Mössbauer Effect Encyclopedia Article

Mössbauer Effect

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Mössbauer Effect

When an electron falls from one energy level to another energy level in an atom, it emits radiation whose wavelength is determined by the difference in those two energy levels. If that radiation is then allowed to fall on an atom of the same kind, that atom will absorb the radiation and use it to raise one of its own electrons from a lower energy level to a higher one.

That theoretical model breaks down, however, when one examines the emission of gamma rays from an atom. During gamma ray emission, an atom recoils, carrying with it some of the energy of emission. An atom of the same kind as the first cannot, therefore, absorb the energy of the original gamma ray. Since the amount of recoil varies from atom to atom, the energy of gamma rays emitted by a group of similar atoms ranges over a wide spectrum.

In 1956, Rudolf Mössbauer found an exception to this pattern. If an atom is tightly locked into a crystal lattice, its recoil during gamma ray emission is taken up by the whole crystal. The total recoil of the massive crystal is nearly zero, however, so that none of the energy of the gamma ray emission is lost in the process. All atoms of the same kind locked into the crystal will emit gamma rays with essentially the same wavelength.

The *Mössbauer effect* has a number of important practical applications. In most such applications, a beam of gamma rays from one crystal is directed at a target crystal of the same kind. If any change occurs in the wavelength of the gamma rays between source and detector, the amount of absorption by the receiving crystal will change noticeably.

Mössbauer was born in Munich on January 31, 1929. He made his discovery while doing his doctoral research at the Munich Institute of Technology, from which he earned his Ph.D. in 1958. He taught at the California Institute of Technology from 1961 to 1964 and at the Technical University of Munich from 1964 to 1971 and from 1977 to the present time. From 1972-1977 he was director of the Institut Laue-Langevin in Grenoble. He won the Nobel Prize for physics in 1961 for his discovery of the effect that bears his name.