Careers in Science

Spectroscopist

Spectroscopists study how electromagnetic (EM) radiation is absorbed, emitted, or scattered by matter. Spectra provide information about properties such as composition, temperature, and motion. Because EM radiation provides information at a distance from the matter, spectroscopy is especially important in astronomy. Spectroscopists also work in medicine, in manufacturing, in agriculture and environmental science, and elsewhere.

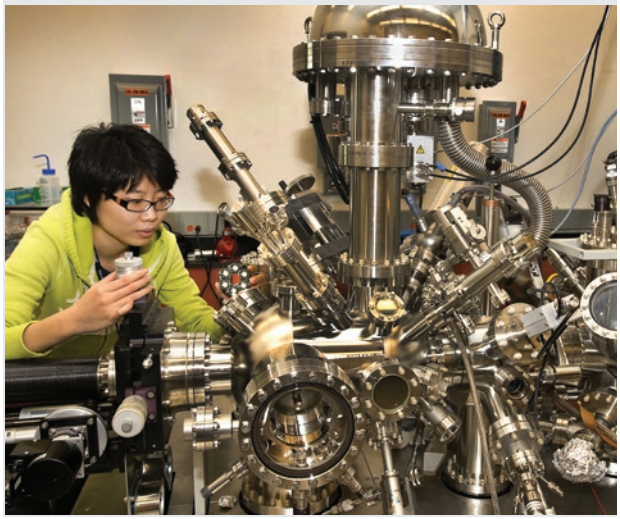
Spectra of EM Radiation

The electromagnetic spectrum spans many ranges of energy. Each range interacts with matter in a different way or on a different scale. High-energy radiation, such as x-rays, gamma rays, and some ultraviolet waves, can produce or interact with ions. Spectroscopists use information from these frequencies to understand events at the atomic scale. Infrared, visible, and ultraviolet light can provide information about separate atoms or molecules. Low-frequency radiation, such as radio waves or microwaves, interacts with molecules and bulk matter, as does infrared and visible light.

In astronomy, radiation is from distant, unreachable sources. Spectroscopy is a form of remote observing. Other spectroscopists make remote observations, such as observing weather from space, but check some of their results with direct observations.

Some spectroscopists make changes to matter and observe related changes in radiation. In nuclear magnetic resonance (NMR), radio waves cause resonance in molecules within a magnetic field, which is detected in the radio waves coming from the molecules. Because this technique does not cause permanent changes to chemical bonds of the molecules, it has become an important way to observe matter inside the human body. Magnetic resonance imaging (MRI) is the medical application of NMR.

FIGURE 26: Mass spectrometer



Mass Spectrometry

Laboratory analysis sometimes involves both EM and mass spectra. In mass spectrometry, atoms or molecules are sorted physically by their charge-to-mass ratio, resulting in a different type of spectrum.

The atoms or molecules are first ionized. The ions pass between strong magnets that act on the moving charges and deflect the ions. The amount of deflection depends on the mass of an ion and the strength of its charge. The ratio of charge to mass can be used to determine the composition of a material.

Language Arts Connection Use credible resources, in print or online, to research an aspect of spectroscopy or the work of spectroscopists. Then prepare a presentation about your research. Your presentation should include a visual display, such as in a poster, a multimedia presentation, or a demonstration of a technique.

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