RHIC-AP-24

POWER SUPPLY ACCURACY IN RHIC

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Power Supply Accuracy in RHIC

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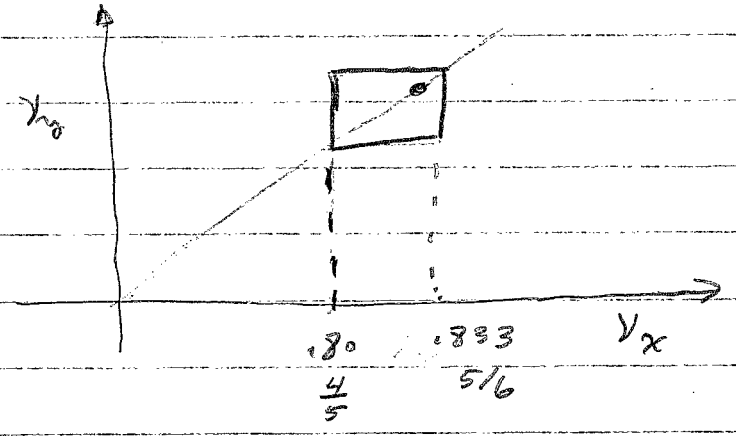
Criterion

ISR, CBA – no $\Delta\nu(t)$

$\Delta\nu \leq 1\times10^{-3}$

RHIC – $\Delta\nu(t)$ present due to synchrotron oscillations

No crossing of 10th order allowed (SPS).



Box is 33×10^{-3} wide

$A_{SL} = 19\,mm \rightarrow \nu = 28.827,\ 28.822$

6×10^{-3} from 6th order resonance

Beam-Beam interaction gives $\Delta\nu \simeq 20\times10^{-3}$

$\nu(A) \lesssim 19\times10^{-3}$

$\nu(A)$ depends on $\Delta p/p \rightarrow$ additional $\Delta\nu = 6\times10^{-3}$

Box is fairly full

Criterion $\Delta\nu \leq 1\times10^{-3}$ seems reasonable.

Major Sources of $\Delta\nu$ errors

QF, QD	tuning
Q1 Q2 Q3	bypass
Q2 Q3	tuning
B2H, B2V	Chromaticity Control
Q7, Q6	tuning

Accuracy Definition

B - swing of 15 $\quad \gamma = 7 \longrightarrow \gamma = 100$

$$\text{Current accuracy} = \frac{\Delta I}{I}$$

$$\text{Power Supply Accuracy} = \frac{\Delta I}{I_{max}}$$

Current Accuracy = 15 x Power Supply Accuracy

Quads in Series with Dipoles, QF Bypass, QD Bypass

Coil	Location	$b_{k,max}$ %	amps	cm^{-1}	ΔV_x	ΔV_y	Power Supply Accuracy	Current Accuracy
					10^{-3}		10^{-5}	10^{-5}
B1H	QF	10	450	.013	.59	.10	1.2	18
B1V	QD	10	450	.013	.10	.59	1.2	18
Q123	Q1Q2Q3	60	1750	.100	.57	.57	1.0	15
Q7I		10	400	.020	.05	.26	10	150
Q6I		10	400	.020	.17	.11	10	150
Q3I		7	200	.012	.20	.07	5	75
Q2I		7	200	.012	.15	.35	5	75
Q1I		7	200	.012	.22	.23	5	75
Q1O		7	200	.012	.23	.22	5	75
Q2O		7	200	.012	.35	.15	5	75
Q3O		7	200	.012	.07	.20	5	75
Q6O		10	400	.020	.11	.17	10	150
Q7O		10	400	.020	.26	.05	10	150
Q8I		5	200		.02	.003	10	
Q5I		5	200		.007	.06	10	
Q4I		5	200		.06	.007	10	
QXI		5	200		.02	.05	10	
QXO								
Q4O								
Q5O								
Q8O								
				ΔV_{Total}	1.06	1.06		

QF, QD – seperate power supply, QF QD Bypass

B1Q	QF, QD	100	4500		.50	.50	.12	1.8
BYQFQD		10	450		.2	.2	.4	6

B1Q, $PSAC \simeq \frac{1}{10}(PSAC(B1H))$

BYQFQD $PSAC \simeq PSAC(B1H) \times \frac{1}{3}$

Ripple Question

Quad Ripple $\rightarrow \Delta \nu_Q$
Dipole Ripple $\rightarrow \Delta \nu_D$

$\Delta \nu_Q + \Delta \nu_D = 0$ if Chromaticity $= 0$
and ripples are equal.

If ripples uncorrelated, and
natural chromaticity ~ 60

$$\Delta \nu = 2 * 60 * \text{Ripple} \leq .2 \times 10^{-3}$$

$$\text{Ripple} \leq 2 \times 10^{-6}$$