CH 660 Spring 2007

Spectrochemical Analysis

Lecture 1

Outline

1. Introduction

2. Syllabus and Grading

3. History of Spectrochemical Analysis

CH 660 Spectrochemical Analysis

INSTRUCTOR
Dr. Alexey Shvarev

LECTURES
MWF 9:00 am to 9:50 pm in GBAD 211

OFFICE HOURS
TR 8:30 am to 10:00 am in Gilbert 249

TERMS OFFERED
Spring 2007, Spring 2009

COURSE DESCRIPTION AND OBJECTIVES

Theoretical concepts and methodology of optical spectrochemical methods of analysis, components of
Spectrochemical instruments, flame and electrothermal atomic spectrophotometry, ICP atomic emission spectrometry,
molecular absorption and fluorescence spectrometry.

Students must demonstrate the ability to state and illustrate the fundamentals of spectrometric measurements (e.g.,
interactions of radiation and matter) identify the critical characteristics of the primary components of spectrometers (e.g.,
sources, photodetectors) discuss the factors that affect the quality of spectrometric measurements (e.g., interferences, signal-to-
noise ratio) and methods to improve the quality of measurements (e.g., standard addition) discuss and contrast specific
spectrometric methods including atomic absorption spectrophotometry, plasma emission spectrometry, ICP/MS
spectrometry, UV-visible spectrophotometry (molecular absorption), molecular fluorescence spectrometry) read and critically
evaluate a current journal article in spectrochemical analysis

This course is not an experimental course and will not cover the operation of specific instruments.

COURSE MATERIALS

Lecture notes

Spectrochemical Analysis by J. D. Ingle and S. R. Crouch. ISBN 0138268762.

COURSE TOPICS

Near UV-visible-near IR region (200 to 1000 nm) (similar instrumental and optical requirements)

Emphasis on analysis (determining the concentration of trace to major species in a sample)

Not covered:

IR and Raman spectrometry, scattering techniques (covered in CH 567)

NMR, mass spectrometry, X-ray techniques (not in textbook)

Coverage by chapter (see table of contents in textbook):

1-6 general principles, methodology, instrumental components

7, 8, 10 atomic spectrometric techniques

12, 13, 15 molecular spectrometric techniques

GRADING (tentative)

100 pts total.

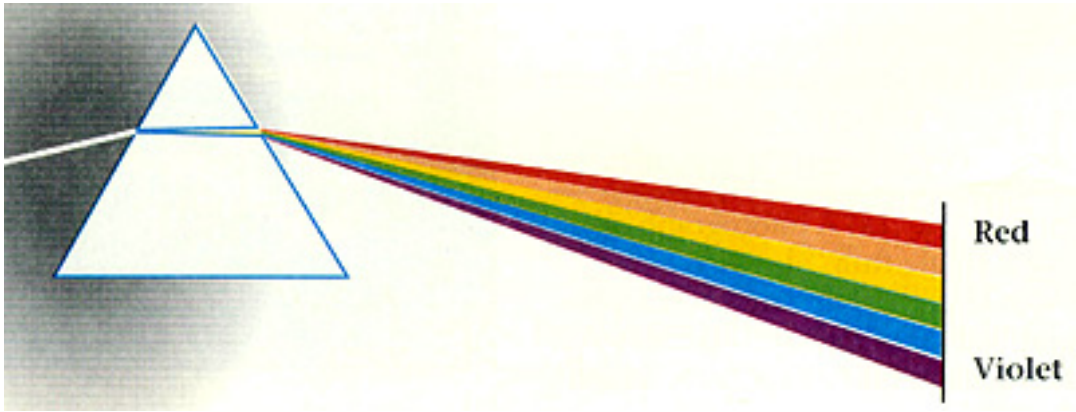
2 midterms and a final. Each is worth 25 pts.

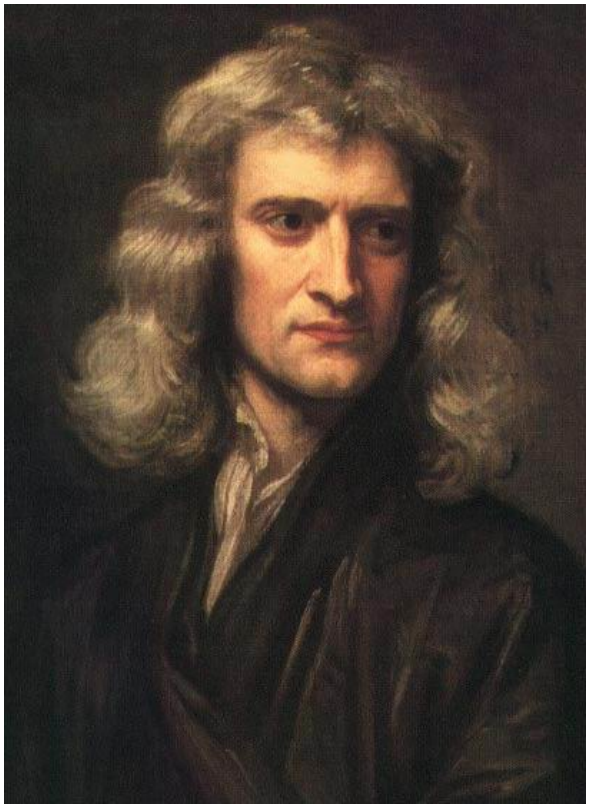
Problem sets 25 pts.

"Spectrochemical Analysis Methods of chemical analysis that depend upon the measurement of the wavelength and the intensity of electromagnetic radiation…"

Encyclopedia Britannica

1670 Refraction of Light, Spectrum

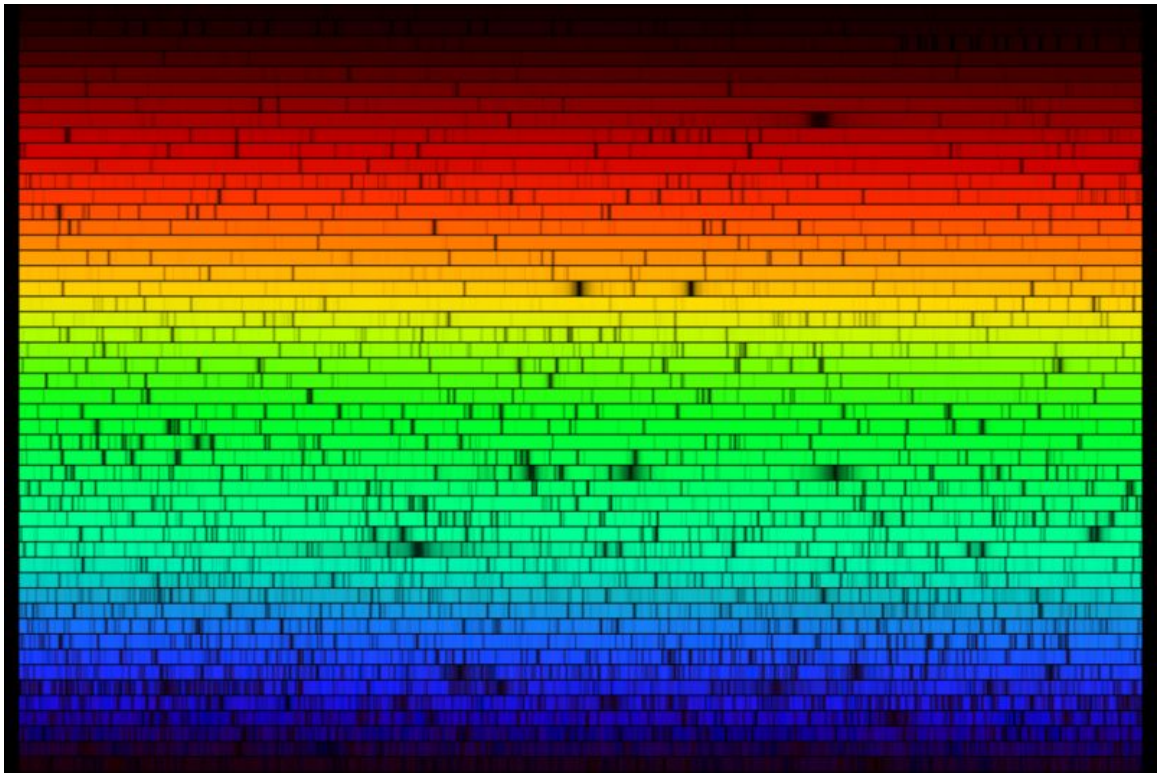




Sir Isaak Newton (1643-1727)

1814 Spectroscope and Diffraction Grating

Josepf von Fraunhofer (1787-1826)



1824 Photographic Process

Niecefore Niepce
(1765-1833)

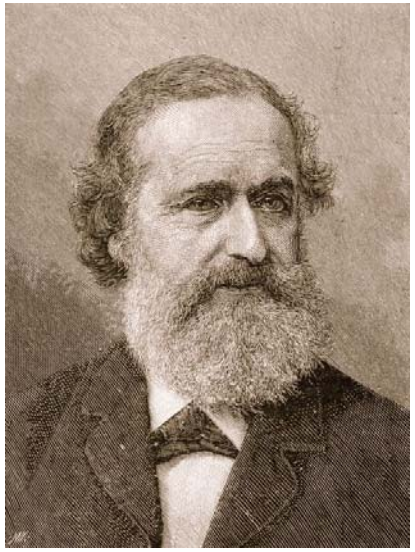
Louis Daguerre
(1787 – 1851)

1826 Spectrochemical Analysis

Sir John Frederick William Herschel, 1st Baronet KH (1792–1871)

"a glance at the prismatic spectrum of a flame may show it to contain substances which it would otherwise require a laborious chemical analysis to detect…"

1860 Spectrochemical Analysis: Discovery of New Elements



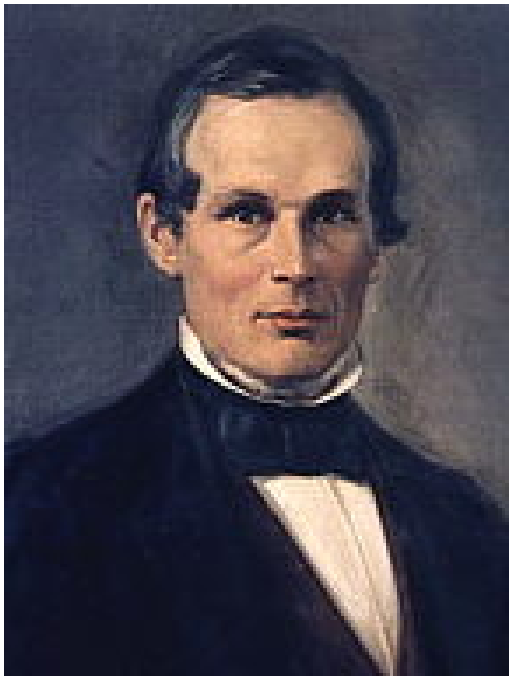
Gustav Robert Kirchhoff (1824 –1887)

Robert Wilhelm Bunsen (1811 – 1899)

1860	Cs, Rb
1861	Tl
1863	In
1868	He
1875	Ga …

"In this time-consuming, extensive research, which need not be presented here in detail, it came out that the variety of the compounds in which the metals were used, the differences in the chemical processes of the flames, and the great difference between their temperatures *had no influence on the position of the spectral lines corresponding to the individual metals…*"

1862 Spectroscopy + Photography = Discovery of Hydrogen in the Sun's Atmosphere



Anders Jonas Angström
(1814 – 1874

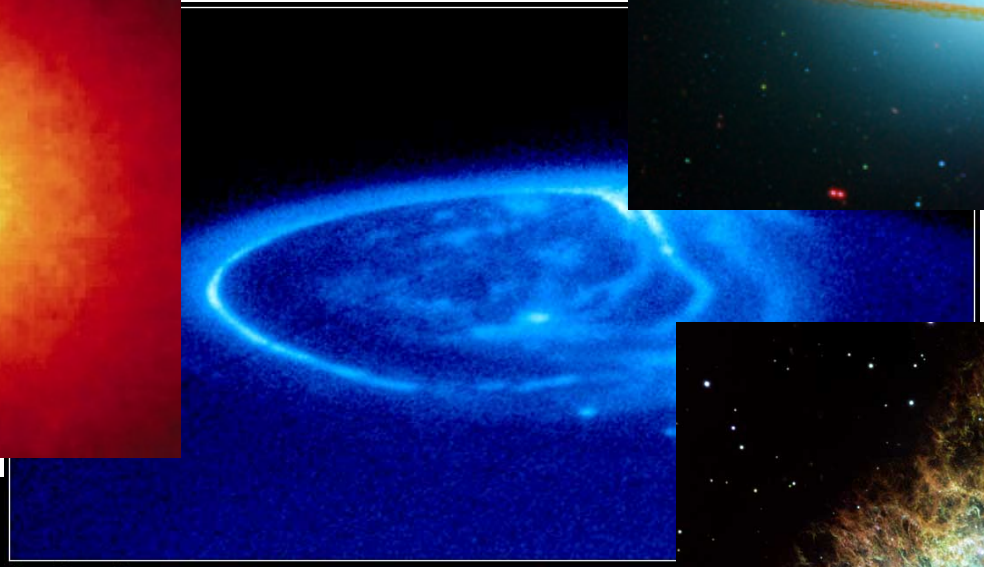
1884 Balmer's Formula

Johann Jakob Balmer
(1825 – 1898)

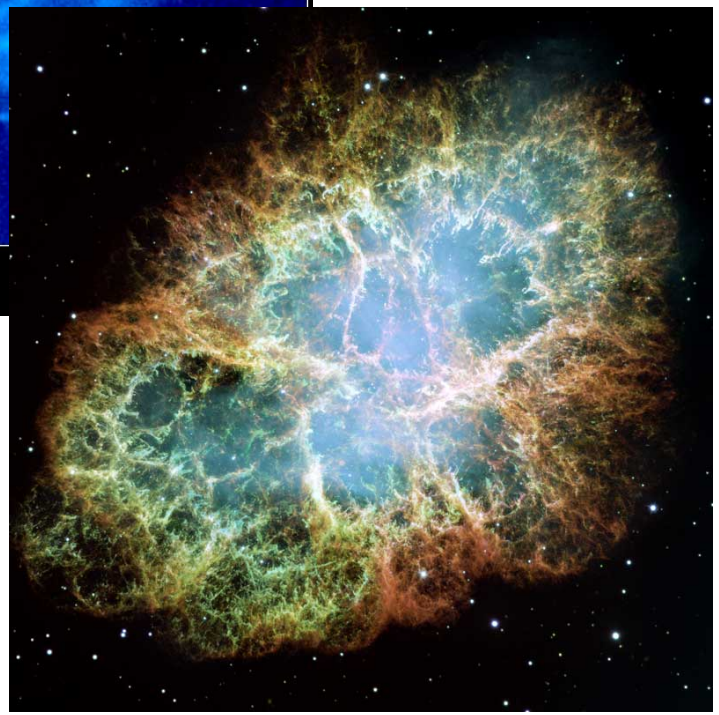
$$\lambda = \frac{hm^2}{m^2 - n^2}$$

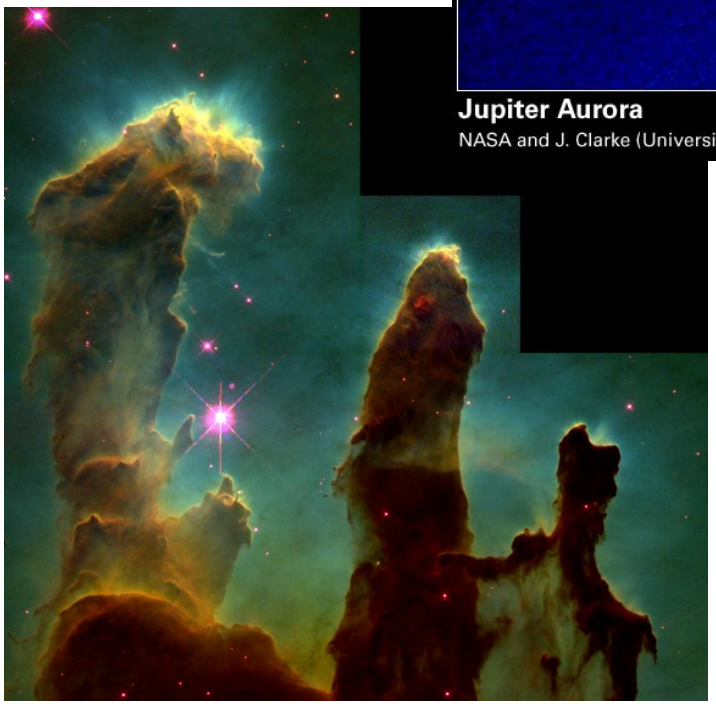
"It appeared to me that hydrogen . . . more than any other substance is destined to open new paths to the knowledge of the structure of matter and its properties. In this respect the numerical relations among the wavelengths of the first four hydrogen spectral lines should attract our attention particularly…"

Hubble Space Telescope



Jupiter Aurora
NASA and J. Clarke (University of Michigan) • STScI-PRC00-38





Source: NASA, www.hubblesite.org