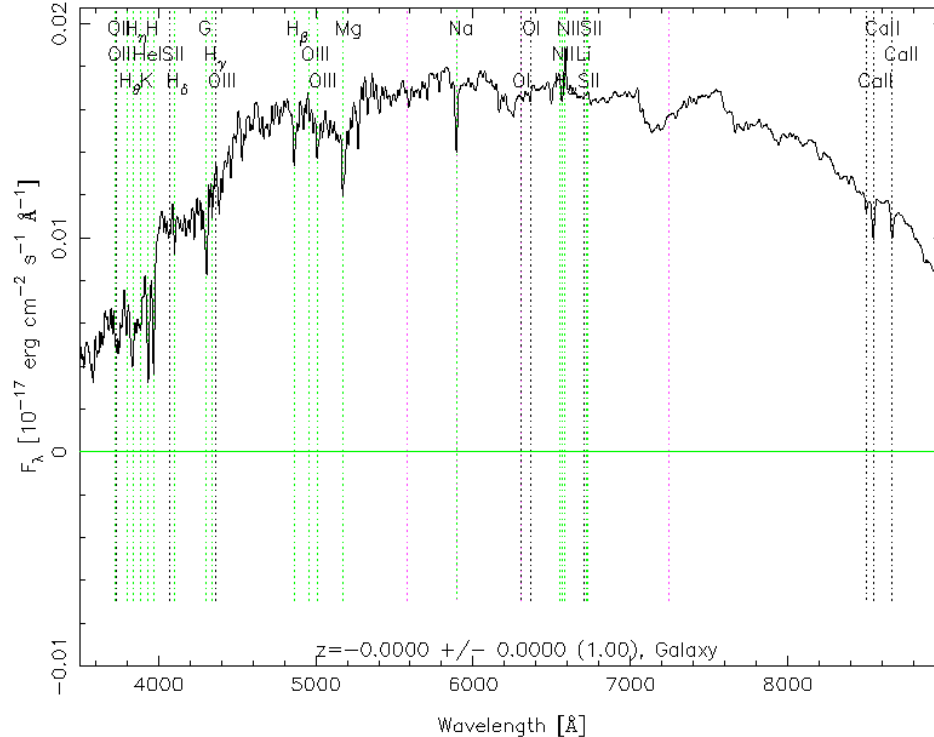


- › Ring nebula is a ‘planetary nebula’ – produced when an old star sheds its atmosphere



Astronomical Spectra - Galaxies

SDSS spectra of galaxies



- › Spectra of galaxies are the sum of all their components – stars, nebulae, even emission from supermassive black holes
- › Analysing these spectra is how we learn about distant galaxies