Astronomy From Å to ZZ — Howard L. Cohen

A Brief Column for the Beginning Stargazer Introducing a New Astronomical Term Each Month

Astronomy is rich with terminology. This column will help beginning stargazers ease into the world of astronomy by *briefly introducing* a new but *basic astronomical term* (word, acronym or abbreviation) each month. This list, which began January 1999 with the letter ***a***, is alphabetical but uses successive letters for each month's entry. (We will return to the letter ***a*** after twenty-six months.)

Word of the Month for December 2000

X ray *n.* (**X-ray** *adj.*) High energy *electromagnetic radiation* (energy) with a wavelength between extreme *ultraviolet* (XUV) and *gamma rays*, approximately 0.01 to 10 nanometers. (One *nano* means one-billionth.) This corresponds to a *photon energy* of about 0.1 to 100-keV (kilo electron volts). Also, called *roentgen rays*. (See note about *electromagnetic radiation* at end.)

X rays from space cannot penetrate the Earth's atmosphere so X-ray astronomy must be done from instruments on rockets or satellites. For example, instruments on rocket flights in the 1950s detected X rays from the Sun (emitted from the Sun's very hot *corona*).

X rays may also come from very hot sources at temperatures exceeding approximately one million Kelvins (about two million Fahrenheit). This is called *X-ray thermal radiation*. However, many astronomical sources of X rays are nonthermal in nature, such as from electrons interacting with other charged particles (ions) in *plasmas* (a highly ionized gas).

The largest class of bright celestial X rays is X-ray interacting binary stars where one component is a degenerate star (*white dwarf*, *neutron star* or *black hole*).

For example, the first X-ray source detected from beyond the solar system was *Scorpius X-1* (1962), the brightest, persistent X-ray source in the sky. Astronomers now believe it consists of a *low-mass X-ray binary star*. Material from a bluish companion star moves onto a neutron star by way of an accretion disk generating powerful X rays as the mass gains gravitational energy

Cygnus X-1 is a well-known *high mass X-ray binary*. Here, matter from an envelope surrounding a high mass star flows directly onto its degenerate companion, which may be a black hole.

Other main types of astronomical X-ray sources are hot, diffuse gases surrounding galaxies or between galaxies, *active galactic nuclei*, and *supernovae remnants*. More than 60,000 celestial X-ray objects are now known, most discovered by the Rosat X-ray satellite (launched 1990 jointly by Germany, the United Kingdom and the United States).

Note: *Electromagnetic (EM) radiation* is a form of energy that can propagate through a vacuum at a speed of about 300,000 kilometers per second (186,000 miles per second). This speed is often called the "speed of light," a misnomer since all EM radiation propagates at this speed in a vacuum.

EM radiation is historically viewed as a series of oscillating electric and magnetic fields. Accelerating electrically charged particles can produce EM radiation. However, EM radiation is now often depicted as the flow of *photons*, quanta of EM energy, discrete particles having zero mass, no electric charge, and an indefinitely long lifetime.

Types of EM radiation include gamma rays, X rays, ultraviolet, visible light, infrared, microwaves and radio waves. Such an arrangement, ordered by changing wavelength (listed here from small to large) is called the *electromagnetic spectrum*. ☼

References. J. Mitton 1991, *Concise Dictionary of Astronomy* (Oxford Univ. Press); I. Ridpath 1997, *A Dictionary of Astronomy* (Oxford Univ. Press); *Explanatory Supplement to the Astronomical Almanac*, 1992, ed. P.K. Seidelmann.