Harvard cyclotron lasted about 250 μ seconds and hence the amplifiers were modified to cut the dead time to about 1 μ second, and further changes cut the rise time to about 0.1 μ second.[10] Crystal diodes were inserted within one of the feedback loops to prevent double pulsing when the amplifiers were overloaded.[11]

D. Solid Angles

The scattered protons leaving the target travel on helices to reach the counters. The radius of any given helix depends for two reasons on the angle that the particle trajectory makes with the horizontal plane. First, the momentum of the particle depends on the scattering angle and second, only the component of momentum perpendicular to the magnetic field is effected by the field. When the particles scattered in the vertical plane reach the top or bottom of the magnet gap they will have moved inward radially from the incident proton orbit because of their smaller momentum and angle with respect to the field. It turns out that the distance they have gone in is very small (about 1/4 inch out of 40 inches original radius) and very nearly constant for all scattering angles. For all positions studied it was also necessary to calculate the angle in the horizontal plane at which the protons strike the probe, in order that the crystals could be set perpendicular to the scattered proton direction. A first approximation to the solid angle of the defining counter is then just the crystal area divided by the square of the distance traversed. Because of the focussing action of the magnetic field,

---

[10] D. Bodansky, Ph.D. Thesis, Harvard, 1950.

[11] W. G. Cross, Phys. Rev. 78, 185 (1950).