



Specification of phase and amplitude control for RF Separator

Since a divergence angle of the beam decreases with energy increasing, the specification of the phase and amplitude control for the highest energy RF separator will satisfy requirements of the other low energy rf separators.

The following beam parameters are assumed at the highest energy rf separator:

beam energy = 4 Gev.

beam emittance = 5×10^{-10} m · rad.

$\beta = 50$ m.

divergence angle of beam = 3.16×10^{-6} rad.

deflecting angle of the rf separator = 10^{-4} rad.

The rf separator has a $Q_L \approx 12000$. The variations in phase and amplitude in the structure caused by a change in either source frequency or temperature of cooling water are shown in Figure 1. It can be seen that a frequency change $df/f = 7.3 \times 10^{-7}$ or a temperature variation $dT = 0.073^\circ F$ brings a phase change of 1° .

A bunch may be located in 0° , 30° , 60° , and 90° with respect to the rf wave in a different operation state in the rf separator. Figure 2 shows a variation in deflecting moment impacted on the bunch caused by a phase change in rf wave in the structure for a different phase. The 0° is the most sensitive case. Figure 3 gives a effect of a variation in the deflecting moment on an increase in the beam emittance.

Variations in phase and amplitude of the rf field in an rf separator will cause an increase in the beam emittance for each beam passage through an active rf separator with multiple active rf separators causing a cumulative beam degradation.

Assuming a 25% increase in the beam emittance caused by variations in phase and amplitude in the rf separator structure a value is chosen. Based upon considerations of technical feasibility and cost, the following specifications are set here for the rf separators phase and amplitude control system:

Specification for rf separators phase and amplitude control system

Temperature stability of cooling water	$\pm 0.2^\circ F$
Field phase stability in rf separator	$\pm 0.2^\circ$ at GHz
Field amplitude stability in rf separator	4×10^{-3}
Resolution for phasing system	0.5° at 1 GHz

In addition, the rf system for the rf separator operates at CW 998 MHz and the main rf system works at CW 1497 MHz. The output power of CW klystrons for rf separators is 11-12 KW. A main phase line with phase stability of $\pm 0.1^\circ$ at 1.5 GHz and water supply of $95^\circ F$ with $\pm 1^\circ F$ stability is required.

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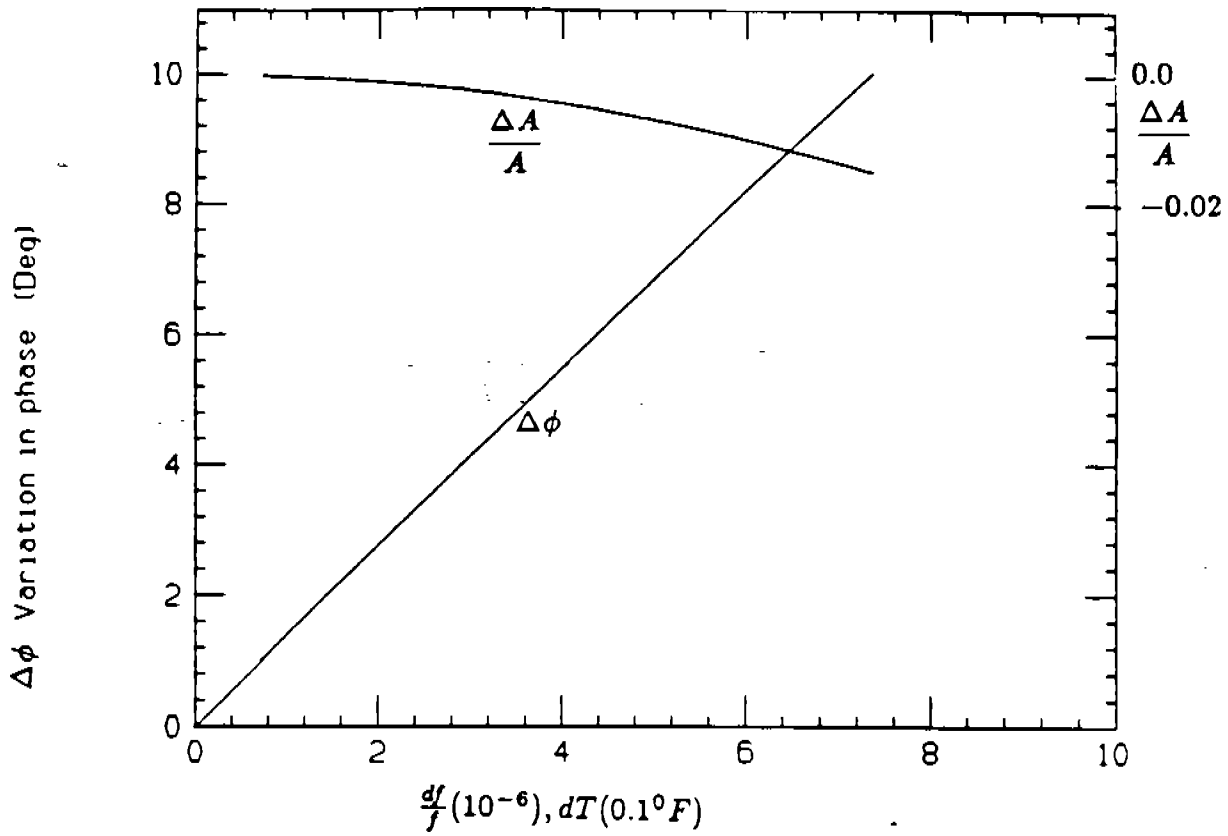


Figure 1. Variations in phase and amplitude due to a change in frequency.

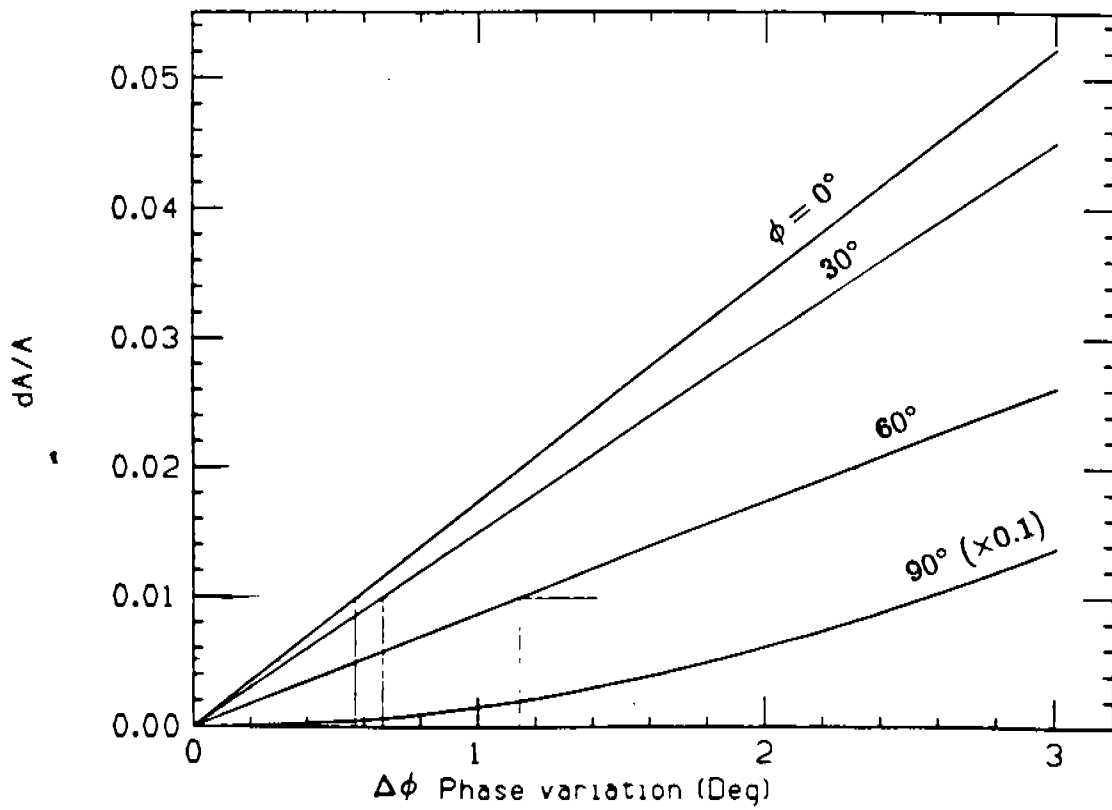


Figure 2. Variation in deflecting moment vs. variation in phase.

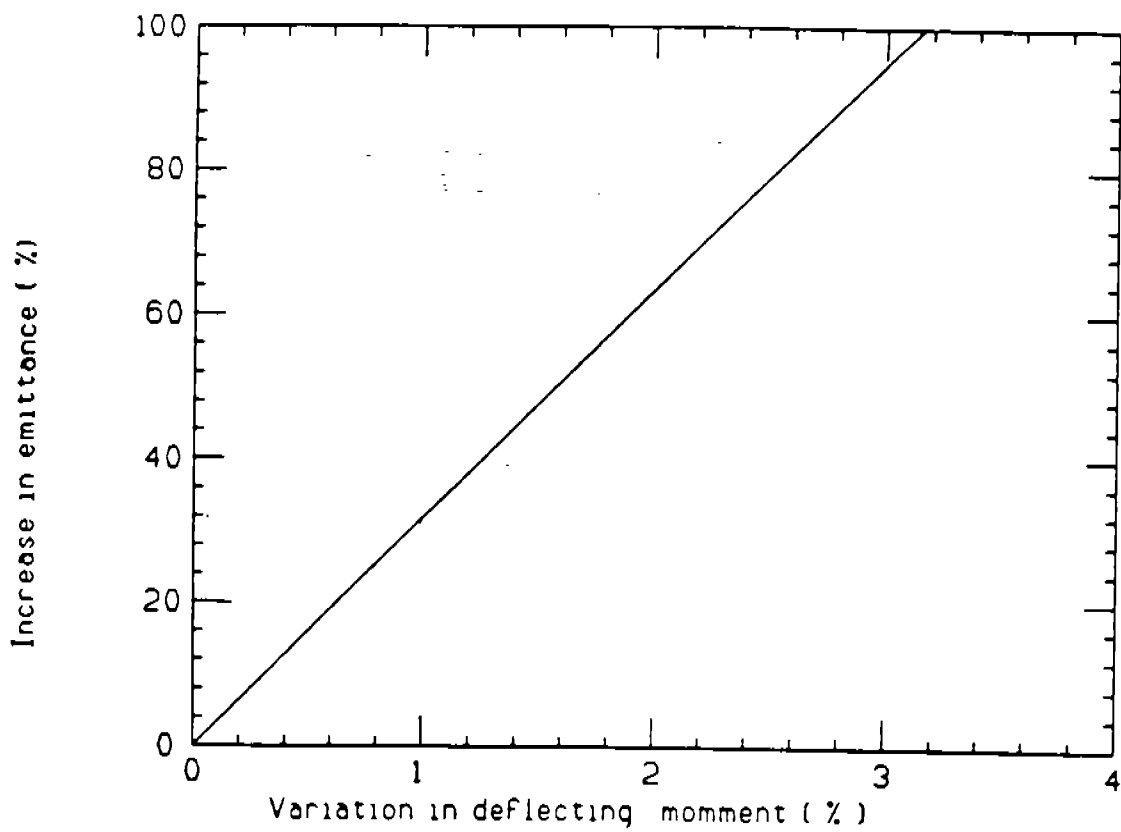


Figure 3. Variation in deflecting moment vs. increase in emittance.