

Electron paramagnetic resonance (EPR) or electron spin resonance (ESR) spectroscopy is a method for studying materials that have unpaired electrons. The basic concepts of EPR are analogous to those of nuclear magnetic resonance (NMR), but the spins excited are those of the electrons instead of the atomic nuclei. EPR spectroscopy is particularly useful for studying metal complexes and organic radicals. EPR was first observed in Kazan State University by Soviet physicist Yevgeny Zavoisky in 1944,<sup>[1][2]</sup> and was developed independently at the same time by Brebis Bleaney at the University of Oxford.

Experimentally, this equation permits a large combination of frequency and magnetic field values, but the great majority of EPR measurements are made with microwaves in the 9000–10000 MHz (9–10 GHz) region, with fields corresponding to about 3500 G (0.35 T). Furthermore, EPR spectra can be generated by either varying the photon frequency incident on a sample while holding the magnetic field constant or doing the reverse. In practice, it is usually the frequency that is kept fixed. A collection of paramagnetic centers, such as free radicals, is exposed to microwaves at a fixed frequency. By increasing an external magnetic field, the gap between energy states is widened until it matches the energy of the microwaves, as represented by the double arrow in the diagram above. At this point the unpaired electrons can move between their two spin states. Since there typically are more electrons in the lower state, due to the Maxwell–Boltzmann distribution (see below), there is a net absorption of energy, and it is this absorption that is monitored and converted into a spectrum. The upper spectrum below is the simulated absorption for a system of free electrons in a varying magnetic field. The lower spectrum is the first derivative of the absorption spectrum. The latter is the most common way to record and publish continuous wave EPR spectra.