SESSION IV. BEAM QUALITY

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Summary

A considerable amount of information on the detailed texture of the cyclotron beam is being accumulated, much of which is not yet published. It is evident that careful attention to certain aspects of cyclotron systems can yield beams with narrower energy spread and smaller angular divergence, and result in much more efficient beam extraction.

Experimental work verifies that limiting the radial oscillation amplitude artificially by diaphragming at the center of the cyclotron, coupled with careful regulation of the r-f amplitude, gives extremely efficient beam deflection, at least for small beams. Theoretical work predicts that high beam brightness (high density in phase space) requires control of various factors including (1) regulation of the amplitude of the r-f trains to perhaps one part per thousand, (2) providing a magnetic field with sufficient precision (low first harmonic) so as not to induce appreciable radial oscillation amplitude, and (3) introducing specially shaped r-f wave forms or adjusting the phase of the beam packets relative to the r-f to compensate for space charge distortions of phase space. One desired goal here is to achieve beam packets separable into discrete energies and undistorted in phase space. This would in principle make feasible a resonant deflector of high efficiency.

Actual measurements on beam brightness (current/cm^2-steradian) were reported. Cyclotron deflected beams were found to be much less bright than dc-type accelerators. It is felt that very large improvements can be made by attention to the above factors.

Various observations on discrete programmed orbits in cyclotrons as an aid to focusing were discussed. Various other observations on beam characteristics were reported including modulation effects of unknown origin which can on occasion be very troublesome. Some very large currents 100 ma of rather poor quality and 8 ma of better quality were reported.