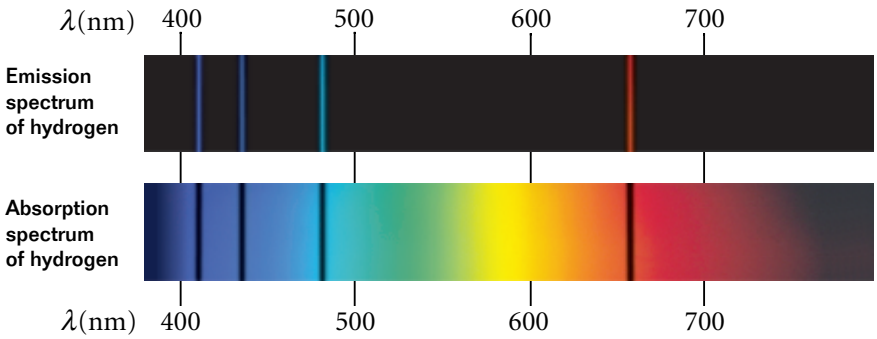

Figure 13
Hydrogen's dark absorption lines occur at the same wavelengths as its bright emission lines.

vapor of the element being analyzed. The absorption spectrum consists of a series of dark lines placed over the otherwise continuous spectrum.

Each line in the absorption spectrum of a given element coincides with a line in the emission spectrum of that element, as shown in **Figure 13** for hydrogen. In everyday experience, more emission lines are usually seen than absorption lines. The reason for this will be discussed shortly.

The absorption spectrum of an element has many practical applications. For example, the continuous spectrum of radiation emitted by the sun must pass through the cooler gases of the solar atmosphere and then through Earth's atmosphere. The various absorption lines seen in the solar spectrum have been used to identify elements in the solar atmosphere. Scientists are also able to examine the light from stars other than our sun in this fashion. With careful observation and analysis, astronomers have determined the proportions of various elements present in individual stars.

Historically, the occurrence of atomic spectra was of great importance to scientists attempting to find a new model of the atom. Long after atomic spectra had been discovered, their cause remained unexplained. There was nothing in Rutherford's planetary model to account for the fact that each element has a unique series of spectral lines. Scientists hoped that a new model of the atom would explain this phenomenon.

THE BOHR MODEL OF THE HYDROGEN ATOM

In 1913, the Danish physicist Niels Bohr (1885–1962) proposed a new model of the hydrogen atom that explained atomic spectra. Bohr's model of hydrogen contains some classical features and some revolutionary principles that could not be explained by classical physics.

Bohr's model is similar to Rutherford's in that the electron moves in circular orbits about the nucleus. The electric force between the positively charged proton inside the nucleus and the negatively charged electron is the force that holds the electron in orbit. However, in Bohr's model, only certain orbits are allowed. The electron is never found between these orbits; instead, it is said to "jump" instantly from one orbit to another without ever being between orbits.

Quick Lab

Atomic Spectra

MATERIALS LIST

- **a diffraction grating**
- **a variety of light sources, such as:**
  - ✓ **a fluorescent light**
  - ✓ **an incandescent light**
  - ✓ **a clear aquarium bulb**
  - ✓ **a sodium-vapor street light**
  - ✓ **a gym light**
  - ✓ **a neon sign**

SAFETY

Be careful of high potential differences that may be present near some of these light sources.

Certain types of light sources produce a continuous spectrum when viewed through a diffraction grating, while others produce discrete lines. Observe a variety of different light sources through a diffraction grating, and compare your results. Try to find at least one example of a continuous spectrum and a few examples of discrete lines.