Measurement of the Momentum Dependance of Orbit Length in the Main Ring

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ABSTRACT

The second order dependence of orbit length on momentum offset from the central orbit is inferred from the transition time for radially offset beam. The transition time is found by minimization of the shape oscillation of the bunches after transition; because the minimum is not distinct and the available momentum aperture is limited, the result is scarcely better than order of magnitude. We find

$$\alpha_1 = \frac{1}{2}\frac{d^2}{d\delta^2}\frac{\Delta R}{R}\bigg|_{\delta=0} = 2.13 \cdot 10^{-3} \pm 30\% \quad (\delta = \Delta p/p) \ .$$

1. Introduction

The behavior of beam bunches as they are accelerated through the transition energy is a matter of practical interest for obtaining beam of the highest intensity or brightness with the least loss. Furthermore, understanding which of several effects peculiar to energies near transition dominate the growth of bunch area may be useful in designing better accelerators.

The principal parameters governing the beam dynamics in the energy-phase plane for a beam near transition energy are listed in Table I with calculated and measured values for the Main Ring where known. The parameter α_1, which gives the lowest order nonlinear dependence of path length on momentum,

$$\frac{\Delta R}{R} = \alpha_0 \frac{\Delta p}{p} + \alpha_1 \left(\frac{\Delta p}{p}\right)^2 + \cdots \ ,$$

has not been previously reported. The values for γ_T and the associated momentum p_T, $\dot{p}_T$, *etc.* are derived from the ramp parameters displayed on page M3 and the observed transition time for centered beam. The values are given in the table because they are needed to determine α_1, but they are not intended to be best effort