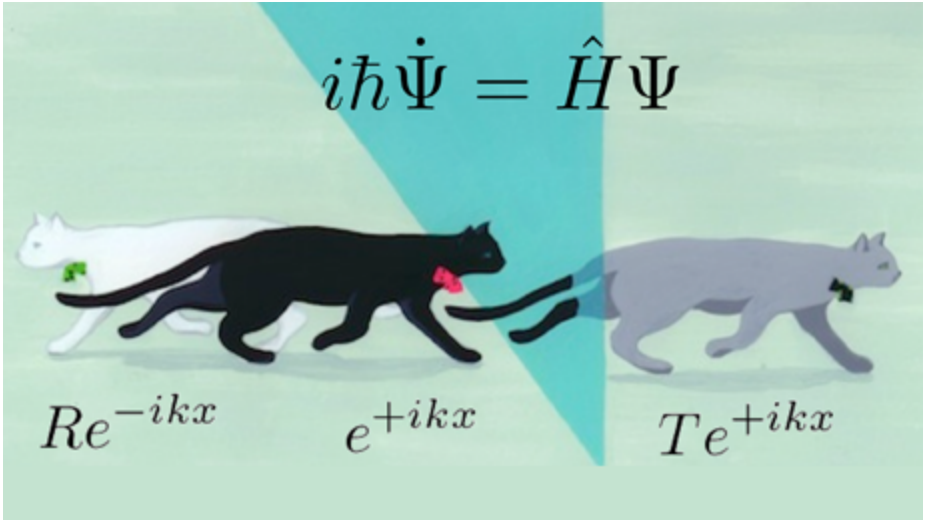
Exploring Quantum Physics

Coursera, Spring 2013 Instructors: Charles W. Clark and Victor Galitski

Atomic Structure and Spectra

Part I. Introduction to optical spectra



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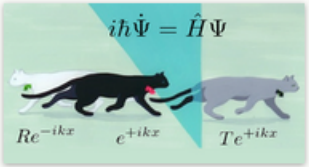

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Additional Materials

Mathematical References

For those who may want to brush up on their mathematics before or during the courses, we present **a short crash course on the math**

Original scientific literature

Some lectures draw on material from original scientific literature, which we provide here for the convenience of students.

- Atomic clocks and quantum computers
- The Bohr model of the atom
- Bose-Einstein condensation
- The discovery of deuterium
- The discovery of deuterium - a simplified account
- The green laser pointer
- The photoelectric effect
- Does quantum mechanics provide a complete description of physical reality?
- Young's double slit experiment and diffraction

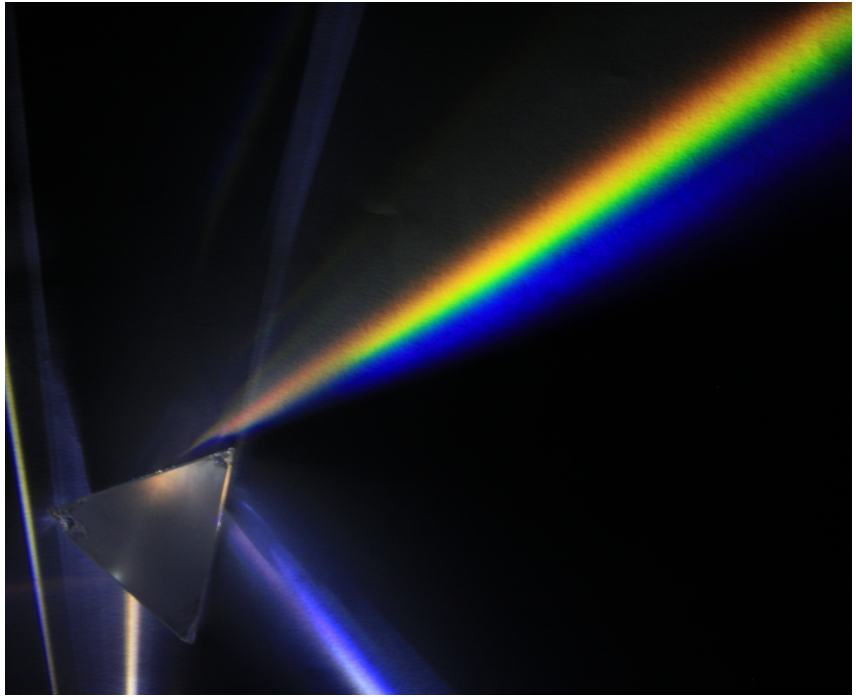
Atomic Structure and Spectra

The “white light” of the Sun is a mixture of colors.

Eric Rolph/Wikimedia Commons

Atomic Structure and Spectra

Tools for controlled dispersion of light: **refraction** and diffraction



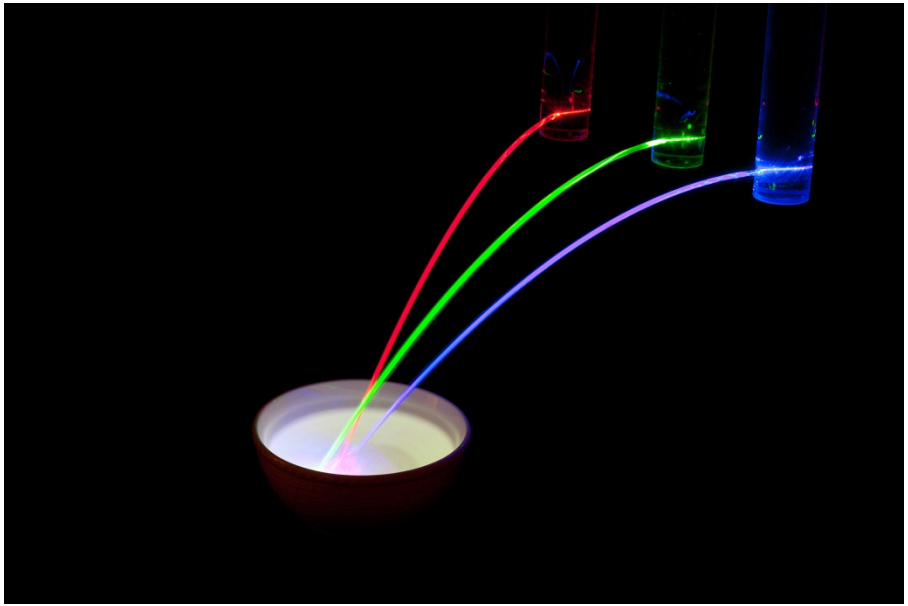
D-Kuru/Wikimedia Commons

Isaac Newton (1666) used the **prism** to demonstrate that sunlight was a mixture of colors. The speed of light in a transparent medium depends upon its color. This causes the *dispersion* of the different colors in a beam.

Today we know that color is an index of the light's wavelength, λ, or equivalently its frequency, $\nu = c/\lambda$.

Atomic Structure and Spectra

Mixing of colors generates white light



Light from three lasers, entrained in streams of water, scatters in ceramic bowl to give apparent white light.

These are our **reference lasers** for the course:

R **λ = 650 nm**
The common red laser pointer

G **λ = 532 nm**
The DPSS green laser pointer

V **λ = 405 nm**
The Blu-Ray laser

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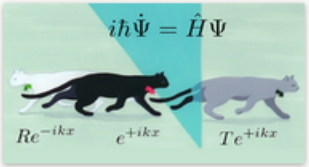

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Tools for controlled dispersion of light: **refraction** and diffraction

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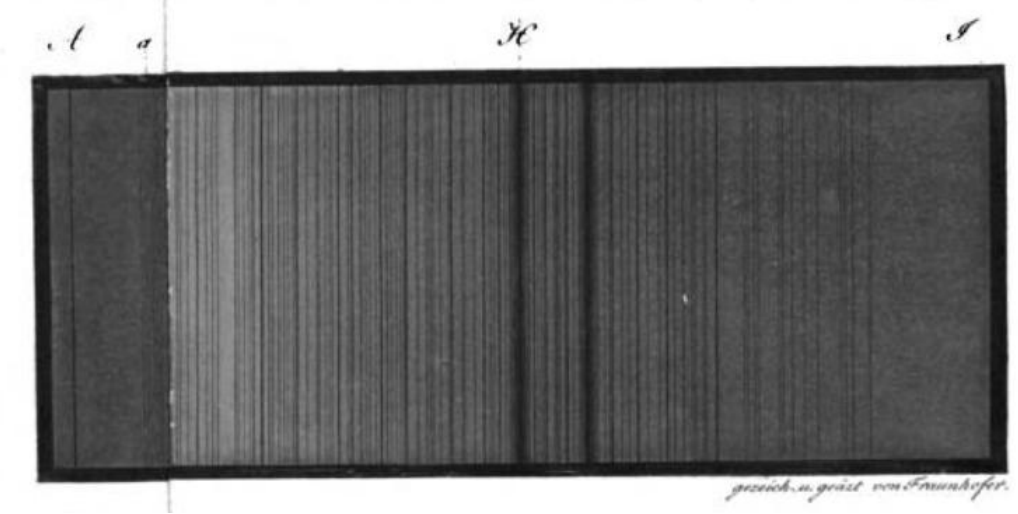

Fraunhofer 1814

In 1814, Joseph von Frauenhofer discovers **dark lines** in sunlight using a highly dispersive prism.

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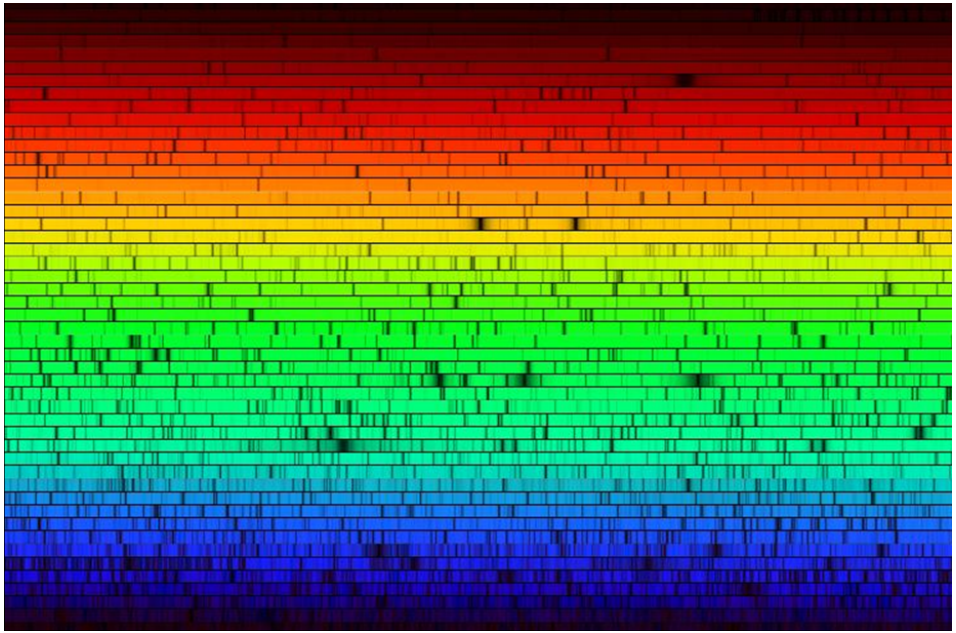
Tools for controlled dispersion of light: refraction and **diffraction**

λ = 650 nm R

λ = 532 nm G

λ = 405 nm V



Nigel Sharp, National Optical Astronomical Observatories

When seen under high resolution, there are numerous **dark lines** in the spectrum of the Sun. This pattern was decoded using the techniques we discuss this week.