4. Endcap Chambers

- by measuring signals from strips and wires, one easily obtains two coordinates from a single detector plane (the precise coordinate comes from interpolation of charges induced on strips),
- strips can be fan-shaped to measure the $\phi$-coordinate in a natural way,
- CSCs can operate in large and non-uniform magnetic field without significant deterioration in their performance,
- gas mixture composition, temperature, and pressure do not directly affect CSC precision and thus stringent control of these variables is not required,
- detector mechanical precision is defined by strips which can be etched or milled with the required accuracy and can be easily extended outside the gas volume, thus making survey of plane-to-plane alignment very simple.

**Fig. 4.1.5:** Schematic view of an endcap muon CSC: a six-plane chamber of a trapezoidal shape with strips running radially (strips have constant $\Delta\phi$ width) and wires running across.

A typical EMU CSC is a six-plane chamber of trapezoidal shape with a maximum length of 3.4 m and with a maximum width of 1.5 m. A schematic view of a CSC is provided in Fig. 4.1.5. The large chambers cover 10° sectors, while the smaller chambers cover 20° sectors. (see Table 4.1.1). Cathode planes are formed by honeycomb panels with copper clad FR4 skins. Gas gaps defined by the panels are either 6 mm thick, for the ME1/1 chambers, or 9.5 mm thick, for all other chambers. Strips are fan shaped, i.e., they run radially in the endcap geometry and thus provide the phi-coordinate of muon hits. The strip configurations are milled in the FR4, and the strip width ranges from 3 to 16 mm for different chambers. Wires are stretched across strips without intermediate supports and, for readout purposes, are grouped in bunches from 5 to 16. They provide the radial coordinate of muon hits with a few cm precision. For the ME1/1 chamber, which is in a 3T $B_z$-field, the wires are strung at a 25° angle to a perpendicular to the chamber centerline to compensate for the skewed drift of electrons.

The most important parameters for all chambers are given in Table 4.1.1. Detailed discussions of the chambers are given in Sections 4.2 and 4.3. Overall, the Endcap Muon System consists of 540 six-plane trapezoidal chambers, with about 2.5 million wires, 210,816 anode channels and 273,024 precision cathode channels. A typical chamber has about 1000 readout channels.