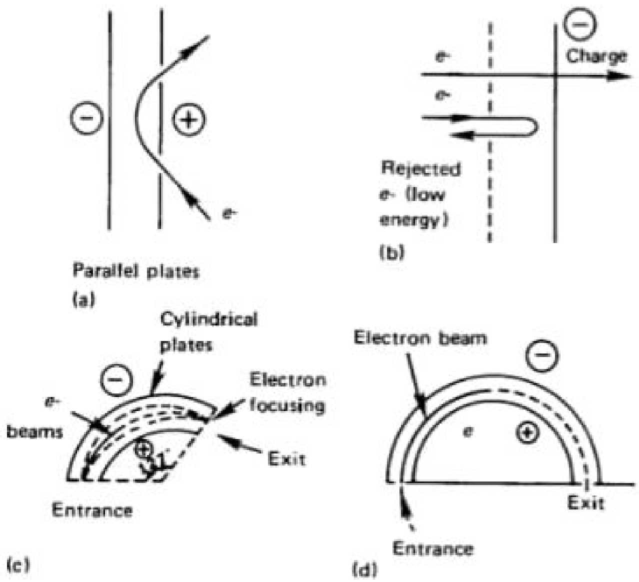

Figure 14.5 Schematic diagrams of several electron energy discriminators.

Electron energy analyzers are equivalent to the monochromators used in spectroscopy. Their function is to disperse the emitted photoelectrons based on their energies. The most commonly used electron energy analyzers incorporate an electrostatic field that is either symmetrical or hemispherical. These systems are in essence an extension of the electron energy filters shown in Fig. 14.5. All electron energy analyzers require shielding from stray magnetic fields as described subsequently. One system is shown schematically in Fig. 14.6; it is based on the system of Fig. 14.5(a) and is called a cylindrical mirror analyzer (CMA). The "plates" are now two coaxial cylinders, thus providing an efficient electron-trapping system while maintaining resolution. The electron source labeled on the figure is of course the sample surface, emitting photoelectrons. A voltage (negative potential) is applied to the outer cylinder; the inner cylinder is grounded. Only photoelectrons with the appropriate energy pass through the apertures and are focused onto the detector. Photoelectrons of energy E will be focused when:

$$E = \frac{KeV}{\ln(r_o/r_i)} \tag{14.2}$$

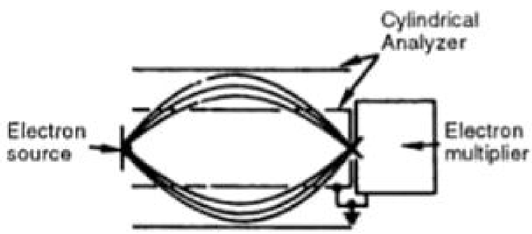

Figure 14.6 Cross-section of an electrostatic cylindrical electron energy analyzer. The electron source is the excited sample surface that is emitting photoelectrons.

where K is a constant; e, the charge on the electron, V, the applied voltage, r_i, the radius of the inner cylinder; and r_o, the radius of the outer cylinder.

The CMA as shown is used for Auger electron spectroscopy. For XPS, two CMAs in series are used to obtain the required energy resolution. This design is called a double pass CMA. The transmission of electrons through a double pass CMA is good, but the resolution is poorer than that obtained using the concentric hemispherical analyzer described subsequently.

The concentric hemispherical analyzer (CHA), shown in Fig. 14.4, is widely used in both XPS and Auger instruments. The CHA consists of an input lens assembly, two concentric hemispherical shells of differing radii, and an electron detector. The input lens